NORTHERN VIRGINIA REGIONAL SCIENCE AND ENGINEERING FAIR

Virtual and Wakefield High School
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7 AS100

Dalton, Arthur

George Washington Middle School

Teacher: Breslin

The Reintroduction of Wolves to Yellowstone

The purpose of the lab is to investigate how wolves affect the environment. To conduct this experiment the following procedures were used: First, I will go over lessons 1-3 coding lessons to learn the basics then I will review lesson 4 which teaches me how to code an ecosystem. Then the simulation will be coded. Next, the simulation will be modified according to the level of the IV Then the grass, deer, and wolves will be measured using the number of animals currently in the situation. The experiment was 5 times for each level of the independent variable: 0 wolves, 15 wolves, and 25 wolves. The data supports the hypothesis because 15 wolves help the simulation run smoothly but 0 and 25 wolves make the ecosystem go extreme. The data shows each animal affects other animals. For example, the deer decrease and the grass increase on the graph show that the grass affects the deer.

8 AS101

Dowler, Mina

H-B Woodlawn Secondary Program

Teacher: Boyle

How Hummingbirds are Able to Fly Backward

The purpose of this research paper was to explore the various reasons why hummingbirds are able to fly backwards. In order to study “why and how”, I looked at habits of the hummingbird such as diet, habitat, and the unique shape of their wings. Some of the key points I researched were attributes related to the hummingbird anatomy, the structure, and shape of their wings. I also reviewed eating and living habits to compare them to birds similar in size and structure. A few key results that led to the uncovering of how hummingbirds are able to fly backwards were found with the diet. Hummingbirds are not only able to fly backward, they are also able to fly vertical, horizontal, and sometimes upside down in order to eat. In conclusion, hummingbirds are able to fly backward due to the anatomy of their wing structure and joints. Through research I have been led to believe it could be attributed to nature's natural selection. Over time many species of hummingbirds have adapted to eating and flying in this particular and unique way.

8 AS102

Schons, Hannah

H-B Woodlawn Secondary Program

Teacher: Boyle

How Do Horses React to Violin Music?

The purpose of this experiment was to test how horses react to violin music. Violin music excerpts (Haydn Violin Concerto Allegro, St. Paul Suite, Handel Violin Sonata Largo and Allegro, and La Gazza Ladra) were performed near the horses (Lily, Classic, Ellie Mae, Kit Kat, Callie, Teddy, Chicken, Thunder, and Remy), individually. An iPad will record each horse as the pieces are played. The response and reactions will be recorded in a data table. It was hypothesized that the horses would prefer and have the strongest reaction to the faster pieces, while the slower pieces would make the horses bored. The violin, the violin player, and music excerpts stayed consistent. Two people interpreted the reactions and put them on a note sheet before they were entered into graphs. The initial experiment could be improved by running more trials in different places and minimizing background noise. The majority of horses showed a strong reaction and paid the longest attention to the slowest piece, Handel's Violin Sonata Largo. According to the results of the experiment, it can be concluded that horses prefer slow and calm approaches in training rather than rushed and hectic approaches because they are more predictable and easy to follow.

8 AS103

Wang, Sidney

H-B Woodlawn Secondary Program

Teacher: Boyle

The Effect of Covers on Guinea Pigs Running Mazes

The purpose of this experiment was to determine the effect of a cover on guinea pigs running maze. It was hypothesized that if guinea pigs ran a maze with and without covers then the trials with a cover would be faster. This was thought because guinea pigs are prey animals and very skittish. Four guinea pigs were observed running a maze with a cover and without a cover. A total of 16 trials were conducted throughout the experiment. The time each guinea pig took to run the maze was recorded, and each trial had a 45 minute time limit for the guinea pigs safety. The difference between the covered and uncovered was notable. The hypothesis was proven correct because each guinea pig took a significantly shorter amount of time during the covered trials opposed to the uncovered trials. The results of this experiment suggested that guinea pigs run mazes better under covered conditions. However the experiment was conducted using the same maze which could have had an effect on the results of the experiment. For a more accurate study each set of trials should be held in a different maze.

10 AS104

Delnegro, Ben

Alexandria City High School

Teacher: Yale

Shark Watch: The Effect of Climate Change on Shark Activity

This experiment will involve the study of how the rising ocean temperatures are affecting sea life. To do this, a focus will be placed on the Cape Cod area, specifically the white sharks that frequent that area. A shark's body temperature is mostly dependent on its surrounding ocean temperature, meaning that the higher the temperature, the more active a shark will be, which could mean a higher amount of shark attacks. With this research, the focus will be on how climate change could be negatively impacting life in the oceans through rising ocean temperatures. I expect that the results will showcase this, by the number of shark detections having a direct correlation with the temperature of the surrounding waters.

7 BE200

Shelton, Amelia

H-B Woodlawn Secondary Program

Teacher: Taggart

How Do Parents Effect Their Children's Political Views?

The purpose of this experiment was to study the effect of parents on their children's political views. The hypothesis was that parents do transmit their political beliefs to their children because children are easily influenced by their surroundings at a young age. The major findings were that parents do affect their children's political views. In the write-in portion of the survey students wrote a short sentence about what they thought affected their political views. Fifteen people answered mentioning that their parents had something to do with their preference or choice.The hypothesis was supported by the data because students reported a 3 percent difference between students and their mothers and about a 22 percent difference from their fathers. The results from this experiment are important because it helps people learn how to better teach their children to be open minded and how to teach children to form their own views.

7 BE201

Watts, M; Penella, Luc

H-B Woodlawn Secondary Program

Teacher: Taggart

How Does Perception of Color Affect Taste?

Our hypothesis was that perception of color would affect taste. We tested this by young people in different locations and giving people of different ages and genders cookies. These cookies were dyed differently colored but the same batch of dough, the people participating in the experiment then said what flavor each color was. Our hypothesis was incorrect because the majority of participants said they all tasted like sugar cookies except for young children. We think this might be because they are more used to sweet things being artificial colors.

8 BE202

Piper, Bailey; Power, Julia

Williamsburg Middle School

Teacher: Bell

The Effect of Type of Music on Memory

Memorization is an essential part of life, from doctors to middle school students, but it may not come easily. Many students listen to music while studying, but does it actually help? If so, what genre should they listen to? This experiment sought to answer these questions by testing the hypothesis that participants who listen to classical music will score higher on memory tests.

24 participants took 5 different memory tests, one for the control (no music), and one for pop, classical, rock, and jazz. These tests all had the same ten shapes, but in varied order for each genre. Participants were given 5 minutes to memorize the order of shapes while listening to a corresponding genre. Then, the tests were taken away and participants had 3 minutes to do any activity of their choice. Participants were given 15 minutes to take part two of the test which had them recall the order of the shapes. This was repeated for every genre.

Rock music had the highest average score of 95%, while classical music scored the lowest with an average score of 87%. The average for jazz and the control was 93%, and 91% for pop.

In conclusion, rock was the most beneficial to memory. Note that participants may have different musical preferences or have found the tests too easy. Further experiments could add more genres, have greater song variety, and harder tests.

9 BE203

Jones, Ingrid

Alexandria City High School

Teacher: Matthews

The Age of Climate Change: Are Younger People More Educated and Opinionated on Climate-Related Issues?

Many problems face the human race today, some definitely more prominent than others. But a constant issue that is progressively getting worse continues to be climate change. Information spreads, but it never seems quite quickly enough, and the question of who really knows what they are talking about arises often. The purpose of my project was to test wide age ranges of individuals to see if younger people are more educated and opinionated on climate-related issues. I created a 10 question multiple choice google form that asks participants varying questions pertaining to opinions on climate change. The questions demonstrated levels of opinion and knowledge. After collecting 96 responses my hypothesis was not supported. The age group that found climate change the most distressing and problematic was actually 70+ individuals. One of the reasons 70+ was the most educated and opinionated was because I had a small number of individuals tested in that age group. In the end, I am unable to support my hypothesis due to the results and data that I collected.

10 BE204

Christino, Ruth

Alexandria City High School

Teacher: Breistanksy

Correlational Study: Height and Success of NWSL Goalkeepers in the 2019 Regular Season

A multitude of different things can give athletes advantages in their sport — what methods they use to train, who they train with, what socio-economic status they grew up in, intrinsic (or extrinsic) motivation … just to name a few. Many, however, attribute athletic success or failure to natural body composition. All sports and positions within sports demand different things from the players' bodies. In soccer, arguably the most unique set of demands for a position falls on the goalkeeper. For a goalkeeper, height comes to mind as an important part of body composition to fulfill the position's needs. Accordingly, this study investigated the question, "Is there a correlation between goalkeeper height and success?"

In this correlational study, statistics collected for all goalkeepers from the National Women's Soccer League's (NWSL) 2019 regular season showed that there was no statistically significant correlation between height and either of the dependent variables used to measure success: average number of goals allowed per 90 minute period played and NWSL Success rate (saves/shots faced). This was determined using the Pearson Product-Moment Correlation Coefficient and by plotting a line of best-fit in Google Sheets software.

This study forms a basis for future experimentation with height as an independent variable, as correlational data analysis cannot determine causation. In the real world, this may help indicate if measures (such as the use of Human Growth Hormone) to modify child athletes' height are beneficial, and whether height should be used as a measure of goalkeeper potential.

10 BE205

Imlay, Bennett

Alexandria City High School

Teacher: Lay

Speech Quality and Performance

The data supports the idea that simply using more words in verbal instructions causes people to spend more time following the instructions. (The experiment was not very large, however, and more research should be conducted to back this up.) The hypothesis--that participants hearing long lines would take, on average, more time to complete the task given to them--was supported. Participants hearing long lines took an average of 13.8 seconds to complete the task, while participants hearing short lines took an average of only 6.5 seconds. Results may have been affected by the environment in which students participated. The classroom and hallway at any given moment were filled with different activities that could have impacted the thought-process of participants significantly. The lines could also have been recited inconsistently (ex. saying the long lines at a faster pace than the short lines). This experiment, if conducted again, would be improved with more planning and time taken to ensure larger participant turnouts and more constant variables.

12 BE206

Berry, Colin

Yorktown High School

Teacher: McKowen

Bringing Truth into Fake News: The Diffusion of Fact-Checked Fake Stories on Twitter

Although prior research shows that the number of retweets of fake stories is much higher than true stories on social media, I seek to understand whether the diffusion of fake stories (by retweets) changes after a story has been fact-checked. This is useful to know because if Twitter can be used to spread false stories, it can also be used to correct false information. Using the fact-checking site snopes.com, I analyzed fake stories from the 2021 calendar year. Looking at diffusion rates right before and right after a false story is publicly confirmed to be false on Twitter, my results show no significant difference in diffusion rates over a one, three or five hour window. Considering the diffusion size (over fifteen days), fake stories have a significantly larger diffusion size than fact-checked stories on Twitter, with fake stories having an average fifteen day total number of retweets of 4154 versus 109 for the fact-checked stories about that false story. Taken together, this study suggests that fact-checked stories diffuse at a considerably lower rate and reach far fewer users of Twitter in addition to having no significant impact on the diffusion rate of the false news it is trying to correct. This suggests that once false information is out, its spread is difficult to stop or correct, making it increasingly important for social media users to reflect and research information before continuing to spread what they read on social media platforms.

9 BI300

Babic, Harlow

Alexandria City High School

Teacher: Matthews

How Does Glycerol Affect The Flexibility of Bioplastic?

In this experiment, I tested how the amount of glycerol (aka. glycerin, glycerine) affects the flexibility of a cornstarch bioplastic. I made the bioplastic, swapping out the amount of glycerol, and tested the flexibility by bending the cooled plastic, and measuring the angle at which it bent. Our data showed that the bioplastic with two teaspoons of glycerol was the most flexible and that the bioplastic with no glycerol was inflexible and barely functional. Understanding how the variables in bioplastic can affect its texture will help others understand how to perhaps make it for themselves, causing them to use less petroleum plastic, which in turn creates less air and earth pollution.

9 BI301

Bowen, Natalie

Alexandria City High School

Teacher: Matthews

Can You Create a Novel Pesticide That Targets Transcription Factors?

Millions of people are infected with mosquito-borne illnesses each year. To try and combat these illnesses I decided to study transcription factors in vector mosquitoes that could be used as targets for mosquito killing pesticides. The mosquito species I studied were Anopheles gambiae, Aedes aegypti, and Culex quinquefasciatus. To better study these mosquito species I used Drosophila melanogaster as a reference species due to the copious amounts of research that has been done on it. I identified a protein referred to as tailles in Drosophila that regulates early embryonic transcription and helps to maintain the central nervous system. Using UniProt I found the FASTA sequence of tailless and next used that sequence in BLASTP to find similar sequences in the mosquitoes. Next, I used Geneious to help me understand and analyze my data. I found that the tailless proteins have two zinc finger regions that have 88.2% similarity between species and one ligand binding that had 34.4% similarity between drosophila and the mosquito. Although, the similarity between the ligand binding sites jumps to 66.4% when only comparing the three mosquitoes. These results indicated that while tailless activates the same genes in all four species, differing small molecules may activate tailless in the mosquito species compared to drosophila.

9 BI303

Ortuno, Evelyn

Washington-Liberty High School

Teacher: Sotomayor

Average Mass (g) of Beef Liver Dissolved in Different pH Levels

The overall purpose of the study was to find out which pH level best dissolved the beef liver. Three pH levels that were tested are vinegar with a pH of 2.5, bleach with a pH of 13 and water(control) with a pH level of 7. Studies have indicated that, vinegar has the potential to dissolve food. In addition, vinegar is shown to have a similar pH level as stomach acid (Whelan, 2019). The hypothesis was if the beef liver is placed in vinegar, then the beef liver will have the least amount of mass left. 10 trials were done for each pH level. The study comprised of 30 dixie cups with 5 grams of beef liver in each cup and a tablespoon of each liquid. The major findings or trends found are the 2 lower pH levels dissolved the most meat. However, the analysis is the vinegar and water had no statistical difference. The acidic and neutral solutions dissolved more meat than the basic solution.

10 BI304

Cohen, Ella

Washington-Liberty High School

Teacher: Bohn

Effect of Humidity (%) on Sugar Content of the *Musa acuminata* After 6 Days (in Brix)

The purpose of this experiment was to see if humidity influenced the concentration of sugar after 6 days in the banana. Enzymes act as a catalyst for chemical reactions that turn starch into sugar. Therefore, this measure would provide an accurate depiction of the ripening. It was hypothesized that if humidity was changed, then 99% would produce the Musa acuminata with the highest concentration of sugar in Brix because 97% humidity was found to be the optimum humidity for ripening in a similar study.

The bananas were stored at the control (47%), low humidity (62%), medium humidity (75%), and high humidity (99%) and 15 trials were conducted at each humidity level. The mean concentration of sugar was measured by a refractometer. The mean concentration of sugar at 47% relative humidity was 18.9 degrees Brix, at 62% relative humidity was 18.9 degrees Brix, at 75% relative humidity was 19.5 degrees Brix, and at 99% was 17.1 degrees Brix. The p-value was calculated to be 0.0040129, lower than the critical value of 0.05 in an ANOVA test. T-tests were conducted which concluded that the difference between the lower humidities was not statistically significant.

The results did not support the research hypothesis as 99% had the lowest sugar concentration, not the highest. It was concluded that the results were different because the optimum humidity was lower than previously thought. Another explanation is that in a study that the hypothesis was based on, temperature was tested in conjunction with humidity.

7 CH400

Archie, Adam

Kenmore Middle School

Teacher: Gantenbein

The Effect of Different Soda on Freezing Rate

In the food industry, maintaining the correct temperature is important in freezing and storage of products, but upon a molecular level what are the factors that effect freezing point? This project will examine how the concentration of a solvent affects the freezing point of a solution. The solution we will use is soda, and sugar will be the solvent under study. The freezing point, time and concentration of sugar will be compared. The solutions used were Coke with 65g of sugar in 20 fluid ounces, Fanta with 73g of sugar in 20 fluid ounces, sparkling water with 0g of sugar in 20 fluid ounces and Sprite with 64g of sugar in 20 fluid ounces. Five ounces of soda were put in plastic cups with an electronic thermometer and placed in a 0° Fahrenheit freezer . Upon review of the collected data, the sparkling water froze first at 220 minutes at a temperature of 29.2°F, followed by Sprite at 253 minutes at a temperature of 24.1°F, then Coke froze at 292 minutes at a temperature of 21.2°F, the last soda to freeze was Fanta at 370 minutes at 23°F.
The experiment results supported the hypothesis by showing that the higher the concentration of sugar in the soda, the slower it freezes. Thus, the concentration of the sugar molecules interfered with the freezing of the soda molecules.

7 CH401

Burke, Katharine

Kenmore Middle School

Teacher: Gantenbein

The Effects of Varying Acids and Baking Soda on Tarnishing Silver

The purpose of this experiment was to create a new, better way to clean tarnishing silver. This experiment was based on the base and acid theory and the classic baking soda and vinegar solution. When a base and an acid come together they normally react to become another substance, in baking soda and vinegars case they are coming together to create h20 or water. This reaction it the thing that cleans the silver so if you swap out the base or in this case the acid the reaction will be different. This experiment uses acidic fruits and baking soda to test to see if this works better than the original baking soda and vinegar combo. The hypothesis was supported and the lemon juice worked the best to clean the silver. I originally started working with these fruits because acidic fruits are often used in household cleaners. Originally an orange was going to be used, but it was decided to use grapefruit instead because of its acidity level. This project is very important to the world because of its impact on women. In many country's still it is the girls who have to clean the silver. They might sit around with a cleaning cloth working away at the tarnish for hours every day. This experiment provides an easy do-it-from-home affective solution to this worldly problem.

7 CH402

Morales, Anthony

Kenmore Middle School

Teacher: Gantenbein

The Effects of Switching Drinks on the Amount of Gas That Gets Released from Them

Drinks are part of everybody's every day life and it is beneficial to know what is inside those drinks. This project will help find out what drinks might be a reason for stomach aches. Hopefully it will help you find out what drinks are the healthiest to consume. The goal for this project is to find the different amounts of gas released from different drinks. For the experiment four different drinks were placed on heating pads to see how much gas would be released into the balloon that was on each one of the bottles. After the balloons were done inflating, the width of each balloon was measured to see which had the most gas. The results were soda(Diet Coke) made the balloon expand 4cm in width. The juice (orange juice) made the balloon expand 3cm in width.The milk expanded the balloon 0.2cm in width and water didn't expand at all. The conclusion for this experiment was that soda is most likely the main reason for stomach aches and stomach pain and that milk and water which produced little gas could help calm the stomach.

7 CH403

Thorsen, Blake

Williamsburg Middle School

Teacher: McFerran

The Effect of Different Surface Materials on the Time it Takes for Acrylic Paint to Dry

The purpose of the experiment was to find out which surface acrylic paint dries on the fastest. The hypothesis for the experiment is; “If I test which surface materials take acrylic paint the least amount of time to dry, then the white canvas will take the least amount of time to dry, because the materials that the canvas is made of will allow the paint dry the fastest.”

In the experiment, acrylic paint on cardboard took the least amount of time to dry, while art board took acrylic paint the most time to dry. The independent variable are the different surface materials and the dependent variable is the time it takes for the acrylic paint to dry. The experiment was conducted with five trials for each level of independent variable. A stroke of six centimeters long was applied to each level of independent variable, for each of the five trials. The drying time for each level was determined by how wet it looked and by touch. When all of the data was gathered, acrylic paint dried faster on the cardboard and dried longer on the art board. Cardboard took acrylic paint the least amount of time to dry on because of the materials it is made of.

The experiment can be extended to seeing what type of cardboard acrylic paint dries on the fastest, if there is a product similar to cardboard that can be compared with drying times and if color affects how fast acrylic paint can dry.

7 CH404

Wielechowski, Teagan

Williamsburg Middle School

Teacher: McFerran

The Effect of the Percentage of Cotton on How Much Tie Dye Spreads

The purpose of the experiment is to determine what percentage of cotton in a shirt works best for tie dyeing. The coronavirus has made more people want to start tie dyeing, and this should help them decide which shirt is best to use while doing this. In the hypothesis, it is stated that 100% cotton will spread the most due to the fact that cotton fibers are very absorbent. The tie dye would be placed in the center of the square cut shirt 17.8cm by 17.8cm, directly on the small dot in the center of the square. This is repeated 4 times for each level of IV. It is noted that the water ring around the tie dye dot is noticeably larger depending on the size of the tie dye circle. The hypothesis is rejected, with the 50% cotton spreading an average of 4.55cm, and 100% spreading an average of 3.7cm. The data showed reliable results, with the range for the control, 100% cotton, being 0.9 centimeters, 0.9 centimeters for 0% cotton, and 0.8 centimeters for 50%. The fact that 50% cotton spread the most could be due to the fact that polyester and cotton are both different materials, and them being combined could make a material very absorbent. The dye would be able to grab onto each fiber, pulling itself forward.

