NORTHERN VIRGINIA REGIONAL SCIENCE AND ENGINEERING FAIR

Wakefield High School

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6AS100

Lerch, Maxwell

Thomas Jefferson Middle School

What Are the Preferred Treats of My Bearded Dragon Lizard?

This experiment was conducted to find out the effect of treat selection on my lizard's behavior. I wondered what my bearded dragon's favorite treat is: banana, superworm, blueberry, or hornworm. I hypothesized that the hornworm would be his favorite because it has more vibrant colors and is very eye-catching. For the experiment, treat trials were conducted by offering two of four treats by hand on different days and comparing each of the treats with the others. The treat that the lizard preferred in each trial was recorded. My results were as follows: banana was never selected, blueberry only was selected against banana, superworm was selected twice, and hornworm was selected three times. My hypothesis was proven: the hornworm was the bearded dragon's favorite treat.

7AS101

Cordts, Gemma; Esquivias, Joselyn

George Washington Middle School

Vermicomposting: Which Organic Matter Will Worms Decompose the Fastest?

Worms play a crucial role in ecosystem sustainability as decomposers, transforming organic matter from deceased plants, animals, and waste into nutrient-rich soil, known as "vermicompost." In the United States, 30-40% of the total food supply is wasted, contributing to landfill organic matter. Our experiment aimed to explore the vermicomposting rates of various organic materials, assessing their efficiency under controlled conditions. This investigation provides valuable insights into vermicomposting as a sustainable solution for recycling organic waste, applicable in waste management and agriculture. The hypothesis posited that organic materials with higher nutritional value would vermicompost faster due to increased microbial activity. Two simultaneous trials utilized identical setups with vermicomposting bins, each containing composting bedding, worms, and different organic materials (broccoli, apples, and dried leaves). The organic matter in each bin set was regularly weighed over 33 days, revealing distinct composting rates. Results showed that worms vermicomposted broccoli at the fastest rate (2.4242 grams/day), followed by apple slices (2.333 grams/day) and dried leaves with the slowest rate (1.9848 grams/day). This experiment provides essential insights into diverse organic material composting rates by worms, offering valuable information for waste management strategies and agricultural practices seeking efficient organic waste utilization to enhance soil quality and divert waste from landfills.

8AS102

Kang, Aidan

Thomas Jefferson Middle School

The Effect of Different Soil Factors Under High and Low Temperature Settings on Earthworm-Induced Soil Carbon Dioxide Emissions.

This experiment was conducted to draw connections between earthworm induced soil emissions, environmental factors, and temperature. More specifically, this experiment tested how different soil factors under two separate temperature settings influenced earthworm induced soil emissions. Knowing that earthworms can instigate increased emissions from soil, from a study conducted in 2013, understanding how soil factors influence this is key to expanding our knowledge of mitigating global warming. This experiment was conducted with two separate condition sets: high temperature and low temperature. Each set had three containers. One with fertilizer, high moisture, and a control. With each container containing four earthworms the initial carbon dioxide (CO2) level was measured in parts per million (ppm). After the initial ppm recording, 1.5 ml water was given to each container daily except the high moisture containers which were given 5.0 ml. Then after 72 hours the final readings were collected. The independent variable was the soil factor and the dependent variable was the amount of CO2 released after 72 hours measured in ppm. The constants in this experiment were the soil type, earthworm type, number of earthworms per container, time tested for each factor, and the type and size of the containers. The experiment aimed to simulate high and low temperature settings with different soil factors. With it already being known that earthworms increase soil CO2 emissions, the researcher wondered how human induced or natural factors impacted that. The results can further our understanding of the relationship between environmental conditions and global warming.

8AS103

Knauer, Nate

Gunston Middle School

Does Bird Seed Quality Matter? An Experiment to See if Birds Prefer Premium Bird Seed over Less Expensive Economy Mix

The purpose of this experiment was to test if local wild birds prefer a premium, nutritious, bird feed over a less-nutritious economy mix. Experts say that to save money, economy bird mixes often contain large amounts of inexpensive “filler” ingredients (seeds that birds will not eat). Experts suggest that birds will often pick out (flick to the ground) these “filler” ingredients in search of more nutritious seeds. In this experiment, the scientist compared a premium, nutritious, wild bird mix from a local bird “specialty” store with a budget seed mix purchased at a large-box hardware store. The scientist hypothesized that the birds that visited the feeders would pick out and reject more of the economy mix seeds (because it contained less nutritious filler seeds) than a premium feed which contained higher quality seed types. To conduct this experiment, the scientist filled two identical feeders with the two types of feed and placed them five feet apart in a backyard setting. A large collection bucket was placed under each feeder to collect any feed that was picked out and flicked to the ground. Each day (over five days), the discarded feed was poured into sealed plastic bags and weighed. The weights were compared against the total amount first placed in the feeder to measure how much was discarded. After measuring and comparing results, a much greater volume and percentage of the less-nutritious economy feed was rejected (flicked to the ground) compared to the more nutritious premium feed mix.

8AS104

Weber, Ryan

Francis C. Hammond Middle School

Does the pH Level of Groundwater Affect the Migration of the American Bittern?

The American Bittern is an elusive heron that lives in wetlands throughout North America. American Bitterns winter in Central America up to southern states of the US. They migrate up to Canada and northern states of the US. Its populations are declining due to the loss of wetland habitat. I wanted to find out whether the American Bittern had a clear preference for a specific pH level of groundwater. From my research, I found that the pH scale is how alkaline or acidic and substance is on a scale of 1-14, 7 being neutral. Anything higher than 7 is alkaline and anything lower is acidic. I also found that American Bitterns prefer a circumneutral pH level of soil which is between 6.5 and 7.3. To calculate the average groundwater pH, combine the soil and rainwater pH levels. After my research, I came up with my hypothesis. If the pH level is between 6.5 and 7.3, American Bitterns are more likely to be present in their migration. For my experiment, I made a map of the estimated groundwater pH level. I then placed 7 tracks of American Bitterns migrating south (sourced from Movebank) over my map. From this, I learned that when breeding, American Bitterns all bred in an estimated groundwater pH level of 6.1. While migrating, the pH level lowered and when wintering, it dropped to an average pH level of 5.3.

8AS105

Awotwi, Lysette; Andrade, Vanessa; Muñoz, Mia

Thomas Jefferson Middle School

Cracking the pH Code: Exploring the Effect on Brine Shrimp Hatching

This project was conducted because the researchers wanted to learn more about ocean acidification and its effects on marine life. If you decrease the pH of water, then fewer brine shrimp (Artemia Salina) eggs will hatch. The hypothesis was tested by hatching brine shrimp eggs at 4 different pH levels. The hypothesis was supported by the experiment because fewer eggs hatched in the more acidic water.

9AS106

Brooke, Josephine

Yorktown High School

The Effectiveness of Meat Alternatives In Crabbing

My project investigated the effectiveness of several sustainable meat alternatives as a substitute for chicken in recreational crabbing. Four common crab traps used in recreational crabbing were baited with chicken and three sustainable meat substitutes (sausage, fake chicken, and tofu). The traps were lowered from a pier to the ocean floor and pulled up every ten minutes. The number of crabs caught in the traps was recorded and the traps were lowered back into the ocean. I did ten trials. Chicken was successful eight of ten times; sausage two of ten times tofu one of ten times; and no crabs were caught using the fake chicken. The sausage bait was 25% as effective as chicken in successful trials and crabs caught. Based on this, the sausage is an effective alternative to chicken, and if used could cut down on the amount of poultry pollution. More investigation is needed to determine what made the sausage so effective and if it can be even more effective.

10AS107

Check, Ava

Yorktown High School

The Effect of pH on Planarian Regeneration

The effect of pH on the planaria's ability to regenerate was tested. This experiment was chosen because the pH of the world's oceans is rising due to increasing carbon dioxide levels. Since Planaria are aquatic organisms and rely on regeneration for survival, the experiment was chosen to see how the rising pH of the ocean would affect their regeneration. In addition, the human liver regenerates with stem cells, similar to planaria. Because it is dangerous to experiment on the human liver without causing harm, planaria can be used as a substitute to research stem cell regeneration. It was hypothesized that if the pH of the water is below 4 or above 10, then the planaria will not regenerate. 3 planaria each were placed in 7 250 mL plastic containers filled with solution with pHs of 2, 4, 6, 7, 8, 10, and 12. After a week it was observed whether or not the planaria regenerated. In pHs 2, 4, 10, and 12, none of the planaria regenerated. In pHs 6, 7, and 8, all 3 planaria regenerated. The results did not support the hypothesis. The planaria could not regenerate at pHs 2, 4, 10, and 12 because planarians get their regenerative abilities from stem cells called neoblasts, which contain the enzyme SMEDWI-2, which replaces cells. When the pH of enzymes becomes too high or low, they will denature and no longer function. SMEDWI-2 seemed to denature at pHs 2, 4, 10, and 12, stopping the planaria from regenerating.

7BE200

Turner, Olivia

H-B Woodlawn Secondary Program

Can Humans Taste the Diffrence Between a Hersheys Bar and Homemade Chocolate?

My project is about if humans can taste the difference between a Hersheys bar or homemade chocolate bar. The hypothesis for this experiment was that humans would be able to taste the difference and my hypothesis was correct. I had a sample of 49 and only 8 of that sample could not taste the difference. In conclusion my hypothesis was correct that humans would be able to taste the difference between the two chocolates

8BE201

Matthews, Leah

Francis C. Hammond Middle School

How Does the Environment Affect Short-term Memory?

Research Shows that noise has negative impacts on kids' learning. Learning how the noise around affects short-term memory would be helpful because you'll know the best way to study before a test and how well you comprehend information the fastest. 10 students were asked to remember a set of words in three different environments: silence, talking, or music. My hypothesis was that If a student is in an environment with silence, they will get more answers correct because there are no distractions and can focus more. My hypothesis was supported because people answered 69% correctly in a quiet environment. When I tested the students in music, 66% of the words were answered correctly. When I tested the students in a loud and talkative environment, 65% of the words were answered correctly.

9BE202

Schildknecht, Ingrid

Alexandria City High School (includes Minnie Howard)

Taste the Rainbow

My science fair project tested whether or not people could tell the different Skittles colors when their eyes were closed or covered. This would help to determine whether or not humans need a visual indicator to correctly identify a flavor. My hypothesis is if a person has their eyes closed, then they will not be able to tell the difference between the red and purple Skittles. My hypothesis was rejected because the biggest mix ups were not between the red and purple Skittles. The yellow Skittles were mixed up with orange skittles the most.

9BE203

Shewchuk, Abigail; Lester, Siena

Alexandria City High School (includes Minnie Howard)

Think Fast!

In our experiment, we sought to observe how age affects a person's reaction time. In order to do this, we researched a reaction time test from Washington University. We then sent the test to consenting participants, 10 in the 14-30 category, 10 in the 31-50 category, and 10 from the 51-80 category. The participants then took the test, following all of the instructions and sent screenshots of their results when they completed the test. We then calculated the average time for each age group based on the participants' scores. Based on the final data, our hypothesis that the youngest age group would be that fastest was incorrect.

10BE204

Brodsky, Anna

H-B Woodlawn Secondary Program

Youth Risky Behaviors and COVID-19 Vaccination Uptake

The teen mental health crisis in the United States was exacerbated by the COVID-19 pandemic. While leading the public health response to the COVID-19 crisis, the US Centers for Disease Control and Prevention (CDC) also conducted its biennial Youth Risk Behavior Survey (YRBS). The YRBS is a questionnaire completed by US high school students to assess the actions and attitudes that put them at risk. Given the exceptional context for the 2021 YRBS, the work presented here examines whether there were significant changes in survey results related to the COVID pandemic -- in specific, whether there is a link between self-reported risky behaviors and COVID vaccination rates. Its hypothesis is that an increase in self-reported risky behaviors would be found in those states that have the lowest rates of teen vaccinations against COVID-19, on the assumption that teens who did not or could not receive the COVID vaccine were more broadly impacted by the widespread messaging that deemphasized this healthy behavior. A linear regression was conducted on YRBS data from 1993 to 2019 in six US states and the 2021 results were studied for their variation from the trend. The resultant z-scores were then analyzed for a correlation with teen COVID-19 vaccination rates. In none of the eight risky behaviors analyzed was a statistically significant correlation found. This preliminary evidence suggests that vaccination behavior is independent of other youth risky behaviors. This result could inform public health officials attempting to curb risky teen behaviors.

11BE205

Marcy, Ava; Powers, Olivia

Alexandria City High School (includes Minnie Howard)

The Effect of Music Genre on Test Taking

The human brain is an intricate system that is stimulated in many different ways, one of the most prominent stimulants being music. For that reason, we aimed to test how different genres affect testing scores. The question that was asked for the procedure is "Does music genre affect testing Accuracy?". The four factors tested in the experiment were pop music, classical music, heavy metal music, and no music (control). The results found that students that listened to classical music had the highest scores. This follows our hypothesis that stated, "If classical music is played for students taking a test, they will have the fastest results". This project is a continuation, following last year's experiment which tested music genres on testing speed. Data from last year showed that pop music produced the fastest results. By comparing the results from both experiments, one can conclude that students test faster when listening to music they are comfortable with (pop) and apply more focus when listening to music that stimulates their reasoning skills (classical). With this knowledge, future education programs are able to alter learning and testing environments to specific students' needs.

12BE206

Dong, Katherine Yiting; Jin, Hao; Peng, Huier

Veritas Collegiate Academy

A Study on Echelon Use Decisions of Retired Electrical Vehicle Batteries

The vigorous development of the renewable energy vehicle industry has driven the expansion of the traction battery industry, giving rise to the emergency of battery asset management companies. Simultaneously, the recycling and echelon use of traction batteries have emerged as crucial topics for sustainable development. In order to address various scenarios for the echelon use of traction batteries, this research establishes models for battery quantity distribution across different stages and a quantity game model considering multiple uses of echelon batteries. It also examines the retirement of power batteries and the distribution of echelon batteries to downstream scenarios for battery asset management companies. The research indicates that: (1) Competition among different echelon scenarios may prevent some scenarios with low actual value or limited economic benefits from accessing echelon batteries. Meanwhile, the health of the batteries deteriorates, or differences increase, yet the profits of battery asset management companies increase. (2) When companies at the upstream echelon can sell echelon batteries downstream, the monopoly held by battery asset management companies in the game of quantity over the downstream decreases, leading to a profit loss. However, these companies will leverage their position at the top of the supply chain to restrict the competitive capabilities of upstream echelon. Consequently, echelon scenarios fully utilize echelon batteries to minimize the volume of batteries sold to the downstream market, thereby maximizing their own utility.

7BI200

Kelley, McKenzie

Swanson Middle School

The Effect of Kiwi Slice Thickness on Mass Lost Through Dehydration

My project is “The Effect of Kiwi Slice Thickness on Mass Lost Through Dehydration.” I hypothesized that, “If the thickness of kiwi slices is less, then the percentage of mass lost will be more.” The independent variable was the thickness of kiwi slices and the dependent variable was the percentage of mass lost in the kiwi slices. I tested this hypothesis by cutting 6 six millimeter slices of kiwi and 6 ten millimeter slices of kiwi, measuring the mass of each slice before dehydration, dehydrating the kiwi slices for seven hours at 135°F, and measuring the mass of each kiwi slice after dehydration. I found that the six millimeter sliced kiwis lost a higher percentage of mass than the ten millimeter slices of kiwi. While this result may seem like a predictable one, research like this needs to be done now, for our benefit in the future. As our population grows, our produce may not. Dehydrated food is a great substitute for traditionally processed produce, as it does not have the added sugars that most processed foods do. Some other benefits are that dehydrated foods have a longer shelf life, they can be rehydrated, and dehydrated foods are easier to ship, as they are lighter and take up less space. Dehydration is an important topic for all of our futures.

8BI301

Erwin, Margaret

Dorothy Hamm Middle School

The Effect of Digestion on the Concentration of Glucose in Common Drinks

Many things that we consume contain glucose, a type of sugar, the amount of which is shown on the nutrition label when these products are packaged and sold. Glucose provides immediate energy to our bodies. Foods often also contain complex carbohydrates, which are slowly broken down into glucose when digested. This project shows the amount of glucose before and after being digested in water, milk, a store-bought smoothie, a homemade smoothie, a protein shake, chocolate almond milk, and orange soda. The hypothesis is that if a drink contains complex carbohydrates, then the amount of glucose in the drink will increase after being digested. Digestion was simulated using the enzyme Invertase. The tested drinks that rose in glucose levels after digestion were the homemade smoothie, which increased by 15,000 mg/dL, the chocolate almond milk, which increased by 3,167 mg/dL, and the protein shake, which increased by 583 mg/dL. As hypothesized, these drinks all contain complex carbohydrates. The store-bought smoothie did contain complex carbohydrates and was expected to increase in glucose levels, so further testing should be done to find out why it did not increase. The glucose concentrations of the water, milk, store-bought smoothie, and orange soda did not change after digestion. The glucose concentration of each drink sample was measured using glucose test strips; digestion was then simulated using Invertase, and then, after 70 minutes, another glucose reading was taken.

