CATHOLIC DIOCESE OF
ARLINGTON

EPISCOPAL
HIGH SCHOOL

NORTHERN VIRGINIA REGIONAL SCIENCE AND ENGINEERING FAIR

VIRTUAL

MARCH 2021

7 AS 100

Meyers, Isaac; Myers, Jonathan

George Washington Middle School

Teacher: Owens/Haisfield

Strike Force Carpenter Ant

So pretty much this research shows that Carpenter Ants are very, very important to the environment. They seem to have more of a brain than any other insect I ave seen. After a few or even one incounter with an insect or bug that is foreign to them they seem to find a way to beat it. Whether it be a worm tail or cricket. I think this shows how important Carpenter Ants are to the environment because they can figure out how to do what needs to be done and keep the ecosystem clean. This shows why we need ants and Carpenter Ants.

9 AS 101

Berger, Cecilia

Washington-Liberty High School

Teacher: Sotomayor

The Effect of Essential Oils on Brine Shrimp Larvae

Organic pesticides are used as a healthier and more environmentally friendly substitute to synthetic pesticides. The active ingredients in most organic pesticides are essential oils, but there is doubt as to whether these oils are actually safe. In this experiment, essential oils from lemongrass, cedarwood, and garlic were tested on the larvae of brine shrimp to determine their lethality. It was hypothesized that garlic oil would yield the greatest mortality rate of brine shrimp. The data supported this hypothesis, as the brine shrimp exposed to garlic oil had a mean mortality rate of 99% after 24 hours, compared to the control's 1%. An ANOVA test showed that these results were statistically significant, as they yielded a p-value of 0.000063. Multiple t-tests performed between each of the experimental groups also produced statistically significant p-values. Lemongrass oil yielded a mean mortality rate of 49%, and cedarwood oil 81%. Pesticides containing essential oils are toxic to brine shrimp and, considering their lethal effects on the insects and other organisms they are meant to target, potentially dangerous for many other life forms. These products should be used responsibly and with caution.

9 AS 102

Dickerson, Rachel

Washington-Liberty High School

Teacher: Sotomayor

Prevalence of Mixed Species Herding with Giraffe Calves

The rapid disappearance of giraffes from the African savanna is an imminent reality, but there is still little knowledge on these famous creatures. Giraffes are known to be found in herds that include other species, such as zebras. The purpose of this investigation was to study whether giraffes were more likely to herd with zebras if there were giraffe calves in the herd. It was hypothesized that the giraffe herds with giraffe calves will herd more frequently with zebras, because the zebras protect the giraffes from predators, which calves are especially vulnerable to. Using live cameras placed in two locations in the Mpala Research Centre, the giraffe herds were observed over a 30-day span. The number of animals that herded together that fit under the four herd type categories (Adult Giraffes only, Adult Giraffes-Zebras only, Adult Giraffes-Giraffe Calves only, and Giraffe herd-Giraffe Calves-Zebras) were recorded. The results supported the hypothesis, because the Giraffe herd-Giraffe Calves-Zebras herd had more animals than any of the other three herd types. The hypothesis was also supported by the Chi-Square analysis, which found a Chi-Square value that was greater than the critical value The relationship between zebras and giraffes, particularly when there are giraffe calves present, could lead to potential further studies on the relationship between the giraffe population size and zebra population size.

10 AS 103

Jones, Amelia

T.C. Williams High School

Teacher: Lay

The Effect of California Wildfires on Native Birds

California has recently experienced a drastic increase in the severity and size of wildfires due to climate change and human-made causes such as fire suppression. Throughout this project, I have analyzed the impacts of the 2003 Cedar Fire to evaluate and predict how this year's August Complex Fire will impact native birds. In this research project, I hypothesized that if research on past wildfires is analyzed, then the impact of new megafires on native bird populations can be predicted. Based on my analysis, I predicted that my control, the Northern Parula, would be least affected by the wildfires. Of the three species native to California, Lawrence's Goldfinch's population is predicted to experience the smallest decrease due to its ability to adapt and ultimately survive. The Oak Titmouse is predicted to be most severely affected due to its size, sedentary nature and dietary needs. These predictions cannot be confirmed or disproved as the data from the August Complex Fire has not been released to the public and the project will need further investigation.

9 BE 200

Snell, Julia

H-B Woodlawn Secondary Program

Teacher: Smith

Does Sex Effect if a Person Will Turn on Their Camera in an Online Class?

This project tested if sex affected the likelihood of someone turning on their camera in an online class. During the online classes, the amount of males and females with cameras on was recorded for 18 days with 61 classes. Sex was determined by name, appearance, and pronouns. It was found that females were 12 times as likely to turn their camera on all class and about 3 times as likely to turn their camera on part of the class, than males. According to the research, this is likely due to the fact that females, generally, are more expressive than males and are more likely to show empathy and self consciousness. Females, therefore, turn on their cameras more due, likely, to empathy for the teacher (teaches ask for cameras to be on) or a wish to emote. This information can be used to further our understanding of online education.

10 BE 201

McAndrew, Rory; Doherty, Gillian

Washington-Liberty High School

Teacher: Barrett

The Effect of Occupation on the Difference in Pay Between Males and Females

The purpose of the experiment was to find out if different job industries had varying compensation differences between males and females. The hypothesis was that if the type of industry was being tested, then there would be a difference in the pay gaps between men and women within each industry. The data collected did not support the hypothesis. The null hypothesis, which was that the type of job industry has no effect on the difference in compensation between males and females, was accepted.The data collected did not support existing research regarding occupational influence on the gender pay gap. Existing research suggested that each job industry had a different gender pay gap due to factors such as competitiveness and experience/skill, as well as gender discrimination. However, based on the p-value and standard deviations calculated, there was no relationship between the type of job industry and the compensation difference between males and females. The most likely cause of this conflict was due to the fact that not every existing job in each industry was included - only the most relevant and common jobs.

11 BE 202

Berry, Colin

Yorktown High School

Teacher: Schuetz

The Impact of Penalties, Population Density, and Partisanship on Compliance with Stay-at-Home Orders During COVID-19

Are stay-at-home orders effective during a global pandemic? Although stay-at-home orders should help to slow the spread of contagious diseases (like COVID-19) by reducing person-to-person contact outside a household, these orders are only effective if people actually stay at home. In this study, I use data on the mobility of anonymized smartphones within states before and after the enactment of stay-at-home orders to try to understand the effects of stay-at-home orders on mobility. The results suggest that stay-at-home orders are associated with a 4.6% increase in the percent of smartphones that remained at home during the late spring/early summer of 2020. The results also show that penalties (jail time and fines) had no significant effect on compliance with stay at home orders (considering all states with such orders), while compliance with stay at home orders in Republican controlled states was 5.3% lower than in Democratic controlled states. States with high population densities had the highest percent of smartphones that remained at home after stay-at-home orders went into effect at 45%. It is important to study whether people comply with stay at home orders to help the fight against the spread of future pandemics in the U.S. It is very difficult to enforce stay at home orders and the results in this paper suggest that although these orders have a significant impact, more study of individual behaviors and choices is necessary to understand when and why people may be more or less willing to shelter at home during a pandemic.

12 BE 203

Fugle, Sebastian

Yorktown High School

Teacher: Amarasinghe

Image Color Distribution and Moment on Time Observed

Despite the quantity of information about color theory and the study of composition on the effectiveness of an image, the way that color moments—a method used to measure color distribution of color throughout an image—affect observation of images was not yet fully documented. This information is helpful to understand the mathematic and visual connection between three measures of distribution each of color, saturation and brightness throughout the image (for a total of nine measures), which can inform artificial intelligence and graphic designers alike. Based on modern design philosophy, specific ranges for specific channels were hypothesized, expecting low hue skewness, medium mean brightness and a low variance saturation, to have a positive effect on viewing time by 10 seconds. Once data were collected, outliers were sorted out. Those that had over 1000 ticks for an individual on only one image were removed. This led to the one third of the data being above average, with all data points being view less than 5 seconds on average. Rather than what was hypothesized, saturation variance was consistently further spread, ranging from 0.25-0.75 (fixed to 8,000) rather than a low value as was hypothesized. The key factor towards the increased viewing time was a high brightness (vibrance) channel, with averaged to around 0.71 in the top 9 images, as compared to the expected middle range of 0.4-0.6. Conclusively, this experiment defines the specific attributes that color composition provides and what degree per measure, which will provide information necessary for AI and graphic design alike.

7 BI 300

Hardwick, Katie

Dorothy Hamm Middle School

Teacher: Kruger

How Much DNA Can Fit in a Cell?

My hypothesis was if the c-value is less than 10 picograms and less than 60 fermis, then the largest species would be 10 picograms and 60 fermis. The data that I found rejected this hypothesis. The largest species that I found were 20 picograms and about 83 fermis. My goal for this project was to figure out the normal amount of picograms for animals. I concluded that all of the animals have a c-value of fewer than 20 picograms and a nucleus size of fewer than 90 fermis.For my procedure, I made a google sheet to keep track of all of the data that I found. It had the scientific name, common name, category (amphibia, bird, or fish), c-value, and nucleus size. I then used the databases provided by Science Buddies to get all of the data I needed. After that, I created a graph with all the data.

7 BI 301

Lau, Melissa

Gunston Middle School

Teacher: Giblin

The Effect of Temperature on the Production of CO2 by Yeast

I looked at the affect of temperature on the production of CO2 by yeast. Yeast produce CO2 in fermentation. Fermentation is used for baking bread. The more CO2 the yeast produce the fluffier the bread turns out to be. So I looked at what temperature would make the yeast produce the most CO2. I found that the temperature of the water affects the amount of CO2 that yeast produce.

7 BI 302

Piechowski, Esperanza

Dorothy Hamm Middle School

Teacher: Kennedy

The Effect of Antibody Strength on Pathogens

The purpose of this experiment was to teach me, as well as others, the effect of immune system/antibody strength on pathogens. I measured this by observing how many iron fillings (in grams) became attached to magnets, each with varying degrees of strength. Magnets binding to the iron filings are a good analogy of the relationship between antibodies and pathogens, as they both bind to the substance they want to hold or destroy. My experiment lasted two days, for 3 trials, one for each magnet. The first, a square piece of magnetic tape, represented a newborn baby, or one who has an uncolonized immune system. As many can predict, this picked up the least amount of filings, the largest being 2.3, and the average being 1.87. The median strength magnet, a generic refrigerator magnet representing a diabetic, picked up a little more than the magnetic tape, but it picked up significantly less than the largest magnet. Its average was 8.8. Lastly, the biggest magnet was a large door magnet. This magnet was supposed to model the immune strength of a young athlete abstaining from any kind of drugs, tobacco, or alcohol. The weights for this last magnet were several times bigger than the first two, as the smallest was 63.7, and the average was 67.9. I was able to draw the conclusions from the data table, that the smallest magnet, as I predicted in my hypothesis, picked up the least amount of filings, and the median and smallest picked up less.

8 BI 303

Vogel, Henry

H-B Woodlawn Secondary Program

Teacher: Boyle

The Effect of Salt on Yeast Growth

My project was studying the effect of salt on yeast growth. In this research area, it is known that salt can slow down or even stop yeast growth. This is through the process of osmotic stress (or salt removing water from the yeast cells). Scientists and bakers alike have experimented with the effect of salt on yeast growth. By doing this experiment, I am trying to determine how varying amounts of salt affect the growth of yeast in dough. Through being surrounded by a society of home bread bakers in the pandemic I have become fascinated with one of the ingredients, salt. After the experiment I now want to learn how to lower the amount of salt used in bread.My hypothesis was that if more salt (salt being the independent variable) is added to the dough, the dough would rise less (the volume of dough being the dependent variable). My background research about osmotic stress supported my hypothesis.I conducted an experiment with four graduated cylinders containing dough samples, each with varying amounts of salt. There were four trials. I found the dough sample with the most salt, on average over the whole experiment was at a much lower volume than the less salted dough samples. I also noticed at about 400 minutes all of the dough samples were at the same volume.In this experiment I have met my goal and my hypothesis was accepted. This experiment has contributed to baking and bread creation.

9 BI 304

Bartrum, Olivia

Wakefield High School

Teacher: Thacker

The Effect of pH on the Solubility of Acetaminophen

The purpose of the experiment was to test the effect of pH of different substances on the solubility of acetaminophen. The project analyzed the intersection of gastroenterology, drug absorption, and pH. The hypothesis was if acetaminophen was placed in lemon juice, it would dissolve more quickly than all other substances. Substances were chosen to represent the pH of areas of the gastrointestinal system. The substances tested included Lemon Juice (gastric antrum), Black Coffee (fundus), Water (blood), Milk (small intestine), and a Baking Soda-Water Solution (duodenum). The dependent variable was the time taken for acetaminophen to dissolve and the independent variable was pH. The experiment was conducted by placing a 325mg tablet of acetaminophen into 200mL of each substance tested, with 20 trials of each substance performed. The acetaminophen was evaluated for solubility at least every hour for six hours, and once at 24 hours. The results of the experiment showed the hypothesis was rejected; none of the acetaminophen tablets in any of the substances had completely dissolved. However, the time for acetaminophen to break down significantly was recorded (with the average in parentheses) and is what is represented in the data. Black Coffee was able to break down acetaminophen the quickest (5 minutes 39 seconds), followed by Water (6 minutes 53 seconds), Lemon Juice (78 minutes 11 seconds), Baking Soda-Water Solution (144 minutes 46 seconds), and Milk (244 minutes). Future iterations of this project may be improved by accounting for other factors (enzymatic, chemical, physical) not considered in this project.

11 BI 305

Zheng, Charles

Episcopal High School

Teacher: Krivaceck

Genomic Biomarker Discovery in Lung Cancer

Lung Adenocarcinoma (LUAD) and Lung Squamous Cell Carcinoma (LUSC) are two of the most common lung cancer subtypes, and effective diagnosis and subsequent treatment of them through the help of genomic biomarkers could benefit the thousands of lung cancer patients. The purpose of this project is to identify potential genomic biomarkers that could distinguish normal tissue and lung cancer tissue. I also aimed to identify the potential biomarkers that could distinguish and therefore molecularly diagnose these two subtypes of lung cancer from each other. Furthermore, I analyzed the biological pathways that are involved by these biomarkers in order to understand the underlying mechanisms that may drive the formation of each subtypes of lung cancer. Principle Component Analysis (PCA) and paired Student's t-tests were used to examine the likely true differences between tumor and normal tissues in the high dimensional RNA-seq data. Various visualizations were used to emphasize their differences in the form of PCA plot, volcano plot and heatmap. Then, genes with the top p-values and mean gene expression difference (between normal and tumor tissues) are chosen for further pathway and functional analysis with DAVID method to link them to tumor formation in lung cancer or the subtypes. KRT5, KRT9, DSC3, CERS3, TRIM29 were identified as lung squamous cell carcinoma biomarkers, when EPHA10, TGM1, ANXA8L1 were identified as lung adenocarcinoma biomarkers, and CENPF, AURKB, and ERCC6L are three that show the greatest potential in serving as lung cancer biomarkers.

7 CH 400

Chikh-Ali, Cherin

Dorothy Hamm Middle School

Teacher: Azzara

The Effect NaHSO Has on the Precipitation of Tin

The Effect NaHSo Has on Precipitation of TinBoth developed and developing countries distribute more than 50% of water throughout metal pipes. Children and adults consume an excess of metals in their drinking supply in over 70 countries. This experiment opens the door to the possibility of decreasing water contamination by metals. The two chemicals used in this experiment are, NaHSO4 (sodium bisulfate) and SnCl2 (tin chloride). Since NaHSO4 makes a great electrolytic solution it allows for electrons to move throughout the solution with ease. As the electrons move through the solution they attract the tin atoms. It takes two electrons for each tin atom to precipitate into a solid state. This process is called electrolysis. Electrolysis is the basis of the experiment. The results from the experiment supported the objective of removing metals from a solution. The theory worked in each experiment tin was recovered however, the experiment was met with challenges due to the limitation of the equipment. Results showed when there was a decreased amount of NaHSO the tin mass was below detectable levels. When there was an excess amount of NaHSO the did show below detectable levels. It was only when 2M of NaHSO did the tin mass show a total of 1g.

7 CH 401

Menta, Arhan

Williamsburg Middle School

Teacher: Zarro

The Effect of Type of Stain Remover on the Shade of the Coffee Stain

The purpose of this experiment was to determine what type of stain remover removes a coffee stain the most effectively. The results of this experiment will save people time, money, and water by removing the coffee stain the first time. The hypothesis was, 3% Hydrogen Peroxide would be the most effective stain remover in removing a coffee stain from a t-shirt. For this experiment, Baking Soda, 3% Hydrogen Peroxide, 5% Distilled White Vinegar, and Shout Laundry Stain Remover were procured to remove a coffee stain from a white cotton t-shirt. First, 15 milliliters of black coffee was poured onto a white t-shirt. After the black coffee was poured, there was a wait of 48 hours to let the coffee stain dry. Once the 48 hours were over, 15 milliliters of the stain remover was poured onto the coffee stain. Subsequently, the t-shirt was washed and dried. The hypothesis was supported because Hydrogen Peroxide worked the best in removing a coffee stain, with a mean value of 3.8 on the shade scale. Baking Soda performed the worst with a mean value of 2.0 on the shade scale. The data was reliable because the type of stain remover that had the highest variation only had a range of 1. When a coffee drinker encounters a coffee stain on their t-shirt, they will know to use 3% Hydrogen Peroxide.

7 CH 402

Panza, Bethany

Kenmore Middle School

Teacher: Gantenbein

The Effect of the Concentration of Salt or Sugar on Evaporation Rates

Water is necessary for all functions of life, and understanding its physical properties is important. This project looked at how different concentrations of salt or sugar in water affects the evaporation rates of the solutions. The different salt concentrations were 1.25 g of salt, 2.5 g of salt, and 5 g of salt, all dissolved into 50ml of water. There were the same amounts with sugar, which was also dissolved into water. The water was measured each day, and put into a spreadsheet. The hypothesis was that plain water would evaporate faster than any of the solutions. The results of the experiment partially supported the hypothesis, showing that plain water evaporated the fastest. The experiment also showed that the higher the concentration of salt, the slower the water evaporated. The saltiest of the water had a daily evaporation rate of 0.88% compared to the plain water's 1.02%, while the sugar water had an average daily evaporation rate of 1.06%.