7 CH405

Zissman, Cooper

George Washington Middle School

Teacher: Thomas

Cheese Science: The Effect of Different Types of Milk on Mozzarella Cheese

For my science fair project, I observed the effects that using different types of milk has on mozzarella cheese. I wanted to see how the cheeses would differ depending on what I used. I hypothesized that ultra-pasteurized milk, which has been heated to rid it of bacteria, would not work for cheese. I made six cheeses, all using a process that took about 45 minutes to an hour. I made two cheeses using whole milk, two using nonfat milk, and two using ultra-pasteurized milk. I eventually observed that whole milk created the cheeses that were closest to mozzarella, and ultra-pasteurized did not work, as I originally hypothesized. This project has illustrated interesting conclusions as to why mozzarella cheese is made the way it is.

8 CH406

Coppenbarger, Sarah

Kenmore Middle School

Teacher: Brown

The Effects of Sand and Salt on Ice Melting Time

Studies have shown that the addition of salts and sand to ice decreases its melting time, but which one is the fastest? This project looks into the impacts of iodized salt (IS), rock salt (RS), kosher salt (KS), and sand on ice melting. Seventy-five ice cubes were placed in five same-sized bowls, over the course of five trials (three cubes/bowl). One teaspoon of IS, RS, KS, and sand were added to their respective bowls. Nothing was added to the control treatment. The bowls were placed in a refrigerator, and a stopwatch was started. Every hour, the ice cubes were observed, and after completely melting, the lap function was used to record the melting time. The hypothesis is that RS would melt the ice cubes the fastest. The experimental results were mixed—the results showed that the average melting time for each treatment was 3.18 hours for IS, 3.405 hours for RS, 3.554 hours for KS, 9.083 hours for sand, and 10.576 hours for the control treatment. While parts of the experimental results aligned with published research as in the case of salts in general, being the best catalysts for melting ice, my initial hypothesis isn't supported because RS came in second to IS, in terms of the most effective treatment. In conclusion, this experiment showed that IS could be used to melt ice faster than the other types of salt and sand.

8 CH407

Islam, Adam

Kenmore Middle School

Teacher: Brown

The Effect of the Type of Solution on pH Level

The purpose of this experiment is to investigate which of the following drinks (Market Pantry® lemonade, Tang® orange juice, Mott's® apple juice, and Pepsi®) is the most acidic. The hypothesis was that if the drinks are tested for pH, lemonade would have the lowest pH. The independent variable was the type of drink used. The dependent variable was the pH level of each liquid. The control group was tap water. The constants were the amount of liquid used (230 mL), the environment they were in, the plastic cups used, the LabRat Supplies® pH testing strips used, and the amount of time the pH strips were dipped in the liquids (two seconds). After taking out the pH strip, the colors on the strip were matched to the colors on the box to determine the pH of the liquid tested. The average of the three trials for tap water was a pH of 8. The average pH of the three trials of lemonade, orange juice, Pepsi®, and apple juice were 2, 3, 3, and 4 respectively. These results support the hypothesis since lemonade had the lowest pH. Overall, the experiment suggests that lemonade is the most acidic, as it has the lowest pH. Some people have certain health conditions such as acid reflux, heartburn, or weak stomachs which can be irritated by acidic foods. It is important for consumers to be aware of the acidity of commonly consumed drinks.

8 CH408

Jaldin Torrico, Eva

Thomas Jefferson Middle School

Teacher: Leonberger

Which Bioplastic Has the Most Admirable Qualities?

Plastic pollution has been taking over our planet for over 50 years, and while we have advanced scientifically in almost every field, we still cannot find a sustainable way to reduce the amount of plastic being polluted. After doing research, I found out that plastic is made from fossil fuels and their production is extremely wasteful, then I discovered bioplastics, which are natural polymers. I decided to experiment with 5 different bioplastic film recipes, then compare their results from a series of tests I performed on them. Ultimately, to see which was the best bioplastic. I decided to use casein, chitosan, carrageenan, cornstarch, and cellulose as my biopolymers, and tested their durability, flexibility, clarity, and heat resistance, and using cling wrap as a control. Following the tests, it was clear that cornstarch did the best out of the bioplastics, yet no one was able to outperform the cling wrap. In short, the bioplastics I produced were not able to compete against the factory made one. I would like to try this experiment again in the future, because I have been greatly limited by science fair protocols and limited resources to yield my plastics and conduct experiments. Also, because the flexibility test failed for most, I would concentrate on fixing the ratio of glycerin (what made the plastics flexible) to the rest of the base. In the end, if it was possible to make bioplastics relatively inexpensive, then factories can too.

8 CH409

Lim, Leo

Swanson Middle School

Teacher: Seliskar

The Effect of the Type of Cooking Oil on the Center Temperature of Tenderloin Beef

Independent variables of the project were the type of cooking oil. Levels were: olive oil, a mixture of olive and avocado oil (each 50%), and a mixture of olive and canola oil. My dependent variable was the center temperature of beef tenderloin. My hypothesis stated that a mixture of olive and avocado oil would produce the highest center temperature of the beef because avocado oil has the highest smoking point within the independent variable group. The procedures of my experiment were quite simple; I pre-heated the pan before putting the beef onto it, flipped the beef a few times on the pan after pre-heating, and recorded the data after taking out the beef from the pan. I made sure my pan was cooled down before heating it again. After collecting data, I found out that my hypothesis was valid, but the results were quite interesting. My reasoning for the hypothesis was the smoking point, but mixture of olive and canola oil produced a lower temperature of the beef than what olive oil produced. This result is interesting because canola oil itself has a higher smoking point than olive oil. I think I got the result this way because the difference of smoke points between canola oil and olive oil is slight (only 14 degrees Celsius), but the difference of smoke points between canola oil and avocado oil is significant (70 degrees Celsius). Therefore, some imprecision of the experiment could possibly make this result.

8 CH410

Musa, Zara

Williamsburg Middle School

Teacher: Warden

The Effect of Acidity on the Time it Takes for a Banana to Oxidize

The rationale for this experiment is to model how fruits and vegetables can be preserved. This is of great importance to industries such as the horticulture and produce industries. Enzymatic browning occurs in many victuals, such as bananas, lettuce, and apples. Enzymatic browning downgrades the tactile and visual properties of a fruit or vegetable ; it can even devalue the fruit or vegetable, making it cheaper. Browning can also decrease the nutritional content of fruits and vegetables; although this doesn't make the fruit or vegetable inedible, contrary to popular belief. This causes the common consumer to throw away these fruits and vegetables leading to financial loss. Enzymatic browning also causes economic harm for farmers that grow victuals that undergo the process of enzymatic browning.

This study examined how long it took for a banana slice to oxidize based on the level of acidity of liquid which was placed on it. It was hypothesized that lime juice would preserve the bananas the best. In the end, the hypothesis was supported. The banana slices in which the most acidic liquid (lime juice) was applied to, took the longest amount of time to brown compared to the less acidic liquids (lemon juice and orange juice). The banana slices that had lemon juice applied to them took the second longest amount of time to oxidize. Finally, the banana slices that had orange juice took the least amount of time to brown.

8 CH411

Scally, Abbie

Dorothy Hamm Middle School

Teacher: Kennedy

The Effect of Deicer Ingredients on the Amount of Time it Takes Ice to Melt

This experiment was done to see if substituting road salt with deicers harmful to the environment is the best way to melt ice and snow. Sodium Chloride, Magnesium Chloride, and Calcium Chloride were tested to see which would melt ice the fastest. The hypothesis was that Calcium Chloride would melt the fastest because it can absorb water and release heat through an exothermic reaction.

Each deicer was applied to an ice cube in a cup. Three kinds of deicer and the control were the levels. The control was the ice melting on its own. After measuring out and distributing the deicers, the time each started melting was marked down. The ice was checked every 15 minutes. The time it took for each ice cube to melt was calculated and recorded, then the average was found.

The Sodium Chloride took 195 minutes to melt. The Calcium Chloride took 204 minutes. The Magnesium Chloride tied with the control at 294 minutes. This was surprising because my research showed Magnesium Chloride as a good contender. Unfortunately, several errors may have affected the results. Ice froze in the mold wrong, which kept the deicer from being properly distributed. The cups were small and didn't allow the ice to touch the water, giving an advantage to the ones that dropped first.

In conclusion, the deicer you use doesn't really matter. Under equal conditions, they all successfully melt ice. I recommend using Sodium Chloride, as it melts the ice the fastest and doesn't damage the environment.

9 CH412

Freeman, Anna

Washington-Liberty High School

Teacher: Sotomayor

The Effect of the Amount of Heavy Cream on the Density of Caramels

The purpose of this experiment was to discern whether the density of caramels was affected by the amount of heavy cream in the caramels. There were five levels of the independent variable: 60 mL, 125 mL, 250 mL (the control group), 375 mL, and 435 mL. The hypothesis for this experiment was that if 375 mL of heavy cream was added to the caramels, then the caramel will be less dense, because the protein in the cream reacts with the sugar to start the Maillard Reaction. An ANOVA test conducted showed that there was no significant difference between the levels of the independent variable, with a p value of approximately 0.055. The null hypothesis for this experiment was that the amount of heavy cream in the caramels would have no significant effect on the density of the caramels. Because the ANOVA test showed no significant difference between levels of the independent variable, the null hypothesis can be accepted.

9 CH413

Patrick, Victoria

Alexandria City High School

Teacher: Holmes

Which Powder Lifts Fingerprints the Best?

The purpose of my research project was to determine if bi-chromatic powder is the best powder to use to lift fingerprints. My hypothesis was if bi-chromatic powder is used, then the fingerprints will come off the best. In my experiment, I found that if bi-chromatic powder made better, clearer fingerprints. Bi-chromatic powder lifted fingerprints with an average of 88% accuracy whereas magnetic powder had 28% accuracy and both baking powder and talcum powder had an average of 0% accuracy. Since both talcum and baking powder absorb moisture, the low accuracy could have caused both powders to absorb the moisture in the fingerprints. The low accuracy of magnetic powder is likely because the powder is much more coarse than other powder used in this experiment. If these powders were exchanged for more neutral and finer powders, the results most likely would have been more even. If bi-chromatic powder is used, then the fingerprints will be lifted the most accurately. This hypothesis was true with all of the data supporting it. The independent variable was each type of powder used and the dependent variable was how well the fingerprints were lifted, there was no change created. My results may have been different than I hypothesized if my powders weren't moisture-absorbing agents or if they were less coarse. A few improvements for the experiment are to let the fingerprint sit with the powder on it for over 90 seconds before dusting it and to use a clearer tape when lifting them.

10 CH414

Baasansukh, Haley

Washington-Liberty High School

Teacher: Fretts

The Effect of Different Solvents on the Retention Factor of Photosynthetic Plant Pigments

The purpose of this experiment was to test if various solvents would influence the separation of several pigments found in spinach leaves through the measurement of the retention factor. Retention factor is measured through the distance travelled by a pigment over the distance the solvent travelled, showing how much of the pigment has dissolved. Chromatography is used to aid in the separation of substances. Solvents would aid in the separation of plant pigments, where capillary action would allow the pigments to be carried along the paper. It was hypothesized that if the isopropyl alcohol is tested, that level will be the most effective in the separation of pigments, due to chlorophyll and carotenoids being insoluble in water, with the isopropyl alcohol having the lowest water content. The null hypothesis for this experiment is that if different solvents were tested, then there is no effect of the separation of the pigments spinach leaves' pigments. From the data collected, it was concluded that the isopropyl alcohol was most effective in the separation of various pigments extracted from spinach leaves, with mean retention factor values of 0.132 for chlorophyll A, 0.452 for chlorophyll B, and 0.725 for carotene. 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 three T-tests on all experiment groups, yielding p-values of less than the critical value of 0.05.

10 CH415

Bergmann, Carly

Washington-Liberty High School

Teacher: Fretts

The Effect of Antacids with Varying Active Ingredients on the Final pH of Simulated Stomach Acid

The purpose of this experiment was to test the effect of antacids with varying active ingredients on the final pH of simulated stomach acid. Simulative stomach acid was prepared by diluting two molar hydrochloric acid to a concentration of 0.01 molar using distilled water. Four antacids were tested: Tums, Alka-Seltzer, Pepto-Bismol, and Mylanta. As well as the four antacids, there was a control of no neutralization. The hypothesis of this experiment was if antacids with varying active ingredients are added to a simulative stomach, the simulative stomach mixed with Alka-Seltzer will be the closest to neutralization because Alka-Seltzer's main active ingredient is sodium bicarbonate, a fast-acting antacid ingredient. Mylanta had the closest pH to neutralization at a mean pH of 7.1. Alka-Seltzer, Tums, and Pepto-Bismol followed respectively. An ANOVA test was conducted to determine the statistical significance of the data, and the resulting p-value was 1.62 × 10-39, which is less than the necessary value of 0.05 to consider the data statistically significant. Since there was no overlapping in the data, T-tests were not performed. This experiment could have been improved by measuring the antacids using moles instead of recommended dosages. This would eliminate situations where one antacid works better due to its higher concentration of neutralizing agents since moles measures the concentration of a solution. Further studies should consider the temperature of the simulated stomach acid to better mimic a human stomach.

10 CH416

Cordero, Gabrielle

Washington-Liberty High School

Teacher: Fretts

The Effect of Detergent Products Containing Sodium Percarbonate on Luminol Efficacy

The purpose of this experiment was to test the effect of Sodium Percarbonate's (also known as Active Oxygen) effect on luminol efficiency. Luminol is a reagent used to detect microscopic traces of iron found in blood. Luminol is a popular tool used by forensic scientists to indicate the presence of blood using a process called chemiluminescence. The increasing use of active oxygen could potentially erase blood affecting crime reconstruction. To test this theory, myoglobin was used as a blood alternative and applied on strips of 100% cotton fabric. It was hypothesized that if clothing fabric was soaked in myoglobin and thoroughly washed with liquid laundry detergent containing Sodium Percarbonate, then there would be a negative luminol test because Sodium Percarbonate is a bleaching and oxidizing agent strong enough to remove microscopic traces of iron that would normally render a positive luminol test. The control group for this experiment used natural detergent that did not contain Sodium Percarbonate. However, no change was observed between the controlled and experimental group, therefore the null hypothesis could not be rejected. A series of tests were then performed to find an explanation for this result. The reason remained unknown. Consequently, this experiment suggests that Sodium Percarbonate has no significant effect on luminol efficiency.

10 CH417

Silva, Leila

Yorktown High School

Teacher: Lovrencic

The Effect of Natural Disinfectants on the Concentration of Volatile Organic Compounds

Volatile organic compounds, or VOCs, are organic compounds with a low boiling point that easily evaporate into the air. Due to their properties, they been found to have a number of negative health and environmental effects. This project was conducted to see if disinfectants labeled as natural release less VOCs than ones that aren't. Two natural disinfectants (CitraSolv and Seventh Generation), two non-natural disinfectants (Clorox Cleaner & Bleach and Lysol), and a control group of no disinfectant were tested. It was hypothesized that the natural disinfectants would result in a lower ppb of VOCs than the other two. The sensor used was the CCS811 Air Quality Sensor Breakout. The control had the lowest values, followed by CitraSolv, with no significant statistical difference between the two. The next lowest was Seventh Generation. This is most likely because while its primary disinfectant, thymol, is a VOC, it contains no synthetic fragrances. Next was Clorox, which did on average have a higher VOCs ppb than Seventh Generation, but not a statistically significant one. The primary disinfectant in Clorox, chlorine, isn't a VOC. It was expected to have higher results due to the bleach, which forms VOCs easily, and the fragrance. However, this didn't make much of a statistical difference. Lysol had the highest ppb which was expected due to its abundance of VOC ingredients like ethanolamine. The results suggested that while natural disinfectants overall had lower levels, the concentration of VOCs ultimately came down to the specific ingredients in each disinfectant.

10 CH418

Sokolove, Charles

Alexandria City High School

Teacher: Lay

What is the Fastest Way to Cool a Soda?

The purpose of this experiment was to determine the fastest way to cool a soda to the average preferred drinking temperature (4° C). It was hypothesized that the fastest time elapsed to 4° C would be influenced by the initial temperature of the cooling substance. 3 trials were performed, each utilizing a different cooling method; Ice-Water-Saline Mixture, Ice Bucket, Freezer. The testing concluded that the initial hypothesis was rejected given that the temperature of the coolant had a seemingly null effect on the end elapsed time. However, even with these results, there was still a great difference between the results of the 3 methods, thus implying a different cause.

10 CH419

Stewart, Samantha

Wakefield High School

Teacher: El-Gamal

The Effect of the pH of Liquid on the Dissolving Time of 200mg Ibuprofen Pills

The purpose of this study was to discover the effect of the pH of liquid on the dissolving time of 200-mg ibuprofen pills. The independent variable was the pH of the liquid. The experimental group included liquids with a pH of: 4.0, 4.5, and 6.5. The control group was 7.0, which is neutral. The dependent variable was the dissolving time of the ibuprofen pills. The constants were the amount of initial substance used (10 mL), the amount of vinegar (30 mL), the temperature of the room, the mechanism used to simulate swallowing, the cleaning process between each trial, the stopwatch used, and the measuring tools used. The hypothesis was: If the pH of the liquid is 4.0, then the Ibuprofen will dissolve the fastest. Each of 12 ibuprofen pills was dissolved in a mixture of cranberry juice and water with a varying pH level. Each pH had three trials. 30mL of cranberry juice was measured in a graduated cylinder, and 10mL of a mixture of water and cranberry juice with a specific pH was added to that graduated cylinder along with a 200-mg ibuprofen pill. The time taken to dissolve the pill was recorded, graphed, and means were found for each pH level. The results showed that the lower the pH, the faster the pills will dissolve. These results supported the hypothesis. In conclusion, the study suggests that 200-mg ibuprofen pills will dissolve fastest in liquids with a lower pH level.

10 CH420

Stewart-Simmons, Daija

Wakefield High School

Teacher: El-Gamal

The Effect of Different Liquid Solutions on the Acceleration of Corrosion

The purpose of this experiment was to determine the effectiveness of different liquid solutions on the acceleration of corrosion. The independent variable was the different liquid solutions used to encourage the corrosion. The liquids include bleach, vinegar, salt water and distilled water which was the control. The dependent variable was how fast the rust formed on each steel wool pad which I would measure by observing each of the petri dishes hourly. The hypothesis for this experiment was if steel wool is immersed in 20 mL of bleach, then rust will form fastest.

There was one steel wood pad in each of the four petri dishes used for each of the independent variables to submerge them in. Photos and observations were made about every five hours during the experiment in order to spot rust formations. I recorded the number of hours it took for rust to be formed in each petri dish. I found that my hypothesis was correct and the steel wool pad containing bleach only took 2 hours to form rust. This experiment could have been improved by doing one or two more trials to add more levels of accuracy and precision.

10 CH421

Gerardi, Mara; Danaceau, Ellie

Washington-Liberty High School

Teacher: Fretts

The Effect of the Type of Oil on the Force Required to Break Hair Exposed to UV Radiation

The purpose of this experiment was to determine the effect of certain types of oil on the strength of hair exposed to ultraviolet radiation. The hypothesis states that if chicken oil is applied to the hair, then the average force required to break the hair after exposure to UV radiation will be the greatest because it has the highest level of unsaturated fats and therefore, the highest UV absorption rate. The independent variable was the type of oil and the dependent variable was the force required to break the hair (in Newtons). The levels of IV included chicken oil, groundnut oil, and coconut oil, in addition to the control. Each oil was applied to groups of ten hairs. These hairs were then exposed to ultraviolet light for sixty minutes. The force required to break the hair was measured using a spring scale and the data was analyzed. The hypothesis was rejected. An ANOVA test was conducted and the null hypothesis was accepted, as the resulting p value (0.125) was greater than the critical value of 0.05, indicating that the data was not statistically significant. The inconclusive data could be attributed to the time spent exposed to UV, which was a notable limitation. Hair health plays a vital role in people's self image and hygiene, so it is important to continue to research and test methods of protection.