8BI302

Siddiqi, Husna

Francis C. Hammond Middle School

Flowy Slime

Slime is fun to play with and I have loved to make slime for years now with my siblings. It can be a great stress reliever, and can provide guidance for many learning chemicals. Slime flows like a liquid, but unlike other liquids, its viscosity is not constant but its viscosity changes depending on what's applied on to it. Viscosity is when you measure a liquid's resistance on how fast or slow it flows. There are many ways that slime can be created with and in this case, different kinds of glues. I will test 3 different Elmer's glues and do 3 trials on each glues and test which one of the slimes has the highest viscosity.

9BI303

Rahim, Inaya

Washington-Liberty High School

The Effect of Different Kinds of Sugar on Yeast Growth

This experiment was conducted to find out which kind of sugar affects the growth of yeast and to see the fastest most efficient sugar. The hypothesis stated that sucrose my control would implement the highest yeast growth. However, out of my other independent variables It was hypothesized that maltose will have the highest fermentation rate on the yeast because of its high concentration of carbon dioxide. Additionally, maltose contains more ethanol. The groups that were tested were Galactose($C_6H_{12}O_6$), Maltose ($C_{12}H_{22}O_{11}$), lactose ($C_{12}H_{22}O_{11}$) and a control of Sucrose ($C_{12}H_{22}O_{11}$). The yeast was mixed with 2.84 grams of each different kind of sugar and 30ml of water. We then waited a total of 10m for the yeast to grow. Results were then compiled in a data table. Data from the experiment supports the hypothesis that sucrose will have the greatest rise because of its complex ability to speed the yeast fermentation process. After sucrose, maltose had the greatest rise. The average rise for maltose was to 52ml followed by the average rise for sucrose was 67.2ml. Standard deviations were calculated as well as an ANOVA test and t-tests, total data was not statistically significant with a p- value of 4.279E-25. Data from the experiment supports the hypothesis that normal sugar will have the greatest effect on yeast growth. After ten minutes the control group had a mean height of 67.2ml, and then maltose with a mean height of 52ml.

9BI304

Hunnicutt, Lucy; Bisrat, Leyat

Alexandria City High School (includes Minnie Howard)

Sugar Content in Drinks

Have you ever wondered if the amount of sugar listed on your drink was lying to you? Well, we figured that out for you! We decided to investigate the sugar content in different drinks. We did this because we wanted to know if the total amount of sugar listed on the bottle was accurate. We also did this so that we could inform people about how much sugar they consume on a daily basis, and hopefully convince them to think twice about what they drink, before they drink it. We hypothesized that if we tested the amount of sugar in our drinks, then we would discover that the labels on the drinks are inaccurate. When we first started the experiment we decided to boil down the drink until there wasn't any liquid left. We realized that would not work and came up with a different idea. For our second try we decided that we should use a hydrometer to measure the density, and therefore the sugar content in the drinks. After doing this experiment, we concluded that the sugar content was relatively accurate.

10BI305

Eclarinal, Elise; Madigan, Michael

Wakefield High School

How Smell Affects Taste

Smell and taste are two vital senses the body utilizes. Flavor is commonly described as the "taste" of food, when in reality, is much more. Though smell and taste are two different senses, the connection between the mouth and nose holds relevance over the experiment. While taste buds in the tongue identify taste and the nerves in the nose identify smell, both sensations are communicated to the brain, hence the ability to recognize and differentiate flavors.

6CH400

Pearson, Amelia

Swanson Middle School

Could Salt Water Batteries Be a Solution to Lack of Electricity in Coastal Communities?

My experiment is about salt water batteries and how they could be a solution to lack of electricity in coastal communities worldwide. While Lithium batteries are commonly used they are negative for the environment and are linked to health problems. Salt water batteries, in contrast, could be readily available without negative environmental or human impacts. The reason batteries are not more widely in areas without electrification is because of availability and expense. If saltwater batteries can be produced cheaply then electricity could be available to people with no current access. I conducted three different tests on salt water batteries: different anode and cathode pairs (AL/C; ZN/CU); amount of solution in a battery (150mL/600mL); and number of cells (4 versus 1 with constant solution volume). Across all tests the aluminum and graphite pair worked marginally better, but the ranges for AL/C were uniformly bigger than for zinc and copper. In my second test, the resulting voltage was no different between 150mL and 600mL of solution. For my third test the average voltage for the series of four 150mL cells versus the single 600mL solution cell was approximately six times greater. In conclusion, the anode/cathode pair and solution volume has little impact on the voltage production of the batteries, allowing batteries to be constrained in size and for more readily available electrode elements to be used. The greatest impact on battery voltage was the number of cells, suggesting batteries should be developed with many cells in series.

7CH401

Atewologun, Corsen

Thomas Jefferson Middle School

Does Your Food Lie?

I will find out if different chip brands lie about their amount of calories in their chips. This is interesting to test because I want to find a healthier version of chips. The hypothesis that I created was that the chip brands with the lower ratings on Yuka will have a bigger chance of lying about the calories in the chips. I'm testing this by using a calorimeter kit. My Hypothesis was incorrect but slightly correct at the same time. My results were correct but the calorimeter could only record part of the experiment. So I reached out to a few different college professors and they had explained to me to use a lid and try to contain the heat to the container and manipulate the heat so it can heat the water up. Therefore it is neither incorrect nor correct.

7CH402

Ganzorig, Aranz

Swanson Middle School

Effect of Filtration on Polluted Water

Water pollution poses a significant threat to ecosystems and human health worldwide. This study aimed to assess the efficacy of various filtration techniques in reducing pollutant levels in contaminated water. The study focused on comparing the effectiveness of gravity, granular, vacuum, and centrifugal filtration in removing pollutants. Polluted water samples were created with tap water, food coloring, and silt. Each filtration method was applied separately, with multiple trials conducted to ensure accuracy. The filtered water samples were analyzed to quantify the reduction in pollutant concentrations via a TDS meter.

The data indicated that all four filtration methods exhibited varying degrees of pollutant removal. Vacuum filtration demonstrated the highest efficiency, with a reduction of up to 9% in ppm. Gravity filtration achieved removal rates of approximately 4%.
These findings highlight the potential of filtration techniques, particularly vacuum filtration, in purifying polluted water. Further research is required to optimize filtration processes and explore their scalability. Understanding the effectiveness of filtration methods is crucial for developing sustainable water treatment strategies to combat water pollution and ensure access to clean and safe drinking water for all.

7CH403

Nyambayar, Saruul

Swanson Middle School

The Effect of Soil on Water pH

My Hypothesis: If I change the type of soil, then the pH of the water will likely be different. The purpose of this experiment is to see if soil can play a role in changing water pH and whether or not it's important or not. Soil is a mixture of organic and inorganic materials.

The type and composition of material affect texture, color, and other characteristics. I used three soil types: loam, silt, and clay. The type of soil affects plant growth, lifespan, and health. Many plants need acidic soils, and others need alkaline soils. For instance, strawberries need acidic soil, while lavender needs alkaline soil. In my procedure, I used a soil and water pH meter to measure the samples before and after mixing. I used test tubes to hold the mixture, a coffee filter to separate the soil and water, and a pH strip to find the results.The results show that loamy soil results in the highest pH with an average of 6, and silty soil makes the water the most acidic with an average of 4.8.In conclusion, according to the results, the effect of soil does change the pH of water because not only does soil play a role, but also the type of soil can play an effect too.

7CH404

Piester, Daniel

Gunston Middle School

The Effect of Baking Soda versus Baking Powder on the Volume of a Cupcake

Cupcakes are a beloved American staple food with a rich history. Making perfectly fluffy cupcakes will impress any guest. Baking powder and baking soda are great leavening agents to produce fluffy cupcakes. But many people don't know the difference between them and how they affect the volume of a cupcake. This project focuses on the effect of baking soda vs. baking powder on the volume of a cupcake. For this experiment, the scientist followed a vanilla cupcake recipe while maintaining the consistency and separation of the different batters. The scientist took the following steps: weighed the cupcake batter before baking to make sure all had the same amount of batter; baked the cupcakes in the same oven at the same time and temperature; measured the weight of the baked cupcakes and their volume using a homemade volumetric measuring device. The hypothesis was if the scientists used baking powder and baking soda in the cupcakes, the volume would be greater than the other ways of leavening in this experiment because the baking soda and powder would give one another the leavening boost that results in greater volume. The results supported this hypothesis by showing that the baking powder and baking soda cupcakes had the highest volume, with a 107% increase compared to the control. In conclusion, including baking soda and baking powder in your batter is the best way to ensure fluffy cupcakes, but if you only have one of these leavening agents the volume will take a hit but they

7CH405

Ramboz, Gavin

Kenmore Middle School

Froze and Cons: The Effects of Viscosity and Sugar on the Freezing Time of Liquids

I was interested in exploring whether the type of liquid affected how fast it freezes. Based on my research, viscosity and sugar were two big factors in the amount of time it takes liquids to freeze. The goal of the science project was to find out how much viscosity and sugar affected the freezing time of liquids. To start, I researched how they affect the freezing process, and found that viscosity decreases the freezing time and sugar increases freezing time. I chose 5 liquids that have different viscosity and sugar contents: Diet Coke, Coke, Apple Juice, Orange Juice, and Milk. I included Water as a control liquid. I put the same amount of each liquid in different cups in the freezer at the same time, and checked them periodically until they were all frozen. I hypothesized that Orange Juice would freeze first and Coke would freeze last. The results followed the predicted order of viscosity and sugar content except for Water and Apple Juice. I concluded that sugar had a greater effect on freezing time than viscosity.

7CH406

Sibley, Kayla

Kenmore Middle School

The Effect of Different Cooking Temperatures on the pH Level of Fruit

This experiment was conducted to see if cooking fruit in a pan increases the pH level. The experiment was done by smashing up tomatoes and pineapple and then putting them in separate pans. PH level measurements were taken at 150, 200, 250, and 300 degrees Fahrenheit. The hypothesis was that the pH would increase due to the Maillard Process. However, the data did not support the hypothesis. After some research, it was discovered that pineapple's pH has nothing to do with the burning feeling. Bromelain is an enzyme found in pineapple and can be found in grocery stores as a meat tenderizer because of its ability to target and break down collagen. According to the researcher's theory, heating the pineapple broke down its bromelain, which eliminated the characteristic burning feeling. Nevertheless, additional investigation would be necessary to verify this theory directly. The experiment's findings may help to dispel any misunderstandings that cooking fruit decreases its acidity. If an individual suffering from GERD decided to cook fruit under the belief that it would lower its acidity, they could potentially encounter notable symptom exacerbations and might have difficulties in pinpointing the source. Should a person coping with GERD come across this experiment, it has the potential to assist them in steering clear of situations that could exacerbate their condition.

7CH407

Choi, Olivia; Carney, Abigail

Dorothy Hamm Middle School

What is the Effect of Type of Fruit on Extractable DNA? Kitchen Secrets: Cracking the Code of DNA.

Deoxyribonucleic acid (DNA) is the building block of chromosomes and genes. With a double helix structure like a spiral staircase and base pairs (A-T, G-C), DNA has specific components. In this study, we asked what is the effect of the type of fruit on the mass of extractable DNA? For methods, we identified multiple fruits for trial and measured them to similar weight (g) including strawberries, blueberries and banana. We also tried plum tomatoes, raspberries, and blackberries. The experiment we conducted consisted of 8 steps using soap, salt and isopropyl alcohol as reagents. We completed them precisely and calculated the weight of DNA. We repeated the trial three times with three different fruits. For results, a single cut banana had extracted the highest mass (8.22g mean) of DNA followed by blueberries (2.52 g mean). The least DNA (0.34 g mean) was extracted from strawberries. Plum Tomatoes, Raspberries, Blackberries did not have weighable DNA. In conclusion, we successfully extracted DNA from fruit. Banana was the highest, followed by blueberries and the least with strawberries. Future assessment may be performed with a chemical test like a PCR test.

7CH408

Pineda Sarmiento, Andre; Bartels, William (Fin); Raver, James

Francis C. Hammond Middle School

Pliability of Wet Wood

Have you ever wondered what wood would hold best against rain-like conditions? Us too! We wanted to find out so we can help you and the community. So we did some research and found some of the best types of wood. So we gathered pine, cedar, and oak wood. After buying the wood we soaked 3 slabs of each wood in water for 5 days. Then we applied 200 pounds worth of weight to each piece of wood to see the amount the wood bent. Then the piece that bent the least is suspected to be the most weather-proof type.

8CH409

Hazlett, Amelia

George Washington Middle School

Don't Dry This at Home

The athletic-wear industry is a rapidly growing market and the options for exercise clothes are vast. Many companies market their workout gear as superior due to their moisture-wicking properties, which prevent water from being absorbed by the fabric. Moisture-wicking fabric uses “capillary action,” which pulls moisture through tiny holes in the fabric to the surface of the garment, where it evaporates. This leaves the fabric feeling dry. Moisture-wicking fibers are synthetic, made by humans through a chemical process, where natural fibers come from living things such as plants and animals. My research question was, “Do natural fibers or synthetic fibers wick moisture faster?” I hypothesized that synthetic fibers would wick moisture faster. To test my hypothesis, I purchased samples of three synthetic fabrics (nylon, polyester and rayon) and three natural fabrics (cotton, linen, and silk). I weighed a swatch of each when dry, submerged the swatch in water, and then weighed each when wet. I then laid the fabrics to dry and weighed them at 10-minute intervals until they reached their original dry weights. The fabric that dried the most quickly was nylon, followed by silk. Polyester and cotton tied as the next quickest, followed by linen and rayon, which also had the same dry time. My findings did not conclusively support my hypothesis. Because I found that some natural fabrics dried faster or at the same speed as synthetic fabrics, I recommend that companies explore using natural fabrics where possible because they are better for the environment.

8CH410

McCaughan, Benjamin

Gunston Middle School

How Does the SPF of Sunscreen Affect the Surface Temperature of 240 mL of Water?

This experiment was about how the sun protection factor(SPF) of sunscreen affects the surface temperature of water. The reason I chose this experiment was because I found out that higher skin temperatures lead to higher risk of skin temperature. My hypothesis was that if the sunscreen's SPF was higher, then the water would have a higher temperature because the higher SPF insulates better than the lower one. I conducted the experiment over the course of three days. Once each day, I put one cup of water into three different ziploc bags. On the first ziploc bags, I put 70 SPF sunscreen. On the second ziploc bag, I put 50 SPF sunscreen. On the final ziploc bag, I put no sunscreen. I put them each under the sun for three hours. I checked the temperature of the water before, in the middle, and after the three hours. The final results were that the ziploc bag covered in 50 SPF sunscreen caused the water to be the hottest.

8CH411

Netto, Sofia

Gunston Middle School

The Effect of Natural Resources in Water pH Levels

About 2 billion people don't have access to safe drinkable water. Water and Climate Change are connected; higher water temperatures and frequent floods and droughts exacerbate water pollution. Drinkable water has neutral pH 7, and reflets drinkable water quality. Commercial water filters can be relatively expensive, based on factors such as brand, features, and filtration capacity. So homemade water filters could be an alternative using available materials, specially for places with limited financial resources. This experiment aimed to determine if homemade filters could be effective as commercial water filter in achieving good water quality, by neutral pH value, and absence of visible impurities and odor, being an sustainable alternative to commercial filters. Three types of homemade filters were constructed: sand and rock (filter 1), gravel and activated charcoal (filter 2), and cloth and cotton balls (filter 3). Results indicate that water filtered by homemade filters 1 and 3 exhibited a pH value of 8.0, closer to the commercial filters pH value of 7.5, comparable water quality. Waters from filters 1 and 3 were clearer, suggesting more effective filtration. In contrast, water from homemade filter 2 demonstrated a higher pH value of 9.0, indicating alkalinity. The effectiveness of homemade filters 1 and 3 in achieving water quality similar to commercial filters shows their potential for use in regions with limited resources. The study also shows that homemade filters using recyclable resource could an environmental sustainability and affordable solution for obtaining drinkable water purification challenges exacerbated by climate change.

8CH412

O'Neil-Vira, Ishaan

George Washington Middle School

The Optimal Temperature For Copper Sulfate(CuSO4) Crystal Growth

Crystal mining is a large problem all around the world. It is problematic because it can affect ecosystems for several reasons. The first being the fact that crystals take years to grow naturally. For example, Diamonds take anywhere between several million to one billion years to grow, and generally for about 100 miles below the surface of the earth. This means to get them you have to make massive holes in the ground and disrupt ecosystems to mine the crystals. Lab-grown crystals are a solution to this problem. This project determined the best temperature to grow crystals at home. Growing crystals at room temperature should make for optimal crystal growth. Five different temperatures were used in this experiment (Hot, Room temp., Cold, Freezing, and Fluctuating). Crystal seeds were strung on fishing twine and placed in a solution to grow. They were then left alone for ~1 month. They were then weighed. The room-temperature crystal grew exponentially better than any of the other crystals. The average weight of the crystal was 3.4g. The heaviest crystal weighed 14.3 grams and two crystals didn’t grow due to some errors in the project. The crystal grown outside did not grow due to the crystal seed slipping out of the fishing twine. The one in the water bath dissolved. These two problems could be fixed by having multiple crystals growing, or monitoring them more. Therefore, if growing crystals at home, the optimal way to do so is to grow them at room temperature.