8 CH 403

Akay, Peter

Williamsburg Middle School

Teacher: Warden

The Effect of Acidity of Drinks on Erosion of Eggshells

The purpose of the experiment was to determine the effect of acidity of drinks on the erosion of an eggshell. In this experiment, the pH level of different drinks was taken using a pH meter. After, the pH level of tap water was altered to match the pH level of these various drinks. An eggshell was then placed inside each jar holding water with varying pH levels for four days to test how much the acidity of each drink eroded the eggshell. A product was used to lower the pH level of water so there were no other factors contributing to the erosion of the eggshell. An eggshell was used to replicate the structure of the enamel of teeth because of the similar structure or eggshells and enamel of teeth. It was hypothesized that the lower the pH level of water was, the more an eggshell would erode. After four days of eggshells submerged in water with various pH levels, each eggshell was dried and weighed using a precise milligram scale. It was shown that as the pH level of water decreased, the erosion of the eggshell increased. This indicates that the more acidic a drink is, the more it will erode your enamel and eventually teeth. This project could be furthered by testing using real human teeth and the acid that is found in drinks that erode teeth, not phosphoric acid.

8 CH 404

Floom, Kate

Williamsburg Middle School

Teacher: Bell

The Effect of the Temperature of a Heating Chamber on the Time it Takes to Develop a Latent Fingerprint

If there is a crime committed, forensic scientist use evidence from the crime scene to figure out the culprit. A lot of times, scientists will look for fingerprints because every fingerprint is unique. Sometimes, though, the fingerprints can be latent, or not visible, so they need to be developed. In this experiment, I was testing to see if changing the heat of a development chamber changes how quickly fingerprints develop. Scientists can use this information to make sure they develop fingerprints as quickly as possible.My hypothesis was; If the fingerprint development chamber is hotter, then the fingerprint will take less time to develop because the hotter the development chamber is, the quicker the superglue heats up and vaporizes, turning into the fumes that are used to develop fingerprints. To test this hypothesis, I made my own development chamber and developed fingerprints with a mug warmer, heating pad, and no heating element (listed from hottest to coolest). My hypothesis was supported because the mean of the mug warmer trials was about 38 minutes, while the heating pad's was about 56 minutes, and "no heating element" 's was over 8 hours.These findings were already supported because forensic scientists use very hot development chambers to develop fingerprints. No new information was found, but it was still super fun!

8 CH 405

Menn, Bella

Dorothy Hamm Middle School

Teacher: Kennedy

The Effect of the Type of Wax on the Change in Mass of the Candle

In my experiment, I was measuring how much wax was burned off from a candle in a certain amount of time. This can determine which waxes in candles are more practical to use compared to others. For this experiment, my mom and I bought a candle making kit off of amazon, and we made our own candles by melting the wax ourselves. I just thought that would be easiest because then we would have more factors staying constant (type of container the wax is in, material of the wick, amount of wax in each candle measured in grams, etc.), because there were no stores online that had the wax we needed in the same type of candle. I used 3 types of waxes in my candles; beeswax, paraffin, and soy. I had 9 candles in total, 3 for each type of wax for the 3 trials. My hypothesis was “If I burn a beeswax candle for 20 minutes, then less wax will be burned because beeswax has a high melting point and is very dense. First, I weighed each candle and wrote down the starting mass (80 grams for each). Then, I lit 3 candles for 20 minutes, dumping/scooping out the extra liquified wax that sat at the top of each candle about halfway through the 20 minutes. Once the time was up, I weighed each candle and wrote down the mass for the wax in each candle and repeated those steps 2 more times.

8 CH 406

Tulchinsky, Ophelia

Dorothy Hamm Middle School

Teacher: Kennedy

The Effect of the Type of Salt on the Amount of Corrosion of the Wires

The experiment's purpose was to look at the effect of the type of road salt on the amount of corrosion of the wires. This experiment was a model of cars (wires) interacting with road salt (salts) and acid rain (vinegar). Acid rain comes from power plant's pollution, and road salt comes from humans. The problem with acid rain is that it lowers the pH of the water supply, and when it precipitates, it corrodes objects, including cars. The problem with road salt is that it also corrodes objects, especially the roads on which it is put. Cars drive over the road salt, starting the reaction of the road salt corroding the car. Wires were twisted into a stand and put into a bath of vinegar and a salt. They were left for 3 weeks. At the end of the 3 weeks, the width of the tip and the area at the waterline of the wire were measured. The salts that were selected for use were sodium chloride (NaCl), potassium chloride (KCl), magnesium sulfate (MgSO4), calcium sulfate (CaSO4), calcium dichloride (CaCl2), and a control (no salt was added). The control (no salt, vinegar only) had the largest mean width at the tip (6.78 mm), and CaSO4 had the largest mean width at the waterline (6.38 mm). The calcium dichloride had the smallest mean width at the tip (2.72 mm), and smallest mean width at the waterline (2.07 mm). The results could indicate that salt inhibits corrosion.

9 CH 407

Baasansukh, Haley

Washington-Liberty High School

Teacher: Sotomayor

The Type of Mordant on the Weight of the Yarn

The purpose of this experiment was to test if various mordants would have an effect on the weight of yarn trials. Mordants are chemicals that are used to help bond the natural dye molecules to the yarn that is being dyed on to form an insoluble compound. A mordant would aid the dye in attaching itself to yarn fibers. It was hypothesized that if the iron mordant is tested, then the yarn will weigh the most. The iron would have caused the dyed yarn's color to be darker because of its reaction with tannin-rich dyes. The null hypothesis for this experiment is that if the mordants are tested, then there is no effect on the weight of the yarn. Three levels were tested: no mordant, alum power along with a Cream of Tartar fixative, and iron mordant. The hypothesis was tested through dyeing 10g yarn trials from three yarn skeins. Yellow onion skins were boiled to create a dye. Two different mordants simmered with their respective skein. Both the alum and iron mordant consisted of a 1:2 ratio. From the data collected, it was concluded that the iron mordant had the highest mean of 13.6g and the control had the lowest mean of 10.9g. The data supports the hypothesis that was tested. Statistical tests were done to determine the statistical significance of the data, with both an analysis of variance (ANOVA) test and one T-test on all experimental groups yielding p-values of less than the critical value of 0.05.

9 CH 408

Bartrum, Sophia

Wakefield High School

Teacher: Fuamenya

What Is The Effect of Different Flours on the Height of a Cupcake?

The researcher's experiment was "What is the effect of different flours on the height of a cupcake?" The purpose of the experiment was to see which flour; cake flour, bread flour, whole-wheat flour, and all-purpose flour, would produce the tallest cupcake. The hypothesis for this experiment was "If cake flour is used in a cupcake, then the cupcake containing cake flour will be taller than the cupcakes that do not contain cake flour." The hypothesis was rejected in this experiment due to the cupcake containing cake flour being the shortest of all the cupcakes. During the experiment, the batter without the flour, baking powder, and milk was made, and the assorted flours were placed in 4 bowls, a different flour being in each bowl. The baking powder, milk and batter were then evenly distributed among the flours, stirring each individual batter until no lumps remained. 1/4 of a teaspoon of assorted food coloring was added to each bowl, colors varying so the researcher could tell the difference between the batters. The batters were then each divided into muffin tins, 3 tablespoons of batter in each cupcake liner. There were 3 cupcake liners for each flour. The cupcakes were then baked and cooled, and were measured using two rulers. The cupcakes containing whole-wheat flour averaged 4.8 centimeters tall, the bread flour averaged 4.66 centimeters tall, the all-purpose flour averaging 4.86 centimeters tall, and the cake flour averaged 3.73 centimeters tall. In conclusion, the cupcakes containing AP flour produced the tallest cupcake.

9 CH 409

Finkelstein, Allie

Yorktown High School

Teacher: McKowen

The Effect of the Type of Fruit on How Much Electrical Energy It Can Conduct

I tested the effect of the type of fruit on the amount of electrical energy it conducts. The independent variable levels I used were lemons, oranges, red apples, bananas, and watermelon. It's known that many fruits are able to conduct electricity because of the citric acid within their juices, which acts as an electrolyte. This led me to my hypothesis that lemons would conduct the most electrical energy because out of all the fruits, they're the most acidic. In order for the fruits to conduct electricity they must be turned into a model of a battery, with 2 oppositely charged electrodes and an electrolyte. The acid within the fruit acts as the electrolyte and for the 2 electrodes I used a copper and zinc nail. This is because copper acts as a cathode (positively charged) and the zinc acts as an anode (negatively charged). A multimeter was used to measure how much electrical energy the fruit conducted in volts. Red apples ended up being able to conduct the most electrical energy, while bananas conducted the least. This rejects my hypothesis that lemons would conduct the most electricity. This surprised me because red apples are less acidic than both lemons and oranges. But, a possible reason for this is that red apples contain more potassium, which is known as a super-conductive ion, than lemons and oranges. The overall trend of the data is that the more acidic fruits (lemons, oranges, apples) conducted more electricity than the less acidic fruits (bananas, watermelon).

9 CH 410

Rosas, Monica

Yorktown High School

Teacher: Dorman

The Effect of Various Drinks' pH Levels on the Change of My Salivary pH

In my experiment, I wanted to find if the pH of different beverages affects my saliva's pH after 5 minutes? Some drinks are made with carbonic acid and some with the addition of phosphoric acid. The acid makes them have a lower number on the pH scale. In similar experiments, the soft drink not only did the soft drink caused the saliva pH to lower, but it also took longer for the pH level of the mouth to return to its normal range. I hypothesized, if the drink consumed has a significantly lower pH level than salivas original pH level then it will cause the saliva pH level to lower and become more acidic. To test this I collected the change of my salivas pH 5 minutes after drinking one: carbonated water, bottled water, Coca-Cola, and coffee. My hypothesis was rejected, the carbonated water caused the most change in my saliva's pH level. It made my saliva's pH level lower on an average of .6 pH. The coffee, which only caused my pH level to change .25 had similar results to published data. Unexpectedly the Coca-Cola did make the pH level change as I predicted it would. Past research showed the Coca-cola causing the greatest change in pH but it did not cause much change in my saliva's pH. Further experiments need to conducted on more subjects, not just myself with more trials and a more precise pH tester.

10 CH 411

Brodsky, Julia

H-B Woodlawn Secondary Program

Teacher: Smith

Optimization of an Electrocoagulation System for the Removal of Polyatomic Ions from Water

Electrocoagulation (EC) is a water purification technique that uses electricity to induce a reduction-oxidation reaction between electrodes and water. It is largely used in industrial settings to remove heavy metals, emulsified oils, and dyes from wastewater. The aim of this experiment was to optimize a battery-operated, household-sized EC system for the removal of polyatomic ion salts from water. The operational parameters sought to be improved were electrode material (Al, CuSn, Cu), inter-electrode distance (IED) (1, 2, 3, 4cm), and number of electrodes (2 or 4). The experiments took place in water containing NaH2PO4, MgSO4, or NaNO3. There were 72 different combinations of the conditions tested. Data was collected with a TDS meter to determine the amount of dissolved solid in the water before and after EC.Cu electrodes were found to be the most effective at removing all three polyatomic salts. CuSn electrodes removed a higher percentage of NaH2PO4 and MgSO4 than Al electrodes but was the least effective at removing NaNO3. The average optimal IED differed between the three pollutants: 2.3cm for NaH2PO4; 3.2cm for NaNO3; 1.3cm for MgSO4. EC with 4 electrodes was more effective than with 2 electrodes. Percent removal ranged from 18.2% to 63.5%, with the most effective combination of conditions found to be 4 Cu electrodes with an IED of 1cm in water containing MgSO4. ANOVA tests found all data comparing IEDs to be significant (p-value = <.05), so the null hypothesis was rejected.

10 CH 412

Carey, Julia

Yorktown High School

Teacher: Hessler

The Effect of Photo Type on Photo Fading From UV Light

The purpose of this project was to determine the levels of fading or color change in photos printed in different ways when exposed to UV light. Photos and other documents degrade over time, partially as a result of UV light rays breaking down pigments, and some types of photos may be more resistant to fading and color change. The three types of photos used were laser printed photos, inkjet printed photos, and photos printed using commercial photo store technology. The hypothesis was that all three types of photos would fade by the same amount. Five photos of each type were placed under a UV light bulb in an enclosed box for 3 days. Each photo was scanned before and after and the RGB color levels were determined using the program ImageJ. After this, the results for each group were analyzed using a T-test and an ANOVA test. The t-test demonstrated that the inkjet and photo store group's probability of no change was <0.01 and was 0.16 for the laser printed group. The photo store group had the lowest probability of no change, indicating that the greatest amount of color change and fading had occurred. The laser printed group had the highest probability of no change, so while some fading likely occurred it was more resistant than the other options. The ANOVA test supported that with a p-value of 2.03E-14.

10 CH 413

Johnson, Phillip

Yorktown High School

Teacher: Hessler

The Effect of Type of Rust Removal Technique on the Amount of Rust Removed

The inconvenience rust causes as well as the health risk it poses creates a great need for method/s to get rid of it. This experiment aimed for finding the best, most easy ways to remove rust with items that may be found around the house. To conduct this experiment rust was created on nails, and 10 trials for each level of independent variable were submerged in the respective rust removal solution. Lemon juice, vinegar, coke, multi-use commercial rust remover, and toilet bowl cleaner were the five methods for removing rust, with the control being no rust removal technique. After the experiment was conducted statistics were calculated and statistical analysis was run. Based on the result yielded from experimentation the best removal method for rust is using vinegar, which removed the most rust without harming the wanted metal. It was also discovered that commercial rust remover may be a viable method to remove rust, with some alterations to the procedures. Additionally, based on the statistics collected from this experiment using lemon juice, coke, or toilet bowl cleaner is not recommended because they either removed too much or too little of the rust/metal. To determine the significance of the data a One-way Anova test was run and based on the p-value the method of rust removal does have a significant effect on the amount of rust removed, and the final weight of a nail.

10 CH 414

Wahl, Joanna

Wakefield High School

Teacher: Gaither

The Amount of Blue Dye #1 in Various Blue-Colored Products

Blue 1 dye is one of two blue dyes approved by the U.S. Food and Drug Administration. It is commonly used in candy, beverages, and medicines. This dye has been found to have connections to allergic reactions, hyperactivity, and cancer. The purpose of the experiment was to find the concentrations of blue 1 dye in various blue colored products. The hypothesis was that if the concentration of blue dye in Powerade, Gatorade, mouthwash, and popsicles is found then popsicles will have the highest concentration of blue dye because of their bright coloration and the fact that they discolor mouths. This experiment was done by making a spectrophotometer and measuring the resistances of these blue colored products. There were 15 trials done per product. The average resistances were compared to resistances of known concentrations of blue 1 dye. This experiment proved the hypothesis correct because the mean resistance of the melted popsicles was 1.256kΩ, for Powerade it was 0.453kΩ, for mouthwash it was 0.428kΩ, and for Gatorade it was 0.392kΩ. The popsicles had the highest resistance and therefore the highest concentration of blue 1 dye. When compared to known concentrations of blue 1 dye its resistance was closest to a concentration of 1/8th of a teaspoon to 8 cups of water.

7 EN 500

Name Withheld Upon Request

Williamsburg Middle School

Teacher: Willet

The Effect of Magnetic Strength on Diagonal Deflection of a Magnetically Levitated Platform

This experiment investigates how magnetic strength affects deflection of a platform with load. Magnetic platforms that experience limited deflection from off-center loads would be useful in everyday life, such as for magnetically levitating furniture and machines that last longer than conventional furniture and machinery. It was hypothesized that a magnetically levitated platform is more resistant to deflection from off-center load as magnetic strength increases. To test the hypothesis, a plywood board was magnetically levitated above another with magnets of the same polarity placed on the four corners of each board. The test then involved placing a fixed load at a fixed location along a diagonal, and measuring the difference in distance between the magnets at the two ends of the diagonal. As the number of magnets on each corner increases, then the measured deflection is expected to decrease, because magnetic strength increases as the number of magnets increases, and the hypothesis states that the stability of the levitated board to off-center load increases with magnetic strength. Ten trials were conducted for each level of the independent variable. The data showed a positive correlation between number of magnets and deflection along the diagonal. Also, the measures of central tendency follow a similar trend in relation to each other, with the mean deflection increasing with the number of magnets. Thus, the data rejected the hypothesis. Future studies could include the effect of magnet shape or material in a similar setup.

7 EN 501

Reiss, Sam

George Washington Middle School

Teacher: Kazanciyan

The Effect of 3D Printed Infill Patterns on the Load Weight

My idea for this project was to find the strongest 3D printed infill pattern. I would use the research to print tools and parts for household products. I would cad my own parts to fix and or make a solution to different household problems like the button on our sink was lost so I printed another one.

8 EN 502

Connor, Hosanna

Kenmore Middle School

Teacher: Brown

The Effect of the Diameter of a Geodesic Dome on its Weight-bearing Capacity

Geodesic domes are a strong, energy efficient structure, however does increasing the diameter increase or decrease its strength? Scientists, architects and engineers are looking at geodesic domes as possible solutions to housing on Mars. Since domes are also the most energy efficient structure, they would also be good sustainable architecture with our declining climate. Therefore, it is important to know how to make these structures as strong as possible. The goal of this project was to find the effect of the diameter on a geodesic domes weight bearing capacity. In order to do this, six different domes (two of each size) were made out of straws and brads. Then each dome's strength was tested by placing bags of rice on top. The bags of rice were later measured on a kitchen scale to determine the exact weight. After conducting this experiment, the smallest dome, with a diameter of 18.5 centimeters, was found to be the strongest. This dome held an average of 638.5 grams more than the middle sized dome, and 1,556.5 grams more than the largest dome. In conclusion, increasing the diameter of a geodesic dome does not increase its strength. So a geodesic dome with a smaller diameter will be able to support more weight.