11 CH422

Houhou, Kenza

Yorktown High School

Teacher: McKowen

The Effect of Illuminance on Temperature

For my science project I wanted to record how luminol's illuminance is effected by temperature. If the temperature is increased, the luminol's glow will increase, because the molecules would move faster from the high temperature. In the beginning I made two different solutions, a luminol solution and an oxidizing solution. I heated both of them in different temperatures and recorded the data by placing a light sensor directly facing the luminol beaker. With the lights turned off I recorded the data and repeated each trial five times. The results conclude that if the temperature increased, the illuminance increased. However, the solutions that were heated up to 50°C to 70°C recorded less illuminance than the lower temperatures. My results related to my background research because the more I increased the temperature, the illuminance increased. Until it was heated up past 40°C, which led the illuminance to decline. The cause of this may be because my reactant was consumed or decomposed.

7 EN500

Borisov, Camila

Kenmore Middle School

Teacher: Gantenbein

The Effects of Building Materials on Structural Stability During Earthquakes

In this experiment the purpose was to determine which of the three common building materials - wood, clay and concrete - is better at withstanding earthquakes. The hypothesis was that concrete would be the best material of the three, since it is sturdier than wood and clay. To test the hypothesis, three miniature houses were built out of these materials and then subjected to vibration which would simulate an earthquake. After being subjected to vibration, the wood house had no structural damage; the clay house had some cracks mainly around the joints; and the concrete house collapsed entirely early into the experiment. The hypothesis was not supported, the cement house was the least able to withstand vibration, and the wood house sustained only minor damage. This is likely because cement is more brittle than wood, and therefore has less ability to absorb vibrations and stresses (unlike a spring). A less brittle material, such as wood, can bend more before cracks will form. Additionally, it was observed that the most cracks formed around the joints of the miniature houses, which suggests that stresses on the houses were absorbed by the joints; however, further experiments would be needed to test this theory. This experiment demonstrated that buildings made of less brittle materials, such as wood, are likely better able to withstand earthquakes than buildings made of clay or concrete.

7 EN501

Mohamed, Ryan

Thomas Jefferson Middle School

Teacher: Holland-Shuford

How Is a Geometrically Shaped Building's Sturdiness Affected by Wind Loads?

How can a geometrically shaped building's sturdiness be affected by wind loads? High-rise buildings shaking in the wind is caused by high altitude which causes high wind speeds. For example, the 432 Park building shakes in the wind causing hundreds of thousands of dollars in damage. The purpose of this experiment was to find which geometrically shaped building is the strongest against wind.

The hypothesis stated that the circular building would be the strongest building against wind loads because the circle doesn't have any angles or vertices. To find out which building was the strongest, replicas of buildings were made using cardboard in the shapes of a triangle, circle, square, and octagon. Then, the buildings were pasted to a base. After, a digital scale was placed and secured behind the building being tested. Then, a fan was turned on at the highest setting to mimic wind loads. Three trials were used for the most accurate results.

The results showed that the octagonal building was the strongest against wind loads. The circle was the second strongest, the triangle in third, and the square building being the weakest against wind. The hypothesis was not supported by the data.

In conclusion, an octagonal building is the strongest against wind loads, with the square building being the weakest. In the experiment, the method for recording the data could have been refined to produce accurate data. After the experiment, I learned that the higher altitude you go, the higher the wind speed.

7 EN502

Normington, Beckett

Thomas Jefferson Middle School

Teacher: Holland-Shuford

An App for Predicting Fall Severity Through Reaction Time

Falls are a serious problem for the elderly and up to 40% of people who have not recently fallen display the fear of falling. While around 30% of people who are 65 and up suffer a fall every year, the severity can vary depending on a number of factors. One important contributor to the severity of falls is a person's reaction time to stimuli. This project explores the possibility of using an app designed to score the severity of a fall based upon a person's reaction time to a visual stimulus. The goal is a 75% accurate prediction success rate at identifying the rough severity of a fall. The app will function by initializing with a black screen. Then, it generates a random number of milliseconds within a range of 1,000 to 4,000 milliseconds. It will wait for this number of milliseconds and then change the screen background color, the cue to tap the screen. When it changes the background color of the screen, it saves the current time which represents the start time. When the screen is tapped, the app restores the original background color and calculates the elapsed time between the start time and the current time which represents the time the person took to tap the screen. Finally, it prints out this data to the screen.

7 EN503

Tarpley, Michael

H-B Woodlawn Secondary Program

Teacher: Taggart

Building a Distance Sensor

A distance sensor is a piece of technology that can detect the distance from the sensor to another object. In this project, I designed and built an ultrasonic distance sensor from component parts. Specifically, I used an ultrasonic sensor (which uses ultrasonic sound waves to detect distance), an lcd screen, and an Arduino (which is a platform to tell all of my components what to do) to create a device that can detect the distance from the sensor to 200 cm away very accurately and then display the distance on the lcd screen. I used my computer to create the code for this project and to upload the code to the Arduino. I used a soldering iron to solder the lcd screen to the Arduino. Lastly, I custom designed a case on a program called tinker cad and then printed the case using a 3D printer.

Some examples of this technology being used around the world are robots. A lot of robots use ultrasonic sensors so that they know where to go and how to avoid objects. Ultrasonic sensors work by emitting high frequency sound waves that humans can't hear to detect the distance from the sensor to an object. This project took me a long time to design and build but it was very fun and informative about how distance sensors work and how to use them.

7 EN504

Ware, Charlotte

George Washington Middle School

Teacher: Owens

Fast & Furious

My project is called the Fast and the Furious. Its purpose is to test if a Sphero SPRK+ robot moves faster through a maze if it is being controlled by a human or with a computer program. I drew a maze on a piece of poster board paper with a Sharpie. My tech class teacher let me use a Sphero robot. I connected and controlled the robot with an app, Sphero EDU, on my school-issued Chromebook. There are two different ways that I moved the robot through the maze. I drove the robot using the W key for forward, A for left, and D for right. I also wrote a program to move the robot through the maze. It took me approximately 45 minutes to write the program. In conclusion, when the robot moved through the maze using the program, it completed the maze in an average of 12 seconds, and when a human was controlling it, the robot completed the maze in an average of 16.5 seconds. Given that it took me 45 minutes to write the program, the program-controlled robot becomes faster on the 601st run through the maze.

7 EN505

Yimer, Sabrina

Thomas Jefferson Middle School

Teacher: Vernier

Education, the Gateway to a Successful Future--But not Everyone Has Access to It

Disparities among academic achievements have been shown with minority students and immigrant families. One main cause is the absence of family and social support in academics, and the unusually large drop in trust among minority students and immigrant families during middle school. Peer-led tutoring is an effective method in improving academic performances and narrowing the achievement gap. It gives students one-on-one assistance from someone close to their age, it also promotes social interactions and decreases off-task behavior. The project aims to create a website platform where students based on matching personalities will be able to contact and connect with possible peer tutors. This was designed using three different programming languages: HTML and CSS to design the outline of the website and PHP to match the students and tutors together, make it possible for tutors to make an account, and for students to then view it. The website platform would help students of minority and immigrant families receive academic support and one-on-one assistance from a tutor around their age. In the future, this website would be made accessible to students. Academic improvements made after tutoring would be collected to assess the website's usefulness and effectiveness on students' academic achievements.

8 EN506

Dawson, Zachariah

H-B Woodlawn Secondary Program

Teacher: Boyle

How Electrical Currents Work: Demonstrated Through An Arc of Electricity

This project is a model of an electrical conductor that can produce an arc of electricity. It shows the process used to make the conductor and explains the science behind how it works. The conductor demonstrates an electrochemical reaction. An electrochemical reaction is the passage of an electric current, involving the transfer of electrons between two substances—one a solid and the other a liquid. The reaction happens inside a battery and the electric current is transferred to an electric circuit that creates a small bridge of electricity between two wires.

8 EN507

Gebrengus, Dersabel

Jefferson-Houston School

Teacher: Rutherford

Unleash the Power of a Pinwheel

The experiment that we did is called unleash the power of a pinwheel. The experiment recalled some materials such as an empty container of oatmeal, thread, construction paper, skewer, protractor, hairdryer, and paper clips. Most of the materials that we used were pretty basic materials used to collect data. Once putting the materials together it was time to test it. For stability to hold the hairdryer we used textbooks. Our resolute was turned out to be a 45-degree angle. Understanding, about which angle a wind is passing can help improve the speed of electricity in our daily lives and help decrease the negative impact it has on wildlife.

8 EN508

Gupta, Krish

Swanson Middle School

Teacher: Seliskar

Herbal Clay-Based Water Filters

Lack of access to clean water is a global issue that is leading cause of various diseases and mortality. Regular water filters rely on the principles of adsorption where dirt particles adhere to solid surfaces, improving quality of water. The goal of this project was to further improve on our previously designed low-cost herbal filter by utilizing clay-based balls mixed with herbs instead of powdered form of herbs and check for removal of common water contaminants while trying to achieve greater clarity of filtered water. Previously the filtered water was not clear due to the presence of loose powder in the filtrate. Two natural indigenous herbs (Azadirachta indica commonly known as 'Neem' and Ocimum tenuiflorum known as 'Tulsi') were used in the design. Three filter groups were designed - regular filter with no herbs as control group, herbal powder filter, and herbal clay-based filter. The results showed herbal clay-based filtrate had the greatest reduction in levels of copper, lead, and nitrate in addition to maximum improvement in clarity of filtrate sample due to unique adsorption and vitrification properties of clay balls. Neem and Tulsi clay-based filters were also superior to other filters in removal of bacterial contaminants, possibly due to a slower flow rate. However, total dissolved solids (TDS) increased over the control group likely due to some of the clay dissolving in the filtered water. In conclusion, herbal clay-based water filters can be a viable option over regular filters to improve the quality of water in a cost-effective manner.

8 EN509

Hwang, Theodore

Gunston Middle School

Teacher: Robles

Constructing an Invention to Purify Water Using Electrolysis

Over 700 million people in the world don't have access to clean water. In theory creating water is possible given our current technology. The purpose of this experiment was to develop a machine capable of purifying water by deconstructing the contaminated water and use the oxygen and hydrogen molecules to rebuild, clean, water. There is a scientific process, called electrolysis, where an electrical current separates the oxygen and hydrogen in water. Electrolysis was performed first to separate the molecules. The gases where piped into a larger chamber that was heat resistant and sealed. They were ignited and ,in theory, the heat energy would spark a reaction that would cause the molecules to rebind creating water. The machine, however, was not successful. 130ml of water were successfully separated but when it was attempted to rebind them no water was found. Although this was a disappointment it highlighted flaws that should be investigated and fixed. This was a prototype design for a larger scale machine and the errors show improvement for a future model.

8 EN510

Leighton, Declan

Williamsburg Middle School

Teacher: Thomas

The Effect of Diameter and UV Exposure on The Strength of a Cylindrical Piece of PLA

The purpose of this experiment was to understand the effect of weathering, specifically UVA and UVB exposure, as well as change in diameter on the tensile strength of PLA, a very common material that is used in 3D printing. After conducting the tests the first hypothesis that said as diameter increases so does the tensile strength, was supported. But the second hypothesis that as UV exposure increases the tensile strength decreases, was not entirely supported. This was due to the fact that ambient moisture would have absorbed into the test pieces, temporarily weakening them. This efect would have been reversed in UV exposed test pieces because the UV light would have slightly heated the test pieces, driving out the moisture. This is why the Non-UV exposed test pieces were in some cases the strongest and in some cases the weakest. It is recommended that further experiments be conducted where the humidity is controlled. It is further recommended that experiments are conducted using humidity as the independent variable.

8 EN511

Snelbecker, Emily

Williamsburg Middle School

Teacher: Warden

The Effect of Type of Insulator on Temperature

Seeing how well insulators work is important because insulators are a big part of what makes homes comfortable to live in. This is important to the real world because as the world heats up, and more natural disasters happen, the harder it will be to have a comfortable home to live in temperature-wise. Also, the better the insulator, the less energy is wasted by heat escaping/entering resulting in using more AC/heating. This experiment tested the effect of three types of insulators on temperature: Foamular, a Multi-Use Small Project Roll, and a ComfortSeal Sill Gasket. The Foamular slab worked best, the Multi-use Small Project Roll worked second best, and the ComfortSeal Sill Gasket worked the third best, and the control worked worst. For the control (no insulator), the average temperature after 15 minutes under a heat lamp rose to 27ºC. The average temperature using Foamular rose to 22º, using the Multi-Use Small Project Roll, it was 22.3º, and using the ComfortSeal Sill Gasket, the average temperature in Celsius was 24.2º. These results supported the hypothesis that the Foamular would do best, and all of the independent variables would keep the model room cooler than the control would.

9 EN512

Watkins, Genevieve

Alexandria City High School

Teacher: Mattews

What Sandbag Layout Best Diverts Runoff in a Residential Neighborhood?

Despite the alarming name, floodplains — low-lying areas near water — are often abundantly populated, with many major cities forming around waterways. Urbanization, however, harms the land's natural defenses, making it less able to cope with the natural risk of flooding, especially with a large population. Common large-scale structural diversion methods like levees have some of the worst consequences for floodplain ecosystems. Simultaneously, global climate change causes rising sea levels and more frequent severe rainstorms. Even people living in areas far from the coast struggle with flash flooding caused by rainwater runoff, which is the issue my project addresses. By placing barriers such as sandbags, homeowners can reduce property damage and encourage proper drainage of runoff, but there is no definitive information on the best exact way to do so. This experiment is designed to find the ideal layout of sandbags in a suburban neighborhood. It represents houses with small plastic boxes; terrain with a clay and corrugated plastic base; and both soil and sandbags with sponges. Testing consisted of pouring water over the model to simulate heavy rainfall with different sandbag layouts. To find the best orientation, I recorded the amount of water that ended up in each house model, and observations of the paths of runoff. I found that the shape that both prevented house flooding and diverted runoff to appropriate areas most effectively was a “V,” where an acute tip faces the highest point of the hill, gradually widening as it approaches the house.

10 EN513

Altenburg, Abigail

Alexandria City High School

Teacher: Briestansky

Which Material Makes a Mechanical Arm Most Functional?

The experiment was which material works best to use for a mechanical arm. For the experiment 4 different materials were used, paper, plastic straws/paper towel roll, 3D printed plastic, aluminum sheet. The experiment tested each hand 4 times to see if it would be successful. In order for a trial to be successful the hand must hold the rubber duck for 3 minutes or 180 seconds. In the end the 3D printed one worked the best.

10 EN514

Soni, Nikhil

H-B Woodlawn Secondary Program

Teacher: Owen

Emotional Detection/Object Detection

As philosopher Yuval Noah Harai said in 21 Lessons for the 21st century: “Those who own data own the future.” This statement has stood the test of time as big data companies such as Facebook, Microsoft and Google use their incredible knowledge of their users to tailor experiences toward consumers and increase sales. However, data collection remains mostly limited to gathering information from what the users do and interact with on the company sites, apps and such. But what does the consumer actually feel when using the product? How do they react in real life, what is their emotion when they use these apps? This can certainly be gauged by reviews, posts, and other text based means to express one's reaction to an experience, but video methods may be a much more effective way to rate user reaction and emotion.

The background to my project came from research on using OpenCV, and Python programming.

The results for the emotional detection component were mixed, with higher accuracy on those without glasses or makeup. Video vs picture accuracy was similar. For the object detection component, objects within the pre-trained model were detected with 100% accuracy. This project could be vastly improved with a new model with a larger sample size.

10 EN515

Savage, William; Shipley, Alexander

H-B Woodlawn Secondary Program

Teacher: Owen

Using Computer Vision and Augmented REality to Uitilize Pupil Movement as an Alternative to Traditional Tactile Input Systems

In recent years, significant advances in the fields of assistive robotics and AI have been made to help those with disabilities experience the world with more autonomy than ever before. However, many of these innovations, such as assistive computer software, care robots, and advanced wheelchairs, while life changing for many, leave behind one demographic: those who lack fine motor control in their hands. Whether they are suffering from paralysis, cerebral palsy, or a variety of other disabilities, people who cannot manipulate their hands with a sufficient degree of precision are unable to profit from the benefits and freedom offered by many assistive technologies.

Our project seeks to change that. By using computer vision, augmented reality, and other rapidly developing technologies, our project is able to use the motion and position of the human pupil as input for applications that would traditionally require a physical input such as a joystick or mouse, opening a wide variety of possibilities for those who are unable to take advantage of traditional assistive solutions. While this system has many limitations, the variety of distinct inputs offered by the eye are enough to replicate many assistive input methods that currently exist, and further development will only improve and expand the capability of eye-based input. Our project demonstrates a novel but versatile and effective system that allows people suffering from disabilities as extreme and debilitating as quadriplegia to reap the benefits of decades of progress in assistive robotics that has thus far been inaccessible to them.

11 EN516

Sanchez, Raphael

Washington-Liberty High School

Teacher: Cook

The Effect of Tuned Mass Dampers on Super-Slender Towers Affected by Vortex Shedding

The purpose of this study was to test how much building sway on super-slender towers from vortex shedding is reduced when a pendulum Tuned Mass Damper (TMD) was being used. The independent variable was the amount of damping. The experimental group was the building with the pendulum TMD. The control group was the building without the pendulum TMD. The dependent variable was the building sway, as measured by an accelerometer. The constants were the building, the accelerometer, and the pendulum used. The hypothesis was: The trials with the building's TMD installed will oscillate less than the trials that will not have the building's TMD installed. A model super-slender tower with a TMD that was set to the natural frequency of the building was treated with different wind speeds. Along with changing the wind speed, the TMD was installed and removed to test how effective a TMD would be against vortex shedding. Results showed that the TMD was most effective at reducing building sway at high speeds; however, the TMD was not very effective at reducing building sway at low speeds. Thus, the results did support the hypothesis in technicality. In conclusion, the study suggested that TMDs could make a difference in reducing super-slender tower oscillation from vortex shedding, but only at high wind speeds.

11 EN517

Sartori, Colin

Yorktown High School

Teacher: Hessler

A Further Study of Clean Energy Harvesting Using Piezoelectric Transducers in Footwear for Sustained Power

The goal of this project was to design and build a shoe using piezoelectric transducers that would generate sustained power while walking and jogging. Piezoelectric transducers are ceramics or crystals that produce electricity when force or stress is applied. To achieve sustained power, Voltage Multipliers were used.

This project had four phases: Capacitor Selection, Insole Design, Metronome Testing, and Treadmill Testing. Voltage, current, and power were recorded in each. Of the six capacitors tested, the 2.2 uF had the longest duration of charge, so it was chosen as the capacitor size for the Voltage Multipliers in the next phases. Of the four inserts tested, Insert 1 had the largest peak power and Insert 4 had the longest duration of charge, so both were used in the next phase. In the Metronome Testing phase, the transducers were tapped at walking (50 BPM) and jogging (88 BPM) paces in 30 second intervals. Insert 1 had a higher sustained power than Insert 4 at both walking and jogging paces, so it was chosen for the next phase. In the Treadmill Testing phase, the current was smaller than the previous phase, resulting in a decrease in power, which is similar to the final results in the previous experiment. Through further studies, the power output could be increased using stacks of transducers. 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.

7 EV600

Burks, Thomas

George Washington Middle School

Teacher: Thomas

Aquatic Microorganisms and Climate Change

For my science fair project, I wanted to research the effect that global warming may have on aquatic microorganisms. This is important because aquatic microorganisms are eaten by larger organisms and if they are not doing well it can affect the food chain.

I got microorganisms from a tidal basin in my area. For my variables, I used salt to change the salinity, lime juice to lower the Ph, and an aquarium substance called Ph up to raise the Ph. This simulated climate change because excess carbon dioxide from climate change lowers Ph in the water, and rising sea levels and precipitation change are effects of climate change that will change salinity.

For my hypothesis, I said that none of the changes would help the microorganisms. Ph up and Ph down will kill the microorganisms and salinity will do nothing to them. My results were that small changes in salinity didn't kill any microorganisms but as you added more salt it started killing more and more microorganisms. A small change in Ph didn't have much effect either, but as you raised or lowered the Ph of the water more, the microorganisms start to die.

In conclusion, a little bit of global warming is probably something that the microorganisms can handle but if it gets to be too much the Ph changes will start killing off aquatic microorganisms. If this will happens, then organisms higher up in the food chain will have no or less food.