8CH413

Pamulapati, Reve

Dorothy Hamm Middle School

The Effect of Different Types of Solutes on the Boiling Rate of Water Using Radiative and Conductive Heating Methods

Every day when I come home, I heat around 400 milliliters of water in my microwave and pour it into a cup of ramen noodles. However, the three minutes in the microwave feels like an eternity in the mind of a ravenous middle schooler. I started to wonder about ways to heat the water faster. The focus of this experiment is understanding the impact of different solutes (salt and sugar) on the boiling rate of water, with a focus on conductive (stove top) and radiative (microwave) heating methods. Particularly looking at whether salt or sugar increases the rate at which the water boiled and if so, whether this was true for both types of heating methods.

8CH414

Park, Thomas

Swanson Middle School

The Effect of Different Types of Salt on the Time it Takes for Iron Nails to Rust

The purpose of this study is to investigate and understand the influence of salt on the corrosion or rusting process of iron. I hypothesized that the presence of salt in the surrounding environment will cause the rusting process to accelerate, leading to a higher rate of corrosion compared to rusting in a salt free environment. I conducted 10 trials for each independent variable, and recorded, with a stopwatch, when the first sign of rust appeared. My data did not support my hypothesis as my independent variables exposed to salt did not exhibit a rusting speed faster than the one without salt.

8CH415

Saperstein, Margaret

Swanson Middle School

The Effect of Salinity on Capillary Action

Plants use capillary action for their vital functions. Though with climate some plants will be exposed to water with differing levels of salinity. For my project I chose to study the effect salinity would have on the function of capillary action. To test this I used glass capillaries and water with various salinity levels. I found that salinity disrupts capillary action because my data showed an inverse relationship between salinity and how far the solution rises from the surface in the capillaries. A posible explanation is that the cohesion between water and water and the adhesion between glass and water got disrupted by higher levels of salinity.

8CH416

Beaulieu, Gabriela; Busigo, Marlena

Gunston Middle School

The Effect of the Way You Make Chocolate on the Speed of the Process

This project is a great way to learn how people made chocolate back when it was done all naturally versus the way it's made today which is using technology. The goal of the scientists' project was to find out the most efficient way and the amount of speed it took to make chocolate from scratch. The scientists decided to figure this out by making chocolate in the most used processes, which are the traditional and modern ways. The difference between the two is the modern way uses all technology like a blender, whereas the traditional way uses more hands-on and traditional tools, such as a molkajete. In the end, the scientists found that the traditional way had a shorter setting and mixing time than the modern, which meant that the traditional way was faster overall.

The scientists are a part of the Hispanic community, specifically Colombian. They also enjoy culinary arts so they found a project that combined both. The purpose of the project was for the scientists to connect to their roots and see how making chocolate was done before modern technology. The scientists learned the ways and the problems with cacao beans. They had a lot of fun and learned way more about their culture.

8CH417

Goldhirsch, Lucy; Gwilliam, Laura-Kate

Gunston Middle School

The Effect of Natural Water Filters on Dirty Water

Most people know that a human being can only survive without water for a maximum of 3 days, but most people don't have access to safe drinking water. The goal of this project was to find the effect of different natural water filters on dirty water. The approach the scientists used was by testing the pH levels of dirty water before and after being filtered by natural filters. The filters that were used were powdered and coarse activated charcoal, which are natural water filters. Safe drinking water should be between the pH levels of 6.5-8.5. The dirty water before being filtered had a pH level of 5. Once the scientists knew the pH level of the water, they could start the filtering process. The scientists mixed the dirty water in with the different charcoals, and after it was mixed it was strained through coffee filters into cups. The pH levels from the coarse activated charcoal had a range from 7 to 8. For the powdered activated charcoal, the pH levels were between 4 and 5, and the control was between 5 and 6. The scientists came to the conclusion that the coarse activated charcoal worked best. It was very surprising that the control did better than the powder. The scientists met their goal by concluding that coarse activated charcoal works best as a natural water filter by testing the pH levels of the water.

8CH418

Temprosa, Noah; Haiki, Tahar

Francis C. Hammond Middle School

Preposterous pH Levels

The reason for doing this experiment is to try and help reduce ocean acidification by finding the most effective item that many people have in their house. We are trying to find the best household item to raise the pH levels. We used baking soda, liquid chlorine, soap, pepto bismol (milk of magnesia), vinegar, baking powder, wine, and an alkaline water filter to test this. Our hypothesis was that, if you use baking soda, liquid chlorine, soap, pepto bismol, vinegar, baking powder, wine, and an alkaline filter, then the liquid chlorine would work the best because it releases a chemical that drastically raises the pH levels. We first mixed the lemons into the water and tested the pH, then put 3 cups of water in each bowl and tested them, lastly we recorded the pH of each. When we did our experiment we were surprised that the baking soda raised the pH the best and the pepto bismol did the worst.

9CH419

Broadway, Sunny

Alexandria City High School (includes Minnie Howard)

Breakfast Item? Not Anymore

The purpose of this experiment is to explore the potential of transforming milk into a durable and useful material. It is hypothesized that when a specific acid (in this case, lemon juice) is added to milk, the proteins in the milk will stiffen and form a hardened plastic-like material; it will also weigh less in grams compared to the other acids. To test this hypothesis, three different acids will be used: citric acid, acetic acid, and stearic acid. - Once the milk and vinegar mixture is poured into the sieve, the curds will gather on top of the sieve, and the liquid will drain through into the clear cup. Curd is obtained by coagulating milk in a sequential process called curdling; just like the cheese making process. Resulting in a hardened plastic-like material. This experiment will provide valuable insight into the potential of milk as a unique material in the manufacture of plastic-like products. The results of this experiment will provide an understanding of how different acids affect the final product and if milk can be used as a viable alternative to traditional plastics.

9CH420

Day, Chloe

Yorktown High School

The Effect of the Type of Food on the Sucrose that is Converted to Glucose by Invertase

My hypothesis for the experiment was that orange juice would have the highest glucose concentration out of almond butter, peanut butter, and unsweetened applesauce. The hypothesis turned out to be correct because orange juice had 2000 mg of glucose which was clearly the highest value out of all the others by a long shot.

My P value was 0.01 percent meaning my experiment was 99.99% accurate. My data that I collected was not randomized so I reject the null hypothesis. Overall, there was a significant difference between all the groups except almond butter and unsweetened applesauce.

The reason that orange juice had the most glucose was because it had the most sucrose and the same with almond butter, peanut butter, and unsweetened applesauce. I tried to practically apply this concept to diabetics in the world by making it easier for them to see how much glucose they are consuming. In this project, I converted sucrose to glucose with an invertase and in the human body sucrose is converted to glucose by sucrase. This helps make the final glucose number for each food more accurate because the invertase is ultimately acting like sucrase in the human body.

9CH421

Freeman, Sarah

Washington-Liberty High School

The Effect of Chalk Additives on Water Absorbency

This experiment was conducted to determine whether FrictionLabs Unicorn Dust climbing chalk, a popular and highly rated brand, or 321 Strong, a generic brand, would be more effective at absorbing atmospheric moisture due to their respective additives.

Because climbing chalk, made of mostly magnesium carbonate (MgCO3), is purified from sediment found in bodies of water, different brands' levels of purification and possible drying agents/other additives included can have a significant impact on the effectiveness of any one brand of chalk.
FrictionLabs Unicorn Dust was hypothesized to perform better compared to 321 Strong and two controls, pure magnesium carbonate and silica gel beads, because of its higher rating and larger audience in comparison to 321 Strong chalk. This implies that its specific recipe of magnesium carbonate and additives is more effective than a lesser-known, generic brand such as 321 Strong.

The hypothesis was supported by the data, which concluded that of the two brands, FrictionLabs Unicorn Dust chalk absorbed 0.0619 grams more on average. Predictably, magnesium carbonate as the negative control was the least effective, and silica gel as the positive control was the most effective.

The results were determined via an ANOVA test to be statistically significant, leading the null hypothesis to be rejected. It was concluded that FrictionLabs Unicorn Dust likely has a more effective variety and ratio of magnesium carbonate to additives.

9CH422

Giambalvo, John (Rocco)

Yorktown High School

Which Type of Moisturizer is Most Effective?

For my experiment, my hypothesis claimed that occlusives would be the most successful moisturizer due to the way my experiment was structured. I previously believed this because the experiment was structured to keep water under the filter paper from evaporating, which is exactly the way occlusives work on human skin. As my evidence shows, there was not nearly enough statistical variation to prove any difference between the moisturizers. However, the filter paper without moisturizer on it proved to have a much higher amount of water evaporated from under it, which proved that although moisturizers work in different ways they are all effective. I believe that my experiment had very little variation between my results because I didn't use a very exact material for my fake skin. The filter paper wasn't quite as accurate as other materials, for example a jello mold (the moist gelatin acts a bit like skin).

9CH423

Mataka, Tomio

Arlington Tech/Career Center

The Effect of Paint on Paints' Lightfastness and the Effect of Light on Paints' Lightfastness

The purpose of this experiment was to inform artists about the lightfastness of different paint brands, and the effect of different levels of light on paintings, something critical to creating art. For IV 1, Crayola Acrylic Paint, Crayola Watercolor Paint, Winsor & Newton acrylic paint, Liquitex acrylic paint, and ARTEZA watercolor paint were chosen as the swatches. For IV 2, a zero lux light level (no sunlight), 509.26 lux light level (indirect sunlight), 2915.13 lux light level (direct sunlight), and 4000 lux level (UV light) were chosen as varying intensities of light. A scale from 0-10 was created, with 0 being 0% opacity and 10 being 100% opacity. The results showed the Crayola Watercolor Paint faded the most in all intensities of light, besides the 0 lux light level, where none of the paint types faded. Thus, the Crayola Watercolor Paint had the least amount of lightfastness, which means the hypothesis for IV 1 was accepted. Both watercolor paints started with a 7 on the scale (as compared to the acrylic paints, starting with a 10), because watercolor is a thinner paint. Crayola brand paints are also cheaper materials marketed towards children, so the material is lower quality, therefore less lightfast. For IV 2, the results show the paint faded the most under the 4000 lux UV light, which means the hypothesis for IV 2 was accepted.

9CH424

Mulder, Malena

Alexandria City High School (includes Minnie Howard)

How Cooking Methods Affect Vitamin C Retention

The purpose of this project was to test the effect of different cooking methods on vitamin C (ascorbic acid) retention in vegetables. I tested the effects of boiling, roasting, and microwaving on broccoli and potatoes using a redox titration test with a cornstarch and iodine indicator solution. I compared the amount of vitamin C retained in the vegetables for each cooking method including raw (control) using a redox titration with solutions made from each vegetable for each cooking method. I counted the number of drops needed to change the color of the indicator, with lower numbers of drops indicating a higher concentration of vitamin C. My hypothesis was that the microwaved vegetables would retain the most vitamins, and the results supported my hypothesis.

Vitamin C is important to our health and the way we cook our foods can affect the amount of ascorbic acid in the foods we eat. Previous research found that cooking can destroy vitamin C, so it is important to determine which cooking methods are least destructive. In this experiment, the raw vegetables had the highest concentration of vitamin C. When comparing different cooking methods, microwaved vegetables required the least amount of drops, indicating the highest concentration of vitamins. Future research will examine whether my hypothesis extends to other nutrients as well as other vegetables.

9CH425

Wielechowski, Teagan

Yorktown High School

The Effect of the Type of Liquid on the Amount of Heat Lost Over Time

The purpose of the experiment is testing how the type of liquid affects the amount of heat retained over time. This is beneficial for the human species because those who enjoy warmer drinks may want to use this liquid in order for it to retain the most heat over time. In addition, the insular cortex of our brain is where humans form judgment or others, as well as regulate their homeostasis. This is why holding a warm drink can promote the positive judgment of others' character. In the hypothesis, it was stated that water will be the liquid that retains the most heat as a result of the high specific heat and heat capacity, which can result in a greater retention of heat over a short period of time. The hypothesis was actually proven incorrect, even though there was statistical significance within the results. The mean for each of the levels of IV are as follows: Water had a mean of 38.9 degrees celsius lost in five minutes, Whole Milk was 37.4, Almond Milk was 37.4, and Oat Milk was 36.66. Oat Milk lost the least amount of heat as a result of the carbohydrate content. Oat milk has 4 grams of added sugar and 19 grams of carbohydrates. Sugar is a type of carbohydrate, and sugar has a high capacity, one that is even higher than fresh water. This is why Oat Milk was able to lose the least amount of heat.

9CH426

Denton, Lilah; Combs, Juliana

Wakefield High School

The Effect of the Amount of Baking Soda Added to Cupcakes on Their Growth

The goal of this project was to test how the amount of baking soda added to cupcakes would affect their growth. Some people would think that cupcakes and other treats would still rise and taste good even without baking soda. But our experiment was to show that baking soda makes cupcakes taste better and rise longer. If different amounts of baking soda are added to cupcakes, each amount will affect the rise of each cupcake. To carry out this experiment, a lot of precision and caution was necessary, making sure that each measurement that was supposed to be uniform was so. As a result of this experiment, baking soda was essential for the growth of a cupcake. Baking soda creates carbon dioxide, which makes the cupcake rise. During the experiment, it was very important to include many before and after photos. As a result, writing was much easier as I could see the results visually. Without baking soda, cupcakes cannot rise and may remain flat. In conclusion, the amount of baking soda added to the cupcakes will affect their growth.

10CH427

Goody, Claire

Washington-Liberty High School

pH and its Effect on the Oxidation Rate of Apples

This experiment was conducted to determine the effect of pH on the oxidation rate of apples. It was hypothesized that a lemon juice solution with a pH of 3.0 would be the most effective at slowing the rate of oxidation since studies have shown that solutions with a low pH have been the most effective at slowing down the oxidation process in apples. Additionally, Ambrosia apples treated with the solutions would brown slower than the Red Delicious ones since they have a lower concentration of phenolic enzymes, including PPO. The groups tested were lemon juice solutions of pH 3.0, pH 4.0, and pH 5.0, as well as distilled water with a pH of 6.6. The experiment was conducted by dipping apple slices into each solution and setting them on a plate. Data would be recorded when initial browning started to show (DV #1) or after a two hour period (DV #2).

The results showed that the pH 3.0 solution was the most effective at slowing down the oxidation process, with averages of 12.18 minutes and a browning score of 0.7 for the Ambrosia apples, which browned slower than the Red Delicious ones dipped in the same pH level (10.68 minutes and a browning score of 1.1). ANOVA tests conducted for the dependent variables were both statistically significant. T-tests conducted for dependent variable #2 for both varieties were not significant.

10CH428

Qadir, Zaineb

Yorktown High School

The Effect of the Type of Substance on the Amount of Vitamin C Present

The purpose of this project was to compare the amount of iron in fruits versus an iron tablet. For those who suffer from iron deficiency, it can cause an impact on daily life, since many deal with fatigue, dizziness, and more. Iron is important to a diet that is well balanced.

In this experiment, strawberry juice, watermelon juice, and iron tablets were utilized. It was believed that strawberry juice would have the highest iron content because strawberries have at least enough iron to persuade someone to include strawberries in their diet, whether they have iron deficiency or not. This experiment was completed using a method called titration. Titration is where one is able to find the unknown concentration of a solution using a known concentration in a solution. For this experiment, the amount of iron was the unknown concentration, while the concentration of KMnO4 (potassium permanganate) was known.

The data displayed that the amount of iron in the iron tablets was the greatest. There was a significant difference between all three independent variables tested, which were strawberry juice, watermelon juice, and iron tablets. The amount of iron in the watermelon juice was less than both the strawberry juice and iron tablet. This portrays that it is beneficial to use an iron tablet for iron deficiency, though it can still be of great assistance to include strawberries and other fruits or vegetables of similar amounts of iron

10CH429

Regen, Suzanne

Alexandria City High School (includes Minnie Howard)

Dye Depth

Color is a universal language, offering meaning when it cannot be translated. Color is often derived from dye that is made from plants, animals, and other natural properties. To that end there two main types of dye: synthetic and natural. Synthetic dyes can cause exponential harmful to the environment, so I focused my project on seeing if natural dyes could achieve the same vibrant color that synthetic dyes achieve. I measured how swatches of 100% cotton were dyed in increments of 1, 3, and 9 minutes. These swatches compared a red rit dye and a beet sourced dye. Both sets of swatches measured on the same depth scale, achieving the same depth. The swatches were compared on the pantone color scale. Overall if the switch was made to natural dyes equal color depth could be achieved.

10CH430

Snyder, Elliana

Washington-Liberty High School

Comparison of Liquids with Varying Calcium Levels to Undergo Spherification and Reverse Spherification

This experiment explores the ability of spherification and reverse spherification. Spherification is the process of turning liquids into spheres through the creation of a gelatinous membrane which has applications within the culinary industry to create high quality meals. The capabilities of liquids with varying calcium levels were tested to better understand the effect it has on the success of undergoing spherification and reverse spherification. It was hypothesized that if a liquid has a high calcium content, then reverse spherification will be more successful in creating spheres of equal diameter because rather than combining calcium filled liquids with calcium lactate, reverse spherification combines the liquid with sodium alginate allowing the liquid to quickly form bonds with the sodium alginate bath and keep a spherical shape. These rapidly formed bonds allow the liquids with a higher calcium concentration to merge. This was supported by the results.