8 EN 503

Oberkirsch, Evan

Gunston Middle School

Teacher: Pentland

Armature Design and its Effect on Motor Torque

It’s useful to know how things run in such a complicated world. And what’s better than building a device that’s found in fans, blenders, electrical toothbrushes, and so much more! In my experiment I studied the construction of a DC motor and its effect on torque. The objective of the experiment was to find if there is a direct relationship between the equation for the strength of an electromagnet, and the torque generated by a DC motor. I predicted that there would be a relationship. I constructed a homemade motor, and measured torque by attaching a sturdy wire onto the motor, so when the motor spun, the wire spun. The wire would hit a precise scale. Multiplying the measured weight by the length of the wire yielded the torque. The motor spun by flowing a current through a wire in the presence of a magnetic field. The magnetic field generated by the current (the electromagnet) interacted with the stationary magnetic field, causing rotation. The independent variable was the amount of loops in the electrical coils that made up the electromagnet (what the current would flow through) and the dependent variable was the torque. Each trial I increased the amount of loops in the electrical coil by 20, and measured the torque. The data I gathered didn't match my hypothesis, but after more research I found a maximum torque equation for a DC motor. There was significant resemblance between the second equation and the data points I gathered.

8 EN 504

Wearmouth, Isla

Kenmore Middle School

Teacher: Price

The Effect of the Type of Stormwater Filtration Method on Litter

The problem is that Arlington, VA has no stormwater filtration system. This means that whatever litter flows into the drains goes directly into our watershed. This topic interested me when I noticed the amount of litter along our local stream, Four Mile Run. The only current solution to this problem is a sign on the drains that states “only rain down the drains”, which is not very effective. The goal of this experiment was to figure out which type of filtration method is most effective at keeping out litter from our watershed. The filtration methods tested were a grate in front of a drain and a netting bag at the end of the pipe where stormwater deposits. The hypothesis was that if the pipe method is used, then it will be most effective at filtering out litter. To conduct this experiment, I built models of a grate and pipe bag. I tested each method multiple times with 2 gallons of water and ~24 pieces of litter. The results showed that the pipe bag method was most effective at catching litter. Compared to the grate, it caught either more or the same amount of litter for every trial. This supports my hypothesis. Arlington County could add these bag filters to the pipes where the stormwater deposits. To deal with the price of labor, people could be asked to volunteer to help change the bags every month or so. I believe using these pipe bags in Arlington could largely improve our environment.

9 EN 505

Berhanu, Eyuel

Washington-Liberty High School

Teacher: Brodowski

The Effect of 3D Printing Material on 3D Print Strength

The purpose of this study was to determine the effect of 3D printing materials on their maximum tensile strength. The independent variable was 3D printing material (PLA, ABS, PETG). There was no control group. The dependent variable was the maximum tensile strength in newtons. The constants were, test sample design, infill percentage, perimeters, testing procedure. The hypothesis was if 3D printed materials are tested for strength then ABS will withstand the most load. 30 3D printed test samples per trial were designed in Autodesk Fusion 360 and printed on the Creality Ender 5 PLUS 3D printer. 10 samples were printed for each material. These test samples were then pulled apart with an electric winch and the averages were calculated. An ANOVA test was also performed to determine statistical significance. The results showed that ABS had the highest average maximum load. These results supported the hypothesis. In conclusion, the study suggests that ABS has the highest average maximum load.

9 EN 506

Brooke, Phillip

Yorktown High School

Teacher: Dorman

The Effect of Type of Insulation on Change in Water Temperature

The purpose of this experiment was to determine if different household materials could be used as insulation. If these materials could be used to insulate a house, it would be easier and less expensive to insulate, and reusing such materials would have less of an impact on the environment. The materials used in this experiment were newspapers, cloth towels, and fiberglass insulation. It was hypothesized that the fiberglass insulation would insulate better than the newspaper or the cloth towels. To conduct this experiment, the different types of insulation were placed inside uniform cardboard boxes. Then, glass jars filled with 200ml of hot water were placed inside of the three cardboard boxes. There was also a control box with no insulation. The data showed that the fiberglass insulation worked the best, followed by the cloth towels and then newspaper. Even though the cloth towels insulated slightly better than the newspapers, the newspaper was much more effective per gram, weighing less than a 5th of the weight of the towels. The null hypothesis was also rejected, suggesting that the type of insulation had a significant impact on the temperature of the water. Newspapers and cloth towels could be repurposed as insulation, but only in mild or temperate climates. For more extreme climates, fiberglass insulation should be used.

9 EN 507

Savage, William

H-B Woodlawn Secondary Program

Teacher: Smith

Autonomous Temperature Dependent Entry Controller (ATDEC)

As schools and businesses nationwide struggle to safely re-open, many are turning to technology to help accelerate the re-opening process. Among the many innovations being used to help slow the spread of COVID-19, handheld no-contact thermometers are among the most popular. However, these devices have a variety of intrinsic issues. In order to take the temperature of a student, employee, or customer, a human operator must come in close physical contact with that person. This puts essential workers at a heightened risk of contracting the virus, and can limit their efficiency as employees in a time when many businesses are under-staffed due to COVID restrictions. The Autonomous Temperature Dependent Entry Controller (ATDEC) solves these problems. Instead of requiring a human operator to function, the device is mounted on a wall, and automatically takes temperature readings when approached. It then has the ability to either unlock or lock an adjacent door based on the readings. This completely eliminates the need for an employee to put themselves in contact with those who are possibly infected, and instead allows them to safely focus entirely on their work. While there are some similar products on the market today, they have an average cost of around $108, more than three times the $30 required to assemble a single unit of the ATDEC. The low cost and idiosyncratic utility of the ATDEC means that it could be a game changing device for businesses, schools, and other essential institutions as they attempt to reopen safely and efficiently.

10 EN 508

Henshaw, Morgan

Yorktown High School

Teacher: Hessler

Building an Autonomous Car

Human error accounts for most car crashes, so autonomous driving technology could vastly improve the safety of drivers, passengers, cyclists, and pedestrians. The goal of this project was to integrate autonomous driving technology into a small scale battery-powered vehicle.The Raspberry Pi 3B+ was set up by enabling Remote Access, establishing Remote File access, and downloading Webcamoid. The PiCar software was configured and the PiCar was assembled with a wide angle camera. OpenCV and TensorFlow were installed for EdgeTPU, allowing the PiCar more processing power. The Python coding translated the live video feed from the PiCar to detect lane lines, calculate heading direction, and stabilize steering angles of the vehicle.The PiCar operated autonomously using the explicitly written Python code. It successfully detected the lane lines and calculated the correct steering angles. Without user input, the PiCar navigated itself to the end of the track. The project achieved its engineering goal by successfully integrating autonomous driving technology into a small scale vehicle. While there were a few issues, all were resolved through trial and error. This project was valuable for gaining an understanding of autonomous technology and appreciating the engineering challenges associated with integrating autonomy on a vehicle.

10 EN 509

Sanchez, Raphael

Washington-Liberty High School

Teacher: Barrett

The Effect of Different Building Shapes on Buildings Affected by Vortex Shedding

The purpose of this study was to test how the shape of a building affects building sway from vortex shedding (an effect of wind). The independence variable was the shape of the building. The experimental groups were the rectangular and spiral-shaped buildings. The control group was the circular shaped building. The dependent variable was the building sway, as measured by an inclinometer. The constants were the fan being used to simulate wind, the environment the buildings were tested in, and the inclinometer. The hypothesis was: If the shape of the building is shaped in a spiral, then the wind will get redirected up and down, thus not allowing the wind to interact in the wake of the building.Several model buildings that were shaped in different ways were treated with 11 m/s winds. The buildings were shaped circularly (control), rectangularly, and circularly, but with a spiral wrapping around it. The solid buildings were mounted on a base that allowed them to sway. Results showed that the spiral building was most effective at reducing building sway. The rectangular building also reduced building sway, but not to the extent of the spiral building. The circular building, as expected, performed the worst, and had the highest building sway compared to the other buildings. Thus, the results supported the hypothesis. In conclusion, the study suggested that a spiral-shaped building is the most effective deterrent of building sway, among other common building shapes.

10 EN 510

Sartori, Colin

Yorktown High School

Teacher: Hessler

The Study of Clean Energy Harvesting Using Piezoelectric Transducers in Footwear

The goal of this experiment was to design and build a shoe that would generate electricity using piezoelectric transducers and harvest five watts of power from walking or jogging. This clean energy production has zero carbon emissions and is produced through daily activities and exercise. Five watts of power is a standard used to charge cell phones and battery packs and was selected as the power goal. Piezoelectric transducers are crystals and ceramics that produce a charge when force or stress is applied to them.This project had four phases: Transducer Selection; Pedestal Selection; Insole Design; and Prototype Testing. Of the four transducers tested, the 41 mm and the 20 mm produced the most voltage. The glue pedestal was originally used, but in the end, the felt pedestal was used because of its high voltage output and easy attachment to the transducer. Of the insoles tested, the 6x41mm transducer insole in the parallel and serial configuration produced the most power. This insole was then put in the shoe, and different movements were tested. While the output of five watts was not attained, with more innovation and improvements, it is well within reach. With this technology implemented, individuals would be able to produce their own energy through walking and exercise and help the world toward the goal of zero carbon emissions.In this experiment, two test benches were built, 805 trials were run, and 1825 data samples were recorded.

11 EN 511

Mukhtar, Suheila

Wakefield High School

Teacher: Harris

Solar-Powered Irrigation: The Future of Sustainable Rural Agriculture

In many rural villages of developing countries, ox-drawn water wheels are relied on to gather water for irrigation. While this method holds historical and cultural value, it is inefficient because the oxen move at inconsistent paces and everyday arduous work is required. So, I asked the question: How can rural agriculture become more efficient while remaining eco-friendly and culturally acceptable? With the growing popularity of renewable energy, especially solar energy, my engineering project is designed to show how feasible solar-powered irrigation is. For the prototype, I constructed a wooden wheel that connected to a motor apparatus, which was a 12V DC high torque motor. To run the motor and wheel, I used a 12V DC solar panel. Then, to test the prototype, I measured the amount of water collected from a container, which imitated a river. Additionally, two wheel positions were tested: the wheel horizontally positioned over the water and the wheel tilted a slight 15° into the water. After successfully constructing and testing the prototype, the results showed that when the wheel was positioned a slight 15° into the water, almost 3 times as much water was collected. In a real world application, this information is important because adapting the wheel to fluctuations in the water level of rivers and wells will ensure maximized water collection. All in all, this small-scale prototype demonstrates that a solar-powered water wheel is a promising and more efficient alternative in villages.

7 EV 600

Chudiwale, Vedica

Dorothy Hamm Middle School

Teacher: Araya

Effect of Different Water Sources on the Amount of Nitrate

People all around the world die every day due to water contamination. Water is a necessity, although it isn't beneficial if it isn't safe for people to drink. It is important to know what is in your water as it can do a lot of harm. My experiment tested for nitrate in a river, waterfall, stream, tap, and fridge . Nitrate is a compound formed when nitrogen is combined with oxygen or ozone. It is important for all living things, although too much can be harmful. Nitrate is caused by runoffs of fertilizers containing nitrate in them. I tested five water sources to see whether they have this contaminant or not, and how much of it they have. I used testing strips to test each water source for the amount of nitrate. The safety level was at or below ten parts per million which they all were at. The waterfall and Potomac river were both at at an average of 6 1/3ppm while the tap, fridge, and stream were at an average of 0ppm. I did three trials for each source and found the average which was the result I noted. The results of the experiment conducted did support my hypothesis stating that the river would have the most nitrate. Although, it did not meet part of the hypothesis because the waterfall had the same amount of nitrate as the river.
The experiment showed that our drinking water is clean and safe to drink, as it is monitored regularly.

7 EV 601

Davis, Zoe

Williamsburg Middle School

Teacher: Zarro

The Effect of the Acidity on the Mass of Shells

The purpose of this experiment was to show the effects of the acidity of water on the mass of shells. This was to show what will happen to shells during ocean acidification, one of the many harmful effects of climate change. The hypothesis was that if the pH of the water decreased, then the mass of the shell would decrease because the acid would break down the skeletal structure and leave the shell to dissolve. The experiment took place in a sunny room in a controlled environment where the shells were left to soak in cups of salt water HBm with varying pHs. The shells remained in the solution for 30 days before the mass was measured and compared to the original mass. After 30 days, the mass of the shells had increased. This was not expected, but was possibly due to errors that could have occured. These include not letting the shells soak for long enough, having the water evaporate, and water leakage. In conclusion, the hypothesis was rejected, but these results are probably not reliable. In hindsight, the experiment could have been more controlled and the shells could have head more time to react.Research shows that many experiments had the shells' mass decrease in lower pH, and also says that possibly the reason the shells' mass increased was due to errors or salt weighing down the shell.

7 EV 602

Lach-Hab, Nadia

Dorothy Hamm Middle School

Teacher: Kennedy

Crystal Clear: The Effect of Water Filter Design on Water Clarity

The purpose of this experiment was to find an easier and more affordable way to find access to safe drinking water through water filtration, as it is a pressing and very concerning problem right now. While conducting research, I found two types of easy to access and low-cost water filter types: sediment water filters, containing sand and pebbles, and activated carbon water filters. It was hypothesized that the activated carbon water filter (Water Filter B) would clean water better, as activated carbon cleans water through absorption where most of the toxins and harmful bacteria are taken out of the water. Two water filters were constructed, one containing activated carbon, pebbles, and cotton balls, and the other containing sand, pebbles, and cotton balls. The project was testing the effect of water filter design on water clarity measured through Exposure Value in both of the two types of water filters. To complete this experiment, water samples were collected from a local river water source and placed through each of my homemade water filters thrice. The samples of water that ran through the water filters were recorded and analyzed through the Arduino my Science Journal application in Exposure Value. My hypothesis was rejected, the water filter containing sand had a relative exposure value of 6.9, while the other filter had a relative exposure value of 6.6 when my initial water samples had a relative exposure value of 1.3. This indicates that sand can filter out unsanitary water in large amounts.

8 EV 603

Connel, Helena

Williamsburg Middle School

Teacher: Warden

The Effects of Different Sources of Water on Lettuce Seed Root Growth

The purpose of the experiment was to test the water quality in the local environment. The goal was to discover the purity of local water sources because it is important to monitor the health of the ecosystem. It was hypothesized that the Potomac River would be more contaminated than Four Mile Run and Spout Run, since it was the largest body of water, and the filtered water would be the cleanest. Water samples were collected from each source, and 2 mL of each sample was poured into its own labeled Petri dish, on top of a 75 mm filter. Then, five lettuce seeds were put into each dish, because lettuce is a bioassay. The dishes sat in a dark place for five days, and when taken out, the root lengths of each of the seeds and the number of germinated seeds were measured. Cleaner water will produce a longer lettuce root. The hypothesis was partially supported because the control (the filtered water) had the most germinated seeds, and the longest average root length. This shows that the cleaner the water, the more germinated seeds with longer root lengths. However, Four Mile Run was the most contaminated water source, rather than the Potomac, but it was a small difference. Spout Run was the cleanest source beside the filtered water. The experiment shows further testing of water sources is needed to ensure healthy local water, since the seeds grew in the local water sources, but not as much as in the control.

8 EV 604

Hemsch, Emma

Dorothy Hamm Middle School

Teacher: Kennedy

The Effect of a City's Number of Public Transportation Trips per Capita on Carbon Footprint per Capita

This experiment was designed to answer the question, what is the effect of a city's number of public transportation trips per capita on carbon footprint per capita? The independent variable was the number of public transportation trips per capita for that city in the year 2013, and the dependent variable was the estimated carbon footprint per capita for that city according to a study published in the year 2014. It was hypothesized that if the number of public transportation trips per capita was higher, then the carbon footprint per capita would be lower, because when more people use public transportation instead of their own cars, there are less carbon-emitting vehicles on the road. Data was collected for ten cities within the US, all of which had varying public transportation options. A scatterplot graph was then made to interpret the results. The results of this experiment showed that overall there was no direct relationship between a city's number of public transportation trips per capita on carbon footprint per capita. When the number of public transportation trips per capita was in a certain range, however, there was a positive relationship between the two variables. The results did not support the scientist's hypothesis that there would be a negative relationship. There were multiple possible sources of error for this experiment, including the fact that not all of the cities used had identical demographics or climate. Next time, the scientist would include more data points to make their research more reliable.

8 EV 605

Minnigh, Charlotte

Williamsburg Middle School

Teacher: Warden

What is the Effect of Green Roofs on Building Temperature?

The purpose of this experiment is to determine whether green roofs have an effect on the temperature of a building. How green roofs affect temperature is important so that Urban Heat Islands can be eliminated. Urban Heat Islands are a major portion of climate change. Therefore, this information could be significant globally. In this experiment, three shoe boxes were modified to represent buildings, sod, tar paper, and thermometers were purchased and added to the shoe boxes to represent buildings with/without a green roof. The tar paper and sod were added to the tops of the boxes accordingly. The thermometers were left in a room temperature place for minutes, to make sure of minimal variation between the thermometers. The thermometers were placed inside the three boxes. The boxes were first left in a dark place for 30 minutes, then the temperature was quickly checked. The boxes were then left in a sunny place for one hour, the temperature was then quickly checked. The boxes were then left in a dark cool place again for 15 minutes, and then an additional 15 minutes. Temperatures were checked accordingly. Tar had the highest temperature, when the building was left out to heat up, with a mean value of 41.6. The next highest was half sod with a mean value of 38.4. Finally, sod had the lowest mean value of 36.4. Additionally, when left out to cool, tar and half sod both reached a temperature of 22.4, sod dropped to a temperature of 24.

8 EV 606

Mohanty, Anna

Williamsburg Middle School

Teacher: Warden

The Effect of the Electromagnetic Field Density on the Biomass of Chlorella vulgaris

The purpose of this experiment was to determine the effect of the flux density of an electromagnetic field on the biomass of the algae, Chlorella vulgaris. More efficient ways to increase the biomass of algae is crucial to biofuel production, which could be key in lowering carbon emissions. Algae is a promising biofuel source; however, it is commonly treated with large quantities of fertilizers to aid in growth (Miller, 2019), which is detrimental to both the environment and the biofuel quality. This experiment was completed by exposing cultures of Chlorella vulgaris to increasingly dense electromagnetic fields. A solenoid wire was coiled around one beaker five times, which connected via the wire to one coiled ten times, which was then connected to one coiled 25 times. An increase in the coils around the beaker meant an increase in the electromagnetic field density around that beaker. The wire was connected to an iron nail and an electrode current source. This and a control group were left for 150 hours; the cultures's biomass being taken, then examined under a microscope for any cell abnormalities every 24 hours. The hypothesis— that the sample with five coils of density would have the greatest increase in biomass— was supported. It increased the most in biomass of all the groups. The ten coiled increased slightly, and the 25 and control groups decreased in biomass on average. On this basis, a low density electromagnetic field would best assist in increasing the biomass of Chlorella vulgaris for biofuel usages.