7 EV601

Wilson, Gabrielle

Kenmore Middle School

Teacher: Gantenbein

The Effect of Types of Waters pH, Nitrate, Water Hardness and Chlorine Levels

One of the many things humans worry about is health, whether it's working out, having time to relax or eating and drinking healthy. Sure, we can help ourselves stay healthy, but we should also help the planet. One thing that pollutes the planet is bottled water bottles. But if the reason we drink from plastic bottles is because we think that the water is better for us, is that true? To find this out the experiment used pH, nitrate, chlorine and water hardness test strips to determine if bottled waters are purer than tap water. The hypothesis in this experiment was that Fiji bottled water would be purest, as it was advertised to be the best mineral profile. But the results showed that there was practically no difference of purity in each type of water. Tap water and Fiji water shared the same pH(7), nitrate (0.5ppm), and chlorine (10). Their only difference was the water hardness, tap (1.5gpg), Fiji(7 gpg), both are healthy levels. This experiment shows that in Arlington plastic bottled water isn't necessary, we should use tap if we have that benefit.

7 EV602

Jacob, Erin; Kammerman, Noa

Dorothy Hamm Middle School

Teacher: Kruger

Which Worm Makes the Best Composting Soil Using Arlington Soil

When Arlington started to offer composting services, we were grateful that we had access to it. But not every family has easy access to county sponsored composting so we wanted to figure out a way for people to do it at home. We did some research and found out that worms are a popular way to enhance small batch compost. Our research did not reveal, however, what kind of worm worked best, so we decided to design an experiment to find out. Based on the popularity of Red Wigglers, we predicted that Red Wigglers would be the most effective way to enhance small batch compost. We purchased three different types of worms: Red Wigglers, Nightcrawlers, and Giant Mealworms, and set up four identical composting compartments using three cups of soil each from our backyard. We also purchased two Lusterleaf rapid soil tests, which test the following levels in soil: pH, nitrogen, potash, and phosphorus. We tested the soil before we added the worms to establish our baseline nutrient levels and then added worms to three of the compost compartments and tested the soil again every two weeks. Ultimately, our hypothesis was proven wrong; while the Red Wigglers did improve the soil quality compared to the soil with no worms, the soil enhanced with Giant Mealworms saw higher overall nutrient improvement, for example phosphorus levels. This experiment gave us clear answers on which worm is the best for composting which is why we can say our project was a success.

8 EV603

Mantler, Zella

Swanson Middle School

Teacher: Swanson

Testing Ventilation in Swanson Middle School During the Era of COVID-19

I tested the effect of the natural ventilation level on the average CO2 change per person in a classroom. I thought that if the ventilation level in a classroom is higher, meaning more windows and doors open, then there will be a lower average CO2 level per person after a 45 minute period because there is more fresh air coming into the classroom. Each morning I went to the classroom I was testing in and made sure the correct number of windows and doors were open for that day of trials. I tested45 minute periods throughout the day and then after school went to the room to collect attendance. I found the difference of the starting amount of CO2 and the ending amount of CO2. My hypothesis was correct. I calculated CO2 change per person for each of my trials and averaged the results. The average CO2 change per person when 3 windows and the door were open was -0.72 ppm. The average CO2 change per person when no windows or doors were open was much a much higher number, 24.49 ppm. I think my results happened this way because opening windows and doors increases air flow in a room. They allow air from outside and in the hallway to float into the room and replace CO2 that people are breathing out. I learned that opening just one door or window can actually make a big difference in the air quality.

8 EV604

Menta, Arhan

Williamsburg Middle School

Teacher: Warden

The Effect of the Location Along the Potomac River on the Amount of Dissolved Oxygen

The purpose of this experiment was to determine what location along the Potomac River on the amount of dissolved oxygen. The results of this experiment will benefit aquatic life because in what locations these organisms are suffering and what factors reduce dissolved oxygen will be known. The hypothesis was Fletcher's Boat House had the highest concentration of dissolved oxygen. For this experiment, Fletcher's Boat House, Mount Vernon, Marshall Hall, and Woodrow Wilson Bridge were the locations where the amount of dissolved oxygen was tested. First, one liter of water was scooped and measured. After that was ensured, the pH of the water was measured (using a pH meter), and that had to be between 7.2 and 7.6. Once the pH was measured, the amount of dissolved oxygen was measured (using a dissolved oxygen meter). Finally, the data was recorded. The hypothesis was supported because Fletcher's Boat House had the highest concentration of dissolved oxygen, with a mean value of 7.18 mg/L. Woodrow Wilson Bridge performed the worst with a mean value of 2.16 on mg/L. The data was reliable because the location along the Potomac River that had the highest variation (mean) only had a range of 0.2. This data suggests that the aquatic organisms living near Fletcher's Boat House will have a higher quality of life than aquatic organisms in other locations, and the organisms in the other locations will struggle more to take in the necessary amount of dissolved oxygen.

8 EV605

Taddesse, Kaleb

Dorothy Hamm Middle School

Teacher: Azzara

Diggin' Deep: Does the Diet of an Earthworm Affect the Enrichment of Soil?

My hypothesis was “If the food given to an Earthworm is changed then the enrichment of its soil will also change, because Earthworms mostly consume food such as cut up fruits and vegetables and most decomposing organic foods, so if their diet is changed from their standard fruit, vegetable and soil diet, to another new wheat diet then, it will most likely have an effect on the soil they enrich, and the growth of the plants around it”. The goal of my experiment was to find out if giving separate and different diets to Earthworms had any effect on the enrichment of soil. I started the experiment by testing the initial pH, Nitrogen, Phosphorus, Potassium. A week later I tested the soil of all 4 pots, I got slightly differing results for each pot. On 12/5 I did my last test and concluded the 3 week long experiment. Throughout this period of time I feed the Earthworms on a weekly basis. I measured how the food I gave them would effect how they enriched soil. The data that I received did not support my hypothesis, other than the pH and phosphorus tests, the results received were practically all the same. The Conclusion I formed is that my data is inconclusive since my results were practically the same. The wheat diet had nearly the same effect as the Lettuce and Orange diets.

8 EV606

Weber, Ella; Aida, Mila; Barry-Lenger, Laura

George Washington Middle School

Teacher: Melis

The Three Little Eco Pigs

In this project, we evaluated different materials--cork, bamboo, and hempcrete--against various environmental conditions. Tests like these are important as we move into a future of using more eco-friendly building materials. Our hypothesis is if you expose cork, bamboo, and hempcrete to different environments, then cork will hold up best because of its resistance to environmental stressors. Each material was placed in one of four groups: group A, submerged in water for 24 hours; B, in the freezer for 24 hours; C, placed outside for 24 hours in high winds and rain; D, our control variable which sat on the counter inside the house for 24 hours. Before we placed them in their environments we weighed them in grams so we could contrast them later. When we collected our results we observed the following: In group A, cork's mass increased by eight grams, hempcrete by 210g, and bamboo's by 19g. In group B, cork's mass increased by one gram, hempcrete decreased by two grams, and bamboo's decreased by one gram. In group C, cork's mass increased by one gram, hempcrete's by 98g, and bamboo's by one gram. In group D, cork's mass stayed the same, hempcrete decreased by 15g, and bamboo's stayed the same. We think that the surprising change in group D by hempcrete was because the limestone was solidifying. The bamboo changed color when submerged in water and hempcrete changed color when placed in water and when placed outside. We found no effects in cork, proving our hypothesis.

9 EV607

Eberly, Lincoln

Washington-Liberty High School

Teacher: Brodowski

The Effect of Urban Trees on Temperature

Climate change is the most dangerous and most plausible existential crisis in all known history. Trees are a great way to absorb the greenhouse gasses of the environment. Trees can absorb much of Earth's greenhouse gasses, and in New York City, with a tree canopy of 21% extracted an astounding 1,821 metric tonnes of carbon dioxide from the atmosphere. Trees can also shade the area of which they are in, cooling not only the global environment but also the ambient environment. If temperature is measured in shade and sun in an urban area, then the shaded area will be cooler, because temperature can be reduced up to 20° Centigrade in the shade.

The researcher conducted the experiment by measuring the temperature of a shaded area and a sunlit area in an urban environment. The results supported the researcher's hypothesis. In all the areas measured, the shaded area was cooler than the sunlit area, and the average difference between the two was 4.2° C. The experiment was conducted midwinter, and yet the shaded area still yielded the suspected result. This is significant for the trees couldn't photosynthesize as efficiently and so it was proven to be lack of sunlight. This experiment outlines the different effects that trees could have on the ambient environment as well as the global environment.

9 EV608

Jemaneh, Zechariah

Alexandria City High School

Teacher: Matthews

How Does Temperature Affect Bread Mold Growth?

With mold having such a dramatic effect on how and when bread can be eaten, “Most common source of microbial spoilage is due to mold growth”, (Ravimannan et al. 2016) and with the possibility of having longer shelf life of bread with small changes in where bread is located, and more specifically the temperature of the environments it is in, the idea for the experiment came about. To be clear, the hypothesis investigated was “If bread is kept in the freezer, then it will show the least mold growth.” In order to test this hypothesis, I put white bread slices into plastic bags, and stored them in different temperature environments for 14 to see how temperature affects it.. My IV was the temperature of the environment, my DV was mold (amount), and my control group was the room temperature setting. [3 Levels: Room Temperature, Refrigerator (40F) and Freezer (0F)] After conducting the experiment 3 times, the data collected supported my hypothesis with the freezer environment yielding no mold in all three trials, the refrigerator environment yielded mold in one trial, and the room temperature group yielded mold in all three trials. While my hypothesis was accepted, I do believe in light of my experiment bringing a longer life of edible bread, that the freezer isn’t the best place to actually keep bread; The fridge maintains much lower mold levels than room temperature, and retains moisture and texture while when in the freezer those attributes are lost and bread freezes.

9 EV609

Pickard, Elle

Washington-Liberty High School

Teacher: Brodowski

The Effect of Different Purification Methods on the Amount of Bacteria in Water

Bacteria are everywhere. They exist on surfaces, in the air, and even in water. Dangerous pathogens like Escherichia coli in drinking water cause many diseases and illnesses such as diarrhea, cholera, dysentery, typhoid, and polio. Globally, 2 billion people drink from contaminated water sources everyday. They are at a constant risk of getting sick. 500,000 deaths are caused by waterborne diseases annually. To combat this issue, this experiment was conducted. The goal was to test 4 different cheap and accessible disinfection methods and determine the most effective procedure. In this experiment, chlorination via bleach, boiling, solar disinfection, and filtration through a coffee filter were tested. Six test strips were dipped into each container of water, and then incubated for 48 hours. The strips showed that the coffee filter and sunlight groups were higher than the control, with both at 167,335,000 bacteria per mL vs. the control with 340,000 bacteria per mL. On the other hand, the boiled and bleach groups were substantially lower. With boiled and bleached groups at 83 and 50 bacteria per mL, and with p-values of 0.0002 and 0.0001, respectively, their data was very significant. Boiling was the most consistent method, and bleach was the most effective. Using this data, it can be concluded that boiling or adding drops of bleach into water are both easy and cheap methods to sterilize it. With these two simple ways, people can easily reduce their chances of getting detrimentally sick, and safely stay hydrated.

9 EV610

Smoyer, Mika

Arlington Tech and Career Center

Teacher: Wardere

The Effect of the Type of Starch on the Tensile Strength of Bioplastic

Bioplastic is plastic that is biodegradable, the reason bioplastic is not widely used is because it lacks certain properties that petroleum-based plastics have, such as strength. This experiment's purpose was to test the effect of the type of starch on the tensile strength of bioplastic. There were four starches tested in the experiment: tapioca starch, potato starch, arrowroot starch, and cornstarch. The strength of the bioplastic was tested using a tensile strength test. Some constants for this experiment were as follows: temperature of the facility, dimensions of the bioplastic, cooling time, time on the stove, and stove temperature setting. The hypothesis is as follows: If tapioca starch, potato starch, arrowroot starch, and cornstarch are used to make starch-based bioplastics, then the cornstarch based bioplastic will have the highest tensile strength, because the level of amylose in a starch affects the strength of the bioplastic. Tapioca starch has an amylose level of about 17 percent, potato starch has an amylose level of about 20 percent, arrowroot starch has an amylose level of about 21 percent, and cornstarch has an amylose level of about 28 percent. Cornstarch has the highest amylose percentage at around 28 percent. (http://www.starch.dk/isi/applic/tapiocafood.htm) and (M. K. Marichelvam, et al., 2019). This experiment resulted in potato starch having the greatest tensile strength. This was most likely because amylose content varies. Based on the results of this experiment, potato starch would be the preferred starch when creating bioplastic that requires strength.

10 EV611

Kotakis, Anastasia

Washington-Liberty High School

Teacher: Fretts

The Effect of Different Kinds of Roadside Salts on Fescue Grass Plant Growth

The hypothesis for the experiment was that the control group, plants tested with only water, would have the highest mean height while of the plants treated with salt, the group treated with sodium chloride would have the highest mean height. The groups that were tested were sodium chloride (NaCl), magnesium chloride (MgCl2), calcium magnesium acetate, and the control of only plain water. The roadside salts were mixed with water to create a solution that the plants were watered with 5 mL of, every other day. 20 plants per group were tested and measured every day for a total of 80 plants. Results were then compiled in a data table and mean heights for each group, every day was calculated and graphed on a summary multi-line graph. Standard deviations were calculated as well as an ANOVA test and t-tests. Data was statistically significant with a p-value of 0.00096549, to show that there was a significant difference between the groups. Data from the experiment supports the hypothesis that plants treated with only water would have the highest mean height. On day 14, the control group had a mean height of 10.2 centimeters. The plants with the second highest mean height were sodium chloride with a mean height of 9.3 centimeters, followed by magnesium chloride with a mean height of 8.7 centimeters, and then calcium magnesium acetate with a mean height of 8.3 centimeters.

10 EV612

Sanchez-Armass, Ana

Washington-Liberty High School

Teacher: Fretts

Differences in Water Quality in the Washington, DC Area

The purpose of this experiment was to determine the water quality of different bodies of water in the area and know which one is the safest/cleanest. The hypothesis of the pH group was the body of water with the largest watershed (Potomac River) would have the highest pH levels because it has the largest watershed compared to the other bodies of water. The hypothesis for the nitrate group was if all the independent variables were tested, the body of water with the smallest watershed (Hidden Pond) would have the highest nitrate levels because it is set in a location where it is exposed to the most soil/fertilizer that contains nitrates. Although this hypothesis was not supported, the results were statistically significant in the body of water with a medium watershed (Donaldson Run Creek) having the highest nitrate levels. The hypothesis for the fluoride group was if all the independent variables were tested, the body of water with a medium watershed (Donaldson Run Creek) would have the highest fluoride levels because fluoride comes from the minerals in rocks, which surround the creek. Although this hypothesis was not supported, and the results were not significant, the fluoride levels of all the bodies of water, despite watershed size, were around 0 ppm if detected at all. This shows that it was not a very important factor to test. pH, nitrate, and fluoride were the dependent variables for this experiment, as they are some of the most important indicators of water quality.

10 EV613

Shapiro, Harriet

Washington-Liberty High School

Teacher: Fretts

The Effect of Urban Heat Island Mitigation Strategy on Surface and Atmospheric Temperature

Urban heat islands (UHIs) are urban areas with consistently higher temperatures than surrounding rural areas and are harmful because they exaggerate the effects of global warming and contribute to worsening heat waves. The purpose of this study was to determine what UHI mitigation strategy best reduces this phenomenon. The strategies tested were green roofs, cool roofs, cool pavements, and trees, while no mitigation effort was the control. It was hypothesized that the cool roofs would be most effective due to their high solar reflectance and greater surface area. The experiment was conducted by constructing model cities and finding the average increase in temperature after one hour under a heat lamp for each of the mitigation strategies. The results showed that the cool roofs and green roofs were most effective at preventing overall heat gain, with mean increases in temperature of 2.2° C and 2.1° C respectively. Conversely, the control allowed for the greatest temperature increase at 3.0° C. The data collected suggests that all four mitigation strategies tested are successful in reducing UHIs and provides further insight into the best strategies to use for various purposes.

10 EV614

Stroud, Lanyi

Yorktown High School

Teacher: Lovrencic

The Impact of Xylem Filter Thickness on the Effectiveness of Water Filtration

Access to clean water is limited in many developing areas. Therefore, filtration technologies that are accessible and can be locally produced should be investigated. A recently-developed filter is the xylem water filter, which is relatively inexpensive and utilizes the xylem tissue within gymnosperm trees to filter out contaminants in water. Optimization of the filter to ensure efficient use of resources could help increase accessibility and performance. Literature has suggested that xylem filters may be as thin as 0.6 cm without compromising the filtration ability.

In my project, I study the impact of xylem filter thickness on the effectiveness of water filtration, as measured by turbidity. Three different filter thicknesses of 0.5 cm, 1 cm, and 1.5 cm were tested. I fond that there was a direct relationship between filter thickness and turbidity: as filter thickness increased, turbidity increased. On average, the turbidity of the water filtered in the 0.5 cm group was 0.355 NTU while the turbidity in the 1.5 cm group was 8.289 NTU. I also observed that increased filter thickness caused the filtered water to be tinted yellow. I believe this may be caused by natural particles within the wood itself that ended up contaminating the filtered water. The thicker the filter, the more contaminants from the wood that were introduced into the water.

Because the thinnest filter level of 0.5 cm was effective at both lowering turbidity and producing clear, non-tinted water, I conclude that using a thin xylem filter would be most effective at water filtration.

10 EV615

Sullivan, Anne

Alexandria City High School

Teacher: Briestansky

Do Pollution Levels Resonate to the Revenue of Big Corporations?

This project studies how the profits of big corporations correlate with increasing pollution in our earth's atmosphere, measured by the amount of greenhouse gas emissions they produce. It focuses on the top 24 global oil and gas companies for the years 2018-2020 because they are among the top corporate polluters. The purpose of this study is to learn more about how to promote sustainability, particularly for industries that contribute so much to our global greenhouse gas emissions.

The hypothesis of the project is that there is a positive correlation between profitability and greenhouse gas emissions. The results of the study show that this is true, although it would be helpful to continue to study over time, particularly as companies implement commitments to reduce greenhouse gas emissions as part of global commitments to reduce global warming through the Paris Agreement.

10 EV616

Walker, Natalie

Washington-Liberty High School

Teacher: Barrett

The Effect of Potomac River's Water Quality on Water Purification

The purpose of this experiment was to see if different simple water filtration types could reduce pH, nitrite, and nitrate sufficiently in the Potomac River's water to be useful for human consumption. Specifically, this experiment was trying to prove that Brita filter, mechanical filter, and/or distillation will improve water quality (pH, nitrite, and nitrate), to a drinkable safe standard. It is hypothesized that if simple water purification methods are applied successfully, then water quality will improve to drinkable safe standards because the methods removed the dangerous impurities. The null was hypothesized that if water purification methods have no effect, then the water quality will not improve as the water is being purified. This effect was believed to occur through different filtration types, focusing on different pH, nitrite, and nitrate levels. Water was collected at one source for all testing levels.

10 EV617

Holguin, Veronica; Baron, Bridget

Alexandria City High School

Teacher: Lay

CO2 in Class

If air quality is tested in differently sized classrooms just before the start of an active school day, and then immediately after the school day, then the CO2 concentration in smaller classrooms will be higher.

10 EV618

Wallander, Sadie; Topchy, Alena

Washington-Liberty High School

Teacher: Barrett

The Effect of Infrastructure on Dissolved Oxygen in Nearby Streams

The purpose of this experiment was to determine if infrastructure had an effect on stream health. The independent variable levels were 20 meters, 10 meters, 5 meters, and 1 meter away from a road. The hypothesis stated that if water samples from different sections of Four Mile Run were tested for dissolved oxygen, then the water samples taken 20 meters away from the road would have the highest amount of dissolved oxygen because they would have the least pollution from nearby surfaces of civilization. The hypothesis was supported by the data. At 20 meters, the amount of dissolved oxygen averaged 9.5 mg/L, which was the greatest amount of dissolved oxygen compared to the other independent variable levels.

The null hypothesis stated that the distance from the road would have no effect on the amount of dissolved oxygen in the water. This was rejected because the p-value was less than 0.05, which meant that the data was statistically significant. The data showed that the distance from the road had somewhat of an effect on the amount of dissolved oxygen in the stream. This experiment was important because road runoff is a big contributor to water pollution.