Whereas the data gained from the process of spherification proved not to be statistically significant, the data gained from reverse spherification did prove to be significant. Further testing was completed and found that the results from comparing orange juice and yogurt as well as orange juice and milk were statistically significant. These results supported the research hypothesis, because the difference in calcium content between these liquids was the greatest, proving that calcium content has a significant effect on the success of liquids to undergo spherification and reverse spherification.

10CH431

Craine, Isabel; Schuerhoff, Cate

Alexandria City High School (includes Minnie Howard)

Organic Chemistry of Glossier You Perfume

The marketing line for a popular perfume called “Glossier You” is that it “smells a little different on everyone.” We investigated how pH influenced the perfume’s compounds to react on skin. We chose to analyze the perfume sample at pH 4, 5, and 6 to bracket the range of human skin pHs.The main way that perfume is analyzed is through a gas chromatograph- mass spectrometer (GC-MS) system (PerkinElmer). This instrument separates gas molecules on the basis of weight and measures how much of a compound is present. When we reached out to a company called Innovatech Labs, they were willing to help run our samples and help us with our project. We hypothesized that “If the perfume is exposed to surfaces of differing pH, then the gaseous compounds released will be different in quantity, identity, or both.” Kimwipes were dipped in solutions of pH: 4, 5, and 6, then the perfume was sprayed onto each Kimwipe in a vial. Each gas sample was pulled into the syringe and injected into the GC-MS. Based on the results of the GC-MS analysis, we were able to identify different organic gaseous compounds present in the perfumes at different pHs. We received abundance-time charts, and a list of every compound found in the sample, which we linked to scents. Overall, we found support for our hypothesis that if the perfume is exposed to surfaces of differing pH, then the gaseous compounds released will be different in quantity, identity, or both.

10CH432

Dong, Yufan; Gao, Jiayin; Li, Yanrong

Veritas Collegiate Academy

Study on Droplet Manipulation of Chemically Modified Biochips

Digital microfluidics has become a key enabling technology for biomedicine, and can be applied to single-cell analysis, high-throughput, and automated chemical testing. In order to exhibit strong hydrophobicity, chemical modification need to be practiced to digital microfluidic chips. In this paper, two modifications, physical adsorption and covalent binding, are designed to make the chips' surfaces hydrophobic. Through measuring the contact angle, the surface of the chip after physical adsorption of Polytetrafluoroethylene (PTFE) is found more hydrophobic, and the hydrophobic angle was 15 larger than that of covalently modified chips. In addition, our results demonstrate that the contact angle of the PTFE-modified chip and the surface tension of droplets decreased after the surfactant is added into the droplet. In the droplet manipulation experiment on the modified chip, the PTFE-modified chip can move the droplet, while the covalently modified chip cannot do it. What's more, the experiment also show that surfactants will affect the movement of the chip, even if 0.01% Tween 20 is added, the droplets still cannot flow.

11CH433

Deng, Haonan; Li, Tianjun; Xu, Jenny

Veritas Collegiate Academy

Transport of Asymmetric Electrolytes in Confined Geometries Studied via Molecular Dynamics Modeling

Electrolytes play an important role in society, with a large variety of applications, from biotechnology to rechargeable batteries. However, ion transport in electrolytes is still not fully understood, despite over a century of scientific study. In particular, no comprehensive theory exists describing the conductivity of asymmetric electrolytes in confined geometries, such as ion channels or nanoscale pores. To address this knowledge gap, I investigate the ion mobility of asymmetric salts and the resulting ionic conductivity in such geometries using molecular dynamics simulations. These properties are studied as a function of temperature, ion concentration and electric field strength. For symmetric electrolytes, Kohlrausch's famous law predicts that the ion mobility decreases with increasing concentration, but the situation for asymmetric electrolytes is far more complicated, as the anions and cations now have different concentrations and experience different forces due to the applied electric field. Through large-scale computer simulations, I demonstrate that the situation may be further complicated by temperature-dependent ion pairing into complexes of different net charges. Using high-precision statistics, I compile one of the first comprehensive data sets that examine whether Kohlrausch's law also applies to asymmetric electrolytes and confirm that his law is still applicable in such systems as long as the temperature is not near the critical point of the electrolyte. Based upon this, I propose that—through careful choice of concentration and temperature—these electrolytes are promising alternatives for increasing the ionic conductivity in energy applications.

12CH434

Tong, Brian Tiansheng; Huang, Meixuan; Xu, Shengying

Veritas Collegiate Academy

Development and Application of Online Acrolein Detector

At present, the detection of acrolein often requires more complex and cumbersome sample processing steps, coupled with high-performance liquid chromatography and other expensive instruments for detection, featuring poor effectiveness and higher costs. Another part of the difficulty of acrolein detection is the collection of acrolein. Common gas sampling device is often large, complex, and difficult to carry out testing at home. Such a device makes acrolein detection cannot be carried out online, causing people facing acrolein exposure risk to be difficult to notice the existence of risk and avoidance the first time.

We developed a visual acrolein online detector by selecting the isophorone-based compound as the fluorescent probe for acrolein detection, developing the gas sampling and detector from Legos, using simple commercially available materials in combination with test paper, and applying the fluorescent signal generated by UV lamp irradiation. In order to further improve the usability of the developed detections, we tried to prepare different material-loaded fluorescent probes, and tested the effect after combining acrolein under different loading materials to find the application with a longer effective time and easier operation. On the slide combining the covalent organic frameworks (COFs) materials, a balance between brightness and effective water retention time was achieved, providing a more reliable basis for the function of the developed project and greatly increasing the potential for commercialization of the developed project.

7EN500

Jones, Jackson

Kenmore Middle School

The Effect of Certain Geometric Shapes on How Light is Scattered

Stealth technology is a great human achievement, but not many people understand it. This experiment helped with that. This project used light to approximate how radar and stealth technology work. The goal of this project was to find out what shapes would theoretically have a lower radar signature. The hypothesis was that “If a shape gains more angles and is more smooth it will have a lower brightness in lux.” My procedures included putting a shape made out of white paper inside a box lined with black paper. A flashlight was shined at the paper after closing the box lid, and then the brightness in lux was recorded using a lux meter. This was repeated with 3 other shapes, running 5 trials each time. Our results ended up with the lowest brightness in lux belonging to the V-Shaped piece of paper, with a 63.7 average. The highest was W-Shaped, with a 192.7 brightness in lux! The two in the middle were the smooth and crumpled cylinder, which had a 95.7 brightness in lux for the Crumpled Cylinder, and a 109.1 brightness in lux for the Clean Cylinder. This experiment contributed to engineering because it showed a simple model of how radar works, and how to make a plane invisible to it. This experiment went as expected, yet was still interesting.

7EN501

Owens, Eamon

George Washington Middle School

Let's Roll

My science fair project is finding out what the slowest surface for a marble on a 5-inch ramp is among different textures at the bottom and I will measure the distance traveled by the marble to find the surface that slows it down the most. After running multiple tests, I found that the hardwood floor allowed the marble to roll the farthest, along with this information I also figured out that the bubble wrap slowed down the marble and added the most friction. This research project is important in history because learning about friction is important to make things start and stop, and it is helpful worldwide to keep people safe on the roads. Leonardo da Vinci is credited with discovering friction and tribometers are used to measure it. Car companies design cars taking friction into consideration to reduce drag and rubber distribution. Electric cars help reduce pollution and keep the air cleaner. In the future, friction will continue to play a significant role in our world because it keeps people safe and smart.

7EN502

Smith, Edward

Dorothy Hamm Middle School

Take A Load Off: The Effect of Support Shape on Load Before Failure

This project is important because it tests how much load different support shapes can hold. All of our buildings, bridges, and other structures around us are made of smaller shapes built together. This experiment explores which shape can best support load by testing multiple types of shapes until they break or fail. My hypothesis was if pyramids (made up of triangles) are the strongest structural support shape, then the pyramids will hold more load than other shapes. I made my shapes with a 3d pen and then put them together. After that I tested to see which shape would hold the most load. The evidence from the experiment unfortunately was not conclusive because none of the shapes tests results were consistent. The experiment could be improved by making the shapes more even with straight vertical support lines during the fabrication process. If fabrication had been better, the pyramids could have outperformed the other shapes. Additional tests will be needed to reach a more accurate outcome.

8EN503

Carpenter, Kylie

Williamsburg Middle School

The Effect of Shingle Color on Temperature

My project is The Effect of Shingle Color on Temperature. The main way this project is linked to climate change is that many roofs absorb sunlight and heat buildings. So new roofs could decrease power plant emissions by reducing the demand for energy to cool buildings (United States Department of Energy, 2023). The hypothesis states that if the shingle color is light gray, then it will have the lowest temperature because the color white reflects 70%-80% of the sun's energy (Gale, 2015). This means that lighter colors reflect more sunlight than darker ones. The results of the project show that the black shingle reached the highest temperature in 20 minutes (average of 92.03 Cº), and the light gray shingle had the lowest temperature after 20 minutes (average of 86.8 Cº); which supports the hypothesis. The heat lamp's temperature intensity seemed to change in cycles, which could throw off some of the data collected. However, the range of temperatures within a given shingle color and time period is very small, so unreliable results are unlikely. This experiment can be further extended by testing the shingle's strength against various simulated natural disasters. Another idea for an addition could be comparing shingle material to test whether the material or color is a more important factor. This would provide a good guide for new homeowners to help people make a stylish, practical, and beneficial choice.

8EN504

Fenster, Esther

Williamsburg Middle School

The Effect of the Angle of a Solar Panel on the Amount of Power It Produces

The purpose of this experiment, testing the angle of a solar panel on how much power is produced, is that solar panels are becoming more frequently used for a variety of different purposes such as homes, buildings, and schools. Knowing the correct angle of the panels is critical to be able to maximize the amount of power being produced. Solar panels are also more climate friendly and can help to reduce greenhouse gas emissions. The hypothesis for this project was that the angle at 0º would produce the most amount of power because it's directly facing the light source. The experiment was tested by placing a solar panel on an adjustable stand below a lamp and changing it to 6 different angles, 0º, 18º, 36º, 54º, 72º, and 90º. Each angle was measured 5 times with a multimeter. The multimeter measures voltage (volts) and current (amps). These were then multiplied to find the power produced (milliwatts). In the data it was clear that the power produced decreased as the angle increased. The hypothesis was then proved as the solar panel at 0º produced the most electricity. The angles all had a very small range within the different trials, showing that the data was precise and reliable. But, the angles were a few hundredths of a degree off and could be improved by having exact angles. This project could also be further experimented by using the real sun instead of an artificial light.

8EN505

Hardwick, Margaret (Molly)

Dorothy Hamm Middle School

The Effect of Type of Starch on Strength of Paper

Paper is used by many companies to ship products. I learned that starch is added to wood pulp to make paper. I was curious what type of starch would make the strongest paper and a better shipping box. This experiment is useful to paper manufacturers and packaging designers. These companies can use my information to improve their paper/cardboard used to ship customers' orders in.

In this experiment I made paper with three types of starch, arrowroot, corn, and potato and tested them to see which one is strongest. To make paper, I created paper pulp by shedding paper, adding it to a blender with a starch and water. I then poured the pulp into a mold and let the paper dry. After the paper was completely dry, I cut three samples from each sheet. In three rounds of each paper, I tested the strength by measuring how much weight the paper could hold.

After I tested the strength, I converted the information to ounces and displayed my findings in a data table and graph. My results showed that corn starch makes the strongest type of paper and potato starch is the weakest. I concluded that manufactures could strengthen their paper by using corn starch.

8EN506

Harris, Brendan

Swanson Middle School

The Effect of Wind Turbine Design on the Efficiency of the Power Output

Wind is a renewable source of energy increasingly used for power generation. Because of concerns about affordability and climate, small-scale residential wind turbines have become increasingly popular. This project compared the efficiency of different designs using a common generator. It was hypothesized that a 3-bladed horizontal axis wind turbine would exhibit superior efficiency due to its larger rotor-swept area. The wind turbines and generator were constructed with a 3D printer and filament. The stator and rotor utilized permanent magnetic bearings to reduce frictional losses. The main steps of the project were collecting the materials, constructing the generator and wind turbines, gathering values for air pressure, temperature, and wind speed, and then testing the wind turbines. Wind power was calculated using wind speed and density, and energy output was measured using rotational velocity and voltage. Because a common generator was used, relative efficiencies could be determined by dividing the energy output by the power input. The experimental data showed that the Archimedes turbine was more efficient at low wind speeds and the vertical axis turbine was more efficient at high wind speeds. Two issues should be corrected in future experiments. First, the ceramic-coated windings never demonstrated reliable continuity. The voltages measured during the experiment should be considered unreliable. Second, the use of a common generator may have reduced the performance of some designs due to potential deflection and flexibility in the connection. This project provides useful research as it could help optimize designs for small-scale wind power generation.

8EN507

Leaning, Alexandra

Gunston Middle School

Rotating Rockets: A Comparative Analysis of the Effect of 3D Printed Fin Angles on Rocket Performance

In the project Rotating Rockets, I explored the impact of 3D-printed fins on the height that a model rocket flies. By altering fin tilt, I aimed to understand its effect on rocket altitude. I initially hypothesized a decrease in altitude in the fins with tilts due to potential aerodynamic instability. I designed and printed the rocket components, including nose cones and fins with varying tilts (0, 2.5, and 5 degrees). Despite initial setbacks like broken parts during testing, I refined the design, adding parachutes and shock cords. Launching the rockets in a field, I collected angle data using an AltiTrak and calculated altitude with a specific formula. While the raw data suggested the 2.5-degree tilt achieved the highest flight, removing outliers revealed the 5-degree tilt surpassed the control. Unexpectedly, both tilted fins consistently outperformed the untilted control. Though I was unable to determine the optimal fin tilt, my results contradicted the initial hypothesis, suggesting tilted fins improved stability and increased altitude. Notably, engine propellant mass emerged as an uncontrolled variable affecting variability. Despite challenges and waste in the design process, the optimized model represents a sustainable solution, aligning with global commitments to sustainability in aerospace. This study not only enhances our understanding of aerial launches but also contributes to a greener and more accessible frontier in aerospace.

8EN508

Shaw, Ryan

Kenmore Middle School

The Effect of Light's Wavelength on the Amount of Power Produced by a Solar Panel

The purpose of my project is to find out what wavelength of light creates the most amount of output power from a solar panel. People should care about this project because it could help solar panels produce more power. The goal of my project was to find the effect of light's wavelength on the amount of power produced by a solar panel. My procedure was to take my materials outside, set up my solar panel, and connect the wires from the voltmeter to the solar panel. Then I took readings with each color filter in front of the solar panel. I measured current in milliamps and voltage in millivolts to calculate the power output of the solar panel. I did this process three times. The results that my experiment showed was that the yellow color filter did the best, producing 481.84 milliwatts (mW), next was the purple filter producing 449.76 (mW), after was the red filter producing 375.07(mW), followed by the green filter producing 335.48 (mW), and lastly the blue filter was producing, 325.30 (mW). My project could contribute to finding a way for solar panels to produce more power by making all of the colors in the visible light spectrum create more power.

8EN509

Silva, Christian-Delfin

Francis C. Hammond Middle School

The Design of a Parachute's Descent

When you think about a pilot, anyone who flies an aircraft, anyone who goes skydiving, or anything that involves being in the air, the first thing you think about is their safety. A typical procedure to guarantee your safety is to have a reliable parachute in an emergency. The problem with parachutes is that the vast majority of incidents with them are the result of human error. I believe that this human error is caused by the user's panic, which may be the result of their parachute still falling too fast. The solution is to make a parachute that descends as slowly as possible. My results have shown that a canopy with a circular shape is the best type of canopy if your goal is to slow your descent as much as possible. They also show that the more surface area a canopy has the slower it will descend. My design met the criteria which was to make the descent 300% (3x) slower than a fall without a parachute.

8EN510

Seyran, Zeynep; Komlodi, Kira

Thomas Jefferson Middle School

Fortissimo: Music Teaching Technology

It's no surprise that both of the researchers play one or more instruments. This, as you have probably assumed, was the main reason Fortissimo was created. The researchers noticed how many of their peers stopped playing music after a short period of time. After conducting research and examining statistics, they discovered that this was a widespread issue and decided to do something about it.

Fortissimo is a self-paced and adaptive program with a user-friendly and simple interface, operated on a display board, a circuit python microcontroller, as well as a PDM analog to digital input microphone. Our program is not only highly beneficial to users because of its innovative capabilities that set it apart from other music learning platforms such as the adaptive tempo and diagnostics, but Fortissimo also contributed to the skills of the designers greatly during the programming process. Beforehand, the researchers were not as aware of the many effects of music, only that they enjoyed it and wanted to share this wonderful experience with others. The researchers also gained knowledge about the coding software, circuit python, specifically its graphic and sound modules, as well as electrical engineering skills.

We hope that Fortissimo will be expanded and used in our school music department to help growing musicians. After all, learning an instrument helps people not only cultivate their musical skills but also leads to greater benefits in general, such as persistence and confidence which are important skill sets for a successful life.

9EN511

Ayele, Efrata

Alexandria City High School (includes Minnie Howard)

The Future of Light!