8 EV 607

Tallis, Dylan

Thomas Jefferson Middle School

Teacher: Faqih

The Effect of Salinity on Soybean Growth

Our supply of freshwater is running out and the oceans are rising and raising the salinity of our soil. Desalinating water through desalination is a possible way to provide us with more freshwater but it is extremely expensive. The majority of the freshwater used is for agricultural purposes but do the crops really need freshwater? This project investigates which salinity of water soybeans grow best in. In each bag, five soybeans were placed on a paper towel and given 20 milliliters of varying salt solutions; 0%, 0.1%, 0.3%, 1%, or 3.5%. The dependent variable was the length of the growth from the soybeans. My hypothesis was that the soybeans grown in the 0.3% salt solution would grow the most. The results of the experiment show that the soybeans grew best in the 0.3% salt solution with an overall average growth of 10.2 centimeters. The soybeans grown in the 0% solution only grew an overall average of 5.6 centimeters. The outcome of this experiment suggests that plants don't need to be grown in freshwater and that slightly saline water improves the growth rate. This also shows to what extent saltwater contaminated soil can be used before the crop yield decreases.

8 EV 608

Waldman, Amelia

Williamsburg Middle School

Teacher: Thomas

The Effect of the Type of Soil Fertilizer on the pH Variation of the Groundwater

The objective of this experiment was to determine the variation of pH in groundwater. Different types of fertilizer were added to soil to see if they affected the pH of the water drained through the soil. It was hypothesized that the fertilizer that is 20% nitrogen would acidify the groundwater the most. Different fertilizers were separately mixed with soil, and then the water drained through the soil was collected and the pH of the water was measured. By mixing soil with a fertilizer high in nitrogen, a fertilizer high in phosphorus, and a fertilizer with equally balanced nutrients, and then draining water through the different mixtures, the hypothesis was tested. It is believed that fertilizers can drastically affect groundwater which is carried to local ponds and streams. The results showed that the fertilizer high in nitrogen, once mixed with soil, acidified the groundwater the most, while the mixture of the fertilizer with balanced nutrients with soil acidified the groundwater the least. The overall conclusion drawn from this experiment was that fertilizers with high nitrogen content greatly acidify groundwater.

8 EV 609

Gaublomme, Peter; Nachnani, Anand

Dorothy Hamm Middle School

Teacher: Kennedy

The Effect of UVB Light on the Change in Growth of a Cucumber Plant

Climate change is one of the worst problems we face today, it causes pollution, global warming, and increases the hole in the ozone layer. The ozone layer is a protective “wall” over the earth that keeps harmful rays out of the atmosphere. One of the rays is UVB, which causes skin cancer and increases skin aging. Our project was the effect of a low moderation UVB lamp on the growth of a cucumber plant. We wanted to simulate what would happen if the ozone layer completely broke, and the effect on plants. We hypothesized that the 125 watt plant would grow less than the control (with no light).In our experiment we used 3 plants which all had a different amount of UVB. The amounts of UVB lamps were a control (no UVB), a 80 watt UVB lamp, and a 125 watt bulb. We watered the plants 50ml everyday, and at the start/end of a 10 day growth cycle we measured them. On average, the 125 watt grew 30mm and the control grew 17mm. The 80 watt plants were not able to germinate. The results did not support our hypothesis, because we said the control would grow more than the 125 watt bulb. This was backed by further research about our confusing results. However, in higher moderation, UVB will be harmful to plants, according to studies by NASA. Other experiments could use a higher level of UVB light to help simulate the sun’s UVB rays better.

9 EV 610

Gerardi, Mara

Washington-Liberty High School

Teacher: McCoart

The Effect of the Average Annual Temperature of California on the Area Burned in Wildfires

The purpose of this experiment was to observe the relationship between temperature and wildfire activity in California, a phenomenon which relates to the current and future impacts of climate change on Earth. The hypothesis of this experiment was: if the average annual temperature in California increases, then the annual total number of square kilometers burned in California wildfires will increase because higher temperatures and their consequences, like arid conditions and earlier snow melt, increase wildfire activity. Annual temperature and wildfire data were collected and the results were found to be statistically significant, allowing for the rejection of the Null Hypothesis. The hypothesis was supported by a positive, relatively strong correlation that was calculated through an exponential regression function. These results are significant, as they highlight the potential role of warmer temperatures in exacerbating natural disasters like wildfires.

9 EV 611

Shapiro, Harriet

Washington-Liberty High School

Teacher: Sotomayor

The Effect of Plant Type of a Green Roof on Internal Building Temperature

This experiment was conducted with the goal of determining which plant type of a green roof would best mitigate heat transferred through the roof of a building, subsequently reducing energy and money spent on air conditioning. Three plants were tested (grass, moss, and sedum) along with traditional roofing tiles as the control. It was hypothesized that the sedum roofs would allow the least heat transfer due to the extensive coverage provided by the thick leaves of this plant. Plywood boxes topped with the plants were placed under a heat lamp for an hour to simulate a green roof subjected to heat from the sun. The internal temperatures of the boxes were measured before and after the hour under the heat lamp, and the differences between the ending and starting temperatures were determined. The results accepted the hypothesis as the sedum roofs allowed for the least increase in temperature, with a mean difference in temperature of only 1.56 degrees Celsius. Conversely, the control group had the highest mean at 3.59 degrees. The statistical significance of the data was determined using an ANOVA test, which yielded a p-value of 6.0027 x 10^-56. This was far less than the critical value of 0.05, allowing the null hypothesis, which stated plant type would have no effect on internal temperature, to be rejected. The results of this study provide vital information on one of many significant advantages of green roofs, a sustainable economic and environmental solution that are beginning to transform modern day cities.

9 EV 612

Sinha, Ananya

Arlington Tech and Career Center

Teacher: Le

The Effect of Additives on Melting Ice

Climate change is a prevalent problem in the world today, caused by the change in the Earth's atmosphere. One effect is that the polar ice caps are melting. In order to slow the melting of the ice caps, this experiment was designed to protect the albedo of ice. Four different additives; glitter, sand, silica beads, glass beads were added to the surface of ice cubes. It was hypothesized that glitter would protect the albedo of ice the best due to its highly reflective properties. It would reflect light instead of refracting or permeating like the other additives. The ice cubes with different additives were heated up under light for 20 minutes, and the average percent of mass change of the ice cubes were calculated for each group. Silica beads had the lowest average percent of mass change, and glitter was close behind. An ANOVA test showed that the results of the amount of ice melt were statistically significant, meaning that the null hypothesis could be rejected. While the results showed that silica beads were the most effective at slowing the melting of ice, a Tukey test showed that the differences between glitter and silica beads were not statistically significant. Glitter and silica beads are both an effective way to reduce the melting of the ice caps. With climate change becoming a growing concern, these results could be used to slow the melting of the ice caps, and postpone the effects of climate change.

9 EV 613

Stroud, Lanyi

Yorktown High School

Teacher: McKowen

The Effect of Ventilation Method on Level of Indoor Carbon Dioxide

Carbon dioxide is considered an indoor air pollutant. Up to 1000 ppm of carbon dioxide is generally recognized as safe, while 1000-2000 ppm is the level associated with lowered cognitive function and feelings of drowsiness. Opening the windows is a common way people ventilate their rooms. My project studies the effect of ventilation method on the amount of carbon dioxide indoors. This study is important as it would help us find the most efficient way of maintaining low levels of carbon dioxide indoors. I found that cracking open the windows for three hours was equally effective as opening the windows entirely for one hour, and then closing them for two hours. However, I found that the effects of opening the windows entirely only lasted for about two hours after the windows were shut at the one-hour mark. By then, the level of carbon dioxide had returned to 1000ppm, the same as when there was no ventilation. Therefore, cracking open the windows would be the better ventilation method in time periods longer than three hours.

9 EV 614

Boerckel, Kathryn; Grove, Allison

Washington-Liberty High School

Teacher: McCoart

The Effect of Weather Patterns on the Spread of Airborne Plastic

The purpose of this experiment was to discover the effects of weather patterns on how microplastics travel from urban to national park locations through the air. This experiment also observed weather patterns in specific regions of the United States and if they had an effect on the transmission of airborne plastics from an urban to rural location. Over the span of seven days, the original (urban) locations of microplastic filled air masses found in national park locations were recorded. Microplastics in the atmosphere are becoming an issue in the world, due to extensive amounts of plastics in the environment and have many negative effects on the health of the earth.Based on the data collected, the hypothesis (If high concentrations of airborne plastics are found in urban areas, then they will travel and affect ecosystems in less populated areas such as national parks because of weather patterns) was accepted as airborne plastics were found constantly traveling long distances to national park locations. The result of an ANOVA test also supported this hypothesis, because it validated the data to be statistically and significantly different. As a result of this data, the null hypothesis (If high concentrations of airborne plastics are found in urban areas, then they will not travel or affect the levels of airborne plastics and ecosystems in less populated areas because of weather patterns) was rejected.

10 EV 615

Carlson, Isla

Wakefield High School

Teacher: El Gamal

The Effect of Air Pollution on the Efficiency of Solar Panels

The purpose of this experiment was to see if air pollution affected the efficiency of solar panels. Air pollution was simulated using a varying amount of translucent sheets that covered the solar panel. Sunlight was simulated using a light positioned above the solar panel. The levels of the independent variable were no sheets (control), one sheet, three sheets, five sheets, seven sheets, and nine sheets. The dependent variable measured the current (microamps), voltage (volts), and power (microwatts). The hypothesis was, if there is low air pollution (1 translucent sheet), then the solar panel will produce the most volts, microamps, and microwatts because the less simulated air pollution there is, the more light reaches the solar panel.To collect data, the correct number of translucent sheets were placed over the solar panel, the light above the solar panel was turned on, and after 30 seconds data was recorded. Ten trials were conducted for each level of the independent variable, the current and voltage were measured on the multimeters and multiplied together to calculate the power. Photos were taken of the light bulb through trials to compare the brightness. The results were, when pollution increased, the amount of microamps, volts, and microwatts decreased. The level of the independent variable with the one sheet had the most electricity measured and brightest light bulb. The level of the independent variable with the most pollution, nine translucent sheets, had the least amount of measured electricity and the least bright light bulb.

10 EV 616

Coe, Elizabeth

Wakefield High School

Teacher: Tran

The Effect of Different Litter on pH of Water

The research question for this project was “What is the effect of different litter materials on the pH of water?”. For this experiment, different top litter pollutant materials were used to observe the effects they have on water’s pH. These pollutants were paper bags, plastic bags, and used sauce packets. In addition to this, a control group was tested as well. It was predicted that the sauce packets would cause the water samples’ pH to decrease the most out of all the groups. Each sample was tested right after the litter had been added to the water, then again after 24 hours. When the experiment was finished, it was concluded that the sauce packets had the lowest pH after 24 hours. This proved the hypothesis correct, however, not enough trials were done to conduct a statistical analysis test, so the alternative hypothesis could not be tested against a null hypothesis. Next time, the experiment will have more trials for a more accurate result.

10 EV 617

Docena, Elise Francesca

Washington-Liberty High School

Teacher: Bohn

The Effect of the Melting of Arctic Ice on Phytoplankton Abundance

Phytoplankton are the base of the oceanic food chain and additionally combat climate change by consuming carbon dioxide and releasing oxygen into our atmosphere through photosynthesis. Since they serve crucial roles, phytoplankton populations must be monitored and protected. That is the aim of this project—specifically, through observing the effect the melting of arctic ice has had on phytoplankton abundance over time. The numerical data for this experiment was retrieved purely from online databases (NSIDC and NOAA). The independent variable was average Northern Hemisphere arctic ice area in square kilometers, and the dependent variable was chlorophyll concentration in milligrams per cubic meter. Measuring chlorophyll concentration is the method in which phytoplankton abundance was measured, since phytoplankton utilize chlorophyll to perform photosynthesis. Despite a positive correlation between the average arctic ice areas and average chlorophyll concentrations, the null hypothesis (if the arctic ice area changes over the years, there will be no difference between the average chlorophyll concentrations) was ultimately accepted over the hypothesis (if there is a decrease in arctic ice area throughout the years, chlorophyll concentration will decrease as well), as there was no significant statistical difference between the average chlorophyll concentrations at each of the different arctic ice areas. One explanation for this is that certain types of phytoplankton may thrive on the conditions created by the melting of arctic sea ice (particularly, increased freshwater in the ocean currents), while others diminish. This would create no substantial change in the phytoplankton abundance altogether.

10 EV 618

Goeke, Madi

Washington-Liberty High School

Teacher: Bohn

A Solution to Plastic Pollution: An Investigation into Microplastic Removal from Water Using Ferrofluid

Plastic pollution is one of the most prevalent environmental issues on Earth. Due to their small size, microplastics are able to circulate in oceans and harm marine life both physically and chemically. Currently, there is no feasible large scale option to remove microplastics from water that is both economical and effective. Ferrofluid has proven effective at removing oil spills from open water and could be used as part of a solution to separate microplastics from water. In this experiment, ferrofluid was tested for its effectiveness at removing six types of plastic: polyethylene terephthalate (PET), high-density polyethylene (HDPE), polyvinyl chloride (PVC), low-density polyethylene (LDPE), polypropylene (PP), and polystyrene (PS). It was hypothesized that ferrofluid would remove at least 80% of each type of plastic.5 g/L of microplastics were suspended in twenty-milliliter samples of water. 0.5 g of magnetite and 0.5 mL of vegetable oil were added to each sample and mixed thoroughly. A neodymium magnet was then introduced to remove the oil, magnetite, and plastic. After microplastic removal, the water was analyzed with spectroscopy to determine plastic removal rates. The results found that ferrofluid successfully removed over 70% of all plastics. It was most effective at removing polyethylene terephthalate (PET) with a removal rate of 92.4% and least effective at removing polystyrene (PS) with a removal rate of 73.7%. This method of microplastic removal shows potential for industrial applications including open water and large scale water treatment plants.

10 EV 619

Lansbury, Ava

Washington-Liberty High School

Teacher: Barrett

The Effect of the pH of Simulated Acid Rain on Radish Seed Germination

The purpose of this experiment was to study the effect of the pH of simulated acid rain on radish seeds. The hypothesis was if radish seeds are germinated in a simulated acid rain solution with a more acidic pH, then there will be a negative effect on germination because the acidity will prevent the seeds from germinating properly. The four levels of the independent variable were simulated normal rain with a pH of 5.6 (control) and simulated acid rain solutions with pH values of 5.0, 4.0, and 3.0. The simulated rain solutions were put into Petri dishes each containing 10 radish seeds and monitored for germination.The control group had the highest mean number of seeds germinated in a 10-day period at 9.8 seeds, while the group with the lowest mean was pH of 3.0 with 0.6 seeds. The pH of 5.0 and pH of 4.0 groups were in the middle with means of 2.8 and 1.4 respectively. Six t-tests and an ANOVA test were calculated to determine the significance of the data. The p-values of four of the six t-tests and the ANOVA test were less than 0.05, meaning this data was significant. Because of these calculations, the null hypothesis was rejected, and the hypothesis was accepted. It was concluded that this was likely due to the simulated acid rain stunting or slowing the germination process. This study demonstrated that acid rain harmfully impacts the productivity of radish seeds in germination and is a serious concern for agriculture.

10 EV 620

MacMullen, Maggie

Washington-Liberty High School

Teacher: Bohn

The Effect of Varying Levels of CO2 in Micropropagation Through Autotrophic Tissue Culture on the Growth of Radish Plants

The objective of this experiment was to test the effects of CO2 levels on the health of radish plants grown through autotrophic tissue-culture. It was hypothesized that, if radish plantlets micropropagated through autotrophic tissue-culture are exposed to varying levels of CO2, then the plantlets exposed to the most, will be healthiest. Three levels of CO2 were tested, a control level of ~400 ug/m3, the amount of carbon dioxide found in the plants' growth environment, a moderate amount of carbon dioxide: 4600 ug/m3, and an elevated amount: 9200 ug/m3. 20 plantlets were grown per level. Plantlet cuttings were extracted and placed in peat pellets, then into growth chambers with designated amounts of carbon dioxide, dispensed by a yeast CO2 generator, then plant heights were recorded.

The control had the least growth, at a mean of 6.603 cm, while the moderate & elevated amounts of CO2 produced plants that grew taller, at 9.189 & 9.163 cm. An ANOVA test was run to determine the significance of data, and it was found that the p-value of data collected was equal to 0.139745, making it possible to reject the null hypothesis that autotrophic radish plantlets exposed to levels of CO2 will result in no correlation between growth and CO2. These findings tell us that increased CO2 levels in a growth chamber are beneficial to growth of autotrophic tissue-cultured plantlets and assist in furthering the research regarding efficiency of mass-propagation systems and contributing to expansion of autotrophic tissue culture research.

10 EV 621

Sherlick, Maya

Arlington Tech and Career Center

Teacher: Le

The Effect of Water Temperature on the Amount of Dissolved Oxygen in Water

The purpose of this study was to test the effect of temperature on the dissolved oxygen levels in the water. Climate change has become a more prominent issue, causing ocean life to be put in danger. This experiment was designed to identify how the rise of temperature impacts the mortality of ocean life, to emulate ocean conditions, and to better understand what might happen because of climate change. The independent variable was different temperatures (6.1ºC; 7.2ºC; 18.3ºC; and 29.4ºC). The control group was 65º Fahrenheit because that is the median ocean temperature in Lewes, Delaware, which is the place the experiment is emulating. The dependent variable was how much dissolved oxygen was in the water. The constants were the pitcher, heat source (water heater), tank salt, ice bath, and the oxygen meter. The hypothesis was that if the temperature increases, then the dissolved oxygen levels will decrease because as water temperatures increase the factor causing dissolved oxygen levels to go down increases. The null hypothesis was that if the temperature increases nothing happens to the dissolved oxygen levels. The hypothesis was supported because 29.4º C had the least amount of dissolved oxygen, meaning that was the most problematic for wildlife. This shows that climate change can seriously impact the environment and have lasting effects on our food chain and wildlife.