11 EV619

Dorsey, Jonathan

Yorktown High School

Teacher: Mower

An Investigation on Changing Ocean Currents as They Relate to the Diffusion Times of Varying Salinity Solutions and Water Temperatures

Ocean currents are heavily dependent on the density of water, carrying warm water up from the equator to the poles and bringing back cold water to the equator, in that process redistributing temperatures around the globe. This process is being destroyed as water is getting less dense, and its weakening is impacting weather patterns around the world by increasing the severity of each storm. The rationale of this experiment was to test to see how long it takes for two different liquids, temperature constant solution with varying levels of salinity and one saline constant solution with varying temperatures to determine how severe of an impact warming global temperatures have on ocean currents and provide an explanation for changing ocean currents. To small-scale these massive systems, the two liquids were mixed together in 275ml containers, and the time it took for total diffusion was the data that was collected. The saline liquid had salt concentration (NaCl) from 20,000 ppm to 50,000 ppm, increasing by 10,000 ppm per level. The second temperature designated liquid had 3 separate temperatures: 20ºC, 25ºC, and 30ºC. This led to 12 levels of IV in total. The results displayed the average diffusion times of each level of IV, and trends from the data showed that as temperature increased and salinity decreased, the diffusion time was near immediate, suggesting a lower density, while as temperature decreased and salinity increased, the diffusion time reached upwards of 3 minutes, suggesting a much higher density.

11 EV620

Felker, Kara

Washington-Liberty High School

Teacher: Hedderly

What is the Correlation Between the Temperature Anomaly in Virginia and the Occurrence of Brown-headed Nuthatches (*Sitta pusilla*) in Virginia?

The purpose of this study was to see if S. pusilla are reacting to higher temperatures caused by climate change by shifting their range north. The independent variable was the occurrence of S. pusilla in Virginia (number per count). There was no control group. The constants were the databases used for the independent and dependent variables, and the month for which the data was collected. The dependent variable was the temperature anomaly in Virginia (oC). The hypothesis was: If S. pusilla occurrence in Virginia over time is compared to Virginia temperature anomalies over time, then as the temperature anomalies increase, the S. pusilla occurence will increase, demonstrating a northward range shift. The null hypothesis was: S. pusilla occurrence will remain constant in Virginia, even as temperature anomalies increase. The study was important because it provided insight into how organisms are reacting to climate change, which could help protect other organisms in the future. The study was completed by compiling the S. pusilla occurrence data and the temperature anomaly data into an excel sheet. The independent variable was calculated using the equation: number per count = number of S. pusilla reported ÷ number of counts reporting S. pusilla. A line graph and scatter plot were made to represent the relationship between S. pusilla occurrence and temperature anomaly; a Spearman's Rank Correlation Test was run. The data showed little correlation between the variables. Further study is needed to accept or reject the hypothesis.

12 EV621

Shiells, Katherine

Bishop O'Connell High School

Teacher: O'Connor

A Study of the Chemical Properties of Leachate from Artificial Turf Infills

Concerns have been raised regarding the potential human health risks associated with artificial turf infills and the effect of runoff on the environment. The objective of this study was to analyze the chemicals that were leached from new crumb rubber, old crumb rubber, and the newly marketed Thermoplastic Elastomeric (TPE) eco-friendly infill at typical ambient and surface temperatures. It was hypothesized that new crumb rubber would leach the highest amount of heavy metals and that the new TPE infill would leach the least. Leachate samples were prepared at typical average surface and ambient temperatures from my previous study on three artificial turf fields. Leachate samples were tested for pH, electrical conductivity, and heavy metals in inductively coupled plasma (ICP) mass spectrometers. The chemicals of interest were cadmium, lead, chromium, nickel, copper, zinc, and iron. The test results showed that the TPE infill was more alkaline than the EPA's acceptable pH levels for both the public water supply and freshwater for aquatic life. The TPE infill's electrical conductivity is more than double the values for crumb rubber, indicating that TPE may leach more chemicals. However, the TPE infill leached extremely low amounts of zinc, while both crumb rubber samples leached well above the freshwater limit for aquatic life. The other elements of interest were at extremely low levels in all infills. It was concluded that although TPE infill leaches less heavy metals than traditional crumb rubber infills, the pH and electrical conductivity levels for TPE infill may be of concern.

7 MC700

Ainspan, Isaac; Vasisht, Janak

H-B Woodlawn Secondary Program

Teacher: Taggart

Speech to Image

Speech to text is a software that has been around for many years. But in this project, it was taken to another level by incorporating images. We wrote software that can take what somebody says, and directly display an image. We came up with this project for one main reason, to test the limits of computer programming; and we were blown away. The start of speech recognition was originally developed in 1962 by IBM, and was called the Shoe Box! And 60 years later, we made software that can take speech, and turn it into images! We used many steps to accomplish this goal. The first was to use a windows notepad(A part of every windows computer). In the notepad there is a function that can recognize speech and turn it into text. To do so, you must press the windows key + h. Next, you must speak into the microphone. From this, a few codes are automatically run to find images on Ecosia, and move the mouse around on screen to do so. Done! In the end, we ended up with a great way to pull images up online, by simply speaking into a microphone. Some things to improve on. The program can't actually open images. All it does is send you to the Ecosia page of what you spoke into the microphone. Sadly, it also requires a person to click a button. Even though there are some problems, the end result is still quite amazing.

8 MC701

Bastuscheck, Nathan

Dorothy Hamm Middle School

Teacher: Kennedy

The Effect of Distraction on Response Time

I chose this project because one day after a soccer game, my sister came home and said her foot hurt. She put it in an ice bath and started to watch television. She lasted very long in it before the numbness was too much. So, I wondered if the same thing would happen with Video games. I also wondered if I could help prove that video games are good for you. This project could even lead to further research to help people. Due to the experience with my sister, my hypothesis was: if the distraction time (video game) increases, the response time(numbness) will take longer because the body is more focused on the game than the response time. The procedure was to submerge my foot in ice water three times, for each type of distraction, one without one, and one playing a video game, Halo Infinite (Multiplayer). The data and graph showed that video games are an effective distraction to pain. Without a distraction, I only was able to keep my foot in for an average of 33 seconds. While playing Halo Infinite's multiplayer, I was able to stay in for an average of 101 and a third seconds. This experiment could help by providing a distraction to hospital patients, or just people in general, in pain. It could also give a better idea of how the brain and nervous system work. I was able to meet meet my objective, but this does not count towards story based games.

8 MC702

Dick, Kellan

Dorothy Hamm Middle School

Teacher: Kennedy

Decoding the EEG with Machine Learning

Here I study the correlation between a person's EEG and their score on a series of pattern recognition tests. I took a close look at prominent correlations and why they might be. During this stage, I found that Beta, Alpha, Delta, and Theta quantities behaved in ways that made sense given their properties. Gamma Waves also functioned along expected lines but variability was high enough that I discarded its prominence. In the second stage, I write code to predict these scores. The code did not turn out to be reliable against the average but did prove substantially better than guessing.

8 MC703

Jiminez, Patrick

Gunston Middle School

Teacher: Robles

The Effect of the Coronavirus Pandemic on the Financial Success of Major Companies and Corporations in the U.S.

The purpose of this experiment was to analyze the effect of the COVID-19 pandemic on the financial success of companies in the United States. The hypothesis was that since COVID-19 restrictions forced people to stay inside and avoid crowds, then goods or services that called for face to face interaction would not profit, and companies that could not find alternatives would suffer. To test this hypothesis, the researcher used the historical data in Yahoo! Finance to record the daily number of stock shares for three companies (Yum! Brands, Darden Restaurants, and The Walt Disney Company) as well as The Dow Jones Industrial Average from February 20, 2020 to January 8, 2021. The data in this experiment shows that on average, The Dow Jones Industrial Average had the highest percentage of shares over the course of the time period, with Disney close behind. Disney and Darden have the largest ranges, but whereas Darden's high range is due to it performing extremely poorly and having the lowest mean percentage, Disney's is due to a brief dip followed by a large increase that finished it out with the highest percentage of shares. After conducting this experiment, the researcher concluded that when faced with a pandemic environment it is best for a company to find more virtual and contact free services to offer, as this will appeal to people's desire for security, and make them more willing to purchase said product. This experiment could be improved by adding more companies, and therefore more variety.

8 MC704

Kambhampaty, Kedar

Williamsburg Middle School

Teacher: Thomas

The Effect of Photo Size on the Accuracy of a Facial Detection Program

This project explores the effect of photograph (photo) size on the accuracy of a facial detection program. In recent years, face detection and facial recognition technologies have become widely used, like in phones and cameras, but are far from being perfect. Facial detection and recognition software can be accurate, but certain factors can lead to inaccurate results, like photo size, objects in photos, and environmental factors, to name a few. In this project, it was hypothesized that as photo size decreased (in pixels), the accuracy of the facial detection program would also decrease because the program would not accurately detect faces in the smaller, less detailed photos. To conduct the experiment, a facial detection program was created and tested using Python. A collection of images focused on the head were used in testing, each with copies at decreasing sizes. In testing, the program was run on the collection of photos at respective sizes, and the results showed that the accuracy of the program did not always decrease with photo size, only agreeing with the hypothesis for the middle to lower range of photo size. The lack of a clear trend indicates that a more extensive library of images may be required for testing, so that the increase in data points would potentially allow for a clear trend to emerge from testing.

8 MC705

Panza, Bethany

H-B Woodlawn Secondary Program

Teacher: Boyle

Learning the Periodic Table of Elements with Guess Who

The Periodic Table of Elements is daunting with its 118 elements, all with different properties. The goal of the project was to code a game of Guess Who to make a fun and easy way to learn about the elements. Guess Who is a popular game for children where two players take turns asking questions in order to guess the other's identity. The code used the programming language Python, and 10 elements from the periodic table to make a game using the same rules as Guess Who. The first part of the code is when the computer tries to guess the user's selected element by asking questions with multiple choice answers. In the second part of the code, the user tries to guess the computer's element by choosing questions that the computer will then answer. In the end, both sections of code ended up working, and the code accomplished the goal, creating an alternative way to memorize facts that can be boring and repetitive. If there had been more time, the code would have made user interactions yes or no questions and added more elements to make the game feel more complete.

9 MC706

Etse, Caleb

Alexandria City High School

Teacher: Matthews

EduVoir

My science fair project is a platform for students to access educational content from teachers/professionals. Utilizing this application can academically assist students; the application can also indirectly prepare students for future careers. This project is a Progressive Web Application(PWA) that was built using the power of the web and code. I was successful in achieving all of the goals that I made for this project.

9 MC707

Gavri, Ethan

Alexandria City High School

Teacher: Matthews

Chi-Square Analysis Helps Determine the Next MLB Hall of Fame Player

This experiment was conducted for a number of reasons. One of them was to identify a clear difference between Hall of Famers and regular players. This was because this difference would provide grounds for current players who seemed like they were on the brink of making the Hall of Fame, but at the same time looked like they didn't have enough. That leads to the second objective which was to identify a unit of measurement that tells us if a player is a Hall of Fame-caliber player. I identified the points system as a measurement as it reflected how much one has accomplished over the course of their career. I approached this experiment by using averages at first. I then discovered the chi-square test, which is better at comparing entities. Some key results I had were when I found the percentages of outperformance. This led me into believing that it was harder to underperform than overpreform because of the mediocre stats some players put up.

9 MC708

Hosen, Anfal

Alexandria City High School

Teacher: Matthews

Crack the Cipher

The Caesar Cipher is a cipher made from Roman lead Julius Caesar which uses the substitution method to encode the alphabet (Brilliant). An example of this would be a shift of 1 would encode the letter “A” as “B”. This project aims to create a Caesar cipher and break it with Frequency Analysis and Brute Force. To meet the objectives of my Engineering Goals, I created 3 programs, The Caesar Cipher Program, The Frequency Analysis Program, and the Brute Force Program. The Caesar Cipher Program would encode the message, and the Frequency Analysis and Brute Force Programs would decode the encoded message. The results showed that the Brute Force Method worked on all Messages; however, the Frequency Analysis Method could not work on smaller messages but was able to break the medium and large messages. These results suggest that although the Frequency Analysis works on medium and large messages; however, when trying to decode the smaller messages, it couldn’t break it because, in smaller messages, the letter “e” may not be the most frequent letter. The Brute Force method was largely successful as it decoded every single message because it tested all the possible combinations. Therefore, the Brute Force method is more effective than the Frequency Analysis method because it decoded messages by testing all combinations while Frequency Analysis decoded messages by assuming that the letter “e” is the most common letter and in cases like short messages, the letter “e” may not be the most frequent letter.

9 MC709

Matthews, Andy

Alexandria City High School

Teacher: Gamby

Baseball Trajectory

Launch angle is a popular term in baseball. Launch is the angle at which the ball is hit after making contact with the bat(Coach Lisle, The hitting Vault). The goal of my experiment is to find out where I need to hit the ball to get the highest average launch angle. My hypothesis was if the impact is in the bottom part of the ball, then the hit will have a higher launch angle. The average launch angle for bottom impact was 0.58 degrees. The average launch angle for middle impact was 1.419 degrees. The average launch angle for top impact was 12.595 degrees. This data indicates that my hypothesis was incorrect, the impact with the highest average launch angle was the top impact.

9 MC710

Thomason, Katherine

Alexandria City High School

Teacher: Paul

How Does The Angle of Air Flow Affect the Projected Origin of Impact of (Fake) Blood Splatter?

This experiment is to test how accurate the formula that is used to find the point of impact is when wind is added into a situation, and whether or not the formula will place the point of origin accurately. During this experiment, a sponge with fake blood on it will be hit to create a splatter on paper-covered walls, while a fan is blowing. This process will be repeated several times with four different groups. The fan will be at three different angles each time, including one control group of no fan. I will then use the formula to measure where the blood droplets place the area of impact. From this experiment, I expected that if the fan is pointed at 45 degrees then that angle of air flow will cause the smallest change in the travel path of the fake blood splatter, which will have the least effect in determining the point of origin, using the formula stated in the procedure. Unfortunately, the data that was collected proved the hypothesis wrong. It instead showed that when the fan is at an angle of 67 degrees, the average distance from the actual point of impact was 4.25 cm, which was the smallest of the trials with the fan.

10 MC711

Angel, Teddy

Wakefield High School

Teacher: El-Gamal

Password Security: How Secure Is Your Password?

The Purpose of this project was to observe general trends in what makes a password secure and potentially debunk any password security myths. The password that is inserted is the independent variable. The dependent variable is the time it takes for the computer to guess the passwords. The Hypothesis was that the computer will take 2-3 minutes on average to guess my passwords, while the overall mission statement was to observe trends in password security.

The project was done by constructing a Python program that would guess each password in a certain amount of time. Each password would then be plugged into the code (template provided by ScienceBuddies.org) in order to generate the amount of time needed to “crack” the password. Once all of the times to “crack” each passcode were collected, scatter plots and other graphs would be used to analyze the data.

It was found that the average time to guess a passcode out of my list of passcodes was 1 minute and 39 seconds. Also, I found that out of special characters, numbers, capital letters, and lowercase letters, numbers and lowercase letters were only beneficial in bulk and just having a few made minimal difference towards overall password security. The experiment could be improved upon by adding more trials, evening out the number of different kinds of passwords and by making identical programs in different computer programming languages to see if there is a difference between the computing languages.

10 MC712

Bolte, Aidan

Alexandria City High School

Teacher: Daigle

Storage Speeds of Hard Drives

In the experiment, three hard drives were tested 10 times each using CrystalDiskMark. It was found that the hard drives got approximately 20 mb/s faster every two years.

10 MC713

Hazari, Vrishin

Washington-Liberty High School

Teacher: Bohn

The Effect of Image Quality on the Accuracy of an AI Software

The purpose of this experiment was to examine the accuracy of an Artificial Intelligence (AI) software with four different clarity levels. The hypothesis of the experiment stated that if an AI software is fed facial images with different levels of clarity, then the images with higher clarity will be more accurately detected by the software because the software would be able to recognize the distinct biometric facial features of the images easier. An ANOVA test was run on the four groups and the result was a p-value of 3.81x10———-6. To follow up on this, six T-Tests were conducted between the groups. Four of the six T-Tests had a p-value less than 0.05, making the results statistically significant. The hypothesis was supported since the p-value was less than 0.05.

As the software was fed the experimental data groups with a lower clarity, it got more difficult for the software to accurately detect the image. It would either return as an error or return the incorrect identification. It is possible that the software was not able to detect certain images due to variations in the lighting and background color. A way this experiment could be improved is by expanding the set of training data with variety in images to enhance the software.

10 MC714

Ovando, Taylor

Wakefield High School

Teacher: El-Gamal

The Effect Materials Have on the Wi-Fi Signal Strength

The purpose and objective of this experiment was to determine the effect a material has on the Wi-Fi signal strength. This would then lead to informing the people around the world of a materials impact when in between the router and device. The independent variable was the type of material used in between the router and device involving no material (control), paper, wood, plastic, aluminum, cardboard, cotton, and metal. The dependent variable was measuring the dBm value when the control or material was involved. The hypothesis formed was that if paper is placed between the router and the wireless device, then paper would have the least amount of interference because paper is thin and a non conductive material. The procedure in short was to place a material in between the router and device to then record the dBm value through a table and graph to then finally repeat for a total of 5 trials for each material.

After 40 total trials and recording the data through graphs and tables, the results were displayed. Attenuation, difference between the control and materials average dBm, was the main factor that determined a materials impact based off of the control. Paper had the least impact on the Wi-Fi signal strength while metal had the most impact. This in turn supports the hypothesis and the research question. One room for improvement would’ve been using more than one application that measures dBm to ensure consistency and accuracy.

7 ME800

McKillop, Maria

H-B Woodlawn Secondary Program

Teacher: Taggart

What Are Germs Most Afraid Of?

The purpose of this project was to study the effect of cleaning agents on bacteria growth. Bacteria support many forms of life, both plant and animal, and they are used in industrial and medicinal processes. Many bacteria grow on human hands and can cause a variety of illnesses, including gastrointestinal and respiratory diseases. Cleaning agents are typically used to remove bacteria from human hands. My research question was to figure out which cleaning agents work best to kill bacteria. I tested two of the most commonly used cleaning agents, soap witch is found in most restrooms and hand sanitizer, sales of which skyrocketed due to the COVID–19 pandemic. My hypothesis was that washing hands with soap is more effective at killing bacteria than hand sanitizer because hand washing with soap is a two-step procedure that includes application of soap and washing hands with water, while using hand sanitizer is a one-step procedure. To test my hypothesis, I used Luria Bertani agar plates to grow bacteria from my fingers after using either soap or hand sanitizer. My conclusion was quite surprising. The hand sanitizer was very affective at killing bacteria, while washing hands with the soap increased bacteria growth in comparison with the control experiments. These results suggest that contrary to what I expected, hand sanitizer is a more effective cleaning agent than commonly used soap. Of note, the soaps are different and my findings might be specific to the soap that was used in my experiments.

7 ME801

Smith, Anise; Tavares-Bryant, Malia

H-B Woodlawn Secondary Program

Teacher: Taggart

The Effect of Moisturizer on Skin

What is one of the most important things to do when taking care of your skin? Moisturizing. In this project we investigated the effects of different types of moisturizers on gelatin, which we used as a substitute for skin. We applied three different moisturizers. The first was a water-based moisturizer; the second was an oil-based moisturizer; and the third was water-based with the added ingredient of triethanolamine, which stabilizes and increases the pH of products to improve the way they feel and interact with the skin. Our hypothesis was that the first (water-based) moisturizer would work best because the water would hydrate the skin and keep it moisturized. We tested our hypothesis by placing one tablespoon of each moisturizer on Petri dishes of gelatin. We had three gelatin Petri dishes per moisturizer, and one control petri dish for each moisturizer, or 12 petri dishes in total. The results showed that the oil-based moisturizer worked the best. This is because the oil trapped the water in the gelatin by keeping it from evaporating. The other two moisturizers turned out to be very similar because they both contained water, but they did not retain the moisture as efficiently as the oil-based moisturizer.

8 ME802

Kunic, Taylor

H-B Woodlawn Secondary Program

Teacher: Boyle

Where on Your Phone Is the Most Bacteria?

The purpose of this project was to discover where the most bacteria is on a cellphone. Bacteria was collected with sterile cotton swabs and placed in Petri dishes. Five locations on a cellphone were tested. A clean cell phone wiped with clorox wipes was used as the control group and a cellphone that was not touched by any cleaning product was used as the experimental group.The Petri dishes were placed to cultivate in a homemade incubator and incubated for a period of five days. Every day the area of bacteria growth in each sample was measured on a piece of 1cm^2 graph paper. The amount of bacteria growth was recorded in a data table and then put in a bar graph. After the experiment was terminated the bacteria plates were disposed of and the incubator was dismantled. The significance of the experiment was that the back case of your phone has the most bacteria overall.