As society shifts toward implementing effective and sustainable technology to help fight against climate change, it is imperative that individuals understand and know how to integrate these advances into their daily lives. This project specifically focuses on lighting technology. Unlike traditional lighting options, such as incandescent, fluorescent, and halogen, which have low energy efficiency and contribute to carbon dioxide emissions, LED light bulbs are sustainable and cost-effective alternatives. This project aims to answer the question: Can a person build an LED light bulb at home from easy-to-find and inexpensive materials? The procedure for this project was to gather all the materials needed to construct an LED light bulb, recording the time it took to complete the assemblage process and where and how easily the materials were obtained. In addition, to determine if building an LED light bulb is more or less cost-effective, the price of the LED light bulb built at home was compared to one that can be bought at a store. The results from the project showed that the parts needed to build one LED light bulb were $1.16, whereas the average cost of a 12-watt LED at stores is $5 to $7. Furthermore, the time it took to assemble the LED bulb was under 15 minutes; however, the materials were not as easily accessible in person and were limited online. In conclusion, although this project didn't meet all the design criteria, it did provide a great way for people from all areas to expand their knowledge of

9EN512

Cohen, Gabriel

Yorktown High School

An Investigation into the EEG Capabilities of the Star Wars Force Trainer

EEG is a technology to measure electrical activity within the brain. The Star Wars Force Trainer II is a discontinued children's toy featuring EEG technology. This experiment benchmarked its capabilities via a previously studied scenario: comparing brain activity between open and closed eyes. Analyzed parameters were the overall powers of different brain waves (alpha, beta, etc), as well as Attention and Meditation (proprietary pre-processed 'eSense' parameters). Data from the headset was parsed and exported by a modified version of an open-source tool known as BrainwaveDetectionUtility. Two people participated, and 5 trials of 30 seconds of each condition were tested. Significant changes in mean values were evaluated for each parameter individually using a Wilcoxon Signed-Ranked Test. The results for the first participant (51y/o, male) showed a significant decrease in Attention (eSense) during the EC condition and a significant increase in Meditation (eSense) during the EC condition. Participant 2 (15y/o, male) produced the same changes as Participant 1, in addition to a significant increase and decrease in both Low Alpha and Theta, respectively. This increase in alpha reflects previous studies strongly but was most likely not seen in Participant 1 due to age. In conclusion, the Force Trainer II has the potential to measure large, sweeping changes in frequency bands, but those measurements are somewhat less reliable than the pre-processed eSense parameters (Attention, Meditation). Future opportunities for research include further analysis of the factors that affect eSense parameters, as well as attempting to screen for disorders like photosensitive epilepsy.

9EN513

Fitzgerald, Maya

Alexandria City High School (includes Minnie Howard)

The Effects of Structure Type and Bond Strength on a Building's Earthquake Durability

Earthquakes cause immense damage and harm to all things, living or not. Not only do earthquakes have the energy to take people's lives, but they can also level buildings. The purpose of my experiment was to test how structure and bond strength will affect a building's durability during an earthquake simulation. Buildings that were smaller, with more distributed weight and a higher bond strength would likely outlast other buildings that were taller, unbalanced, and had a poor bond strength. I built a total of 15 structures, five types of structures for all three materials (Jenga blocks, Lego blocks, and Lincoln Logs), with five trials for each structure. For each trial, the time it took for the structure to collapse or fall over below three blocks was recorded. For Jenga blocks, in corresponding order, the average collapse times were 9.8, 15.9, 13, 30.6, and 93.3 seconds. For the Legos, all trials ended by reaching the cutoff time of five minutes. Finally, for the Lincoln Logs, the two structures had averages of 191.08 and 13.5 seconds, respectively, and the last three structures all exceeded the cutoff time. In summary, the structures with materials with the highest bond strength and a better weight distribution outlasted the other structures.

9EN514

Flashberg, Natalie

Washington-Liberty High School

The Effect of Different Insulation Materials on Heat Transfer

Conserving energy is crucial to save a significant amount of energy. Therefore, Insulation is the process or material that is used to reduce the transfer of heat. This experiment was conducted to find the best insulator which lost the least amount of temperature change. The hypothesis for the experiment was that styrofoam should have the least temperature change. The null hypothesis was that the material surrounding the container would not affect the temperatures. The groups tested were styrofoam, cardboard, aluminum and the control being no material. For this experiment, yogurt containers were covered in the same mass of designated material. Before and after 15 minutes, the temperatures were measured and subtracted from each other. The results were then organized in a data table. The mean temperature change was calculated and gathered on a data table then plugged into a bar graph. Standard deviations were calculated in addition to a T-test and an ANOVA test. The data was statistically significant with a p-value of 0.0000008916. The data supported the hypothesis that the material with the least heat transfer was styrofoam and can reject the null hypothesis. Styrofoam had the lowest mean of 2.6 degrees celsius. Aluminum was the second lowest mean of 3.4 degrees celsius, followed by cardboard with a mean of 4.0 degrees celsius, and lastly the control with a mean of 6.1 degrees celsius. According to the graphs and the standard deviation lines, there was a significant difference between the control and other groups.

9EN515

Fredricks, McKenna

Yorktown High School

The Effect of Growth Rings on the Amount of Weight Supported

I wanted to find the strongest type of wood. My dad and I woodwork together. Wood has growth rings on it. These are used to see the age of the tree and how fast the tree grew. I wondered if these growth rings affected how much weight the wood could support. Scientists and engineers need to know what is the strongest type of wood and if it is based on the growth rings. My hypothesis is if wood has more growth rings, then it will support more weight. I used wood from fir trees that measure _ inch by _ inch with a 12 inch overhang. I used 30 pieces, 10 for each category. The categories are 1-3 growth rings, 4-8 growth rings, and 9 or more growth rings. I clamped the wood onto a strong workbench. I hung a bucket _ inch from the far end of the wood. I carefully placed weights into the bucket one pound at a time until the wood broke. My hypothesis was only supported with weak evidence. While my mean did not follow my hypothesis, my median did. This means my data was majorly affected by outliers. My data show that the amount of growth rings on a piece of wood does not have a strong effect on the amount of weight it can hold. I have found that growth rings are based on how fast the tree grows, not on density. Density should have more of an effect on the amount of weight a piece of wood can support. When doing woodworking projects, people do not have to worry about growth rings.

9EN516

Pines, Asher

Yorktown High School

The Effect of Faraday Box Designs on EMF Radiation and the Potential to Prevent Car Theft

This study investigated various Faraday box designs in blocking electromagnetic fields (EMF). A Faraday box is able to prevent car thefts through relay attacks when people store their car keys in the box. Relay attacks are a method used to steal cars where thieves amplify the signal between a car's key fob and the vehicle. This allows the car to be opened and turned on remotely even when the key is far away. Faraday boxes are metallic enclosures that block EMF and thus the signal which could be potentially amplified by a car thief. The research tested five different materials to cover Faraday boxes: 1) aluminum foil, 2) stainless steel mesh, and 3) Faraday fabric, 4) no material, and 5) phone. The outcome was the ability of the box to block EMF from a cell phone used as the EMF source. The hypothesis was that aluminum foil would be most effective due to . its high conductivity. The results showed that average electromagnetic radiation readings were significantly lower for the aluminum foil-lined box compared to the other boxes. Stainless steel mesh worked better than Faraday fabric. In conclusion, Aluminum foil was the most efficient material tested. Limitations include the potential for unsealed portions in the box and the accuracy of the EMF detector. Future research could be done to confirm the findings and support the development of an actual product to reduce the risk of car theft from relay attacks.

9EN517

Sun, Juyeng

Washington-Liberty High School

The Effect of Material Type Used as Sound Insulation on Sound Level Detected

Acoustics is the study of sound/sound waves. Acoustic architecture uses the principles of acoustics to control sound. Sound insulators are materials which limit the travel of soundwaves by absorbing/reflecting them. The purpose of this project is to determine which material is the most effective sound insulator and reduces the most sound from being detected. The independent variables were the type of materials tested. These materials were foam acoustic panels, felt tiles, and plywood. No material was the control group. The dependent variable was the decibel level detected. It was hypothesized that the felt tiles would cause the least number of decibels from being detected because it is both porous and dense. The null hypothesis for this experiment was that the materials would not impact the decibel level detected. The experiment was conducted by cutting out pieces of each material and placing them around a carboard box. The lined carboard box was in front of a guitar amplifier, which acted as a sound source. A decibel meter was placed inside the cardboard box. A guitar was played and the decibel level was recorded. The results showed how the IV did affect the DV and that felt tiles and acoustic panels had statistically similar data. The null hypothesis was rejected. Acoustic Panels had the lowest mean of 72.31 dB. The hypothesis was not supported. The data collected demonstrates how the materials were successfully able to limit the travel of sound.

9EN518

Tappan, Gabrielle

Alexandria City High School (includes Minnie Howard)

Generating Renewable Energy for the Grid

My goal was to use wind energy as an alternative resource to power a household item. I started by building a homemade windmill. I needed 8 to 12 volts of electricity out of this windmill, so I experimented with different blade materials and how many blades were needed to achieve the voltage. The current, 22 milliamps (mA), was enough to charge a battery. I got a small plastic fan blade which created about 9 volts of electricity.

After finalizing my windmill, I designed and built my circuit that can take the voltage from the wind turbine and step it down to 5V. I tested the circuit with a 9-volt battery and an LED bulb. After, I created my circuit with the USB. I needed to trickle charge a battery pack by using the windmill because the current was so low, instead of charging the watch directly from the windmill. This is consistent with the way that wind energy is stored for insertion into the electric grid.

I was able to charge the batteries and successfully charge the smartwatch. I tested how long it took for the watch to charge 10% with the battery versus an outlet. I found that the watch charged faster and more consistently when plugged into the outlet, but it was still able to charge 10% when connected to the wind circuit. Overall, I was able to achieve my goal that a household item can be charged by wind power, which creates another viable option for energy.

9EN519

Tarpley, Michael

H-B Woodlawn Secondary Program

A Wearable Sign-to-Text Translation System Using Sensor Arrays

There is a communication barrier between users of American Sign Language (ASL) and English speakers. It is very difficult for English speakers to receive and understand sign language without prior knowledge and it is difficult for the Deaf community to know and understand English. A wearable sign-to-text translation glove can accurately translate the symbols of the ASL alphabet onto a screen in real time. A common glove has been modified to include an array of sensors, a circuit board and an Arduino allowing for a real-time translation of signs into English text on a screen. The translation glove offers a technological solution to the communication barrier between the Deaf community and English speakers.

9EN520

Kwan, Alexander; Kwan, Benjamin

Washington-Liberty High School

The Effect of Propeller Blade Angle on the Force of a Propeller in Viscous Fluid

The purpose of this study was to determine the propeller blade angle that produced the most thrust in a viscous liquid. This experiment's hypothesis was that the propeller with the greatest blade angle would produce the most thrust, and the null hypothesis was that a change in blade angle would result in no difference in the thrust produced. There were 5 groups tested: blade angles of 5, 10, 15, and 20 degrees, with a propeller of 0º as a control. The experiment was conducted by vertically mounting a force sensor and motor with a propeller submerged in a glycerol-water solution. The 15º propeller produced the greatest thrust, while the control produced the lowest. The thrust increased with each propeller until it fell at 20º. Notably, degrees 10 and 20 produced almost the same overall mean thrust, with -0.100 and -0.109 N, respectively. The results were statistically significant, with a p-value of 0.234 in the ANOVA but one of 0 in a t-test between the 15 and 0 degree propellers, allowing for a rejection of the null hypothesis. This means that the changes in blade angle definitely had an effect on performance and could definitely have real-world applications like oil cleanup.

10EN521

Burden, Owen

Alexandria City High School (includes Minnie Howard)

Creating an Automatic Plant Watering System

The demand for efficient and sustainable solutions in agriculture and home gardening has led to the development of various automated plant care systems. This project focuses on the design and implementation of a combination of previous and new features to create an Automatic Plant Watering System (APWS) to provide a reliable and user-friendly solution for maintaining optimal moisture levels in soil.

The APWS incorporates various sensors to measure soil moisture levels and environmental conditions such as temperature and humidity. These sensors provide real-time data, enabling the system to make informed decisions regarding watering schedules and duration. Additionally, the system is equipped with a peristaltic pump and is able to control water flow based on specific requirements. Another feature included in the APWS is the ability to remotely monitor and control the system through an online software.

The implementation of this automatic plant watering system offers numerous benefits, including water conservation through efficient water usage, improved plant health and growth by ensuring consistent moisture levels, and reduced maintenance efforts for users. Furthermore, the system is built using off-the-shelf components and can be easily customized to accommodate different plant species and growing environments.

Through rigorous testing and validation, the APWS demonstrates significant improvements in water efficiency and plant health compared to traditional manual watering methods. By automating the watering process, this project aims to empower individuals and communities to cultivate thriving gardens while conserving water resources and reducing labor-intensive tasks associated with plant care.

10EN522

Hogans, Catherine

Washington-Liberty High School

The Effect of Different Blade Lengths of a Wind Turbine on the Amount of Energy the Wind Turbine Produces

The purpose of this experiment was to determine whether longer blades on a wind turbine would create more energy, making this form of clean energy as efficient as possible. The research hypothesis tested was: If the length of the blades on a wind turbine is changed, then the wind turbine with the longest length of blades will create the most energy in volts on the multimeter because the longer blades will be able to pick up more torque and feed off of more of the aerodynamic forces from the wind. The independent variable was the length of the blades, with independent variable levels of 8 cm, 10 cm, 12 cm, and 14 cm. The dependent variable was the amount of energy produced in volts.

The blades that were 14 cm long produced the most amount of energy. The energy was produced by kinetic energy and the change in air pressure around the blades coming from the wind. The larger blades would have been able to pick up the most wind, so they would able to generate the most kinetic energy. The lift and drag, created by the changed air pressure, would cause the rotor to spin, spinning the generator and producing the most electricity. The 14 cm blades had the most mass and were the longest, hence, they were be able to produce the most energy. The research conducted prior to the experiment also supported the results.

10EN523

Kiesel, Emily

Washington-Liberty High School

The Effect of Different Fins on a Model Rocket's Altitude and Velocity

The purpose of this experiment is to test the effect of different fins on a model rocket's altitude and velocity. The hypothesis was: If the fin shape is changed, then the elliptical fin shape will go the highest because that will cause the least induced drag and cause the elliptical fin to obtain the highest velocity. The tested fin shapes were the Tapered Swept Fin (Control), Elliptical Fin, Swept Delta Fin, and the Trapezoidal Fin. While the Tapered Swept Fin had the highest altitude and velocity, the results were not statistically significant.

Each group was tested 3 times, and an ANOVA test was conducted for each dependent variable and while the results for altitude were statistically significant, the results for velocity are not. T-tests were also done between the Tapered Swept fin with the Elliptical Fin and the Tapered Fin with the Trapezoidal Fin. The first comparison was the only statistically significant result.

While conclusions could be made about the significance of the altitude, the day on which the rockets were launched had winds of 14 miles per hour, and the results were affected by that. The wind grabbed the rocket and made it fly in irregular patterns. In the future, improvements of this experiment could be more trials per group, and less wind on the day the rockets are launched.

10EN524

Miller, Andrew

Yorktown High School

The Application of Visual and IMU Input for 6DOF Tracking

Inexpensive, widely available, high precision 6DOF tracking is greatly sought after in industries involving the movement of objects in virtual 3D space. Such areas include but are not limited to the consumer VR, AR, MR, and animation industries; with the most relevant industry to this project listed (consumer VR) projected to grow by an astounding ten billion USD over a course of three years (Topic: Virtual Reality (VR), 2023).

Currently, to achieve consistent 0-9 mm tracking, stakeholders are required to obtain a variety of costly hardware (with the cheapest solutions coming to ~450 USD at a minimum for reasonable use). Such solutions include SteamVR tracking, which utilizes an array of IR lasers and timing relating to diode response in order to discern a position (Yates, 2014); successful products such as Tundra trackers and Vive trackers use this technology. Any other cheaper current solutions either introduce too significant an amount of latency, or drift over time (for instance, SlimeVR, or Nolo tracking). Furthermore, a large consumer base of individuals possessing either a Quest 1 or Quest 2 HMD desire portable tracking at a price within their budget that can be used with relative ease. Reviewing the hardware given, it’s simply not possible to meet all of those criteria at once. This project aims to appeal to that untapped market.

10EN525

Noorzai, Mohammad Elyas

Alexandria City High School (includes Minnie Howard)

Optimizing Drone Design for Improved Stability and Control

We wanted to make drones fly better, so we tested a store-bought drone and a homemade drone made from popsicles and motors. We looked at how different designs affect how well the drones fly. Our tests showed that the design really does make a difference in how stable and easy to control the drones are. Our science fair project contributes to the field of drone design by highlighting the significance of design factors in influencing flight performance. Understanding this can help make drones safer and more useful for important tasks like taking pictures and delivering packages.

10EN526

Espiritu, Arianna; Hettinger, Grace

Alexandria City High School (includes Minnie Howard)

Sun Seeker 2.0: Thermal Generating Heliostats

In this project, we are answering the question, “Can we improve a DIY Heliostat and enable it to generate thermal energy efficiently?” According to the U.S. 2020 Census, Alexandria consumes about 61 million kWh of electricity per month; 55% of which is nonrenewable (Morawski, 2018). We propose an easier and more cost-effective method of gathering energy for our community. A dataset from NASA’s Solar Energy Program assessed the potential of global CSP (Concentrating Solar Power) plants, which amounted to 150 times the present world electricity consumption (Müller-Steinhagen, 2013). This makes our research on thermal-generating Heliostats relevant and fitting for young people wanting to help solve environmental crises. We designed and built a new heliostat using Onshape and a 3D printer, then flew it out to the desert for testing. The heliostat reflected sunlight onto an aluminum can, heating the water inside. A control can was used for comparison. The heliostat was programmed to adjust as the sun moved using offset angles, which were noted for patterns. Our results indicate that the heliostat is efficient.