10 EV 622

Watson, Ivy

Washington-Liberty High School

Teacher: Bohn

The Effect of Firework Display Length and Frequency on Amount of Particulate Matter 2.5 in the Air

The purpose of the investigation was to determine a method to coordinate local firework displays in order to decrease levels of particulate matter 2.5 (PM2.5) released. The hypothesis was that having one firework display per night over several nights would release lower levels of PM2.5 than having multiple firework displays on one night.

Data from the EPA's Air Quality Service API was downloaded from three locations. The data was organized into three groups: before, during, and after firework events, and the average was calculated for each hour of the day.

Hourly data from the night of each firework event showed a large increase in the PM2.5 levels for Washington D.C. in 2019 and 2020. In 2019, Weston, WY didn't have as large of an increase, however it was statistically significant. The highest levels during the night of the firework display were found in DC 2019 and the lowest levels were in Weston 2019.

The results indicate reduction of PM2.5 released by firework displays in a region with frequent displays is to schedule events across several days as opposed to all being released on the same night. Applications of this investigation are relevant as particulate matter has detrimental health effects on people with respiratory conditions, such as Covid-19. Covid-19 increases the risk of lung infections and diseases and can also reduce lung function, placing more people at risk from fireworks and particulate matter.

10 EV 623

Wayman, Elizabeth

Yorktown High School

Teacher: Hessler

The Effect of Percentage Cloud Cover on the Amount of Solar Energy Produced

The purpose of this experiment was to determine how much weather changes, specifically the percentage cloud cover, affect a rooftop solar array. Additionally, the results of the experiment helps homeowners, businesses, and power companies better understand the potential fluctuations in the power output of rooftop solar arrays due to changes in cloud cover. The hypothesis for this experiment was that, if the percentage of cloud cover is closer to 0, then the amount of solar energy produced will be greater because the fraction of the sky covered by clouds will be less. Therefore, less visible light is refracted before being able to hit the panels and produce energy. To test this hypothesis, the daily percentage cloud cover was tracked using the Accuweather application. While the corresponding number of kWh of energy produced was monitored using the Enlighten application. All data was recorded in a data table along with the date for thirty-one days. Next, the data was graphed and the line of best fit for the amount of solar energy produced was calculated. The resulting graph showed a clear relationship between cloud cover and energy production; as the percentage of cloud cover increased, the amount of solar energy produced decreased. These results likely occurred because clouds refract light in different directions, decreasing the chances of the light hitting the solar panels on cloudier days. Overall, it can be concluded that increased cloud cover has a negative effect on the energy production of rooftop solar arrays.

10 EV 624

Estevao, Rebecca; Gordon, Alexandra

Washington-Liberty High School

Teacher: Barrett

The Effect of the Type of Soap on the Germination of Radish Seeds

This experiment was conducted to determine if water polluted with hand soap had a negative effect on the germination of radish seeds, and to discover whether hand soaps marketed as more environmentally friendly actually have less of an effect on plant life. In the experiment, the seeds were tested with Softsoap, Dawn, Tom's of Maine, and the control group of water. It was hypothesized that Softsoap would have the greatest effect on the plants, causing the lowest germination rates. The experiment was conducted by leaving the seeds in petri dishes soaked with a solution of hand soap and water for ten days to allow for the full germination period of the radish seeds. After testing all of the IV levels, the results were statistically inconclusive however when observing the sprouts, the plants watered with the soap solution looked significantly less healthy. Of the types of hand soap, Tom's of Maine germinated the greatest number of seeds followed by Softsoap, then Dawn. The experiment though perhaps not statistically significant, did demonstrate that water polluted with soap has a small effect on plant life.

11 EV 625

Ackleson, Thomas

Washington-Liberty High School

Teacher: Hedderly

Modeling Oncorhynchus nerka Populations Near Pebble Mine, Alaska

The proposed pit mine in Pebble Bay, Alaska is predicted to displace up to 8.4 million tons of mine rock waste for every year it will be in use. This waste contains highly acidic chemical compounds, namely sulfide acid and copper nitrate. Mineral waste like this will increase pH levels in the surrounding water system and Bristol Bay. Responsible for 46% of the world's sockeye salmon (Onchorynkus nerka) production, this water system is also an important cultural and spiritual hub. The predicted impacts of rising pH from rock waste on O. nerka reproduction has been researched, but not modeled over time. This project's purpose was to conduct that modeling, taking various pH estimates into account. Python simulation software was programmed, which used an iterative formula to calculate Bristol Bay salmon spawning statistics at various pH levels for the next 40 years. It was found that any pH levels less than normal conditions (7.0 - 7.9) would slow the rate of reproduction significantly, and any pH level less than 5.0 would lead to negative growth. The pH environment most likely to arise from Pebble Mine waste displacement, pH 5.0 - 6.9, saw a nearly 68% slower population growth rate than normal levels. It was concluded that, given the many assumptions and generalizations the model took, the precise numbers calculated by the model were largely inaccurate, however the trends they show likely are. If the mine is approved, salmon populations and their economic and social values will be put into jeopardy.

11 EV 626

Quinn, Sam

Yorktown High School

Teacher: Wright

The Effect of Different Types of Rocks on Nutrient Runoff

The use of fertilizers contributes to pollution in streams and other water bodies. The purpose of this experiment was to find a solution to reduce nutrient runoff. In my experiment, I tested the effect of different types of rock on potentially reducing nutrient runoff. I started my experiment by making a fertilizer mixture and poured the mix into cups filled with different types of rocks. The cups had holes in the bottom so that the fertilizer mixture could filter through the rocks and drain into empty cups beneath. I measured and compared the total dissolved solids (TDS) of the fertilizer mix before and after being filtered through the rocks. Every variable tested decreased the TDS measurement of the fertilizer mix. The most significant reduction occurred during the testing of lava rocks. The lava rocks reduced the TDS measurement of the fertilizer mix from 1450 ppm to an average of 1090.5 ppm, a 359.5 ppm reduction. I assume lava rock had the most significant reduction because it has an appropriate porosity. All of my data was quantitative. I performed an ANOVA statistical test on my data. The p-value was greater than .05, which means that the results of my data were insignificant. To improve on my experiment, I could use a single rock as a filter to remove the factor of size and shape differences which could affect the testing.

11 EV 627

Stievater, Adam

Washington-Liberty High School

Teacher: Hedderly

The Effect of Highway Proximity on Lichen Prevalence in Prince William Forest Park

The purpose of this experiment was to determine the effects of distance from an interstate highway on the prevalence of epiphytic lichens in Prince William Forest Park. The research hypothesis was that epiphytic lichens would be more prevalent farther from the highway, because automobile pollutants would restrict the growth of the lichens closer to the highway. The null hypothesis was that lichens would be equally prevalent no matter the distance from the highway, because automobile pollutants would have no effect on the lichens. Trees were observed in areas 0.25, 1, 4, and 10 km from the highway. Each tree in a 30-metre-long section of trail was assigned a qualitative value between 0 and 3, representing the amount of lichen on the tree. The prevalence of each value in that section of trail was calculated and shown on the summative graph. It was found that more trees with large amounts of lichen were found farther from the highway. A pearson correlation coefficient was calculated, and found that there is a strong, but not perfect positive correlation between distance from the highway and lichen prevalence. This provides evidence to reject the null hypothesis and accept the research hypothesis. Therefore, it can be concluded that the prevalence of epiphytic lichens increases as distance from the highway increases, which means that automobile pollutants have harmful effects on lichens.

12 EV 628

Licato, James

Washington-Liberty High School

Teacher: Sotomayor

Development of a Zeolite Composite Material for the Simultaneous Removal of Pharmaceuticals, Personal Care Products (PPCPs), and Perfluorinated Alkyl Substances (PFAS) in Water Treatment

Perfluorinated alkyl substances (PFAS) are chemicals found in heat, stain, and water resistant consumer products, including Teflon. Like pharmaceuticals (PPCPs), these “forever chemicals” are found extensively in wastewater and are toxic to humans and the environment. Wastewater treatment facilities (WWTFs) currently lack technology capable of removing PPCPs and PFAS. This investigation designed a new composite material to remove these contaminants using zeolites - a type of synthetic sand that acts as a filter at the molecular level. Six zeolite composite variants were tested through batch experimentation using both a lab-controlled mixture and WWTF effluent. The lab-controlled mixture, containing 21 PPCPs and PFAS of concern, yielded adsorption data for all zeolite materials under controlled conditions. Langmuir isotherm modeling was applied to calculate adsorption capacity and adsorption favorability. WWTF effluent from three Washington D.C. area locations was collected, tested, and analyzed for a schedule of 111 different PPCPs and PFAS. The effluent was then used to determine zeolite composite effectiveness in a wastewater treatment plant setting. Three conclusions were drawn: 1) PPCP and PFAS concentrations in effluent violated accepted safety thresholds, demonstrating a need for new WWTF technology targeting micropollutants, 2) the novel zeolite composite materials effectively removed both PPCPs and PFAS simultaneously under both controlled and real-world conditions, and 3) no single mechanism was found to predict efficacy in a complex solution. The zeolite composites exhibited effective and efficient removal of both PPCPs and PFAS in WWTF effluent, performing better than existing WWTF methods under comparable conditions.

7 MC 700

Stievater, Henry

Swanson Middle School

Teacher: Seavolt

The Effect of School Size, Percent of Teachers With a Master's Degree or Higher, and Per-Pupil Expenditures on SOL Pass Rates

The Virginia Standards of Learning (SOLs) are tests taken by all students in Virginia from grades 3-12 and are used as indicators of teacher and student ability. The purpose of this experiment was to test for any correlation between SOL pass rates (the dependent variable) and school size, percent of teachers with advanced degrees, or per-pupil expenditures (the independent variables). The hypothesis was that SOL pass rates would have a positive correlation with percent of teachers with advanced degrees, a negative correlation with school size, and no effect on per-pupil expenditures. The data used in this experiment was collected from the Virginia School Quality Profiles (a Virginia Department of Education database), and a least squares regression was performed on the data. The standard error was less than the magnitude of the slope in every case. For every SOL, per-pupil expenditures had a negative correlation, school size had a positive correlation, and percent of teachers with advanced degrees had a positive slope—that is, the more the school spends per student, the worse the school's pass rate on the SOLs, the larger the size of the school, the better the school pass rate on the SOL, and the greater the percent of teachers that had advanced degrees, the better the school's pass rate on the SOLs. The hypothesis regarding teacher degrees is accepted, but the hypotheses regarding school size and per-pupil expenditures are rejected.

8 MC 701

Klinger, Andrew

Swanson Middle School

Teacher: Schultz

Weather Conditions Affect on GPS Running Routes

My project was conducted with the interest of informing athletes of the accuracy of their metrics that they rely on in different conditions. Athletes depend on their numbers to enhance their training regardless of the condition and deserve to know if they can depend on the accuracy of their metrics. If the weather is rainy, then GPS running routes won't be as accurate. I used GIS along with Strava (GPS running maps and metric application) and The Weather Channel to perform my experiment. I inserted each trial from Strava into ArcGIS to take measurements. I found that rainy weather had the worst performance of the different independent variable levels I tested with a mean of 7.82 meters of inaccuracy. I deduced that partly sunny weather performed the best of all of the levels with only 4.89 meters of inaccuracy. Sunny weather fell between with a mean inaccuracy of 7.18 meters. My results supported my hypothesis because rainy weather performed the worst. Although, there was one result that surprised me. I was surprised that partly sunny weather conditions outperformed sunny weather conditions. I came up with two explanations for this. One is that the difference in the actual conditions was so little that the results between these levels might fluctuate. Another explanation might involve government interference with GPS. To end, my experiment brought a lot of insightful information to athletes about their metrics. Athletes can expect to see very reliable metrics but might see worse results in rainy conditions.

9 MC 702

Silva, Leila

Yorktown High School

Teacher: Paz-Soldan

The Effect of Different Materials on Wi-Fi Signal Strength

This experiment was conducted in order to test how different household materials block Wi-Fi signals. Due to Covid-19, more people than ever before are working from home, and a bad signal can greatly affect job or school performance. Wi-Fi uses radio frequencies that can be blocked or absorbed. The strength of Wi-Fi is measured in dBm, with numbers closer to 0 representing a stronger signal. It was hypothesized that aluminium would weaken the signal the most compared to no material, glass, plastic, and wood, because it was the densest material tested, and dense materials absorb more of the signal. The experiment was set up using two stools. One had an iPhone on it, and the other a Wi-Fi hotspot. The material was set up 15 cm away from the hotspot. The app Airport Utility was used to measure dBm. The hypothesis was rejected. It was predicted that aluminium would have the lowest dBm, while the data showed it had the highest dBm at -58. The level hypothesized to have the highest dBm, no material, had the lowest. Something of note is that the average Wi-Fi signal strength went up in the order that the levels were tested. One possible explanation for the results is that the hotspot required time to reach its full strength, and that it was still improving while the experiment was being conducted. Another possible source of error was the varying size and thickness of the materials tested.

10 MC 703

Beasley, Elise

Yorktown High School

Teacher: Hessler

Connecting Monitors with Raspberry Pi Zero W

With rising technology usage, more advanced devices gain availability and widespread interest, especially with expanded applications. Due to this growth, the public can obtain computers with low prices and extensive online information like Raspberry Pis, enabling innovation and technological exploration. However, the relative novelty of Rasp Pi ZWs means that information is more limited than what previous Raspberry Pis have. The objective of this project was to demonstrate the capabilities of Rasp Pi ZW by animating code through Turtle that moves a ball across the screens of two monitors. By using a messaging queue system and a base communication code, two code files were written for Rasp Pi ZWs to send messages to each other over Wifi. The messages contained coordinates and a color, which dictated where a ball moved and the starting color. When the ball reached the end of the monitor screen (transfer wall), the Rasp Pi ZW sent a message to the second Rasp Pi ZW to continue the motion on the second monitor screen. When the ball reached the next side, it bounced, changed color, and moved back towards the transfer wall with a new, randomly generated y coordinate. Through asynchronous input-output, socket programming methods, messaging queues, and multithreading, the ball moved continuously until program termination. With the extra features, this project expanded beyond the objective, adding to the project's success. Future studies include additional Rasp Pis, improved axis control, eliminating walls, fail-safe checks, pop-up screens, and possible game development.

10 MC 704

Haron, Rose

Washington-Liberty High School

Teacher: Bohn

Predicting Ideal Group Sizes for COVID-19 Pooled Testing Using Mathematics

Pooled testing is a method which combines multiple individual samples together and tests them as one. If that sample returns positive, one or more members of the pool are COVID-19 positive meaning the entire group must be retested individually. If the pooled sample is negative, then all individuals are negative. This strategy is particularly relevant to the unprecedented global pandemic the world currently faces. Pooled testing is potentially an efficient method for curbing the spread of COVID-19 through increasing testing capacity. For this experiment, It was assumed that a group size of 20 would result in maximum reductions in testing across most prevalences of COVID-19 since the group size would be large enough to decrease number of tests needed to test a population, without having to retest the majority of pooled groups. For this experiment, COVID-19 prevalence and group size were plugged into a mathematical equation in order to obtain the theoretical percentage of groups which would return positive, leading to the number of tests required to sample an entire population of 10,000 individuals. The results for this experiment did not support the hypothesis. A group size of 4 achieved the maximum reduction for 30 of 40 COVID-19 prevalences tested. The p-value regarding the effect of COVID-19 prevalence on reduction in tests required was 2.64e-245. The p-value regarding the effect of group size on test reduction was 2.48e-132. These p-values suggest a statistical significance between prevalence, group size, and test reduction, meaning the null hypothesis was rejected.

10 MC 705

Sharma, Ambica

Washington-Liberty High School

Teacher: Barrett

The Effect of Algorithm Based Neural Network Machine Learning on the Projection of the Basis and Progression of Alzheimer's Disease

This experiment has used neural network machine learning to project the baseline diagnosis and progression of Alzheimer's Disease, a neurodegenerative disease without any known cure. Clinicians believe that if caught early, the progression of Alzheimer's can be decelerated. Machine learning has been commonly used to generate predictions in the biomedical sciences. The research hypothesis had suggested that out of the overlapping eight, eleven, and fifteen Feature (Biomarker) Training Groups, the predicted diagnosis for the fifteen Feature Training Group will have the highest mAUC score (accuracy) because it held the most data points for the machine learning tool to use. An algorithm had been developed, implemented on the machine learning tool, Scikit-learn, and assessed by entering eight, eleven, and fifteen biomarkers for 450 patients to produce a prediction of stage diagnosis (Cognitively Normal, Mild Cognitive Impairment, or Dementia) at various intervals over six years since testing initiation. The 8 Feature Training Group (FTG) had projected an mAUC score of 0.9481 (90% accuracy), the 11 FTG projected an mAUC score of 0.9617 (92% accuracy), and the 15 FTG projected an mAUC score of 0.9754 (94% accuracy). The average accuracy rate across all FTGs was 92%. With this new machine learning algorithm, clinicians have the ability to project diagnoses for patients up to six years, allowing them to be diagnosed during an earlier stage when the growth of Alzheimer's Disease can be potentially arrested.

11 MC 706

Gordon, Max

T.C. Williams High School

Teacher: Mirto

Using AI to Detect and Deter Telemarketers

Telemarketers and phone scams are the biggest source of complaints to the FCC, swindling nearly $40 billion from phone users. While much of this is illegal, it is impossible to enforce American laws, such as the Do Not Call Registry with telemarketers based in India and China. This project explores the possibility of using a recurrent neural network (RNN) to identify telemarketers through natural language processing (NLP) classification. The goal is an 80% success rate at identifying telemarketers with less than a 5% rate of false positives. In addition, computational simplicity is critical so it can run on a Raspberry Pi, making it accessible to everyone. The system will answer calls to the user's smartphone and begin to talk to the caller. Speech from the caller is classified into six possible categories: information, question, command, conditional (if … then …), general exchange (banter and greetings), and persuasion. A telemarketer will be identified by persuasion; if greater than 30% of the caller's sentences are persuasive, the program will flag them as a telemarketer. To engage the caller in conversation, another RNN (chatbot) will generate responses. During the conversation, the classifier RNN will continue classifying while the chatbot tries to keep the telemarketing talking for as long as possible. If the NLP classifier does determine the caller is a telemarketer, it will stop analyzing the telemarketer's speech while the chatbot continues to loop until the telemarketer hangs up. Otherwise, the system will forward the caller back to the user.