8 ME803

Lach-Hab, Nadia

Dorothy Hamm Middle School

Teacher: Marszalek

Microplastic, Macro Problem: The Effect of the Amount of Microplastics on the Survival Rate of *Daphnia magna*

Microplastics are everywhere, from the water we drink to the bottom of our oceans. The purpose of this experiment was to stimulate how microplastics can affect the survival rate of aquatic organisms. While researching, I found that microplastics can have detrimental effects to other organisms, so I wanted to see how the amount of microplastic would affect the survival rate of a model invertebrate, Daphnia magna. It was hypothesized that the group of Daphnia with the most microplastic would have the lowest survival rate because microplastic can intoxicate and even kill other aquatic organisms who are exposed to microplastic. To test the hypothesis, I set up three different ecosystems: one with no microplastic, another with 0.5 ml of microplastics, and a third with 2 ml of microplastics. I had three trials and put the same amount of Daphnia magna in each ecosystem. The survival rates of the Daphnia were monitored until all of the Daphnia magna died out. The researcher's hypothesis was supported: the group with the highest amount of Daphnia magna had the lowest survival rate. The Daphnia magna with 2 ml of microplastics all died on the first day, while the sample with 0.5 ml of microplastics all died on the second day experimenting. The trails with no microplastics had a steadily declining survival rate, all dying on the fifth day. This indicates that microplastic has a large impact on a model organism, meaning it can have a drastic effect on other organisms, including ourselves.

8 ME804

Lkhagvasuren, Jessica; Burton, Mallory

H-B Woodlawn Secondary Program

Teacher: Boyle

Do People Who Are Closely Biologically Related Have the Same Fingerprint Pattern?

The purpose of this experiment was to study the effect of close biological relations on human fingerprint patterns. Studies performed by other people on fingerprint patterns had different results. A scholar in 1989 claimed that a child has the exact same pattern as its mother and grandmother. A more recent study claimed that "Multiple genes are involved, so the inheritance pattern is not straightforward." (Are Fingerprints Determined by Genetics?", 2020). Thirty humans who were related to other participants had their fingers pressed into an ink pad, and next pressed on a piece of white paper. The fingerprints were analyzed and the researchers discovered which of three patterns (loop, whorl, and arc) they were. After every participants' pattern was taken, the patterns were compared with other people they were related to. Twins and triplets were the most likely to have the same pattern as each other. Parents and children came next, with a 65.2% chance. Siblings were the least likely, with a 50% chance of having the same fingerprint pattern. In general, there is a 68% chance of biologically related people having the same fingerprint pattern. From this human studies experiment, it was concluded that genetics had a significant effect of the type of fingerprint pattern a person would have. Fingerprints could have been additionally classified into 8 different patterns, which would have made our studies more specific and accurate.

9 ME805

Carr, Mariel

Alexandria City High School

Teacher: Johnson

After-School Activity versus Blood Oxygen Level

The question I was researching for this project was, what after school activity has the most positive effect on someone's blood oxygen level? I used three groups of 15 students grades 8-12 to collect data. The first group was people who play soccer on a regular basis. For this group I used people on my soccer team. The second group was people who sing on a regular basis (choir students) and the third group was people who do neither soccer nor singing on a regular basis. I took blood oxygen measurements using a pulse oximeter. The data I collected from all three groups was very similar. Depending on the way I average the data, different after school activities seem to have a higher blood oxygen level. When the 15 data points from each group are averaged by finding the mean with one data point removed as an outlier, the order of activities from highest to lowest SpO2 is soccer, singing, and then control group.However, if you average the data by taking the median of each group, the singing and soccer groups both have a 98 average SpO2 and the control (neither) has the highest at 99 SpO2. Because the data points show no definite order of the activities from highest to lowest SpO2, I can conclude that there is no discernible relationship between afterschool activities and Blood Oxygen levels.

9 ME806

Gossel, Kendall

Alexandria City High School

Teacher: Triplett

Does Hand Sanitizer Really Kill 99.9% of Germs?

We use hand sanitizer on a daily basis. Since the beginning of the pandemic, we have been using hand sanitizer more often. But, I wondered if it really helps kill germs and I was interested in seeing which hand sanitizer kills the most bacteria. Finding this answer could help keep us safe from all kinds of germs including those that cause COVID-19.

Hand sanitizer contains ethanol, isopropanol, or propionaldehyde which are active alcohol based chemicals. The alcohol in hand sanitizer disrupts the lipid and protein molecules in bacteria or virus cells, killing them so they can't harm you. The CDC recommends hand sanitizers with over 60% alcohol to kill germs. For my project, I tested hand sanitizers with different alcohol percentages to see which level is the most effective in killing bacteria. My hypothesis was that the higher the alcohol percentage, the more effective the hand sanitizer is at killing bacteria.

I believe this project is important because it can help people choose which hand sanitizer will kill the most germs and keep you healthy, which is especially important now during the global pandemic. In conclusion, my science fair project met the goal of testing the effectiveness of hand sanitizer on killing bacteria.

9 ME807

Shah, Jaya

Washington-Liberty High School

Teacher: Leonard

The Effect of Glucose Sensor on the Functioning of an Artificial Pancreas Model

The purpose of this experiment was to see how conductivity affected the functioning ability of the Artificial Pancreas (AP) System. Diabetes is a chronic health condition which impacts how the body converts blood sugar into energy. When blood sugar increases, it signals the pancreas to release insulin. For those with type 1 diabetes, their pancreas cannot produce insulin.This is why an AP may be necessary for those with type 1 diabetes. This experiment specifically looked at how the glucose sensor impacted the functioning capabilities of the AP.

The experiment examined two levels: copper wires distanced 6cm apart, and copper wires distanced 5cm apart. The expected outcome was that if both levels were tested using the AP model, they would work effectively, meaning that there would be 50 ± 5mL of vinegar leftover and a neutralized solution between 6.5-7.0. This was because the expected function of the AP was to give enough insulin to combat blood sugar. The experiment was conducted by building an AP model made up of a circuit, conductivity sensor, and pump infusion device. After the device ran, the amount of vinegar left was recorded, and the pH of the newly neutralized solution was measured.

After the trials were conducted, the results determined that the hypothesis was accepted. While there were slight differences in results, the artificial pancreas functioned in both levels. The acceptance of the hypothesis proved that modifications in the glucose sensor of the AP did not significantly impact the
results.

10 ME808

Cura, Marina

Wakefield High School

Teacher: Muñoz González

The Effect of tACS Neurostimulation on Alpha Brainwaves

We are enduring a worldwide crisis of mental illnesses affecting every human either directly or indirectly. Scientists are desperately looking for solutions to this growing problem, it's possible that neurostimulation will solve it.

The tACS neurostimulation (Transcranial Alternating Current Stimulation) specifically is being investigated. The difference between tACS and other technologies is that it’s a non-invasive method that applies a weak external current stimulating one neuronal cell, which stimulates the next, etc. until transforming into a new brainwave. Scientists have proven that inducing Alpha brain waves using tACS is beneficial in long-term treatment of mental illnesses. The question explored was: Which frequency best artificially induces Alpha brain waves? If a researcher uses tACS technology at the ideal strength, then they will be able to induce an alpha brain state and test it using an EEG.

In this research analysis, experiments with varied participants who received stimulation from a bihemispheric tACS cap were studied.

Those results explained that a frequency of 10 Hz was ideal for inducing an Alpha wave. At that frequency, the participants had less control of complex bimanual actions, speed, and a high error rate. These were all signs of low cognition, which was desired to obtain a state of trance or intense tranquility. Research scientists and engineers must work in harmony to create a new effective neurostimulation treatment.

10 ME809

Yan, Chloe

Episcopal High School

Teacher: Olsen

Development of RNA Vaccines Targeting Alzheimer's Disease Using Single-Cell RNA Sequencing and Proteomic Analysis

Alzheimer's disease (AD) is a neurodegenerative disease affecting more than 33 million people globally, the seventh leading cause of death worldwide. Although several protein hallmarks associated with AD have been identified, such as extracellular amyloid plaque deposition formed by Aβ peptide, and intracellular neurofibrillary tangles resulted from the accumulation of hyperphosphorylated tau, we still lack clarity regarding the pathogenesis mechanism behind AD progression. Like COVID-19, there are very few confirmed disease-modifying treatments that reverse or stop the progression of AD, making prevention an efficient strategy. I investigated the potential of the two known protein hallmarks to be vaccine targets. While Aβ is not an effective target, I designed a tau-based RNA vaccine. Additionally, this study uncovered a promising novel target, S100A11. By 2050, AD is estimated to cost for than $1 trillion within the US, one-twentieth of the US's GDP. The proposal of this vaccine and a new target not only uncovers a potential strategy to prevent AD's development, but also provides insights into the early development of AD and the interactions between the immune system and the nervous system throughout AD's disease progression. This study also reveals new, potential pharmaceutical targets, inspiring the development of new AD treatments and prevention measures, which saves millions of lives from AD and significantly improves their quality of life.

11 ME810

Rylander, Lauren

Washington-Liberty High School

Teacher: Hedderly

The Effect of Educational Intervention on Knowledge of Tissue Donation in High School Students

Knowledge of tissue donation, along with altruism and other factors, has been shown in multiple studies to be a characteristic of the typical tissue donor (Nijkampa et al. 2008, Lwin et al. 2002). Therefore, public education may be a valuable and effective strategy for producing tissue donors (DeJong et al. 1995, Ganikos et al. 1994). Given that most donors are young people (Nijkampa et al. 2008, Tscheulin and Lindenmeier 2016), and thus a key demographic to increasing the number of tissue donors, this study targets high school students. Using a survey-based approach, 68 participants from Washington-Liberty High School took a brief quiz out of 23 points to determine their knowledge of tissue donation. They were assigned to the experimental condition, which provided a 5-minute, peer-led educational presentation video, or to the control condition, which showed a buffer video of the same length, and retook the same quiz. Between the first and second score, there was an average gain of 5.29 points in the experimental group and 0.05 points in the control group. A two-tailed T-test performed between the groups produced a highly statistically significant p-value of 7.99x10-8. Therefore, the study concludes that peer-led presentations could be an effective tool in educating high school students about tissue donation.

7 MI900

Piedrahita, Julie

Williamsburg Middle School

Teacher: Willet

The Effect of Place in School on Number of Bacteria Colonies

The purpose of this experiment was to identify the dirtiest surface in the school. With COVID variants coming this informs how to avoid getting sick, so with this and the places in a school to take extra precautions. The surfaces swabbed were the door handles, toilet seats, sink handles, iPad screens, and locker locks. It was hypothesized that if the door handles were swabbed, then they would grow the most bacteria, because kids tend to not wash their hands after various activities that would gather germs, and are then passing on said germs to the door handles. The experiment was conducted over three days in a research lab, everything was sanitized to make ensure no cross-contamination. The agar was autoclaved and was then poured into 45 separate Petri dishes which were left to cool overnight. Once cool each sample was streaked three times, and was then incubated for 24 hours at 37 degrees Celsius. The stated hypothesis was rejected because the locker locks actually grew the most bacteria with 7 colonies, and the toilet seats grew the least with 0 colonies. The greatest range was in the iPad screens which had a range in data of 13 colonies, and the least range was the toilet seats with a data range of 0.
Possible places where error could've occurred include cross contamination of the samples, inconsistent swabbing of the surfaces, and inconsistent inoculating of the plates. Ways to extend this experiment could include determining the type(s) of bacteria that were grown.

7 MI901

Shoffner, Sophia

Swanson Middle School

Teacher: Seavolt

The Effect of the Type of Juice on the Amount of Bacteria Destroyed

My project is about how types of juice affect bacteria on a classroom table. My hypothesis is that the juice that would prevent the most bacteria (from a table) was lemon juice because of its effectiveness in other experiments. The independent variable is the type of liquid (lemon, lime, and orange juice) and the controls are Lysol and no juice. The dependent variable is the decreased number of bacteria colonies. To test this, I grew bacteria for 5 days with each type of juice. The procedure was to put each liquid onto 50 Petri dishes (10 Petri dishes for each liquid). Since the lime juice evaporated it was put into the petri dish at a different time though that did not affect the amount of bacteria in the dish. The hypothesis was proven false and the best juice in preventing bacteria was lime juice. On day 5, the lime juice had an average of 9.4 bacteria whereas the lemon juice had an average of 24.3. However, both the lemon and Lysol had outliers. The lemon juice's average after taking away the outlier would be 15. Also, if the outlier in the Lysol was removed the average would be 10.3. After extra research, according to Clemson.edu, lime juice has a PH level of 2-2.35 whereas lemon juice has a PH level of 2-2.6. This means that lime juice is more acidic. This is most likely the reason less bacteria grew in the lime juice Petri dish.

7 MI902

Yoo, Andrew

H-B Woodlawn Secondary Program

Teacher: Taggart

The Effect of UV-C Light on Bacteria

We live in a world full of pathogens. We encounter thousands of harmful microorganisms each day. This experiment was intended to study the effect of UV-C light on bacteria. UV-C light is light with a wavelength of <280 nm. UV light with a wavelength of <300 nm has been proven to kill most bacteria. The bacteria Escherichia coli was chosen to represent bacteria because it is common and generally available. The hypothesis was that all exposure times would kill a significant portion of the plated bacteria. E. coli was exposed to UV-C light for different amounts of time in order to test the efficaciousness of UV-C light in killing bacteria. The bacteria were observed for 48 hours, with colony counts every 12 hours. The experiment concluded that UV-C light had an effect on E. coli, but only if the bacteria was exposed for long periods of time. The effect also wore off quickly. This experiment showed that UV light, while highly effective, may not be a perfect candidate as a disinfectant.

8 MI903

South, Caroline

Dorothy Hamm Middle School

Teacher: Marszalek

The Effect of Over-the-Counter Medicine Coating on the Release Time of the Medicine in a Low pH Environment

Tylenol has different coating types, making the medicine easier to swallow. I wanted to test the difference between coating dissolving times. The motivations for the project were that I have an interest in medicine, and wanted to know which pill relieves pain the fastest. The procedure was to pour water into a glass, test the water's pH, and change the pH with chemicals until the water was in the stomach's pH range. Then heat the water to the average temperature of a human stomach. Next, drop the Tylenol into the glass and start the timer. When the medicine coating was dissolved, stop the timer, and note the results. Do this four times for each coating. The data did not support the hypothesis. The hypothesis was if different kinds of over-the-counter medicines are put in a low pH environment, then the coated tablets will release quicker, because the coated tablet doesn't have a shell around it, so less covering will have to come off to get to the medicine. The results were that the Coated Tablet took the longest to dissolve—averaging nine minutes and twenty two seconds. The Gelcap was in the middle averaging four minutes. The Caplet dissolved the fastest averaging one minute and fourteen seconds. The important takeaway is that some pill coatings take longer to release medicine than others. If you are in pain or have a bad headache, then you should take the Caplet, because the medicine will enter your bloodstream first.

8 MI904

Zurita, Lilian

Gunston Middle School

Teacher: Robles

The Effect of Cleaning Products on Bacterial Growth

The purpose of this experiment was to determine The Effect of Cleaning Products on Bacterial Growth and it is used by different cleaning products which were Lysol Wipes,Lysol Spray,Windex,Vinegar,dawn dish soap and I had to use the control which was the Carolina Nutrient Agar to grow the bacteria in the petri dish. I had picked this project to see which type of cleaning product would actually kill the most amount of bacteria and to support human beings during Sicknesses and Diseases. It was hypothesized that if alkaline cleaning solutions eliminate germs,then,Lysol Wipes will be the most effective cleaner because they have the lowest pH. After multiples it was discovered that the hypothesis did NOT support my hypothesis since Dawn Dish Soap and then secondly Lysol Spray,Windex and Vinegar. Some things that I did to have the experiment conducted was soak the Paper circles in each ingredient in the plastic weigh dishes then put it in the Petri Dish. But I also had to pick up a single colony and use a loop to streak the Petri dish using a quadrant method.Some of the results were that the Dawn Dish Soap had killed the most germs since it killed 100% of all of the germs in each trial but the Lysol Wipes had not cleaned most of the germs as expected.Finally there were also some things that I needed to have correction and add for example the Procedure and name of Bacteria which was the (Carolina Nutrient Agar).

8 MI905

Nimerala, Maddie; Hans, Addison

Williamsburg Middle School

Teacher: Warden

The Effect of Disinfectants on Bacteria

The purpose of this experiment is to discover which disinfectants are the most effective in killing surface bacteria. The findings of this experiment can help influence which brand of disinfectant wipes people will purchase to effectively clean surfaces. This experiment will also demonstrate the amount of germs that grow on everyday surfaces. The hypothesis states that the Clorox wipes would be the most effective disinfectant at killing bacteria due to higher concentrations of strong germ killing ingredients in Clorox bleach. The test was conducted in a science classroom in Williamsburg Middle School. A sterile cotton swab was used to wipe bacteria off of an uncleaned table and then swiped onto a Petri dish. Each Petri dish was then wiped with four different disinfectant wipes and placed into an incubator. After 48 hours, the Petri dishes were examined and the amount of bacterial spores on the Petri dish were counted and documented. The Petri dish that grew the least amount of spores would indicate that it was treated by the most powerful and effective disinfectant agent. Ultimately, the experiment proved the hypothesis was correct in that Clorox wipes are the most effective disinfectant wipes and the Benefect Generic Wipes were the least effective. In conclusion, the results of this experiment demonstrated that higher percentages of active ingredients in a disinfectant will result in greater effectiveness at killing bacteria.

9 MI906

Bushardt, Isabella

Washington-Liberty High School

Teacher: Sotomayor

The Effect of Antibiotics on the Growth of *Escherichia coli* Containing Plasmid

The purpose of this experiment was to demonstrate how antibiotic resistance occurs in bacteria. The hypothesis was that Escherichia coli bacteria containing plasmids will be able to grow in the presence of ampicillin. Ampicillin is a type of antibiotic that kills bacteria by covalently binding to PBPs in the cytoplasmic membrane. Plasmids are self-replicating pieces of DNA that commonly carry antimicrobial resistance genes. E. coli strains were tested to determine if they contained plasmids by growing them in media that contained ampicillin as well as media without ampicillin. The results demonstrated that two E. coli strains were able to grow in the media without and with the antimicrobial agent, while a third E. coli strain only grew in the media without ampicillin. The strains were then run through electrophoresis. The results were analyzed showing the E. coli containing ampicillin contained bands and the E. coli that did not grow in the ampicillin did not contain a band. Indicating the E. coli that grew in the presence of ampicillin contained a plasmid with a resistance gene. A limitation of this study was the number of trials. This experiment incorporated controls, like DNA ladders. This experiment confirmed that plasmids play a role in antimicrobial resistance, and demonstrated why some bacterial strains are not able to be inhibited using some antimicrobials. It emphasizes the need to perform antimicrobial susceptibility testing for patients to ensure that they are treated with appropriate antimicrobial agents. It should be noted that plasmids have benefits in biomedical research.

9 MI907

Klein, Sasha

Washington-Liberty High School

Teacher: Brodowski

The Effect of Different Antibacterial Sprays on the Deterrence of *Escherichia coli* Growth

The purpose of this experiment was to learn which antibacterial sprays should be used to prevent the spread of Covid-19. The experiment tested which antibacterial sprays deterred the growth of Escherichia coli. The null hypothesis, if the E coli is exposed to different antibacterial sprays, there will be no difference in the deterrent of its growth was accepted. The null hypothesis was supported by the data; the zone of inhibition of the Escherichia coli growth when the Petri dishes were treated with Clorox® Clean-Up® Cleaner + Bleach, Lysol® Disinfectant Spray, or 409 Multi Surface Cleaner was 4.25 cm2. The zone of inhibition of the Escherichia coli growth when the Petri dishes were treated with the control (water) was 0 cm2. This rejected the hypothesis: if the E coli is exposed to different antibacterial sprays, then those exposed to Clorox will have a greater deterrent in growth because of Clorox's sodium hypochlorite concentration. The data showed that all the antibacterial sprays stopped the growth of E coli. Knowing growth stopped is helpful because finding a way to kill E coli is important in this Covid-19 pandemic since E coli spreads similarly to Covid-19. Further tests should be performed with different independent variables, such as chemical versus natural sprays. Further experimentation should include a second control, bleach, to test the independent variables more thoroughly. This experiment and future studies are important because they could be used to statistically show which spray to use to disinfect a surface.