11EN527

Bahrambegi, Cyrus

H-B Woodlawn Secondary Program

Analyzing Sustainable Energy Production Using Anaerobic Cellular Respiration from Microorganisms Derived from a Modified Microbial Fuel Cell System

Research into alternative energy sources is a priority due to increasing concerns over the effects of climate change. Microbial Fuel cells (MFCs) are a partial but promising solution towards combating the over-reliance on fossil fuel-based electricity. MFCs produce energy from microorganisms through anaerobic respiration, which can turn into usable electricity. An anode and cathode chamber comprise the MFC system with a membrane (Nafion 117) held within a bridge connecting the chambers. Limitations, however, have slowed the advancement of MFC development. There is a need to demonstrate how MFCs can be altered or enhanced to increase power generation through more sustainable and cost-effective means. Utilizing new microorganisms and electrode materials has shown promise in sustainable technology. This study aims to maximize the amount of usable electricity an MFC can yield by engineering modifications to allow the system to create more energy. By using bacteria such as Clostridium sporogenes, Escherichia coli K12, Saccharomyces cerevisiae (haploid), and Saccharomyces cerevisiae (alpha), the MFC can generate chemical energy through the anaerobic respiration of the bacteria under a controlled environment. All four bacteria were tested in the MFC system over two-week intervals, and a liquid glucose substrate was added every two days over the trial period. Each bacteria was measured at a controlled time daily to ensure a 24-hour time frame before measuring the voltage growth and checking to see if the bacteria had a constant current. Continued research into electrochemistry and microbiology is a priority in demonstrating how MFCs can become a viable energy source.

6EV600

Nizami, Arooj

Patrick Henry K-8 School

Filter Fun

Many individuals have wondered, which resource filters lake water the best? My Science Fair project is about testing different resources and to figure out which resource is more effective. My project includes charcoal, sand, and gravel as its three resources. My experiment was finalized by doing 3 different types of tests (pH, nitrate, and phosphate) on the lake water before and after being filtered. My hypothesis was that if I use sand, then it will filter the water the best, because my research showed that sand is very beneficial resource because it had the lowest nitrate and phosphate. However, sand had the highest pH. Therefore, my hypothesis was incorrect, and I learned that gravel is the best resource in water filtration.

7EV601

Lieberman, Cameron

Kenmore Middle School

The Effects of Weather on Stream Quality

Our streams are always changing. Some streams change for the better and some for worse, but I wanted to see how recent precipitation and temperature affect the overall health of the stream. I did this experiment because our streams are an important part of our ecosystems and unhealthy streams directly affect the area around it. When I started my experiment, I hypothesized that recent precipitation would increase the flow rate and overall health of the stream would improve. I also hypothesized that lower temperatures would improve the overall health of the stream. For my experiment, I tested dissolved oxygen (DO), Ph. and nitrates (dependent variables) using chemical tests at two different streams (independent variable, or IV) on three different dates (IV). I used the dependent variables to determine if the stream fell into healthy parameters. My experiment showed that flow rate does increase with recent precipitation, but recent precipitation does not make the stream healthier. My experiment was inconclusive on whether a stream becomes healthier during colder temperatures.

7EV602

Ludlow, Wren

H-B Woodlawn Secondary Program

Measuring Arlington's Urban Heat Island Effect

This experiment was conducted because of the author’s interest in cities and urban environments. The purpose of the experiment was to measure the Urban Heat Island Effect in Arlington County using temperature readings in different locations. The Urban Heat Island Effect is the theory that places with a higher population density are hotter because more asphalt, glass and concrete is used in urban construction which absorbs heat instead of reflecting it. In other words, the Urban Heat Island Effect is when a built-up urban area is hotter than areas with lower population density. To measure the temperature differences, a small digital thermometer was used at ten locations spread out evenly across the County on the afternoon of November 17th, 2023. Two temperature measurements were recorded at each location and the final temperatures were determined by the mean average of the two readings. The results showed that the areas in Arlington with the highest population density: The Arlington corridor (Rosslyn, Courthouse, Clarendon, Ballston) and Pentagon City were the areas with the highest temperatures. The highest overall temperature was recorded in Clarendon. The only result that was perplexing was that the temperature recorded in Rosslyn, which is a high-density neighborhood, had the same temperature as another location located in a much lower density area. This probably was because of the wind coming off the Potomac River creating wind tunnels in Rosslyn. This experiment demonstrated an Urban Heat Island Effect in Arlington and could be used to test this theory in the future.

7EV603

Zee, Rebecca

Kenmore Middle School

The Effect of Different Fertilizers on Water pH Levels

Each time a fertilizer is used, run-off carries those fertilizers into waterways. These fertilizers significantly impact water quality by altering the pH levels. Aquatic organisms struggle to survive as their lives are uprooted, and their habitats are destroyed. The goal of this experiment was to find the effect of different fertilizers on water pH levels, and more specifically, to find which of the three main components of fertilizers would have the greatest impact on water pH. Three fertilizers were chosen, each having more of either nitrogen (blood meal), phosphorus (bone meal) or potassium (kelp meal) (independent variable). 8 grams of each of the fertilizers was mixed with 250 millimeters of water, and after 10 minutes, the pH of the mixture was tested (dependent variable). The hypothesis was that the blood meal fertilizer and water mixture would have a pH level the farthest from neutral (7 pH). The results supported the hypothesis because on average, the water mixed with the blood meal fertilizer had a pH farthest from neutral (6.12 pH), compared to the bone meal fertilizer-water mixture (7.45 pH), and the water mixed with the kelp meal fertilizer (7.21 pH). The research and results of this project show that when the goal is to keep the environment healthy, blood meal fertilizer (and nitrogen based fertilizers in general) should not be used.

7EV604

Hsu, Eowyn; Hsu, Esme

Dorothy Hamm Middle School

Demonstrating the Greenhouse Gas Effect in a Simple Experiment

In order to demonstrate the greenhouse-gas effect (GHG), we created two closed systems consisting of glass mason jars containing one-half cup of plain water each. One of the jars had three alka-seltzer tabs to introduce the CO2, which is a greenhouse gas, while the other jar contained only water. The two mason jars were placed an equal distance away from each other and from the energy source, a halogen lamp. We recorded the temperature above the water's surface for both jars every 3 minutes until the temperatures stopped increasing. Subsequently, we turned off the lamp and continued to take measurements every one minute as the temperatures decreased. We repeated this process several times. In each case, we observed that the jar with CO2 heated up more slowly, reached a higher peak temperature, and cooled more slowly compared to the jar without CO2. These results are consistent with the GHG effect, which is expected to slow the rate of heat loss.

8EV605

Bell, Darin

Dorothy Hamm Middle School

Impact of Salinity on Effectiveness of Desalination

Salt water is unsafe to drink and needs to be desalinated before human consumption. This project seeks to find out if the initial salinity of water affects the final salinity or volume of water after desalination.
The hypothesis was more salt in the input water would cause more salt in the water after desalination due to limits on the desalinator's efficiency. The results did not support the hypothesis. Every test resulted in about the same output salinity irregardless of input salinity.

Multiple trials were conducted for several different input salinities while both output salinity and volume of water produced were measured.
The experiment seemed to indicate that some specific amounts of salinity allow for more water to be evaporated. The measurements showed some input salinity values resulted in a higher volume of output water compared to other input concentrations. This is interesting and could be researched in the future.

Numerous different configurations of desalinator were researched and implemented before a successful design was achieved. The experiment involved considerable troubleshooting and iterative design improvements before the desalinator used in the project was created.

8EV606

Chudiwale, Arya

Dorothy Hamm Middle School

How Does Motor Oil Affect Plant Growth?

Motor oil pollution is happening all day, everywhere, more than we realize. Thousands of farmers and agriculture are affected by this without anyone to take action. After spilling or leaking, the motor oil will seep into plant roots and then poison the animals that rely on them for food or shelter. Through my experiment, I wondered how much motor oil concentration is needed to actually make an effect on a radish plant's growth. In this project, there were 4 concentrations of motor oil that I was testing for 0%, 1%, 10%, and 100% motor oil dilution. After conducting research, I came to the hypothesis in which I predicted that the motor oil concentration increases, then plant growth decreases because motor oil can poison plants by killing microorganisms found in roots. After tracking the growth of 40 plants over one month, I was able to find the average growth per week. Through this, I found my hypothesis proved to be correct. As the concentration of motor oil increases, the plant growth exceedingly increases.

8EV607

Duckworth, Sullivan

Kenmore Middle School

The Effect of Cloud Coverage and Pollution on the Electrical Output of a Solar Panel

All around the world there are places that only use fossil fuels like coal and natural gas as their main source of energy. For example the Middle East, most of their countries are a hundred percent fossil fuels. This is bad because fossil fuels produce over 75% of greenhouse gasses emissions. The goal of my experiment was to determine the effect of pollution on solar panels and the amount of electricity they produce. In this experiment I set up a rig to show the sun beaming down on a solar panel. I measured the amps, volts, and Lux. After each time I measured Volts, Amps, and Lux I added 2 semi transparent sheets to simulate pollution. On average without semi transparent sheets the solar panels produced 5.88 Volts. When I added all 10 transparent sheets the average amount of energy the solar panel produced was 5.56 Volts. Through my results of this experiment I verified that the more semi transparent sheets that showed pollution the less energy I received from the solar panel. In conclusion, I believe that if we cut down on the amount of fossil fuels we use and collect more electricity from solar panels we can cut down on the amount of greenhouse gasses we create.

8EV608

Kuhn, Lorien

Francis C. Hammond Middle School

The Effects of Different Amounts of Water on the Success of Composting

The goal of this project was to answer the question: What would happen to the success of decomposition if you didn't add the ideal amount of water, which is 40-60%? Using this question I conducted an experiment where I set 3 groups of trials with different amounts of water to determine which amount of water would work the best.

At the beginning of this experiment I measured 4 different items and put equal amounts in all of my trials so that at the end I could re-measure them and whichever one had decomposed the most was the most successful trial. I hypothesized that if you add 25% of the mass of the compost in water then you will have less success than when you add 50% of the mass.

After 4 weeks I opened up 1 bucket from each set of trials and found my original 4 items. I re-measured these items to see which trial had the most progress after 4 weeks. My results were that the 50% trial was working the best followed by the 75% trial and then the 25% trial. After 7 weeks I opened up the 9 remaining trials and re-measured the items, the results stayed consistent with the midpoint results. What I can conclude from this experiment is that having 50% water in your compost will be the best for quick composting. Having 75% water in your compost will still work but not as successfully and 25% won't work very well at all.

8EV609

Wells, Cassidy

Williamsburg Middle School

The Effect of Seven Different Fluorescent Colored Solar Panels Against Two Times of Day on the Amount of Energy Produced

This experiment's purpose is to test Solar Panel efficiency when used at two different times of day against seven different fluorescent colored panels. Solar Panels are usually made mainly with blue and black colors, but those only have a 22% rate of efficiency. The IV's were the two times of day (Official Sunrise and Noon), and the seven Fluorescent colors of Solar Panel (ROYGBIV). The DV was the amount of energy (mW) produced by each color of panel at each time. Official Sunset was not tested as the weather was not consistent enough to get accurate data during the testing period. The hypothesis was that if the sun is at its highest point in the sky during the middle of the day, and Fluorescent Blue is the darkest color, then the Blue Solar Panel at Noon will produce the highest amount of energy. This hypothesis was proven partially correct as Noon was the highest overall mean of time, but Blue was the third overall mean of color. Fluorescent Red at Noon was the highest producing panel and when tested together, they produced over 3000mW twice out of four tests. This is five times the result of Fluorescent Red at Sunrise. The second highest overall mean of color and time was Fluorescent Indigo at Noon. Therefore, to maximize Solar Panel efficiency, Fluorescent Red should be used instead of the current designs.

8EV610

Procida, Eliana; Milam, Emmeline

H-B Woodlawn Secondary Program

Efficacy of a Homemade Water Filter on Water Quality

The purpose of this experiment was to test the effect of a homemade water filter on water quality. This experiment was intended to show if a homemade water filter, made from various materials, can effectively filter water and make it safe to drink. Harmful substances, such as micro plastics, chlorine, bacteria, and pesticides can be found in water, and the purpose of a water filter is to remove such impurities. It's proven that homemade water filters remove not nearly as many contaminants as commercial ones, and extra measures such as boiling the already filtered water need to be taken. Part of this experiment was to test the amounts of different parameters in the water after the water was filtered and boiled. This was done by using a water testing strip which changes color showing the amounts of parameters in the water. Each parameter can be dangerous or helpful to the water so seeing the amounts can help show what is dangerous in that specific water.

The hypothesis for this experiment was that the water will become clear, but not fully drinkable, because no water filter–especially not a homemade one–can fully remove all contaminants in the water. By putting dirty water into the homemade water filter, and testing the amounts of parameters in the water after being filtered and boiled, we will test our hypothesis. Filtered fridge water and tap water were also tested in order to see the difference between each water quality.

9EV611

Abdelbagi, Amna

Arlington Tech/Career Center

The Effect of Different Levels of Salt Concentration on Plant Growth

Road salt can be defined as heavy amounts of salt that are distributed onto roads that reduce the melting point of ice when it snows. While this clears up the road quicker for safer driving, it can worsen the impact on the plant's lives that lives beside the road. The purpose of this experiment was to test out different salt concentrations that range from low to high to determine the maximum amount of salt a salt-tolerant plant needs to tolerate and grow. It was hypothesized that if the plants are watered with different salt solutions, then the 3.5% salt solution will grow the highest because less salt concentrations increase growth. The independent variable is the different levels of salt concentration. The dependent variable is the plant height, measured in centimeters. The experimental variables were 0%, 3.5%, 5%, and 8% salt concentration. The salt concentrations consists of the respective amount of salt for each experiment group mixed with 44 mL of purified water. The experiment consisted of four bins that include ten individual trays in each bin. Each of the 4 bins was labeled as the experimental variables that had ten trials. Out of all four experimental groups, the results revealed that the 0% salt concentration was the most successful at growing the most height. The 3.5% salt concentration was second best. The 5% and 8% salt concentrations grew the least, making them the experimental group that grew the least.

9EV612

Amundson, Clara

Yorktown High School

The Effect of Smoke From Various Burnt Materials on the Difference in Height of Cat Grass

This experiment was designed to test how significantly smoke from different burnt materials could affect the growth of cat grass. This is because particles and chemicals within smoke could be detrimental to plant health, but the extent of the damage varies based on the source of the smoke. The experiment started with growing cat grass for a week, before the grass was divided and placed into large, individual glass jars. Each variable: Oak wood, wet wood, cardboard labels and magazine papers were ignited using a fire pit and placed inside a smaller jar beside the cat grass. The larger jar was shut and a timer was run for 30 minutes. Afterward, the grass was repotted and grown for another week. The average amount of centimeters grown a week after being introduced to smoke from each variable are as follows: No smoke, 5.375, oak wood, 4.55, wet wood, 6.1, packaging labels, 4.025, magazine papers, 4.075. Using ANOVA, the p=.0001. Therefore, the null was rejected. There wasn't a major difference between magazine paper and the packaging labels, but there was between the two and the control. Oak wood and wet wood didn't make a significant impact on the cat grass. It was concluded that smoke from plastic materials would have the greatest effect because it contains more chemicals than from a natural material. These chemicals could affect natural processes in the plant. Conversely, smoke from wet wood has chemical reactions that can be beneficial for growth.

9EV613

Hearding, Reese

Alexandria City High School (includes Minnie Howard)

Ocean Acidification: The Effect of Acid on Seashells

The purpose of this experiment is to explore the effect of low pH on the mass and density of oyster shells. CO2 emissions from burning fossil fuels dissolve into the ocean, making sea water more acidic. Ocean acidification is threatening to reduce ocean biodiversity. In my experiment, I recorded the mass, volume and density of 25 oyster shells before and after they were placed in jars filled with seawater of varying pH for 3 weeks. The pH was reduced by adding CO2 from a soda stream. My independent variable was the level of pH in the seawater, or the amount of CO2 added. The dependent variable was the average percent change in mass and density of the shells. My hypothesis was that if the level of the pH in the sea water was lower, then there would be a higher percentage change in mass and density of the shells. The average change in mass of the shells decreases more as the pH becomes more acidic. To improve my results, I could have found a way to more thoroughly seal the jars so CO2 would not escape over time and increase the pH. Overall, my experiment supports the claim that CO2 dissolved in water can cause ocean acidification, and result in the dissolving of calcium carbonate shells. In addition to climate change, ocean acidification is yet another reason why we should not burn fossil fuels as a source of energy.