9 ME 800

Abera, Elida

Wakefield High School

Teacher: Troiano

The Effect of Different Types of COVID-19 Testing on the Frequency of False Negatives

If it takes the human body 1-3 weeks to accumulate a significant amount of antibodies large enough that it could be detected in a molecular assay, then coronavirus antibody tests may be more likely to have a higher false negative rate than rapid antigen, rapid molecular or molecular testing. I expected that, because of my background research, antibody testing would have been the one with the most false negatives, but these results mention that rapid antigen testing is the least efficient in testing for COVID-19. These results (antibody) are also not efficient because the sensitivity (ability of a test to correctly identify patients with a disease) is too low during the first week. I expected that, because of my background research, antibody testing would have been the one with the most false negatives, but these results mention that rapid antigen testing is the least efficient in testing for COVID-19. In the end, my data rejected my hypothesis, but my research backed it up. It takes the body a while for it to start to produce a blood protein that fleshes out foreign substances in the blood. Therefore, antibody tests should only be taken after 2 weeks have passed since you first started seeing symptoms. They shouldn't be the first course of action.

9 ME 801

Ahmed, Sabrin

Washington-Liberty High School

Teacher: Sotomayor

HIV Infection Rate in Fiji, Malaysia, and Ukraine From 2009-2019

The effect of HIV infection over a ten-year increment was examined in an experiment using data from the World Health Organization. The purpose of this experiment was to evaluate whether or not the HIV infection rate would decrease as years went by from 2009-2019 in Fiji, Malaysia, and Ukraine. This virus is becoming more and more common, with people all over the world obtaining it. Couldn't this virus be stopped with people having an education concerning how the virus is acquired and transmitted in the first place? If HIV becomes obtained by an individual and not appropriately treated, it could lead to a significant threat to the individual and their health. The null hypothesis stated as the years advance, a difference in the number of HIV cases will not be present. Due to the collected data, the null hypothesis can be rejected, due to, there was a difference in HIV cases as the years advanced. Initially, the hypothesis of this analysis was thought to decrease in HIV cases as the years advance. Thus, due to the years and the number of infections increasing, a rejection to the hypothesis can be made. An ANOVA test was constructed and ran to evaluate the differences between the three countries. The results revealed that the data is statistically significant. Overall, the outcome of this analysis was not the expected conclusion.

9 ME 802

Ben Hammouda, Malek

Washington-Liberty High School

Teacher: Sotomayor

The Relationship Between Exposure to Fine Particulate Matter During Pregnancy and Preterm Births

The purpose of this study was to test the correlation between exposure to fine particulate matter, commonly known as PM2.5, during pregnancy and the number of preterm births. The levels of PM2.5 were measured using an Air Quality Index score. The relationship between Air Quality Index scores and preterm births were examined using data from the Environmental Protection Agency and the Kids Count Data Center. The annual AQI scores and numbers of preterm births were found for seven of the states with the highest levels of PM2.5 between 1999-2017, in intervals of every other year. The states used were Alaska, California, Pennsylvania, Oregon, Texas, Utah, and Washington. The hypothesis was: If AQI scores are associated with preterm births, then AQI scores will have a direct positive correlation with preterm births. A Pearson's R Correlation Coefficient was used to test the type of correlation between the AQI scores and the number of preterm births. The results showed a strong, direct correlation between the variables, leading to the acceptance of the hypothesis and the rejection of the null hypothesis. The standard deviation and the linear trendline showed somewhat high variability in the data, slightly decreasing the accuracy of the data.

9 ME 803

Buchholz, Claire

Yorktown High School

Teacher: Paz-Soldan

The Effect of the Deep Knee Bends on Knee Stress

The knee is an important joint in the human body, but it is also very easily injured with the wrong amount of force or tension. The knee joint is where the femur and the tibia meet. The patella, also known as the kneecap, is in the front part of the knee. When the knee bends, the tension increases in the quadriceps muscles across the patella. The purpose of this experiment was to see the effect of angle of the knee on the amount of tension across the patella. A model was built to represent the knee and tension placed on it. The model was reset after each variable (ten trials per variable), and then set to the trial angle. The length of the spring, which measured the tension, was measured using a metric ruler. The results showed a r2 value of 0.998, meaning that the rate at which tension increases in a knee while bending is close to the square of the angle. There was also a P-Value of 0.002, meaning that the null hypothesis for this experiment was rejected. In conclusion, this project showed how the tension has a direct impact on the patella with an exponential polynomial function.

10 ME 804

Aniss, Lina

Washington-Liberty High School

Teacher: Bohn

The Effect of Tissue Thickness on Temperature Change Induced by Cellular Radiation

This experiment tested the effect of different brain tissue thicknesses on temperature change induced by cellular radiation. This experiment was conducted to show how vulnerable brain tissue is to cellular radiation. For this experiment, I purchased five cattle brains which were all cut into halves. For each trial, I placed a cell phone 10 cm away from the brain tissue, which was also in a call with another phone to simulate a phone call. Three precision thermometers were then placed in different thickness to measure the temperature change. The temperature was recorded every minute for 15 minutes. The results showed that the highest change was found in the grey matter (2mm, 12mm) of the brain, which increased on average .64 degrees Celsius. The lowest change was found in the white matter (22mm), which increased on average .4 degrees Celsius. An ANOVA test and three T-Tests were done in order to determine if the data was statistically significant, which according to the tests they were. Standard deviation was calculated as well, which showed that the data was also reliable. These tests led to a rejection of the null hypothesis because they showed that the independent variables did have an effect on the dependent variable. This experiment's results were also compared to online resources in order to assess how dangerous the temperature increase was. The results demonstrated that the temperature was enough to cause health impairments like eye cataracts, cell proliferation, permeable blood-brain, tissue damage, and irregular sleeping habits in humans.

10 ME 805

Cunningham, Charlotte

Washington-Liberty High School

Teacher: Bohn

The Effect of Elapsed Time on the Thickness Level of Commercial Kefir as Measured by the IDDSI Flow Test and Framework

The purpose of this experiment was to determine the effect of elapsed time on the thickness level of commercial kefir as measured by the International Dysphagia Diet Standardization Initiative (IDDSI) Flow Test and Framework. Kefir is a lactose-free fermented beverage made with beneficial bacteria. Despite its known health benefits and use in hospitals, there has been no prior study found on how the IDDSI Level of kefir changes over time. The hypothesis was that if the amount of time a glass of kefir is set out increases, the IDDSI Level will decrease as the drink becomes warmer and thus flows faster through the syringe. Three brands of commercial kefir, Lifeway, Green Valley, and Maple Hill, and three levels of milkfat, Nonfat (0%), Lowfat (1%), and Whole Milk (3.25% and 3.5%), were tested in 5-minute intervals over an elapsed time period of 30-minutes. These intervals were important to notice changes in the IDDSI Level over time. Results showed that the hypothesis was partially accepted. As elapsed time increased, the temperature of the kefir increased, making it flow faster through the syringe. However, the overall IDDSI Level did not change within the 30-minute elapsed period. This experiment benefits persons with dysphagia or other swallowing disorders who need to consume liquid thickened to a specific level to avoid choking or aspiration. Based on this research, these persons could safely pour a glass of commercial kefir and consume it over a period of time knowing that the IDDSI Level would not change.

10 ME 806

Felker, Kara

Washington-Liberty High School

Teacher: Barrett

The Effect of the Occurrence of CD226 Gene Variants on the Death Rate of COVID-19

The purpose of this study was to determine any role the CD226 gene plays in the severity of COVID-19. There were two independent variables: the CD226 polymorphisms rs73661 and rs727088. The IV levels were: two countries with ~66% mutated allele; two countries with ~50% mutated allele; and, two countries with ~33% mutated allele. The dependent variable was the death rate of COVID-19. The constants were the database used for each dataset (gene mutations and COVID-19 death rate) and the date used for the death rate of COVID-19. The hypothesis was: if the death rate of the countries with ~66% mutated allele is compared with the death rate of the countries with ~33% mutated allele, then the countries with ~66% mutated allele will have a higher death rate. This experiment was completed by compiling population samples of gene mutations for countries with several percentages of the mutated alleles and comparing the COVID-19 death rates of these countries. The data show that the countries with ~66% mutated allele of the rs73661 polymorphism had a higher death rate than the countries with ~33% mutated allele, however the countries with ~50% mutated allele had the highest death rate. For the rs727088 polymorphism, the countries with ~66% mutated allele had a lower death rate than the countries with ~33% mutated allele. These results reject the hypothesis. The null hypothesis was accepted. From the results, no conclusions can be drawn about the role of CD226 in the severity of COVID-19.

10 ME 807

Licato, Anne

Washington-Liberty High School

Teacher: Bohn

The Effect of Proximity and Particles Exhaled Based on Breath Rate on the Number of COVID-19 Virus Particles Accumulated

In early March of 2020, the COVID-19 pandemic overtook the world. Since then, the CDC and other public health organizations have stressed wearing masks and remaining 6 feet apart from others to help prevent the spread of the virus. The purpose of this experiment was to determine how many COVID-19 virus particles were accumulated by people standing in a line at different proximities to an infected person and by the position of the infected person in the line. The hypothesis for this experiment was if a person with a higher breathing rate was infected with COVID-19 and they stood in a line with a proximity of 1.5 feet to the people around them, then the people around them would accumulate more COVID-19 virus particles, because the infected person had a higher breathing rate and they were standing closer to the people around them. The breathing rates for all simulated persons was randomized and the number of particles exhaled and inhaled per person was calculated. The number of virus particles accumulated based on the infected person was then calculated. The results found that when infected, position 4 caused the most spread of virus particles. It was also found that the greatest accumulation of virus particles for distances and positions, occurred when position 9 was infected and stood 6 feet apart. All data was statistically significant, however the breathing rate of the infected person had little to no effect on virus particles accumulated.

10 ME 808

Portner, Benjamin

Washington-Liberty High School

Teacher: Bohn

The Effect of the Chemical Constituency of Type of Milk Dominant in an Area on the Percent of Lactose Persistence of Human Groups

Lactose persistence (LP), i.e. the ability to digest lactose, is well-studied topic in genetics, but the explanation for its uneven distribution around the world is still a subject of research. Fat and protein are two dietary necessities for humans, and their deficiencies have been linked to a number of developmental issues. The goal of this study was to identify a possible link between the percentage of fat and protein in the dairy supply and the prevalence of LP genes in a region.The study focused on Eastern Africa. Using data from Itan et al. (2010) and the UN FAO, among other sources, the study found a strong correlation ($p<.01$) between both the amount of fat and protein in the milk supply in a location and the level of LP genes in the population. Still, the relatively low r2 value suggests that, while there is a correlation, it is not the sole actor in influencing the distribution of LP genes.These findings support the conclusions of much previous research that has showed dietary necessities directly impacting genetic changes, and even built on those previous studies by illustrating how such genetic changes could take place over a smaller time frame. Despite this, a few elements of the project could be refined, notably regarding the uneven diaspora of different ethnic groups and recent climate shifts. In summary, this study has derived useful information on the topic of LP gene distribution by performing statistical tests and through a geospatial model.

10 ME 809

Qadir, Sanah

Yorktown High School

Teacher: Hessler

The Effect of Different Painkillers on the Time of Solubility

Pain is a universal feeling. It is your nervous system's way of signaling to your body that something is wrong, which is why the question should be asked, which painkiller works the quickest? This project focuses on the solubility of different painkillers in a simulated environment of the stomach. The medicines that were tested were Ibuprofen, Aspirin, Acetaminophen, and Naproxen. These medicines (independent variable) were tested for the time in seconds (dependent variable) it took for them to dissolve. The hypothesis was that Aspirin would take the longest due to no sign of coating when compared to the other medicines.

To simulate the environment of the stomach, the temperature was kept constant at 37°C (the internal temperature of the body) and white vinegar, with a pH of 2.5, was used to simulate the acidic nature of the stomach. The experiment was done with 4 trials of each medicine, with the placement of each tablet in 100ml of white vinegar and left to dissolve while timing this process. After each trial was conducted, the average and p-value were taken.

Acetaminophen took the shortest amount of time to dissolve, with an average of 1738.055 sec, which means the initial hypothesis is rejected. Additionally, the p-value came out to be less than 0.05, meaning the null hypothesis was also rejected.

In the end, this experiment showed that there, in fact, is a difference between the solubility times of different pain killers and that the difference is a significant one.

11 ME 810

La Piana, Caroline

Washington-Liberty High School

Teacher: Hedderly

Is There a Correlation Between Current Smokers and Heart Attack Mortality for Individuals Over 65?

The research question is, "Is there a correlation between current smokers and heart attack mortality for individuals over 65?"The study investigated the relationship between smoking and heart disease. The first variable was the percent of current smokers over 65. The second variable was the heart attack mortality rate for individuals over 65. The null hypothesis is, “There is no correlation between current smokers and heart attack mortality for individuals over 65.”The hypothesis is, “There is a positive correlation between current smokers and heart attack mortality for individuals over 65 because consistent smoking has direct adverse effects on the function of the coronary arteries.”Pre-existing data concerning current smoking and heart attack mortality for individuals over 65 for 11 different states (for a total of eleven trials) from 2000-2018 was sourced from the Center for Disease Control National Environmental Public Health Tracking Network Data Explorer. The Pearson Correlation Coefficient Test was used to determine the type and degree of relationship between the two variables for each trial. Ten out of eleven states supported a positive correlation between the two variables, and six out of eleven states supported a statistically significant positive correlation between the two variables. The null hypothesis was rejected and the hypothesis was accepted with modifications. It was concluded that there is a weak positive correlation between current smokers and heart attack mortality for individuals over 65.

11 ME 811

Marco, Emma

Yorktown High School

Teacher: Wright

The Effect of pH on Ibuprofen Solubility

Prostaglandins are hormones associated with wound repair that lead to pain and inflammation. Ibuprofen is a weak carboxylic acid and an anti-inflammatory drug that reduces Prostaglandin production in order to ease someone of their pain. Living with my grandparents, who have arthritis, Ibuprofen is a household staple, so I hope to investigate what may contribute to the time before the effects of Ibuprofen are seen in the body. The results of my experiment may help explain why Ibuprofen has greater difficulty easing pain in one person's body over another or at one time of day over another. Stomach pH varies depending on numerous factors, but tends to be around 1-2 during digestion and 4-5 resting. I hypothesized that, if the most acidic solution is tested (pH of 2), then the Ibuprofen will dissolve most quickly because it most closely resembles that of stomach acid, which, under normal conditions, digests ingested drugs in the human body. My results, however, indicated that the solution with the pH of 2 took the longest amount of time to dissolve the Ibuprofen and, even then, solid precipitate still accumulated at the bottom of the cup. This is because Ibuprofen contains a polar carboxyl (COOH) functional group and non-polar alkyl groups, decreasing its polarity, making it barely soluble in water and other acids. The Ibuprofen dissolved the most quickly in the solution with a pH of 10 because sodium hydroxide ionizes acids like Ibuprofen. However, the common ion effect hindered Ibuprofen's solubility in the pH 13.

11 ME 812

Nemirow, Devin

Washington-Liberty High School

Teacher: Hedderly

Testing the Effect of Tampons on pH in a Simulated Uterine Environment.

Tampons are a necessary product for billions of women worldwide, yet many tampons contain unnatural and potentially harmful substances.Tampons are regulated by the FDA and are considered Medical devices. Medical devices are not required by the government to disclose their materials, and thus deciphering what you are using becomes challenging. This lack of regulation causes confusion when determining the safety of feminine products. For example, many tampons have additives to provide different accommodations such as scenting, or pH balancing. In my experiment I take the tampons out of the uterus and experiment them in a controlled environment. This should isolate other factors like bacteria, pre-existing conditions, and bodily events. Balancing the water before experimenting provides an equal starting point for each experimental group. Before beginning the experiment, adjust the pH of the water in the cup by adding baking soda and/or citric acid. Using plastic wrap and tape, suspend the tampon in the water and cover the cup to mimic the environment in the uterus. After 4, 8, 16, and 24 hours passes, test the pH of the water to collect data on the change of pH over time. Repeat this testing procedure for 10 trials for each independent variable. When observing the data over time, a negative correlation was observed in all trials. These results prove that the chemicals and additives used in tampons do alter the natural environment of the uterus. These changes may be harmful, but with increasing experimentation, information will be available to solidify these results.

11 ME 813

Schiavo, John

Arlington Tech and Career Center

Teacher: Swisher

The Effect of Filter Material in a Face Mask on the Reduction of Outward Aerosol Spread

The original purpose of the effect of filter material in a face mask on the reduction of outward aerosol spread was to answer the question of which material creates the most effective face mask for blocking aerosol droplets. The seven types of cloths tested to determine this result were non-woven polypropylene (which is used in surgical masks), t-shirt cotton, polyester, a cotton-polyester composite, silk, linen sheets, and no cloth as a control. It was predicted that hydrophobic cloths with a higher density would be the most effective in blocking moisture particulates, and the tighter weave would allow for less matter to pass through. Additionally, the hydrophobic properties of the cloth would mean that it would absorb less moisture and become less saturated (and therefore a less effective barrier) when compared to hydrophilic cloths. To test this hypothesis, each different cloth was placed at the end of a PVC tube with a chemical spray bottle at the other end to introduce moisture to the controlled environment. Before and after each trial, the spray bottle, cloth sample, and PVC pipe were all weighed in order to measure the amount of moisture that passed through the cloth. This process was performed 10 times for each of the 7 types of cloth to provide a multitude of data points that would contribute to more accurate results.