9 MI908

Mohanty, Anna

Washington-Liberty High School

Teacher: Sotomayor

The Effect of a *Staphylococcus epidermidis* Infection on the pH of its Medium

The purpose of this experiment was to determine if pH tests could be used as a cost- effective early intervention medical device in wound care, specifically when working with Cesarean surgical site infections in rural areas. This is difficult to examine in actual wounds because the variation in each case, so this experiment was conducted by isolating cultures of Staphylococcus epidermidis in nutrient broth. The pH of each broth was measured repeatedly over 90 hours to see if it had been affected by the bacterial presence. The medium was not altered outside of a normal pH range within the four-day period. The results yielded indicate that the null hypothesis should be accepted: a presence of Staphylococcus epidermidis does not affect the acidity of a bacterial medium within the early intervention time. But since other vital information is suggested by these results, it can be discerned that pH still has a prominent role in making wound treatment more equitable by utilizing cheaper, but functional technologies.

9 MI909

O'Toole, Gabriel

Yorktown High School

Teacher: Paz-Soldan

The Effect of the Duration of Ultraviolet Radiation Exposure on Bacteria Growth

In a world full of harmful germs, bacteria, and disease, scientists are constantly searching for efficient ways to maintain clean, sterile environments. Ultraviolet radiation has been used for decades to disinfect water, surfaces, and the air. The type of ultraviolet ray best suited for eradicating pathogens is known as UV-C. UVC is commonly used in hospitals, labs, and even domestic settings as a disinfectant. A big question about this disinfectant technique is how long this method takes, and how effective it is. While most research indicates that UVC is not one hundred percent effective in exposure durations of under eight minutes, current data suggests that UVC does limit bacterial growth in exposure spans of under one minute. Understanding the amount of time this process takes is an important piece of fully utilizing this sanitization method. In this experiment, the exposure durations were the levels of independent variable; bacteria was exposed to UVC for 0, 2, 5, and 30 seconds. Twelve agar plates spread with E. Coli were exposed to UVC for said amount of time, incubated for 24 hours, then measured. The results proved that 30 seconds of UVC exposure limited the bacteria most, only allowing a mean diameter of growth of 0.47 inches. In 2 out of the 3 trials for this IV level, there was no growth at all. In conclusion, the longer bacteria is exposed to UVC, the less will survive, yet this data suggests that the exposure duration of 100% effectiveness is possibly lower than expected.

9 MI910

Trucano, Anna

Washington-Liberty High School

Teacher: Brodowski

The Effect of the Active Ingredient in Hand Sanitizer on Deterrence of *Staphylococcus epidermidis* Bacteria Growth

The purpose of this experiment was to see how the active ingredient in hand sanitizer affects the ability of hand sanitizer to deter of Staphylococcus epidermidis bacteria growth. This study was meant to find a way to prevent S. epidermidis infections, as illness and even death can be caused by S. epidermidis. The hypothesis was if Staphylococcus epidermis was treated with different hand sanitizers with different active ingredients, then those treated with isopropyl hand sanitizer would have the least bacteria growth. The null hypothesis was if S. epidermidis was treated with different hand sanitizers with different active ingredients then there will be no difference in bacteria growth between the groups. After the experiment was conducted, the research hypothesis was rejected, and the null hypothesis was accepted based on the p-value.

The experiment was a standard zone of inhibition experiment, the S. epidermidis bacteria was inoculated with hand sanitizer and the zones of inhibition were measured 48 hours later. After measuring and analyzing the results, it was determined that the active ingredient in hand sanitizer has no significant difference in deterring S. epidermidis—with all the hand sanitizers having an almost complete zone of inhibition. Standard deviations were low indicating accuracy of data. The data pointed to the conclusion that S. epidermidis transmission can be significantly cut down if hand sanitizer is used.

11 MI911

Brodsky, Julia

H-B Woodlawn Secondary Program

Teacher: Young

Anti-biofilm Activity of Isolated Bacteriophages for the Treatment of Multidrug Resistant Pulmonary Infections

A rise in the prevalence of antibiotic-resistant infections has begun a search for alternative methods to combat bacteria in the human body. Bacteriophages (or “phages” for short) are a type of virus that can kill specific strains of bacteria, and were first observed in the early 20th century, just before the discovery of penicillin. The difficulty associated with finding phages targeted to a specific infection is one reason the treatment is used relatively infrequently. The prospect of personalizing phage treatment by isolating new species for individual infections is promising. This study aimed to isolate phage species for multi-drug resistant strains of Pseudomonas aeruginosa and Staphylococcus aureus, the most common causes of chronic infections in patients with cystic fibrosis. Three samples of human fecal matter, one sample of feline fecal matter, and one sample of rich soil were tested for the presence of both S. aureus- and P. aeruginosa-hosted phages. Using the double agar overlay method of phage enumeration, it was found that six of the ten stocks contained bacteriophages, at titers ranging from 3.9x10^4 pfu/mL to 2.8x10^7 pfu/mL. The potency of the Pseudomonas-hosted isolates in eradicating biofilms was compared to the efficacy of an antibiotic cocktail and the enzyme cellulase through an in vitro resazurin cell viability assay. Each treatment was performed in sextuplicate. Metabolic reduction of resazurin to resorufin (which proceeds in the presence of live cells) was quantified at 24 and 48 hours of growth using a microplate reader set to measure absorbance at both 570nm and 595nm.

11 MI912

Ermovick, Ryan

Yorktown High School

Teacher: Amarasinghe

The Effect of Different Methods of Water Treatment on the Growth of Microorganism Colonies

This experiment was conducted to compare the effect of different water treatment methods on the growth of microorganism colonies in water. The hypothesis is that “If the method of water treatment is a UV light, then the least amount of microorganisms will grow because the Deoxyribonucleic acid (DNA) of the cell is disrupted.” For this experiment, water was collected from a pond in Arlington, VA and treated using four different methods of water treatment: two chlorine-based, one iodine-based, and one using a UV light. A fifth level was not treated, which was the control. The water samples were incubated on Agar Plates for 48-hours, and the resulting number of microorganism colonies were counted, and the average number of each method of treatment were calculated. The hypothesis was rejected, as the most effective method of water treatment tested was a Chlorine-based method, not the UV Light method. The null hypothesis, which was that there is no effect of the type of water treated on the growth of microorganism colonies was rejected. A One-way ANOVA test was run on the data to determine if the data had a statistically significant difference. The P-value was less than 0.05, meaning that there was statistical significance in the data. The conclusions of this experiment can be used to educate people on methods to treat water in places where clean water is not readily available.

11 MI913

Sharma, Ambica

Washington-Liberty High School

Teacher: Hedderly

The Effect of Nicotine and Lead on Dopaminergic Neuron Morphology, Function, and Alpha-Synuclein Levels in a *Caenorhabditis elegans* Model

An electronic cigarette is a device that simulates cigarette or tobacco smoking by atomizing a liquid into an inhalable vapor. It is often billed as a smoking cessation device, safer than cigarette smoking; however, these devices are feared to work inversely as a gateway to cigarette smoking through nicotine addiction. In addition to the danger from e-cigarette injury and death, there are also neurological implications to using an e-cigarette. This research aimed to determine the effect of chemicals and chemical combinations commonly found in e-cigarette aerosol, specifically nicotine and lead, on dopaminergic neuron morphology and alpha-synuclein (α-synuclein) protein levels. Caenorhabditis elegans (C. elegans) were treated with different doses of lead acetate, nicotine, or a mixture of both to simulate the neurological effects in a human being. Fluorescence imaging was used to indicate α-synuclein levels and neuron morphology by using ImageJ software. Results from the fluorescence images of C. elegans (NL5901 and BZ555 strains) demonstrated decreased activity of dopaminergic neurons, smaller sizes of the C. elegans themselves, and increased protein aggregation with the higher concentrations of each lead, nicotine, and the lead and nicotine mixture. The findings from this experiment confirm that e-cigarettes have significant neurological implications, including the inhibition of dopamine secretion, an inverse risk of Parkinson's Disease, neural circuit development difficulties, and the pathogenesis of Alzheimer's Disease.

12 MI914

SanSeverino, Melissa

Yorktown High School

Teacher: Wright

The Effect of Repeated Exposure to Ampicillin on the Antibiotic Resistance of *Escherichia coli*

Antibiotic resistance is a growing and serious health threat for both humans and livestock. The CDC estimates that more than 2.8 million antibiotic-resistant infections occur in the U.S. each year, killing more than 35,000 people annually. Antibiotics are used in farming to fight livestock illness and improve growth, but too much antibiotic use can lead to antibiotic-resistant bacteria living in animals that enter the food supply and infect humans. The objective of this experiment was to discover both how long it would take for a large amount of E.coli colonies to become completely resistant to the antibiotic ampicillin and the rate at which the diameter of inhibition would decrease. This experiment concluded that after five exposures to the ampicillin antibiotic, E.coli could become completely antibiotic resistant. In addition, the rate of decrease of the area of inhibition over the five exposures was 1.2 millimeters per exposure. This experiment shows why great care should be exercised in the administration of antibiotics to humans or livestock. If antibiotics are given unnecessarily, or if a prescribed course of antibiotics is ended too soon, it can contribute to the growth of antibiotic-resistant bacteria. This experiment shows how quickly antibiotic-resistant E.coli becomes dominant and prevails over the non-resistant bacteria.

7 PH1000

Desai, Suhani

Williamsburg Middle School

Teacher: Zarro

The Effect of a Bicycle's Tires' Air Pressure on the Distance the Bicycle Travels Once the Brakes are Applied

A bicycle's tires may deflate after not riding for a period of time, which can affect its performance in many ways. Riding with the wrong air pressure in your tires may compromise safety. The purpose of this experiment was to determine the effect of the bicycle tires' air pressure on the distance the bicycle travels after braking. It was hypothesized that if the tires are inflated to 192 kPa (70% of the recommended tire pressure which was the lowest level tested), then it will travel the shortest distance once the brakes are applied. This is because the surface area of a tire that is in contact with the road is the greatest, so it will resist the motion of the bike the most because of friction. The experiment was conducted by having a bicycle travel down a hill at a constant speed, maximally braking at a prespecified point, and then measuring the distance from the last point of contact of the front tire with the road to the braking point. It was shown that as the pressure in the tires increased, the distance the bicycle traveled after the brakes were applied increased. The hypothesis was supported because according to the data, the lowest level of tire pressure tested traveled the least distance. This experiment can be developed further by testing the speed and handling of different tire pressures to determine the optimal tire pressure.

7 PH1001

Rendak, Michael

Kenmore Middle School

Teacher: Gantenbein

The Effect of Different-Sized Magnets on a Rolling Ball

Sometimes it's considered common knowledge that the bigger the magnet, the stronger it attracts, but is this true? This project looks at how different sized magnets attract or change the course of a metal ball rolling by at constant speed. This is measured by having a lot of lines spanning the width of an a4 piece of paper. After you record where the ball landed you can from that line trace it back and compare it to the control roll. The hypothesis for this experiment was that the bigger the magnet the more the ball will change course. The findings of this project support the hypothesis because the average degrees off course the ball went for the 5mm magnet was 1.2 degrees, the 6mm magnet average was 1.8 degrees, a surprising 0 degrees for the 8mm, 6.8 for the 10mm magnet, an even 11 for the 12mm magnet, and lastly 20.4 degrees for the 15mm magnet. As you can see the average was rising with the magnet size. These results also showed that smaller refrigerator magnets were a lot weaker than the ones that were bigger.

7 PH1002

Routhouska, Nicklaus

Hammond Middle School

Teacher: Kochis

Pass Back Accuracy

In this experiment, I sought to determine the best area to shoot a ball on a lacrosse pass back to return an accurate pass back to the person passing the ball. I performed four trials with two passers (a right-hander and a left-handed) performing two passing trials each. I defined accuracy as passes that returned around the area of the head and upper torso from hip to hip. We record data on the location of balls thrown on the pass back and the areas the pass was returned.

7 PH1003

Clemence, Idris; Salo, Kai

George Washington Middle School

Teacher: Thomas

Observing Black Holes with Magnets

Our purpose was to see if we can demonstrate the way astrologists can detect black holes using magnets. No one should care about our project, as it didn't work and you cannot use this information. This is not something that should cause people to change the way they go about life? As we made an inaccurate hypothesis and our data did not add up. This was not a great experiment and it was more of a fun experiment and not a science fair project.

Problem: We did not have a problem but we did have a purpose. And that was to see if we can demonstrate the way Astrosists can detect black holes using magnets and we got into that and our project was inconclusive.

Procedure: We had a pretty direct approach that was to set up an environment to simulate as if we were in space And we use magnets to demonstrate the black hole and the things being affected by that black hole

Final results: were inconclusive as we had 49 for yes and 51 for no

Conclusion: Our project does not affect anything. Now this could affect people's way of thinking of seeing black holes. Most people think you just look through a telescope and then you'll see it but that's not the case. We see black holes by seeing how it affects things around it. But we did not properly execute that idea

8 PH1004

Cai, Emma

Swanson Middle School

Teacher: Seliskar

Fabrics as Thermal Insulators

For my science project, I tested (IV) a strip of cotton, polyester, and denim fabric wrapped around a jar of hot water for twenty minutes (my control group was no fabric), and observed what the ending temperature was (DV), so I could see which fabric could insulate the best (the higher the ending temperature is, the better it could insulate, because there is less heat loss). My hypothesis was that cotton fabric would insulate the best, because based on research, cotton could trap the most air, and therefore be the best insulator.

I had four of the same Mason jars and filled them with the same amount and temperature of water, then wrapped each fabric around one jar. I waited twenty minutes, then used a temperature probe to measure the temperatures for each jar. I had four IV levels, and did ten trials of each. After testing, I found out that cotton fabric insulated the best. Polyester fabric was the second best insulator, denim came next, and the control group of no fabric had the lowest average of ending temperatures.

I could have had more accurate data by keeping the same density and mass for each strip of fabric the same, but even when I found that the strip of cotton and polyester had a lower mass than the denim strip, it still justified my hypothesis and data, since a lower mass would most likely result in poor insulation.

In conclusion, I learned that cotton fabric was the best insulator.

8 PH1005

Din, Kai

H-B Woodlawn Secondary Program

Teacher: Boyle

Windy Heights

Wind is a large problem when it comes to skyscrapers. It can reduce the lifespan of skyscrapers by up to 95%. The idea for this experiment was created when observing an outdoor team competition to build the highest tower with newspapers and tape. The tallest structure fell down due to wind and ruined the entire competition for that team. The purpose of this experiment was to find the effect of wind on differently shaped structures to find which shape is most resistant to wind. The approach for this experiment was to create miniature towers of small wooden dowels and hot glue and then blow air towards them with a fan to simulate wind. Contrary to the predicted outcome, the complete square tower had the best resistance to winds. The square design lasted 18 seconds on setting 2 compared to the other designs like Triangle and Modified Triangle which both lasted 16 seconds on setting 2 and Modified Square being the worst at 14 seconds. The hypothesis was that if a structure had less surface area for the wind to hit then it will be more resistant to wind and the evidence supports this idea. The experiment showed that square designs for towers were best for withstanding wind. This study can benefit the skyscraper industry and that team that lost. Although results for this experiment were limited, future experiments could have the potential to be greater by adding more variety of the fan settings or tower designs.

8 PH1006

Gooden, Elisha

Dorothy Hamm Middle School

Teacher: Kennedy

The Effect of String Played on Time of Resonant Response

The purpose of this project is to see how a single string's vibration affects the vibration of strings nearby on a guitar. Frequency is the speed at which something vibrates, measured in hertz, and when two things have the same frequency, resonance occurs between them causing them both to vibrate faster. The hypothesis is that if the string played is a higher frequency then the remaining strings will sustain the vibration longer because the higher frequency can travel at the same frequency as the lower one.

For the experiment, a six string guitar was used. Each of the strings has a different natural frequency and are ordered from lowest to highest. Going from lowest to highest frequency, each string was played then muted to see the resonant response from the other strings.

The conclusion rejects the hypothesis. The hypothesis says that the resonant responses would decrease from high to low. However, the research shows that the lowest, second lowest, and highest strings had similar responses, while the second highest had the most response, and the middle two had the least responses from the other strings. The trend is that most of the strings have the same resonance while some go way higher or lower than it. This shows that the resonant response of the strings does not increase or decrease because of the frequency.

8 PH1007

Gowdy, Benjamin

H-B Woodlawn Secondary Program

Teacher: Boyle

How to Decode the Golden Record

Golden Records are time capsules in the form of a vinyl record placed on the Voyager spacecrafts in 1977 with the purpose of preserving pictures and audio samples of humanity and humanity's work. One of the Golden Records is over 14,402,825,406 miles from earth-- one of the most fascinating and farthest missions ever performed by NASA. This Golden Record is extremely significant in the history of cryptography and likely carries the first images from our solar system that extraterrestrial intelligent life will ever see… if it is out there. There is important scientific information on the record including human anatomy, the structure of earth, and a solar system location map. The record cover contains the key to unlocking using a combination of scientific knowledge, cryptography, and binary code. My research paper discusses the Golden Records, decoding the covers, their purpose, how they were made, and their contents.

8 PH1008

Graham, Breanne

Swanson Middle School

Teacher: Swanson

The Effect of the Color of an LED Flashlight on How Many Lights on the Circuit are Lit

My project used a circuit and photoresistor to test which color of an LED flashlight, white light, red light, green light, blue light and UV light, shone the brightest. To measure this, I counted the number of lights on the circuit that lit up. I thought that the UV LED flashlight would shine the brightest because it had the highest wavelength and therefore, the most energy. In order to carry out this experiment, I tested each different color of light a certain number of times by shining the light over the photoresistor on the circuit for a certain amount of time. My results showed that my hypothesis was not supported as the white LED flashlight did the best, while the UV LED flashlight actually did the worst. The red LED flashlight came in second, followed by the green LED flashlight and the blue LED flashlight. My best explanation for how this happened was that white is the closest color to the brightest color for human eyes, a fluorescent yellow/green. The circuit picked up the white light the best and couldn't pick up the colors with higher wavelengths. If I could improve my experiment, I would use a better circuit with more levels and use a machine to shine the light to create an exact angle. Overall, this experiment taught me that the white LED flashlight did the best, while the UV LED flashlight did the worst.

8 PH1009

Monroy, Sebastian

Dorothy Hamm Middle School

Teacher: Marszalek

The Effect of Nerf Gun Angle on Dart Distance

This experiment used observations of the 21 cm hydrogen line to build up a map of the Milky Way galaxy from radio observations using the 20 meter telescope at the Green Bank Observatory. The 21 cm hydrogen line is a radio emission signal from hydrogen atoms spread around the Milky Way and other galaxies (Encyclopedia Britannica, 2020). This signal is emitted at 1.420406 GHz, but that frequency is shifted by the Doppler effect to slightly different frequencies because of the Milky Way's rotation velocity. By analyzing the frequency shifts and translating each spectral data point into a position in the Milky Way galaxy, it is possible to build up a map of the Milky Way and its spiral arms from many observations (Englmaier, Pohl, and Bissantz, 2011). For this experiment, this was done with 261 individual observations, which after processing using Python scripts, created two maps: a heat map and a scatter plot, showing galactic structure. These graphs showed several galactic spiral arms and confirmed the fact that the Milky Way is a spiral galaxy.

8 PH1010

Pericak, Ryan

H-B Woodlawn Secondary Program

Teacher: Boyle

The Effect of the Amount of Coils on the Strength of an Electromagnet

The purpose of this experiment was to determine the effect of the amount of coils of a copper wire on the strength of an electromagnet. Electromagnetism is created when a metal core is electrically charged using a power source. An electromagnet can be manipulated by engaging and disengaging a power source, unlike a permanent magnet. This can be particularly useful in many scenarios where the magnetic strength needs to be controlled. It was hypothesized that a greater amount of coils of copper wire around a nail would result in a stronger electromagnet. An electromagnet was created using copper coil, a six volt battery, and a nail to test the hypothesis. A ruler was used to determine how far in millimeters a paperclip could be attracted using fifteen, thirty, and fifty coil electromagnets. Ten trials were conducted, indicating that more coils consistently attracted a paperclip from farther away, resulting in a stronger electromagnet, and supporting the hypothesis.