9EV614

Klancnik, Sara

Washington-Liberty High School

The Effects of Environmental Conditions on Desertified Landmasses

This experiment identifies environmental conditions that facilitate the growth of Fescue grass blades in desertified soil, as measured by the grass blades' number and height. It was predicted that the desertified dirt samples placed at room temperature and low humidity and given two ounces of fertilized water would produce the tallest and the greatest number of grass blades. The temperatures in the experiment varied from high to low, as did the humidity. Water was given to all samples, except for the control group, and half of the samples were given fertilizer. The trial levels only differed by one condition when compared with other specific levels. The conditions that produced the tallest grass blades and the greatest number of grass sprouts differed. The results show that low temperature, low humidity, and fertilizer produced the tallest grass blades. In contrast, the conditions of high temperature and low humidity without fertilizer resulted in the most sprouts. The p-values of 1.59 x 10-84 and 7.26 x 10-58 showed statistical significance between the recorded heights and count levels, respectively. All the conditions placed on the levels that produced the tallest grass blades and the most sprouts agreed with past research, except for the humidity level. All levels resulted in growth besides the control. The control group, the level that had the same environmental conditions as real life desertified landmasses, was the only level that did not result in growth.

9EV615

Organek, Noa

Alexandria City High School (includes Minnie Howard)

Stay Cool!

This project was designed to determine which building insulator is the most cost-effective. Three common insulators were tested: fiberglass, polystyrene, and radiant barrier. Two combinations were also tested: fiberglass with a radiant barrier and polystyrene with a radiant barrier. To assess cost-effectiveness, an experiment involving the change in temperature over time was conducted using different types of insulators. The data showed that the fiberglass and radiant barrier insulation together were the most cost-effective. The results of the experiment provide valuable insight into the cost-effectiveness of different insulation materials, aiding homeowners and builders in making informed decisions to maximize energy efficiency and minimize long-term expenses.

9EV616

Yimer, Sabrina

Washington-Liberty High School

Impact of Soil Type on Fertilizer Runoff and Algal Growth

The experiment was performed to find the type of soil that induced the lowest fertilizer runoff. The purpose was to allow farmers to be aware of the soils that hold the lowest fertilizer runoff and algae growth. The dependent variables were the nitrate levels of the fertilizer runoff and the algae growth, measured using a nitrate strip and sechhi disk. The hypothesis was that sand would have the lowest nitrate levels and algae growth, meaning it filters more fertilizer, and clay would have the highest nitrate level and algae growth, meaning it filters less fertilizer. The results showed that clay held the highest nitrate levels followed by topsoil and sand. An ANOVA test showed a p-value of 1.0125E-12, and the results were statistically significant. For the second dependent variable, results showed that clay held the highest algae growth however it was not statistically significant. A T-Test was run, it showed a statistical significance between sand and topsoil, sand and clay, the control and topsoil, and the control and clay. While the two dependent variables held slightly different results, theory states that an increase in fertilizers induces higher levels of nitrate and algae growth. The hypothesis was supported, and it can be inferred that the second dependent variable's results were due to limitations in the experiment, and the type of soil impacts the fertilizer runoff and algae growth. In future studies, one can allow for the algae to grow for longer periods of time and use more fertilizer during the experiment.

10EV617

Ackleson, Emma

Washington-Liberty High School

The Effect of *Pseudomonas fluorescens* and *Bacillus cereus* on the Degradation of Microplastics

This experiment evaluated and compared the biodegrading efficiency of two bacterial species, Pseudomonas fluorescens and Bacillus cereus, on polystyrene microplastics. It was hypothesized that if Pseudomonas fluorescens and Bacillus cereus bacteria were placed in sterile nutrient broth solutions and combined with polystyrene microplastics, the P. fluorescens will break down and feed on the polystyrene more effectively than the B. cereus. This is because P. fluorescens has a faster metabolism with a primary diet of carbon, the main component of polystyrene, and B. cereus has a relatively decreased capacity for carbohydrate metabolism compared to P. fluorescens.

Both species of bacteria were cultured with 0.05 g of microplastics in separate nutrient broth tubes and incubated at 37°C. After 35 days, the remaining microplastics were filtered from the nutrient broth, treated with a bleach solution, and washed with water to remove any residual bacteria. The remaining polystyrene was then massed, and the data was analyzed. Results showed that both bacterial species were able to degrade microplastics, but P. fluorescens had a larger margin of degradation: P. fluorescens had a mean mass of 0.017 g, and B. cereus had a mean mass of 0.029 g. Results were then compiled in a data table and graph. An ANOVA test was conducted which yielded a p-value of 7.62 x 10-10. The statistical tests indicate that the research hypothesis was supported, and the null hypothesis was rejected. Results from this experiment could be used as an alternative approach to reducing microplastics from the environment.

10EV618

Chudiwale, Vedica

Washington-Liberty High School

The Effect of the Type of Absorbent on the Amount of Absorbed Motor Oil

This experiment was conducted to study the effects of the planet's primary fuel, supplying 33% of the world's required energy. Motor oil is used everywhere, but the environment is not prepared when even the slightest spills occur. Through the project, accessible, efficient, and inexpensive ways were tested to find a better way to clean up spills. Four types of adsorbents including feathers, cotton, polypropylene, and coconut husk, were used to determine the best absorbent for cleaning oil spills. Each material was put in an oil and water mixture and tested for how well it was able to soak up the liquid. The hypothesis for the experiment was that the organic cotton pads would have the best ability to absorb the oil over the other materials because of their magnetic-like cotton fibers. The absorbent least able to absorb the liquid was hypothesized to be the ostrich feathers because feathers have insulating features that prevent liquids from penetrating their oil-coated layers.

The ANOVA test results revealed statistical significance with a p-value of 2.28 x 10-6. By the mean of ratios, the coconut husks had the best ability as absorbents, while the cotton pads had the last. However, additional t-tests proved for the coconut husk results to be insignificant along with the polypropylene pads, concluding in organic cotton pads being the best absorbent with a mean ratio of 2.58mL, supporting the hypothesis.

10EV619

Kambhampaty, Kedar

Washington-Liberty High School

The Effect of Ecological Region on Emissions from Wildfires

This experiment investigated carbon dioxide and particulate emissions from wildfires in different ecological regions of the western United States by simulation. These emissions are the direct or first order effect of wildfires, affecting climate through their impact on global warming. Particulate emissions also harm respiratory health in humans.

The research hypothesis was that wildfires in the Northwestern Forested Mountains would produce the most emissions of carbon dioxide (CO2), particulates of 10 μm diameter and smaller (PM10), and particulates of 2.5 μm diameter and smaller (PM2.5). Mixed coniferous forests present in Northwestern Forested Mountains have ample trees and dense vegetation that release CO2, PM10, and PM2.5 as they burn. The null hypothesis stated that if wildfires are simulated in selected ecological regions, then there will be no difference in emissions data for wildfires in these ecological regions. The regions tested were Northwestern Forested Mountains, Great Plains, North American Deserts, and Mediterranean California.

Ten trials (simulations) were run per ecological region using the First Order Fire Effects Model (FOFEM) available within the FlamMap software package. ANOVA tests on data from the simulations showed statistical significance in the difference between ecological regions for CO2, PM10 and PM2.5 emissions with respective p-values of 0.00757, 0.00589, and 0.00590, rejecting the null hypothesis. However, the experiment did not support the research hypothesis that Northwestern Forested Mountains as having the most emissions, as emissions in this region were not found to be statistically significant from the mean in t-tests.

10EV620

Lee, Caroline

Washington-Liberty High School

The Effect of pH on The Degradation of Calcium Carbonate

This experiment was performed to determine the effect of pH on the degradation of calcium carbonate, which composes the shells and exoskeletons of aquatic organisms. The acidification of the ocean endangers the ability of these organisms to build their shells/exoskeletons at a rate matching the rising pH of the ocean. The hypothesis was if the pH of water is more acidic, then calcium carbonate will degrade at a higher rate because as pH levels decrease more carbonate ions will convert into bicarbonate ions making calcium carbonate more vulnerable to degradation. Limestone rocks were placed in water with pH levels of 4, 5, 6, 7 (control), 8, and 9, and left to sit for 5 weeks. The hypothesis was supported as the acidic pH levels of water degraded the limestone the most, with the levels of 4 and 5 having a mean weight loss of 1.9 and 1.8 grams. Alternatively, the limestone in alkaline water with pHs of 8 and 9 degraded the least at 0.3 and 0 grams. Qualitative observations showed rocks submerged in acidic water produced more residue. Through these findings, a direct relationship was established between the acidity of water and the degradation of calcium carbonate.

An ANOVA test showed the data was significant with a p-value of 5.139 x 10^-14., allowing the null hypothesis to be rejected. However, t-tests between the pH groups of 4 and 5 and 7 and 8 were not significant, which was likely due to random error.

10EV621

Taimanglo, Sol

Alexandria City High School (includes Minnie Howard)

The Effects of Parking Lot Sediments on Daphnia Viability

The intent of this project was to determine if sediments from a parking lot contain toxins that are harmful to aquatic organisms, specifically Daphnia magna. The answer to this question could help raise awareness for the aquatic ecosystems that are negatively affected by these pollutants. The hypothesis was that if parking lot sediments are added into an aquarium with Daphnia, then the number of viable Daphnia will decrease.

This experiment was conducted by setting up 3 separate aquariums that each received a separate concentration of the parking lot sediment sample. The number of dead Daphnia were then calculated every 8 hours over the span of 48 hours before being added together to find the final number and percentage that had died in each test group.

The results showed that the aquariums that had the sediments placed in them saw a larger decrease in viable Daphnia compared to the control, which supports the hypothesis. If this experiment were to be repeated in the future, conducting more trials would help prove that it is, in fact, the sediments that are causing the decrease in population.

10EV622

Mcmillan, Alex; Katz, Sofia

Alexandria City High School (includes Minnie Howard)

Sol Power Part 2

This experiment will examine a potential adjustment to the standard SODIS procedure that could accelerate the process using commonly found materials and allow bottles to be recycled through the process within one day. These findings could lead to better clean water access throughout the world. To perform this experiment, we collected water samples from Timber Branch Creek by using a 16.9 oz water bottle to collect the samples from the creek and transferred them to 3.78-liter bottles. We filled 3.78-liter bottles to 80% capacity with 6 full 16.9-oz bottles. We also filled two 16.9 oz water bottles from the creek and preserved them in a dark place away from the sun (dirty control).We concluded that the water surrounded by rice was quicker to reach potability than the water that was not surrounded by rice.

11EV623

Beaumont, Nicola

H-B Woodlawn Secondary Program

Use of Chlorella Algae as a Coagulant to Remove Polyethylene Microplastics from Wastewater

Microplastics (MP), formed by plastic degradation and manufacturing, are found throughout the water system, and threaten the health of aquatic species and humans as they enter the food chain. While wastewater treatment removes most organic material, additional methods are needed to fully remediate MPs. Chemical coagulation and flocculation processes are an option, but these can have adverse environmental impacts. Algae is an eco-friendlier coagulant, whose cell walls have a variety of functional groups that can act as binding sites. Existing research has found that Chlorella algae is an effective coagulant/flocculant for polyethylene (PE) microplastics with diameters averaging around one micron. However, given the wide range of PE sizes in wastewater, this study's purpose was to see if Chlorella would be equally effective at remediating larger sized PE. To obtain the coagulant, Chlorella was grown in a photobioreactor; solutions were ultimately centrifuged and algal mass dried. Next, varying sizes of polyethylene microspheres (10-150 microns, 250-300 microns, and 600-710 microns) and varying concentrations of Chlorella were added to distilled water over a range of pH and mixed. Solutions were placed into separating funnels; the supernatant was removed and filtered. The efficiency of Chlorella PE removal was calculated as the difference in the dry filter paper's weight before and after filtering, divided by the original filter paper weight. Minimal efficiency was recorded for the larger PE sizes tested. Thus, this study found that Chlorella may have limited use as a coagulant/flocculant for larger PE particles.

11EV624

Liu, Ziyin (Daniel)

Episcopal High School

Fukushima Wastewater Release and its Profound Impact on the Fishing Industry

This study investigates the profound impact of Japan's decision to release Fukushima wastewater in August 2023 on the fishing industry, utilizing comprehensive analysis through linear and multivariate regression models computed with SPSS. Following the catastrophic event at the Fukushima Daiichi Nuclear Power Plant in 2011, concerns have heightened regarding the discharge of treated but still radioactive wastewater into the ocean. This research aims to understand the extent of contamination and its effects on marine life and the fishing industry, crucial for regions relying heavily on fishery exports, especially in the Northern Pacific.

Utilizing data from the North Pacific Anadromous Fish Commission and Japan's Exports of Fish & Fish Preparations, alongside a simulation model developed by Tsinghua University, this study provides a detailed examination of how nuclear wastewater dispersal affects marine ecosystems and the economic viability of the fishing industry. The results reveal a negative correlation between nuclear wastewater discharge and the fishing industry's health, not limited to Japan but extending to other Northern Pacific countries.

Through linear variable regression and multivariate regression models, the analysis demonstrates the significant ecological damage and economic losses incurred by the fishing industry due to contamination. This study not only sheds light on the immediate impacts of the Fukushima disaster but also offers predictive insights into the long-term consequences for Japan and potentially affected nations. The findings underscore the critical need for effective disaster response and management strategies, emphasizing the importance of ecological balance for industry sustainability and community livelihoods.

7MC700

LaFalce, Gavin

Dorothy Hamm Middle School

Can a Computer Program Predict Survival on the Titanic?

Computer science is an essential part of life, it is a great tool for problem solving and predicting. This simulation is a computer program. What the program does is it generates a random person, including their first and last name, gender, age, and fare price. Then it runs these factors through multiple trials/rounds of generating random numbers to determine their odds in surviving that specific round. But it's not completely random, the odds are based on actual real life odds. For example, a thirty year old female in first class would have better odds of surviving than a seventy four year old man in third class. Or to be even more specific, seventy five percent of women survived the Titanic, while only twenty percent of men survived.

8MC701

Mirabile, Mason

Williamsburg Middle School

A Model of Acceleration in Sports Cars

The purpose of this project was to identify which aspects of sports cars affect their acceleration. My hypothesis was that as power increases or mass decreases that acceleration would increase. Through my research I identified the independent variables I wanted to use in my project: power, torque, mass, drivetrain, and decade manufactured. I found a reliable data source and collected data on over 100 sports cars. To understand how each of these variables independently impacted acceleration, I created a multiple linear regression model. Microsoft Excel's multiple linear regression add-on analyzed all the data and created a model to predict the acceleration of a sports car as a mathematical function of all the independent variables in my project. One significant finding of my project was that the most influential factor of acceleration in sports cars was the power to mass ratio of the car. The power to mass ratio variable had a coefficient value of 9.40, meaning that for every unit increase in the power to mass ratio variable, the dependent variable, acceleration, increases by 9.4 m/s2. The other factors (torque, drivetrain, decade manufactured) were each statistically significant predictors of acceleration as well. Newton's second law of motion can be rewritten as acceleration equals force divided by mass. The most significant predictor of acceleration in my model was power to mass ratio, a strong proxy for force to mass ratio. The relationship displayed in my model was very closely supported by Newton's second law of motion.

9MC702

Desai, Suhani

Yorktown High School

The Effect of Building Materials on WiFi Signal Strength

This experiment tested how common materials used in houses will affect the strength of a WiFi signal. This research is important because this knowledge can help maximize the function of WiFi as its usage has become an essential part of life. This was tested by placing a building material in between a router and a phone, which has an application that scans the WiFi signal strength in decibel-milliwatts. The tested materials should weaken the signal because they are blocking the radio waves used by WiFi from traveling. It was hypothesized that if an aluminum sheet was used, then the WiFi signal strength would be the weakest. A one-way ANOVA test was conducted, resulting in a p-value of 0.00000000012281, which the data is statistically significant. The data shows that dry wall, wood, aluminum, glass, wooden pegboard, and plastic all decrease the strength of a wifi signal. The hypothesis was supported because aluminum decreased the strength of the signal the most, due to it conducting the electromagnetic signal the greatest. The wooden pegboard decreases the strength of the signal as well, however slightly less than the other materials. Dry wall, wood, glass, and plastic all similarly decrease the strength of the wifi signal.

9MC703

Docena, Jacob Oliver

Washington-Liberty High School

The Effect of Different Interference Types on the Accuracy of a Particle-Filter-Based Image Tracker

This experiment was conducted to determine which interference type would have the strongest impact on the accuracy of particle filter-based object trackers. The independent variable was the type of interference used and the dependent variable was the pixel error of the tracker. The interference types tested were a control with no interference, full occlusion, partial occlusion, and visual noise. It was hypothesized that full occlusion would have the most significant impact on the performance of the object tracker. The null hypothesis stated that if a particle filter is disrupted in different ways, there will be no significant difference in the accuracy of the particle filter. Each experimental group consisted of 10 trials. The experimental group with the highest average pixel error was full occlusion at 327 pixels, followed by noise with 230 pixels and partial occlusion with 73 pixels. The group with the least pixel error was the control with no interference with a pixel error of 10 pixels. With no interference, there was a standard deviation of +/- 4 pixels, with full occlusion, +/- 153 pixels, with partial occlusion,+/- 192 pixels, and with noise, +/- 224 pixels. The standard deviation of partial occlusion was larger than the mean, and the difference between the standard deviation and mean for noise was only 6 pixels. The data were statistically significant with a p-value of 0.000459. The data support the hypothesis that full occlusion would have the greatest impact on the accuracy of the object tracker. The null hypothesis was rejected.