11 ME 814

Shiells, Katherine

Bishop O'Connell High School

Teacher: O'Connor

A Study of Popular Artificial Turf Surfaces' Ability to Sustain Bacterial Growth and Associated Health Ramifications

As much concern has been raised regarding potential human health risks associated with artificial turf infills, the objective of this study was to verify these health related speculation and determine the microbial population of infills for synthetic turf systems. It was hypothesized that the reproduction of e. coli pathogens is greater on artificial turf with crumb rubber infill than grass or natural infill surfaces. Twenty-one sets of measurements were conducted July 9 to August 29, 2020 on three artificial turf fields and three grass fields, all in close geographical proximity. Average ambient air and surface temperatures of 88.5°F and 103.5°F were then calculated for grass and artificial turf respectively. Six duplicate specimens of turf with different infills were preheated and tested for their ability to sustain e. coli at 88.5°F and 103.5°F temperatures. Measurements showed that at 88.5°F, natural grass harbored significant lawns of e. coli cultures, while cork infill showed the largest culture count for the infills. At 103.5°F, cork again sustained the most e. coli cultures. It was concluded that natural systems, especially grass and cork, harbor significantly more bacteria growth than completely artificial options. Extending the study further, three samples of crumb rubber were tested to determine the amount of volatile emission under a UV light by measuring their changes in mass. It was concluded that artificial turf's crumb rubber infill initially lost mass due to volatile emissions, but it was not determined if this loss continued over time.

11 ME 815

Tripathi, Anika

Washington-Liberty High School

Teacher: Hedderly

The Relationship between Particulate Matter 2.5 and Case-fatality Percent from COVID-19 in Virginia Counties

The purpose of the experiment was to determine if there was a correlation between the particulate matter 2.5 air pollution and the case-fatality percent from COVID-19 in various Virginia counties. COVID-19 is a respiratory targeted virus and finding a strong positive correlation between the variables could indicate that PM2.5 air pollution has an effect on morbidity from COVID-19. 17 Virginia counties were randomly sampled. The PM2.5 averages from 2019 and the case-fatality percent were tabulated for each county. It was hypothesized that there would be a strong positive correlation between the two variables because based on Wu et al. 2020, the researchers found a positive relationship in the U.S between mortality rate and PM2.5. Descriptive statistics were tabulated for each of the 17 Virginia counties. Factors tabulated included population density, average persons per household, and other factors. Smaller data sets were created by isolating a factor with a specific range in an attempt to observe the correlation when a confounding variable was controlled. All the data sets were plotted on scatter plots with trend lines after calculating the Pearson's correlation coefficient. The random sample had a correlation coefficient of .132. The value indicated very weak positive correlation but rejected the null hypothesis. The smaller data sets showed stronger positive correlations than the random sample, indicated by the r-value, except for the data set matched for average per capita income, regarded as an outlier.

11 ME 816

Wang, Susan

Episcopal High School

Teacher: Olsen

Single-cell RNA Sequencing Analysis of Human Neural Grafts Revealed Unexpected Cell Type Underlying the Genetic Risk of Parkinson's Disease

Parkinson's disease (PD) is the second most prevalent neurodegenerative disorder, affecting more than 6 million patients globally. Though previous studies have proposed several disease-related molecular pathways, how cell-type specific mechanisms contribute to the pathogenesis of PD is mostly unknown. In this study, we analyzed single-cell RNA sequencing data of human neural grafts transplanted to the midbrains of rat PD models. Specifically, we performed cell-type identification, risk gene screening, and co-expression analysis. Our results revealed the unexpected genetic vulnerability of oligodendrocytes as well as important pathways and transcription factors in PD pathology. The study may provide an overarching framework for understanding the cell non-autonomous effects in PD, inspiring new research hypotheses and therapeutic strategies.

12 ME 817

Junwoo, Lee

Episcopal High School

Teacher: Olsen

Study on the Application of 3D Artificial Skin Structure to induce Immune Response to Blood Cells of Allergens

Allergies are an extremely common condition, with allergic reactions ranging from skin rashes to potentially severe, life-threatening immune responses such as anaphylaxis. Yet, the development of testing methods has advanced very little in the past years to detect potentially deadly reactions beyond the localized epidermis. Existing in vivo tests where allergens are applied to a patch of skin are only able to predict reactions at the level of the epidermis; however, allergens move through the bloodstream to elicit responses in other tissues. This study aims to create a 3D artificial skin structure through utilizing naturally-derived collagen scaffolds with similar functions and characteristics of a cell to develop a sophisticated, personalized allergy testing method capable of detecting global allergic reactions. To create the artificial skin structure, THP-1 cells were utilized as monocyte cells, CCD-27SK cell lines as skin fibroblast cells, and HaCAT cell lines as skin keratinocytes. Collagen extracted from bovine tendons, chicken feet, and pig skin was used to develop artificial skin scaffolds, and were cultured to create a 3D skin structure. 24 hours after applying allergens to the HaCAT cells, an RT-PCR analysis confirmed an increase in the expression of the IL-1α gene related to immune response in the THP-1 blood cells. In conclusion, cultivating skin fibroblasts with epidermal cells collected from patients to produce 3D artificial skin structures can create an in vitro allergy test that eliminates the risk of direct allergen application to patients while being able to predict reactions occurring outside the localized skin area.

Microbiology has been merged with Biochemistry.

7 PH 1000

Stidman, Sophia

Gunston Middle School

Teacher: Quiroga

The Effect of Different Amounts of Friction on a Model Train Car's Speed

Does friction affect the speed of a train? I conducted this experiment because I had this question. My project finds the answer to this question. The purpose of my project was to find the effect of friction on a model train's speed. The train was tested in three different modes each with a different force of friction. The different modes were wheels, which had the least amount of friction, maglev, which had a medium amount of friction, and sled, which had the largest amount of friction. I used 5 trials for my data for each of the modes. The hypothesis was that if the force of friction decreases, then the speed of the train will increase. The results of this experiment supported the hypothesis by showing that when the friction was decreased, the average speed of the train increased. For example, the maglev and the sled modes. For the maglev, the force of friction was 2.552 newtons and the average speed was 1.050 seconds, while the sled had a force of friction of 2.88 newtons and the average speed was 1.284 seconds. My project contributes to this area of physics by reinforcing that speed is affected by friction.

7 PH 1001

Van Hoey, Josephine

Gunston Middle School

Teacher: Giblin

The Effect of the Material of String on the Sound Wavelength

I have used different types of strings, and they sounded completely different. But was that difference actually measurable? The objective of this experiment was to find the effect of the string material on the sound wavelength. My hypothesis is that the strings made of a denser material (fluorocarbon and titanium) will have a shorter wavelength because they have a brighter sound, and the ones made of less dense material (nylon) will have a longer wavelength because they have a mellower sound. I put three different types of strings (fluorocarbon, titanium, and nylon) on a ukulele and plucked each string three times into an app called Spectrum Analyzer to find the frequencies. Then, I entered the mean of all frequencies for each string into a TranslatorsCafe Unit Converter to find the mean wavelength. The titanium and nylon strings had wavelengths of 77.702 cm, and the fluorocarbon string had a wavelength of 39.089 cm, so my hypothesis was rejected. My science fair project contributes more information about how string material affects an instrument's sound to the science and music worlds. It could help the science world by providing more data for similar research or experiments. This project also contributes to the music world because as a musician, I know it can be helpful to understand the science behind your instrument, including your strings. My goal was to figure out how the material of a string affects the sound that the instrument produces, and I met this goal.

7 PH 1002

Hwang, Theodore; Hwang, Dorothy

Gunston Middle School

Teacher: Giblin/Quiroga

How Does the Type of Current at Different Voltages Affect Electromagnetic Force?

Electromagnets are constantly used in daily life, but which current is the most effective- alternating currents or direct currents? This project set out to investigate how the type of current affects electromagnetic force at 3, 6, and 24 volts. Two nails wrapped in copper wire were used as the alternating current and direct current electromagnets. They were tested at different voltages to see how many staples each one attracted and then the results were compared to each other. The hypothesis was that the alternating current electromagnet would be more powerful and effective than the direct current electromagnet. However, the results did not support the hypothesis, showing that the direct current electromagnet was stronger. At 3, 6, and 24 volts, the mean of the staples attracted using the direct current electromagnet was 0.25 to 0.75 more than the alternating current electromagnet. The medians also opposed the hypothesis, as the direct current electromagnet's medians were 0.5 to 1 more than the alternating current electromagnet's medians. Direct current electromagnets would be more efficient than alternating current electromagnets for a variety of uses such as transformers, audio equipment, construction, and generators.

8 PH 1003

Merdad, Obai

Dorothy Hamm Middle School

Teacher: Kennedy

The Effect of the Number of Rocket Fins on the Trajectory of a Rocket

My purpose for this project was to show how rockets were affected by the difference in the number of fins, and how it would change flight patterns. My hypothesis was If the number of fins is 4, then the trajectory of the rocket will be the best because there is more fins to stabilize it. My procedure consisted of building the rockets- a rocket with 0 fins, 2 fins, 3 fins, and 4 fins, inserting fuel into the rockets, launching the rockets, and how to collect the data. This data showed that the 3 and 4 fin rockets were more accurate than the 2 and 0 fin rockets, because these rockets were able to fly in a straight line, unlike the 2 and 0 fin rockets which flew accurately for a very short amount of time but spun around mid-air for the rest of the flight. With this, I concluded that the 4 fin and 3 fin rockets were the most accurate, and the 2 fin and 0 fin rockets had an inaccurate trajectory. This was shown in the data when the 0 fin rocket went more than 20 degrees off course and the 2 fin rocket 45, while the 3 and 4 fin rockets stayed within 10 degrees of the initial launch. If this project were to be done again, Parachutes would be added to the rockets to do more repeated trials, and the wind would be checked to be below 5 mph in any direction.

8 PH 1004

Shah, Sheel

Dorothy Hamm Middle School

Teacher: Marszalek

The Effect of the Type of Mask on Air Flow

For my experiment I tested different kinds of everyday masks on air flow because I want to know which type of mask I should wear to better protect myself and others. I used a hair dryer covered by a mask to see if it could blow out a candle. I had a control which was no mask, a one-use plastic mask, a double layered cotton mask, and a mouth covering gaiter. I predicted that the double layered cotton mask would be the most effective because it has two layers, has no air flaps, and it was the thickest.

I set the experiment up by plugging in the hair dryer and covering it with one of the masks. I would then put the candle on the box and light it. I would place the hair dryer 10 cm away from the candle to see if it blew it out. I would repeat this three times for each mask.

Based on the results my hypothesis was partially correct. I thought the double layered cotton mask would be the best, which it was but it was tied with the mouth covering gaiter and the one-use plastic mask. I can conclude that all of these everyday masks would be effective. The only mask that I wouldn't want anyone to use is a clothing mask because clothes have these tiny holes in them which is small enough for air to travel through them. I hope to use this to make an affordable mask.

8 PH 1005

Thomas, Alexander

Swanson Middle School

Teacher: Seliskar

Ultraviolet Light Protection: The Guide

In my project, I tested different strength sunscreens (15, 50, and 100 SPF), aluminum foil, and facial tissue to see how much ultraviolet (UV) light would get through. After testing, there are some interesting conclusions I can make. First, the data shows that each higher tier of sunscreen did better than the last, supporting my hypothesis that higher SPF sunscreens would block more UV light. Even so, the results from the 50 and 100 SPF sunscreens were closer than I expected. The 50 and 100 SPF were closer than the 15 and 50, showing that there is less need to get the highest SPF rating possible. Additionally, the data shows that aluminum foil is excellent at blocking UV light, as it never read above 0, and that the facial tissue -- which was meant to mimic clothing -- was slightly better at blocking UV light than SPF 100. In conclusion, my data did support my hypothesis, and the data suggests that there is no need to buy the highest SPF possible.

8 PH 1006

Bass, Sonia; Bass, Ally

Swanson Middle School

Teacher: Swanson/Seliskar

Discovering the Brachistochrone

The goal of our experiment was to find out what the fastest ramp is for a ball to roll down from one point to another lower point. Previous research has concluded that this ramp is not a direct line between the two points like one might assume, but is in fact a curve known as a cycloid. A cycloid is a curve that is made by a point on a circle being rolled along a flat line. For our experiment we made three plexiglass ramps: a cycloid, a curve with a steep initial drop the flatline, and a flat line. We then rolled a ball down each ramp and found that the cycloid curve took the shortest time for the ball to roll with an average of 0.48 seconds. The cycloid was closely followed by the steep ramp with an average of 0.49 seconds, and the flat line, which is actually the shortest distance, was by far the slowest with an average of 0.54 seconds. We concluded that the cycloid was the fastest ramp because it is a compromise between being too steep initially then flattening out and being too flat and not taking advantage of acceleration. So even though the cycloid ramp isn't the shortest path in terms of length, it's still that fastest for a ball to roll down because of acceleration.

9 PH 1007

Chung, Eric

Yorktown High School

Teacher: Dorman

The Effect of Propellant Amount on Projectile Launch Distance

This project examined the correlation between fuel amount and the distance that a liquid propelled cannon could shoot a projectile. PVC potato cannons are a common backyard project that utilizes aerosolized fuels in order to shoot projectiles. Cannons are commonly composed of a combustion chamber followed by a smaller barrel. The cannon used in this experiment used a modified barbecue lighter in order to ignite the fuel. This experiment tested how far a cannon would shoot a ping-pong ball with 1,2,3, and 4 seconds of hairspray. What the experiment found was that the cannon did not fire with 100% reliability with 1-2 seconds of fuel, but that after 3 seconds of fuel was added, the cannon fired reliably. What is also important to note is that the difference in launch distance between 3-4 seconds of fuel was minimal and that while analyzing the graph, it appears as if the launch distance plateaued. This could be explained by the fact that because there is only a limited amount of oxygen in the cannon, only a set amount of fuel can be combusted. While a reasonable explanation, this cannot be definitively proven or disproven unless further experimentation with larger amounts of fuel is conducted.

9 PH 1008

Kaminski, Maya

Washington-Liberty High School

Teacher: Brodowski

The Effect of Artificial Lighting on the Ability to View the Night Sky

This experiment's purpose was to examine artificial lighting's effect on the ability to view the night sky in summer and fall. Artificial light (light pollution) wastes energy, harms the ecosystem, and interferes with visibility of the night sky. There were two hypotheses: (1) if the light is brighter in a location, then fewer stars will be visible; and (2) if measurements are taken in the fall, then more stars will be seen. Eight locations in Arlington were visited for 33 nights in summer and fall. At each site, the constellation Hercules (summer) or Perseus (fall) was located in the sky and compared to star charts, ranked zero to seven (zero, meaning no stars seen, to seven, meaning a sky filled with stars). Globe at Night, a citizen science program, supplied these charts. A light meter was used at each location to measure the lux (measurement of light) given off by streetlights, as well as a sky quality meter, which measured mag/sq arcsec (measurement of sky quality). The results supported both hypotheses. The first hypothesis was proven true: the location with the most artificial light had the fewest stars seen, whereas the location with the lowest average light measurement had the highest average star chart ranking. The second hypothesis was also proven: most Perseus (fall) average star chart rankings were higher than those of Hercules (summer). The star chart classifications were entered into the Globe at Night website, giving the world knowledge of Arlington's light pollution.

9 PH 1009

Kappler, Rachel

H-B Woodlawn Secondary Program

Teacher: Smith

Do Different Temperatures of Water Freeze Faster?

This experiment tested the Mpemba Effect, which states that hot water freezes faster than cold water. The reason this experiment was chosen was that most projects conducted in school have already found a widely accepted answer. This experiment has found many outcomes, which allows scientists to continue testing the Mpemba Effect. The hypothesis is the hotter water would freeze faster than the colder water based on the Mpemba effect and previous experiments testing the Mpemba effect. The data was collected by setting the water to the starting temperature then distributing the water into the ice cubes. The ice tray was put in the freezer and a timer was set to check the temperature every 20 minutes. The variables tested were 4 different starting temperatures: 50°F, 70°F, 110°F, and 212°F. The results show that the colder temperatures (50 and 70 degrees Fahrenheit) reached 32 degrees Fahrenheit faster than the hotter temperatures (110 and 212 degrees Fahrenheit). Although the 50-degree water reached 32 degrees first, the boiling water dropped in temperature faster than the other variables. The main limitation of this experiment was that after the water froze over, it could not be measured in temperature even though the water was not fully frozen through. In conclusion, the hypothesis was rejected since the colder water froze faster than the hotter water. This may mean the Mpemba Effect is not real.

9 PH 1010

Planey, Violet

T.C. Williams High School

Teacher: Kazanciyan/Matthews

The Effect of Car Model on Speed

The purpose of this project is to determine which model of car is most effective. First, three cars, the Ford Mustang, Ford Torino, and Monte Carlo SS were constructed using wood, and they were sized, scaled, and sanded to be approximately the appropriate size and shape. Then, the wheels were put in, along with eye hooks on the bottom. Holes were previously drilled in the back of the car, in order for a rocket engine to be placed in the vehicle. When testing, an s-hook and spring wire system was used, in order to regulate the tautness of the wire. Each car was placed on the wire system three times, and launched by an EIS. The photogate being used to measure speed, velocity, and acceleration did not work, so the data was collected by scanning through trial videos frame-by-frame to calculate the speed. This determined that the Mustang was the fastest, the Torino second, and the Monte Carlo SS third. Speed is not always the best determining factor for effectiveness, so in the future, an experiment with different or more cars and a more accurate testing system could be used.

9 PH 1011

Watchman, Sam

Arlington Tech and Career Center

Teacher: Le

The Effect of Constellation on Signal Power at 21cm

This study focuses on the spectral line at the 21-centimeter radio wavelength, which is emitted by hydrogen atoms, specifically in the Milky Way. This hydrogen is spread across the Milky Way galaxy, but is concentrated in its different spiral arms. This study examines the amount of power emitted by the hydrogen at this spectral line in different parts of the sky, and also at the Doppler effect frequency shifts in this spectral line caused by the galaxy's rotation. This is especially important because by looking at the amount of frequency shift, it is theoretically possible to measure the galaxy's rotation speed and detect its different spiral arms. To detect the 21 cm hydrogen spectral line, this experiment used a 1.5-meter aperture horn antenna to collect and concentrate the signal. The signal was amplified by a Nooelec H1 amplifier and then detected by an RTL-SDR Software Defined Radio. The data was collected in software, and then processed to remove noise and boost the signal itself. The results were that there was more signal in the regions of the sky where the plane of the Milky Way passed through, and that there was a noticeable Doppler shift in the signal in some parts of the galaxy.