8 PH1011

Van Hoey, Josephine

Gunston Middle School

Teacher: Pentland

The Effect of the Distance Between Two Binary System Stars on Apparent Magnitude

Binary system stars have fascinated scientists and astronomers alike for many generations, yet there are still so many unknowns. The goal of this project was to find how the distance between two binary system stars affects their apparent brightness. Lightbulbs--which were used to model the stars--were placed 2 cm, 5 cm, 8 cm, 9 cm, and 10 cm apart. A photometer was used to measure the apparent brightness from these lightbulbs in a dark room. It was found that for the first two levels of independent variable, the apparent brightness was an average of 16 lux and 10 lux, showing that, when the two binary system stars are close enough together that they are viewed as one star, then the apparent brightness will get dimmer the farther apart they get. The researcher thinks this is because the light combines less. The means of the last three levels of independent variable are 13.6, 12.2, and 12.2 lux, which shows that, once the two stars get far enough apart to be viewed as multiple stars, then they initially become brighter—because two separate light sources are seen very close together—and then grow slightly dimmer—because the two separate light sources are farther apart in the field of view. This project contributes to its field because there are still a lot of unknowns relating to double stars and apparent brightness. This project helps further research in this area and ignite public interest on this topic.

9 PH1012

Berlett, Andrew

Alexandria City High School

Teacher: Riley

Burning Wood: Measuring Mass Loss During Combustion

The reason I picked this project is to find how quickly different kinds of wood burn. This will help the construction industry when they are picking which type of wood they should use when they are building houses. I found that a very small thing drastically changed the performance of a certain wood type. I tested this buy setting equal sized pieces of wood to a flame. I found out that hardwood burns very quick. While on the other hand things like normal soft wood take some more time to burn.

9 PH1013

Cohen, Nate

Yorktown High School

Teacher: Dorman

The Effect of the Color of Paint on Wood on the Temperature of a Wood Block

The title of this experiment is The Effect of the Color of Paint on Wood on the Temperature of a Wood Block. The purpose of this experiment was to find a relationship between heat and color. The levels of IV were None, Black, White, Red, Yellow, and Blue. There were 5 trials with each block. The painted blocks were left one by one under a heat lamp for 20 minutes. The temperature of the block was measured with an infrared thermometer before and after being under the heat lamp. The range was calculated in order to show what color changed the most and least under the heat lamp. The black block had the highest range, and the white block had the lowest range. Therefore, the color black absorbs the most energy out of the 5 colors, and the color white absorbs the least. White is a mix of every color, which means that almost all light is reflected off of it. Because the white absorbs less energy, it is colder. Black is the lack of color, which means that almost all light is absorbed into it. Because the black absorbs more energy, it is hotter. In general, this experiment found that darker colors absorb more heat, and lighter colors absorb less heat.

9 PH1014

Dawit, Danie

Alexandria City High School

Teacher: Matthews

Which Material Best Stops the Decay of Radioactive Material?

My research objective was to find the material that best stops the decay of radioactive material. I approached this by testing Americium 241(Am-241) in 3 different materials which were paper, aluminum foil, and cloth; I also tested the Am-241 by itself with no materials covering it as a constant. I was testing for which material had the least number of tracks and smallest size in centimeters. The paper had the lowest number of tracks at 12 and aluminum foil had the smallest tracks at 2.33 centimeters. I concluded that both aluminum foil and paper were the best ones to choose from.

9 PH1015

Gordon, Shira

Alexandria City High School

Teacher: Riley

3D Printing Model Rockets

The purpose of my project was to see if 3d printed PLA rockets can fly better than traditional model rockets. This is significant because PLA rockets are more durable and cheaper, making them a better option to use. This research is potentially very important because it could change the entire model rocketry view. For example, instead of using mostly cardboard rockets, people could start printing their own rockets or buying PLA rockets. The approach for this experiment was to create a rocket that flew, I had little knowledge of rocketry. The procedure for this experiment was to first fly the Estes rocket, to have something to compare the 3d printed rocket's results to. X1 and X2 were then designed and flown and new rocket designs were created, printed, and eventually flown. Throughout a lot of trial and error, the results concluded that X7 performed the best, with acceleration and speed that compared to the Estes rocket. If designed and experimented with, a 3d printed rocket can perform better than an Estes rocket.

10 PH1016

Bartrum, Olivia

Wakefield High School

Teacher: El-Gamal

Analyzing the Efficacy of Inorganic UV Filters on Their Ability to Block UV-A Light

The experiment was undergone in an attempt to determine if certain inorganic compounds were more effective in the blocking of UV-A radiation. The independent variables in experimentation were the different inorganic compounds used, being Titanium Dioxide and Zinc Oxide. The dependent variable was the UV intensity after the application of Titanium Dioxide and Zinc Oxide, measured in μW/cm². Several control groups were instituted to avoid the development of potential confounding variables, accounting for outside factors that may have impacted the reliability of the data. It was hypothesized that if a UV-A light was placed under Zinc Oxide, it would be able to limit the transmission of UV light to the greatest extent, resulting from Zinc Oxide's photostability. To test this, one gram of each inorganic compound was placed on separate sheets of quartz glass, which were raised two inches above the ground. A UV intensity meter was placed underneath each sheet, with a UV-A light placed approximately 8 inches above the quartz glass. Eight trials were undergone. The results showed that on average, Zinc Oxide was able to most effectively limit the transmission of UV-A radiation, with an average UV intensity of 28.625 μW/cm², in comparison to Titanium Dioxide, which had an average UV intensity of 53.25 μW/cm². To determine statistical significance, an ANOVA test was performed. This test demonstrated that there was statistical significance between experimental levels. Based on these results, it was concluded that in general, Zinc Oxide was more effective than Titanium Dioxide at blocking UV radiation.

10 PH1017

Watchman, Sam

Arlington Tech and Career Center

Teacher: Reese

Mapping the Milky Way: Observations of Galactic Structure from the 21 cm Hydrogen Line

This experiment used observations of the 21 cm hydrogen line to build up a map of the Milky Way galaxy from radio observations using the 20 meter telescope at the Green Bank Observatory. The 21 cm hydrogen line is a radio emission signal from hydrogen atoms spread around the Milky Way and other galaxies (Encyclopedia Britannica, 2020). This signal is emitted at 1.420406 GHz, but that frequency is shifted by the Doppler effect to slightly different frequencies because of the Milky Way's rotation velocity. By analyzing the frequency shifts and translating each spectral data point into a position in the Milky Way galaxy, it is possible to build up a map of the Milky Way and its spiral arms from many observations (Englmaier, Pohl, and Bissantz, 2011). For this experiment, this was done with 261 individual observations, which after processing using Python scripts, created two maps: a heat map and a scatter plot, showing galactic structure. These graphs showed several galactic spiral arms and confirmed the fact that the Milky Way is a spiral galaxy.

11 PH1018

Henshaw, Morgan

Yorktown High School

Teacher: Parent

Harmonic Analysis of the B-flat Clarinet

The purpose of this experiment was to develop a better understanding of the Bb Clarinet's acoustics by analyzing the harmonics of its full range. Each note of the clarinet was recorded and the sound file was uploaded into SPEAR software, which performed a Fast Fourier Transform and decomposed the sound file into its constituent harmonic frequencies. In the lowest register, only odd harmonics were present, explained by the clarinet functioning as an open-closed pipe. In the upper registers, both odd and even harmonics were present, suggesting the clarinet lost its characteristic open-closed pipe structure.

This research will help musicians improve their sound by providing knowledge of the clarinet's acoustic properties. Further research into the clarinet's acoustic impedance and the effect of different bell shapes and varying reed strengths would expand on this knowledge.

7 PS1100

Ayscue, Quincy

Kenmore Middle School

Teacher: Schnappinger

The Effect of Roundup on Aquatic Plants

When chemicals are sprayed on yards and farms, rain can wash those chemicals into waterways and bodies of water where it can harm aquatic plants and other life. It is important to know what concentration of chemicals can cause damage to the ecosystem. The purpose of this project was to determine what concentration of toxic runoff kills aquatic plants. One such plant is duckweed. Duckweed oxygenates the water and provides nutrients for aquatic life. It is assumed that higher concentrations of chemicals cause increased plant death. In this project Duckweed was placed in 4 different jars of aquarium water, each with different concentrations of the herbicide, Roundup (0cc, 10cc, 15cc, and 25cc each). It was hypothesized that at least 25cc of Roundup in 600cc of water would cause at least 20% plant death. Notes were taken using observations and common knowledge of plant and water coloration to measure the viability of the Duckweed over time. After a week of conducting the experiment, the data put into tables and graphed. At the conclusion of the project, it was shown that the original hypothesis was supported, since the concentration of 25cc reduced the viability of the duckweed by at least 20%.

7 PS1101

Keane, Taogh

H-B Woodlawn Secondary Program

Teacher: Taggart

The Effect of CO2 on Plants

I set out to test the effect of CO2 on plants. To find out what CO2 does to plants, I put two pots of radishes with equal soil in some airtight containers with equal sun. One plant had a candle which would remove oxygen and replace it with CO2. I watered each plant with 10 ml every time they needed water and I measured the height for each day for 1 month. The candle and plant were kept far apart and the temperature was watched so the plants were always the same temperature. I found that the height of the experimental group at the end of the experiment was taller than the control on average. Also, the plants with extra carbon dioxide grew faster than the control group, and their leaves were noticeably bigger. The control group grew normally. The experiment ended before radishes formed so I couldn't find out how CO2 affects radishes. In conclusion, I found that plants grow better with CO2. CO2 helps plants make sugars which helps them grow. That means the experimental group had more sugars to grow so they grew taller.

7 PS1102

Lawler, Catherine

Williamsburg Middle School

Teacher: McFerran

The Effect of the Amount of Light Per Day on Plant Height

The purpose of this experiment was to determine the best amount of light for lima beans to receive each day. It was hypothesized that if plants got twelve hours of light, they would grow the tallest after three weeks. The experiment tested if zero, six, twelve, or eighteen hours of light is the best amount of light to increase the height of plants. The plants, starting as seeds, received their set amount of light from an LED plant growth light to ensure that the amount of light was stable each day. After three weeks, the plants with 12 hours of light every day grew the tallest. The hypothesis was supported by the data. Scientific data proves that plants which get relatively similar amounts of light and darkness in a day thrive. Light allows plants to photosynthesize and conduct necessary functions for life, while the darkness actually stretches the stem of the plant and produces more upward growth. The data collected seemed to be unstable, which is to be expected from plants, so the data shown may not be an exact representation. To expand the results of the project, it could be repeated with more plants in each category or a wider variety of species. Once more concrete, this data could be used to give more precise growing instructions to indoor gardeners or larger producers of Lima beans.

7 PS1103

Zee, Rachel

Kenmore Middle School

Teacher: Schnappinger

The Effect Of Different Fertilizers On Plant Growth

Advertisers are always saying their fertilizers will make your plant grow very tall very quickly, and different websites show many different things that can be used as good fertilizers. Most fertilizers have three main elements, phosphorus, potassium, and nitrogen, but have you ever wondered which element in fertilizer makes your plant grow the tallest? Or even just what kind of fertilizers do that? This project looks at the effect of the type of fertilizer on the height of a bean plant after one month. I used three different fertilizers, bone meal (high in phosphorus), kelp meal (high in potassium), and blood meal (high in nitrogen). Three seeds were planted in four pots, and each contained one of the fertilizers, except for the control. They were watered and rotated every day, and after a month, the plants were measured. The hypothesis was if the kelp meal is used, then the bean seed will grow the tallest, because it is high in potassium which helps the plants' internal structure and growth. The results supported the hypothesis because the plant with kelp meal grew the tallest (an average of 37.1 cm), compared to the averages of bone meal (33.1 cm), blood meal (26.9 cm), and no fertilizer (33.1 cm). So next time you're watching a fertilizer commercial and are interested in height, be sure to look for something that is high in potassium, like kelp meal.

7 PS1104

Klancnik, Sara; Klancnik, Amelia

H-B Woodlawn Secondary Program

Teacher: Taggart

Will it Sprout?

The purpose of this project was to see whether cutting up onions will affect onion growth. Five onions were cut up into various shapes and sizes and planted to see if they would grow. The first hypothesis was that the smallest piece of the onion with roots would sprout. The second was that an onion without roots would grow roots. The experiment showed that onion parts with roots will sprout and onion parts without roots will not grow roots and sprout.

7 PS1105

Motley, William; Mota-Clem, Caio

Thomas Jefferson Middle School

Teacher: Holland-Shuford

How Will the Temperature of a Strawberry Affect Its DNA Yield/Mass?

The purpose of the experiment was to understand and figure out how temperature affects DNA yield.This is important because the DNA can be used to make medicine and treatments, understanding how the DNA works. For the procedure, we first smashed the strawberries, and put in a special solution,(full instructions are in materials and steps) and used a coffee filter and strainer to strain the solution. After that, we put equal amounts in different containers and added the isopropyl alcohol. The DNA showed, we extracted, and used the scale to measure amounts. We concluded that our hypothesis was accepted and proven. This was an extremely interesting experiment and went very well in terms of hypothesis testing. We also figured out that the water in the DNA being freezed made it heavier and therefore yielded more DNA.our hypothesis was this as well. We figured out that the water in the DNA being heated, evaporated and melted down by microwaves influenced the DNA yield as well. We recommend trying out this experiment as it is not only fairly easy, but it is super entertaining and interesting to see the DNA form and become bigger. Another thing worth saying is that the cups in the experiment may look like they vary in sizes, but the amount of solution is the exact same in each cup. Everything is written on the science fair board, and is easily understood. We enjoyed seeing our hypothesis and ideas come to life and hope to see more people trying out experiments like this or tweaked to their own new ideas.

8 PS1106

Hwang, Kyungsup

Gunston Middle School

Teacher: Robles

The Allelopathic Effect of *Juglans nigra* on the Growth of the Invasive *Pueraria montana var. lobata*

The agricultural and the environmental fields are faced with a growing population of invasive species, some of which have developed resistance to chemical controls. Chemical herbicides pose significant health risks and cause lasting damage to the environment. This experiment investigated the practical application of an allelopathic concentrate extracted from Juglans nigra (eastern black walnut tree) as an herbicide on the invasive vine Pueraria montana var. lobata (kudzu). J. nigra produces an allelochemical, juglone, that has potential uses as a natural herbicide or pesticide. The flesh from J. nigra fruit hulls was soaked in DH2O (distilled water) for 48 hours to make a solution, which was then applied to cuttings of P. montana var. lobata. These samples were watered with 60 mL of liquid at 4 levels: Undiluted, .5 mL juglone/1 mL DH2O, .3 mL juglone/1 mL DH2O, and the control, DH2O. It was hypothesized that the undiluted J. nigra concentrate would be the most effective at stunting the growth of P. montana var. lobata. The results, taken over the course of 14 days, supported the hypothesis, as the height of all the samples tested with J. nigra concentrate decreased from 0.5 cm to 2 cm whereas the height of the control increased by 0.5 cm. However, only one trial was able to be conducted, due to time constraints and cold weather. As J. nigra was proven to negatively impact P. montana var. lobata, this research could help develop an allelopathic control method for invasive plants.

9 PS1107

Hemsch, Emma

Washington-Liberty High School

Teacher: Sotomayor

The Effect of Water Stress on the Rate of Transpiration of *Pisum sativum*

The purpose of this experiment was to determine the effect of the frequency of watering on the rate of transpiration of a common North American garden plant as a model for increased drought-like conditions as a result of climate change. It was hypothesized that if groups of sugar snap peas (Pisum sativum) were given 30 mL of water every 3, 4, 5, and 7 days, then the plants watered every 3 days would have the highest rate of transpiration, because the plants not under water stress would have developed fewer adaptive features meant to slow the rate of transpiration. Some examples might be a thicker cuticle, less open stomata, and fewer aquaporin proteins in the root cells. The plants were grown from seeds for 10 days before their frequencies of watering were changed. After one month, the rates of transpiration were measured using potometers. The group of plants watered every 4 days had the highest rate of transpiration, at 0.084 cm/hour, and the group watered every 5 days had the lowest, at 0.015 cm/hour. These results did not support the research hypothesis. An ANOVA test showed that the results between groups were not significantly different, so the null hypothesis was accepted. The results of the experiment were inconclusive; however, the experimental design could be repurposed for further studies, with some changes such as increasing the days between watering and number of trials per group in order to achieve statistical significance.

9 PS1108

Hubbard, Leia

Alexandria City High School

Teacher: Matthews

iPhone EMR Effect on Fern Plant Growth

My project was testing how different amounts of Electromagnetic Radiation (EMR) exposure from an iPhone XR affect the growth of fern plants, during photosynthesis. My goals were to use this information to then know if EMR poisoning from an iPhone can affect a living thing such as a plant, then maybe it could also affect humans, maybe not in the same way but it still could be dangerous. My outcome was that the group of ferns that had no EMR exposure did grow, bloom (grew many stems & leaves), and remain healthy. The group that had 4 hours of EMR exposure grew a little but didn't bloom in ways it should have. The 8 hour EMR exposure group shrunk by massive amounts, the EMR poisoning did greatly affect the growth, and the overall plant shape causing stems to break, and lean over. This does give supporting information to a hypothesis that EMR from iPhone's could be damaging towards us humans, and we should be careful whilst exposed.

9 PS1109

Maxwell, Daisy

Washington-Liberty High School

Teacher: Brodowski

The Effect of Sunscreen on *Elodea canadensis*

The following experiment investigated the effect of sunscreen on Elodea canadensis, an aquatic plant that supports many marine ecosystems. Sunscreen often ends up in waterways, and knowing whether that has detrimental impacts is an important step in preserving the environment. To conduct this experiment, 96 elodea plants were placed into individual test tubes and separated into four groups: chemical sunscreen, natural sunscreen, bleach, and nothing. The hypothesis was that the group with chemical sunscreen would be of the least length after 8 days. It was expected that the ingredients in the chemical sunscreen, oxybenzone and octocrylene, would prevent necessary processes from occurring within the plants, stunting their growth.

The t-tests taken on the collected data signified inaccuracy in the natural sunscreen and bleach groups, so those measurements were discarded. The inaccuracy most likely stems from deviation between the elodea; those cut from the ends of plants were thinner and less healthy than the ones taken from the tips. However, the hypothesis was supported, since the mean data shows that the chemical sunscreen caused the plants to be of less length than when nothing was added. This information is significant because it offers a fairly easy way in which humans can adapt to treat the environment better.

10 PS1110

Keng, Amelia

Washington-Liberty High School

Teacher: Bohn

The Effect of Different Types of Composted Organic Waste On Bean Plant Growth Speed

Did you know that composting dog waste and cow manure can be vital to prevent pollution? The purpose of this experiment was to determine the effects of composted dog waste, cow manure, and vegetable peelings on the growth speed of a bean plant. The hypothesis of this experiment was if bean plants are treated with different types of composted organic waste, then those treated with dog waste compost will grow the fastest because it supplies nutrients like nitrogen and phosphorus to plants. The plants that were planted in cow manure had the highest mean growing average of 13.8 cm and the mean rates for the dog waste and the vegetable peelings were 11.83 cm and 9.535 cm. The control group that was planted in soil had the lowest mean of 6.27 cm. An ANOVA test was run to determine if the results were statistically significant. The p-value for this data was 0.10538366 which was much greater than the critical value of 0.05. This indicated that the null hypothesis couldn't be rejected and showed that there was no difference in growth between the bean plants in all groups.

This experiment could have been improved by trying different variations of compost and growing them outdoors instead of inside. Due to the cold weather conditions, plants had to be grown indoors. Further studies can be conducted with different types of plants and compost than with just one type of plant or one composted item.

11 PS1111

Wayman, Elizabeth

Yorktown High School

Teacher: Parent

The Effect of Hydroponic Growing Medium on Growth of Swiss Chard

This experiment's purpose is to test how different types of growing mediums used in a hydroponic system can impact the production of Swiss chard. The results of this experiment helps at-home gardeners, professional farmers, and engineers decide if the type of growing medium they use in a hydroponic system will affect their plant's growth. The hypothesis was that if the type of growing medium is coco coir, then plant growth will be the greatest because it has a medium porosity in comparison to rock wool and clay pebbles. This was hypothesized because background research shows that plants need a growing medium with enough air pockets to keep their roots from drowning due to a lack of oxygen. To test the hypothesis, 21 plants (7 per each level of the IV) were grown using wick-and-jar hydroponics over the course of 27 days. The mass of each plant was measured using a scale the data was statistically analyzed. The data did not support the hypothesis, therefore the null hypothesis is accepted. This is likely because all plants were able to receive enough nutrients regardless of their growing medium as they had the same fertilizer. Additionally, all growing mediums provided adequate support for the plant's roots, leading to similar results. In conclusion, the difference in hydroponic growing mediums did not affect the Swiss Chard plant's growth.