10 PH 1012

Ashfaq, Zainab

T.C. Williams High School

Teacher: Winborne

The Egg Drop

Going to the grocery store and picking up eggs is something most if not all people do but there is always the fear of accidentally breaking them since they are very delicate. My experiment was “The Egg Drop”, In this experiment, I tested various materials such as cardboard, bubble wrap, and tape to see how they would affect the delicateness of the egg and prevent it from breaking.I hypothesized that the bubble wrap would be most effective in preventing the egg from breaking but it turned out to be wrong. The cardboard turned out to be the best at preventing breakage hence, why I did an additional trail with it to further investigate. Thus, The cardboard box was the best at protecting the egg but it was not perfect so it’s still to be determined what would work flawlessly.

10 PH 1013

Bain, Angelica

Washington-Liberty High School

Teacher: Barrett

The Effect of Different Blue Light Mitigation Techniques on LED Blue Light Irradiance

The purpose of this experiment was to test different blue light mitigation methods' impact on the amount of blue light energy emitted from LED screens of smartphones. As more information about the negative health effects of blue light emerges, factors that affect the dosage of LED light are gaining importance. The hypothesis stated that if different blue light mitigation techniques are tested for the amount of blue light relative irradiance (w/m^2) using a Spectryx USBVIS spectrometer then the night shift mode will prove to be the most effective at reducing blue wavelength irradiance.

Based on the results of this experiment and an ANOVA test, the null hypothesis stating that blue light mitigation techniques would have no effect on the amount of relative irradiance was rejected. The ANOVA test yielded a p-value of 1.10 x 10^-15, which falls far below the needed 0.05 to prove the independent variable had an effect on the dependent variable. All blue light mitigation methods tested had a significant effect on the amount of relative irradiance emitted, the control data set emitted on average around 220.6% more light in the targeted blue light wavelengths as measured by relative irradiance. Although this fact stands, the hypothesis was not accepted because night shift mode was not the most effective; the blue light blocking screen filter was. Despite the blue light reduction method, they all significantly decreased the potential retina damage, which just furthers emphasizes the importance of protecting your eyes and using blue light blocking methods.

10 PH 1014

Buckley, Ford

Yorktown High School

Teacher: Fenstermacher

The Effect of Spoiler Angle on Downward Force Produced

The purpose of this experiment is to find the optimal angle for a vehicle spoiler to produce maximum downward force. Downward force on the road is known as traction, which is grip on a road. This is important because each year more than 18,000 people are killed in run-off-road accidents (NHTSA). With more traction, some of these accidents could have been avoided. The intention of this project is to encourage the spoiler use on vehicles for better traction on the road. A wind tunnelI was designed and built and a test vehicle mounted. Downward force the spoiler produced was measured by mounting and securing a test vehicle on the digital scale. The highest value that was observed over the 15-second running period of a small box fan was recorded. Four levels of spoiler angle were tested. They were: 0º (no spoiler), 30º, 60º, and 90º. After ten trials at each level of IV, the data was recorded and analyzed. The ANOVA test was run to determine the p-value, standard deviation, mean, median, mode, and range for the statistical data. There was a significant statistical difference between the levels of IV, when compared to the trials without a spoiler, trials with a spoiler created significantly more downward force. The results were as anticipated. The data proved that using a spoiler creates significantly more downward force than not using one. Additionally, it should be noted that as the angle of the spoiler is increased, the downward force that is produced also increases.

10 PH 1015

Ermovick, Ryan

Yorktown High School

Teacher: Hessler

The Effect of Insulated Tumbler on Change in Water Temperature Over Time

This experiment was conducted to see if the Yeti brand Tumblers are worth their higher prices. Many insulated tumblers are made of either plastic or stainless steel, have two walls, and a vacuum in between. Yeti tumblers are stainless steel with double wall insulation, but in addition have a copper coating which helps minimize radiation heat transfer. Six tumblers were tested, three plastic, and three stainless steel. The hypothesis is “If the Tumbler is Yeti Brand then it will retain its water temperature for longer because of its copper coating." Data was collected six times, three times testing cold water, and three times testing hot water to find the average rate of temperature change in degrees fahrenheit. Data was collected over five hours at 15 minute increments for each trial. The hypothesis is accepted and the null hypothesis is rejected because the p-values for the hot and cold water trials were less than 0.05. The stainless steel tumblers had lower average rates of temperature change than the plastic tumblers. The difference in the average rates of temperature change among the stainless steel tumblers are not that large which means the Yeti Tumblers are not significantly worth their higher price. This shows that in this case, purchases should not be based on popular name brands, such as Yeti, but on other factors such as quality and features.

11 PH 1016

Sheehey, Alexander

Yorktown High School

Teacher: Schuetz

The Effect of Face Masks on Volumes of Different Frequencies that Correlate to Speech

The purpose of this experiment was to test how much different types of CDC-recommended face masks dampen frequencies that are analogous to speech. This was achieved by playing frequency sweeps, 200 Hz to 8 kHz, from a speaker in the mouth of a foam head, which was wearing the masks, and recording the sounds with a microphone six feet away. The recorded dB-time data was exported into Google Sheets, where it went through a series of steps until six dB-frequency graphs were created, one for each of the masks and one for all the masks over layed on top of each other. These graphs each included a baseline with no mask which clearly showed how much the masks dampened the different frequencies. After analyzing the graphs three main conclusions can be drawn from them. The first is that face shields dampen the lower frequencies, around 1 kHz to 3.5 kHz, more than any other face covering. The second is that kn-95 masks dampen the entire range of frequencies the most overall. The final main conclusion is that, on average, synthetic face masks dampen the entire frequency range the least. While this test does not take into account the different protection capabilities of the masks, it does offer some interesting and useful information for people who have to speak in public. For instance, if a person has to address a group of people it might be wise for them to choose a synthetic mask if hearing/understanding is a concern.

7 PS 1100

Coppenbarger, Sarah

Kenmore Middle School

Teacher: Haile

The Effects Of Coffee On Mung Bean Growth

Does the addition of coffee really increase plant growth? Studies have shown that the addition of coffee to the soil that plants grow in increases their growth and keeps them healthier. This project looks into the impacts of coffee beans (CB) and coffee grounds (CG) on mung bean ("beans") growth. Thirty beans were grown in six pots (five seeds/pot). Fifty milliliters of filtered water (FW) was added to each pot. Then the pots were divided into three groups of two. Five grams of CB were added to group one, five grams of CG to group two, and nothing more to group three (control). The hypothesis was that the plants with coffee treatments would grow the tallest. The experimental results were mixed—the results showed that the average FW beans grew 0 and 13.4 centimeters, when compared to the FW + CB beans whose average was 5.2 and 13.625 centimeters and FW + CG beans grew an average of 7 and 12 centimeters. Mold was visible on the treatments with CG after week two. While parts of the experimental results aligned with published research as in the case of the beans treated with FW + CB, others didn't. For example, mung beans exposed to CG had an average height of 7 and 12 centimeters after three weeks, which was less than those treated with only FW. In conclusion, this experiment showed that coffee beans and grounds could be used to further the agriculture industry by growing produce faster and more efficiently.

8 PS 1101

De la Cruz-Novey, Coral

Gunston Middle School

Teacher: Robles

The Effect of Different Caffeine Products on Plant Growth

Caffeine products have many essential nutrients for plants such as nitrogen, potassium, and more. But some, in large amounts, can hurt the plant. I was curious to see the effects of yerba mate powder and ground espresso on plants when added to plant soil. The goal was to find out different caffeine products' effects on plants, and which one was more positive. I put 3 tablespoons of soil into 9 plants. I added 1 tbsp of yerba mate powder into 3 plants, a tbsp of ground espresso into the soil of another three, and added nothing extra into the remaining three (the constants). I gave them 14.7 ml of water every three days. Every week for a month, I collected the height, width, and number of leaves (dependent variables) of the plants with espresso, yerba mate, or nothing in their soil (independent variables). In the end, the plants with espresso added together grew the tallest (101 cm), widest (50.6), and had the most leaves (21). The constant plants summed had a height of 96.5, a width of 49.7, and an altogether leaf count of 18. The plants with yerba mate did not grow. My hypothesis was that the espresso would give the best results, because of its nutrients (potassium, iron, etc). It was correct because espresso had the best effect on the plants. From further research, I also concluded that the reason yerba mate killed plants was because of its extremely high nitrogen levels, which can be harmful to plants.

8 PS 1102

Lowe, Sydney

Kenmore Middle School

Teacher: Brown

The Effect of Hydrogen Peroxide on Seed Germination

Hydrogen peroxide is a product frequently used by farmers. This experiment tests the effect of hydrogen peroxide on seed germination. First, the researcher made four different growing solutions (250 ml of water, 5 mL of hydrogen peroxide and 250 mL of water, 15 ml of hydrogen peroxide and 250 ml of water, 30 ml of hydrogen peroxide and 250 ml of water), each with a different concentration of hydrogen peroxide. Secondly, each bag was labeled with the concentration of hydrogen peroxide and a paper towel was folded to fit flat in the bag and the growing solution was added to the bag. Ten (garbanzo)seeds were evenly lined up on the damp paper towel inside of the bag. Lastly, the bags were placed on a flat surface where they could get plenty of sun for fourteen days. After 14 days, the experiment showed that, 92% of the seeds with no hydrogen peroxide germinated, whereas only 70% of the seeds with high hydrogen peroxide germinated. The hypothesis was if less hydrogen peroxide is added to the seeds, then more seeds will germinate and they will germinate healthier, and possibly grow taller. In conclusion, the researcher‘s hypothesis was supported. The data supported the hypothesis by showing that as the amount of hydrogen peroxide increased, the amount of seeds germinated decreased.

8 PS 1103

Shah, Jaya

Williamsburg Middle School

Teacher: Thomas

The Effect of Legumes on the Germination Rate of Lactuca sativa

The purpose of this experiment was to figure out how legumes affect the germination rate of Lactuca sativa (lettuce). Upon conducting research to understand natural fertilizers, it was found that legume tree root systems are commonly used to help fertilize soil. But, there was no implementation of this system in indoor container gardening. Fertilizers are expensive and not everyone can afford them. The intent of this experiment was to be able to inform others on whether legumes help promote the germination and growth of plants and can be used as an alternative to fertilizers.

The experiment examined three levels: 1) lettuce, 2) lettuce and legumes, and 3) lettuce, legumes and nitrogen fertilizer. It was hypothesized that the level, lettuce, legumes and nitrogen fertilizer would do best. This experiment was conducted by planting ten lettuce seeds each in aluminum containers. There were three aluminum containers (one for each level), and were watered daily with the same amount of water. The legumes used were a combination of oats and peas, and they were combined and counted as “cover crop.” For every one lettuce seed, there were eight cover crop seeds surrounding it. In the end, the hypothesis was rejected. The rejection of the hypothesis showed that lettuce without legumes and nitrogen fertilizer did best. These results illustrated that very little money is needed to grow good food, all that is needed are basic variables such as water and soil.

9 PS 1104

Guith, Kendall

Yorktown High School

Teacher: McKowen

The Effect of Different Concentrations of Road Salt on the Growth of Grass Seeds

The goal of this experiment is to test if the salinity levels found in select eastern watersheds will have an effect on plant height due to the increase of Salinity caused by Road Salt. If I expose grass seeds to road salt contaminated water, then the grass seeds watered with a higher concentration will not be as tall as seeds watered with a lower concentration.For this experiment, you will be growing grass seeds for 14 days each IV group will have 5 seed segments. Plant your grass seeds in the container. Create your water solutions of 500ml, pure H2O, 0.05% of NaCl then CaCl2, 0.25% of NaCl then CaCl2, 1.18% of NaCl then CaCl2. Everyday water each seed segment 5 ml of their designated solution. Measure the grass height every two days for each seed segment. After 14 days calculate and analyze your data and results In conclusion, the grass that grew taller were those watered with pure H2O instead of a road salt solution. According to these results, we can see a negative effect that the different solutions had on the seed's height. hen applied to a line graph, the means of each group's height decreased when the amount of solution increased linking the results to salinity. An ANOVA test was performed on the data with a p-value of 1.1102e-16; the Null hypothesis was rejected.My statement hypothesis was supported by my data.

9 PS 1105

Zouhon, Moya

Wakefield High School

Teacher: Troiano

The Effect of Eco-Friendly Multi-Purpose Cleaners and their Ratio on the Height of a White Dutch Clover

The purpose of this study was to test the effect of eco-friendly multi-purpose cleaners and their ratio on the height of a White Dutch clover. The independent variable was the concentration ratio and brand of eco-friendly multi-purpose cleaner. The experimental group included: Home & Planet Multipurpose Cleaner concentration ratios: 1:5, 1:2, 1:1, Method All Purpose Cleaner concentration ratios: 1:5, 1:2, 1:1, and Mrs. Meyers Lavender Multi-Surface Everyday Cleaner concentration ratios: 1:5, 1:2, 1:1. The control group was no cleaner at all. The dependent variable was the height of the white Dutch clover plant. The hypothesis was: If White dutch clovers were given a 1-5 ratio of Home & Planet Multipurpose Cleaner to water then they would grow the tallest.48 cups were labeled, filled with soil and one seed and separated into four groups. Each group was watered with a different eco-friendly solution and ratio every day for three weeks. The highest mean heights were the plants watered with Home & Planet with an average of 2.4. The plants with the lowest mean height were the plants watered with Mrs. Meyers with a mean of 0. The plants watered with the 1:5 ratio of cleaner to water had the highest mean of 2.6.The 1:1 ratio had the lowest mean of 0. In conclusion, not all eco-friendly cleaners are created equal and some may be just as harmful as everyday cleaners. Also, the ratio of cleaner to water does have an impact on plant height.

10 PS 1106

Huson, Teo

Washington-Liberty High School

Teacher: Barrett

The Allelopathic Effect of Allelochemicals such as Juglone in Juglans nigra on Zea mays and Glyphosate-Resistant Weed Amaranthus retroflexus

Glyphosate-based herbicides are both terrible for the environment and lead weeds to develop immunity from chemical herbicides, leading to ultra-resistant weeds terrorizing horticulture throughout the US. The study of allelopathy, the process of a tree or plant producing biochemical inhibitors to influence the growth, has been seen as a potential alternative field to current herbicide uses. If a Black Walnut solution (from husks of black walnut seeds) inhibits the growth of plants and vegetables, then a Black Walnut solution will inhibit the growth of pigweed (a glyphosate-resistant weed) because the residue contains allelochemicals that hurt germination, growth, and reproduction of plants.A solution of Black Walnut husks and water was created to study the Eastern Black Walnut effects on Corn and Redroot Pigweed (weed resistant to glyphosate-based herbicides) germination rates. In varying amounts, the solution was given to Corn and Pigweed Seeds in Petri dishes over the course of 15 days, in which data was collected. As the amount of IV through each group increased, Corn germination was minimally impacted, as shown by an ANOVA test with a value greater than 0.05 (0.108). On the other hand, Pigweed germination was significantly impacted by the increase in concentration of IV through each experimental group as shown by the ANOVA test less than 0.05 (8.32 x 10-15).As the Black Walnut Solution increased the germination rate of Pigweed decreased, while the germination rate of corn stayed the same. This accepts my hypothesis and shows the potential of using allelopathy in herbicide studies.

11 PS 1107

Whiting, Abigail

Washington-Liberty High School

Teacher: Barrett

The Effect of Nitrate Concentrations in Water Sources on Shade Mix Grass Growth

Nitrogen is one of the most important elements for life on Earth and is known to aid plant growth in the right volumes. However, excessive nitrogen or nitrate concentration in edible plants can harm the health of humans. Hence, this experiment aims to find the ideal water source for plants, preferably without having to resort to fertilizer. In this experiment, over 200 containers of shade mix grass seeds were fed water from different sources to test the effect of nitrogen in water on plant growth over 30 days. The seeds were tested under five different water sources; stream water, tap water, rainwater, fertilizer water, or distilled water. Each water source contained different levels of nitrate (as measured in parts per million), with fertilizer water having about 416 ppm of nitrate, followed by rainwater (10 ppm), stream water (3.33 ppm), and finally tap and distilled water (0 ppm). The results of the experiment concluded that rainwater and fertilizer water are the best sources of water for grass, with rainwater being more environmentally friendly. Outside factors influencing the result would be the potential presence of fluoride in the tap water and bacteria and sediment in the stream water. With the widespread use of fertilizers in soil and water industrially and at home, this experiment proves that by utilizing rainwater as an alternative, gardeners and farmers can maximize crop yield while preventing pollution attributed to the use of fertilizers.

11 PS 1108

Williams, Fiona

Washington-Liberty High School

Teacher: Hedderly

Do Antibiotics Affect the Germination and Height of Plants?

What is the effect of different types of antibiotics on the germination process and final height of a carrot plant?Antibiotics treat humans when a bacterial infection arises, however, plants are just as susceptible to these infections and require treatment similar to humans. To test if the germination process and overall height of carrot plants are affected by antibiotics, an experiment was conducted. Amoxicillin, tetracycline, and gentamicin treated 20 carrot plants daily over 21 days. The hypothesis for this experiment was if a carrot plant is manipulated by the antibiotics amoxicillin, tetracycline, and gentamicin, then its germination process will be slower, and height after three weeks will shorter compared to plants untreated by antibiotics because antibiotics used on plants are known to suppress callus formation and limit cell division. An Anova and t-Test show descriptive statistics resulting from the experiment. The p-value is larger than 0.5, therefore, the data is significant and the null hypothesis can be rejected. The plant group that germinated the fastest on average was the group unaffected by antibiotics. The plant group that grew the most after 21 days of experimentation was treated with gentamicin. In conclusion, antibiotics do have an effect on the germination process and growth of plants to an extent. The findings show the hypothesis can be accepted. Claims made about the inhibiting factors of amoxicillin and tetracycline were proven to be true, however, the inclining that gentamicin would lessen the germination rate and final height of the plants was proven incorrect.