9MC704

Finnegan, Sean

Arlington Tech/Career Center

Using Python to Create a Password Cracking Algorithm

In today's digital age, password security has become a pressing concern for individuals and organizations alike. To explore this issue, I embarked on a science project to create a hash cracker using Python. My goal was to understand the intricacies of hashing and hash cracking and to test various methods of enhancing password security. Modern passwords use a technology called "hashing," which turns plain passwords into unrecognizable strings of numbers and letters in an irreversible process. During my testing, I explored various hash-cracking methods, including dictionary attacks, rainbow tables, and brute-force cracking. After rigorous testing, I found that brute-force attacks were the most efficient and reliable. They were able to test over 1.9 million attempts per second and required almost no memory, unlike rainbow tables, which took over ten minutes to initialize and used close to 32 gigabytes of memory. My project demonstrated the importance of diversifying and lengthening passwords to enhance security. It was an enlightening exploration into the world of passwords and hash cracking, and it underscored the need for robust password policies and practices. With password security being a crucial aspect of our digital lives, the findings of my project are relevant to anyone who wants to ensure their online accounts are secure.

9MC705

Vasisht, Janak

H-B Woodlawn Secondary Program

AI Medical Text Parser

The AI Medical Text Parser was developed to create a method of presenting complex medical or scientific articles to people of all levels of understanding. Medical text often contains terminology that is difficult for the vast population to understand.

I am a ninth grade student who loves science and programming. This passion led me to develop a Python program called the AI Medical Text Parser, which harnesses the power of natural language processing (NLP) models like ChatGPT, OpenAi and HuggingFace to identify complex medical terms within text. The program then finds the definitions of those selected terms from Webster's Medical Dictionary. This algorithm can be harnessed to do many other functions based on user input, like identifying words that may be unknown to different age and reading levels. It can even translate complex words into other languages. Most importantly, this project can be transformed into a broader platform that is accessible to people across the world, and can make a huge impact by increasing understanding of complex scientific language for all.

10MC706

O'Reilly, Brendan

Yorktown High School

An Investigation of Stochastic Cellular Automata and Coherent Noise and Their Utility for Natural Terrain Generation

The goal of this project is to create a Java program that is capable of making unique terrains (game worlds), that conform to set constraints, everytime it runs. I want to make such a program so that I may experiment with applied coding and game design without the most time consuming step in game design—which is the creation of multiple enjoyable game worlds for a replayable game. The main techniques used in the program were stochastic cellular automata (a way of applying non-deterministic functions on a set of “cells” to change their state) and coherent noise (algorithms based on interpolating purely random values for continuous outputs across their domain). First, I created a data format for my “cell”, made my first few cellular automata functions, made debugging tools, and finalized my cellular automata library. Then, I used FastNoise Lite by Jordan Peck to sample noise values for biome aspects (temperature, humidity, and erosion), and deliberated the cutoffs for biome placement (ie: necessary humidity to make a dessert). Finally, I made the code to place biomes and output the finished map. My final program is able to output a biome map and key after around six seconds. For each randomly generated seed, it is fully automatic and deterministic. The next steps include placing rivers and implementing 3D noise utilization to create overhangs, caves, and other details.

10MC707

Stansbury, Devesh

Washington-Liberty High School

The Relationship Between Regional Household Income and Cell Signal Strength

This experiment was conducted to investigate the relationship between different areas with varying income levels and the cellular strength in those respective areas. The hypothesis for this experiment was that areas with lower average household income levels would tend to have lower levels of cellular strength throughout the zip code. Four different income levels were tested throughout the experiment; high-income levels, which had an average annual household income level of $125,000 or more, middle to high-income levels ($95,000 to $125,000), middle-income levels ($45,000 to $95,000) and low-income level, which had an average annual household income of less than $45,000. It was found that areas with low average income levels had stronger cellular connectivity, rejecting the hypothesis.

Five separate points in each zip code were visited, and cellular strength was measured in Megabits per second (Mbps). Three separate zip codes were visited in the D.C. metropolitan area, including northern Virginia. An ANOVA test was conducted, and it was found that the data was statistically significant, with a p-value of 8.6×10^{-4}, rejecting the null hypothesis. The data collected consisted of high-income levels, with a mean cellular strength of 31.4 Mbps, middle to high-income levels, with a mean cellular strength of 34.1 Mbps, middle-income levels, with a mean cellular strength of 62.2, and low-income levels, with a mean cellular strength of 92.9. The purpose of this experiment was to identify any sort of disparity across various socioeconomic statuses.

11MC708

Song, Sicheng

Episcopal High School

Attention Graph Neural Network Solution for Early Detection of Pancreatic Cancer

The diagnosis of early-stage pancreatic cancer is notoriously difficult for its lack of characteristic symptoms, leading to a particularly challenging situation for even experienced doctors and radiologists to discern. Pancreatic cancer, after passing the early stages when it is the most curable, also becomes one of, if not the most, lethal cancer. Computer vision, especially Graph Neural Network (GNN) based solutions, however, presents a promising solution for pancreatic cancer early diagnosis. Other neural networks like convolutional layers, vision transformers, and segmentation networks have also excelled in medical imaging tasks. Here, we propose a Graph Attention Transformer (GAT) augmented approach for pancreatic cancer diagnosis that is comparable to state-of-the-art detection mechanisms. The system proposed first separates three-dimensional CT images into two-dimensional slices, and then cuts them into smaller patches. The patches are then passed through a simplified VGG network to separate the patches into three different categories based on the presence of pancreatic tumors: true-positives, false-negatives, and true-negatives. The adjacency lists and graphs are then created according to these three classes and put into a GAT-augmented GNN model for training and, later, testing.

8ME800

Foerster, Nolan

Thomas Jefferson Middle School

The Effect of Natural Cleaners Compared to Chemical Cleaners

In my experiment I compared the organic cleaners to chemical cleaners. I wanted to learn if natural cleaners were as effective as chemical cleaners.

My hypothesis was that chemical cleaners would be more effective than natural cleaners. I conducted two trials each using 10 Petri dishes. I started my experiment by making agar and added it to each Petri dish. It provides all the right nutrients for bacteria. I swabbed one area of my school for the November trial and a different area of my school for the second trial in December. I put 2 ml of cleaner into each Petri dish and labeled them. I also had a control group to see how much bacteria would have grown if no cleaner was added.

I calculated my results by counting the bacteria colonies growing in the Petri dishes and observing the color of the bacteria colonies. Natural cleaners averaged 7.7 bacteria colonies. Chemical cleaners averaged 2.2 bacteria colonies. The control group averaged 38.7 bacteria. Organic cleaners struggled to kill the yellow and white bacteria but did well against the weaker bacteria.

I also performed a t-test to determine if my results for chemical cleaners were significant. The p-value for chemical cleaners versus natural cleaners was 0.00127 which is less than 0.05 meaning chemical cleaners are significantly better at killing bacteria with a 95% confidence rate. My hypothesis was proven correct because the p-value was statistically significant.

8ME801

Menta, Rahil

Williamsburg Middle School

The Effect of the Concentration of Ampicillin on the Size of the Inhibition Zone

Bacteria and microorganisms exist all around us. Most of them are harmless, and some of them are even beneficial to humans. Nonetheless, there are also many bacteria that cause diseases. Discovering antibiotics and other antimicrobial agents assists us in preventing and stopping bacterial infections. However, “the excessive use of antibiotics can lead to bacteria developing some sort of resistance/immunity to these antibiotics,” (Horowitz, D, 2022). This may lead to the growth and multiplication of a new population of resistant bacteria or to a longer recovery time for people suffering from an infection. “Stronger/more effective antibiotics might have to be used on the patient with harmful side effects,” (World Health Organization, Jul 31, 2020). In investigating how E. Coli K-12 reacts to different concentrations of ampicillin, this experiment is important in understanding how to create better and non-bacterial-resistant antibiotics.

9ME802

Sirak, Sam

Alexandria City High School (includes Minnie Howard)

ColonRiskNow: A Machine Learning Based Desktop Application to Detect Colorectal Cancer

According to the World Health Organization, “Colorectal cancer is the third most common cancer worldwide, accounting for approximately 10% of all cancer cases and is the second leading cause of cancer-related deaths worldwide.” Colon cancer typically arises from polyps, which are abnormal growths inside the colon. Early detection is key to preventing colon cancer, and colonoscopies have proven effective in reducing its incidence. However, colonoscopies are operator-dependent, and hold a concerning average miss rate of 22-28%, which prompts the need for the advancement of more comprehensive and minimally invasive diagnostic approaches. In response to this issue, I created an accurate, accessible, and non-invasive colorectal cancer assessment tool: ColonRiskNow. ColonRiskNow was developed using machine learning and integrated into a desktop application. ColonRiskNow comprises imaging and survey tabs, with each model meticulously trained using artificial neural network classification techniques. The survey model utilized basic health information and cancer diagnoses as input features and labels. Meanwhile, the imaging model sourced data and labels from diverse online polyp databases. The training of these models involved iterations until both succeeded with commendable accuracy. The classification models achieved accuracy scores greater than 95% and 90% respectively, exceeding benchmark accuracies. ColonRiskNow can be used by doctors globally, from enabling them to pinpoint patients that are high at risk of colorectal cancer, prompting them for more frequent colonoscopies, to analyzing images derived from colonoscopies, enabling gastroenterologists to be able to identify potentially cancerous polyps, ColonRiskNow has the potential to contribute to better colorectal health outcomes worldwide.

9ME803

White, Peyton

Alexandria City High School (includes Minnie Howard)

Which Drink Has The Most Electrolytes?

For my science fair project, I tested multiple drinks, and recorded which ones contained the most electrolytes. Because many drink brands put on the market are not always true, the goal of my experiment was to see if these companies live up to their promises. I tested orange juice, water, blue Gatorade, and an electrolyte packet mix. To test my experiment I made a closed circuit using a multi meter and other various materials. Once my circuit was created, I poured each of the drinks that I was testing into separate bowls. I dipped the straw into the drinks for 30 seconds, I recorded the number shown on the multi meter. I did this five times for each drink that I tested. My hypothesis was that blue Gatorade would have the most electrolytes. The graphs showed that orange juice had the most electrolytes. Following close behind was the electrolyte packet mix. From there however, there is a significant drop to blue Gatorade. Finally, the beverage with the least amount of electrolytes is water. This does not come as a surprise because aside from its hydration benefits, there are no other nutritional supplements contained in water. My hypothesis was incorrect and I learned to be more selective of the drinks I buy when I am looking for a re hydrating beverage. Because this project had a very wide variety of drinks, In the future, I plan on testing specific categories of drinks to go into greater detail.

10ME804

Batenhorst, Maya

Yorktown High School

The Effect of Suture Techniques in The Dermis on Tensile Strength

This project aimed to research various suture techniques on an incision wound in the dermis of pig skin. Suture techniques are commonly used in surgical settings for providing mechanical support to the wound and aiding in the body's natural healing process of cell proliferation and migration. Different suture techniques are used in various wound states. The force that is being applied to the wound and cosmetic preferences of the patient help in clinicians' decisions of the use of a particular technique. Four techniques were tested, using nylon monofilament suture thread; simple interrupted, running, horizontal mattress, and figure of eight. LoggerPro software was used to graph the probe force being applied to the skin as it was pulled apart using a force testing rig. Six relative maximums were recorded for each technique to determine the maximum number of newtons that were withstood before failure. The techniques were then observed for alleviation of tension of the thread, force vectors in the subcuticular region of the skin, and force directions being applied to the incision.

10ME805

Lach-Hab, Nadia

Washington-Liberty High School

The Effect of the Concentration of Polyethylene Glycol on the Zone Of Inhibition of *Lactobacillus acidophilus*

The purpose of this experiment is to determine the effect of polyethylene glycol (PEG) on the zone of inhibition of Lactobacillus acidophilus. It was hypothesized that if Lactobacillus acidophilus was treated with any concentration of polyethylene glycol, then the zone of inhibition for Lactobacillus acidophilus growth would be larger than the control group because polyethylene glycol has bactericidal properties. The tested groups were 0% (control), 0.5%, 1%, 2%, and 5% concentration of polyethylene glycol. The experimental group treated with a 5% concentration of PEG had the largest mean zone of inhibition of 17.4 mm and the group treated with 0.5% concentration of PEG had the smallest mean zone of inhibition of 10.8 mm. The control group had growth all around.

16 trials per group were tested by treating the bacteria culture with the independent variable. An ANOVA test showed the statistical significance of this data with a p-value of 4.9*10-2. T-test comparisons between the lower groups did not show statistical significance (tests done between the groups with 0.5%, 1%, and 2% concentrations). This data supported the research hypothesis. Observational data indicated light growth of the bacteria in all trials and growth of a fungus assumed to be Candida albicans in all experimental groups after results were collected.

This experiment is important in determining the effects of polyethylene glycol. It could be expanded to look at the effects polyethylene glycol, a chemical found in feminine hygiene products, has on the vaginal probiotics.

10ME806

Ladewig, Madeline

Yorktown High School

The Effect of Brand of Tampon on Absorbency

Women across the world face a monthly problem: menstruation. In 2023, the FDA tested a wide range of period products with human blood, ranging from period underwear to menstruation cups. That study found that many products absorbed less than advertised. That led me to question whether tampon brands absorbed as much as advertised. This study aimed to find the most affordable tampon option for consumers that had a high absorbency level and were relatively inexpensive by testing three major brands U-by Kotex, Tampax, and Cora. The expected outcome of this experiment was that Cora would be the most absorbent because the main ingredient, cotton, is a very absorbent material. The result of this study was that Tampax, on average, absorbed the most solution out of all three brands; followed closely by Cora. We can connect this to the number one ingredient in both brands: cotton. The brand of tampon that was the least absorbent was U-by Kotex, however, even though this brand did poorly in the experiment, we can conclude that U-by Kotex is successful at sales because of the targeted advertisement U-by Kotex sends to teen girls. This study was statistically significant because it had a P-value of <0.01 for the relationships between Cora vs. U-by Kotex and Tampax vs. U-by Kotex means that the null hypothesis is rejected. However, the relationship between Tamapx vs. Cora has a P value of >0.05 more research is needed to understand the relationship between Tampax and Cora. Consumers should buy tampons from

10ME807

Muhammad, Khamille

Alexandria City High School (includes Minnie Howard)

How Do Different Biomarkers Help Diagnose Different Types of Dementia?

The problem researched was how biomarkers found affect how a person is diagnosed with a specific type of dementia; the purpose of this project is to research factors that impact early diagnoses. This project provides background information on the three most common forms of dementia in the U.S and biomarkers associated with that type of dementia. There were five biomarkers studied in Alzheimer's, Lewy Body Dementia, and Vascular Dementia. The procedures involved researching how each form of dementia develops and looking into openly available trials already performed comparing the different amounts of a certain biomarker to different types of dementia. The information was then condensed into tables on a Google Sheet. The data I found are that higher amounts of neurofilament light chains and homocysteine indicated VaD; higher amounts of CSF tau indicated AD; and higher amounts of a specific form of alpha-synuclein and beta-amyloid 42 peptides indicated DLB. Furthermore, testing samples from CSF compared to blood serum resulted in CSF displaying much higher amounts in pg/mL of NfL than serum did, which supports additional studies on how invasive diagnostic tests such as the sampling of CSF is more precise than non-invasive techniques. In conclusion, there are certain amounts that could be found of a certain biomarker or protein that could assist in identifying the specific form of a disease, potentially allowing a patient to receive early treatment; however further research would involve identifying a certain range for scientists to use to point to a certain disease.

10ME808

South, Caroline

Washington-Liberty High School

The Effect of Digestive Enzymes on Cellulose Microplastics

This experiment was conducted to test the effect of digestive enzymes on cellulose microplastics. The hypothesis for the experiment was if different digestive enzymes are exposed to cellulose microplastics then amylase will be able to break down the most microplastics because amylase is responsible for most of the breaking down of carbohydrates in the digestive system, and cellulose microplastics is mostly made of cellulose, which is a carbohydrate. The tested groups were protease, amylase, lipase, and water, which was the control.

Fifteen trials per group were tested by exposing approximately two grams of microplastics to 10mL of each solution, which is left in a petri dish for three days. An ANOVA test showed statistical significance with a p-value of 4.62 x 10-17. A T-test was conducted to test the statistical significance between the amylase and the lipase, and the T-test concluded that there was statistical significance with a p-value of 0.0178. The experiment supports the hypothesis that microplastics exposed to amylase have the greatest percent decrease. Amylase had a mean percent decrease of 27.39. Lipase had a mean percent decrease of 20.18, followed by protease with a mean percent decrease of 14.55, and then water, the control, with a mean percent decrease of 4.78.
The experiment is important in determining the decomposition of microplastics in the digestive system. It could be expanded to look at biomagnification of microplastics in organisms.

10ME809

Uddin, Maqsuda

Wakefield High School

The Neurological Effects Of Predormital Hypnagogic Sleep Paralysis on a More Strained Anxious Mind Opposed to More Moderate Tempered Mind with Repetitive Basis of Occurrence

Hypnagogic sleep paralysis, also known as predormital sleep paralysis, occurs when the stages of REM sleep and awake overlap; this is the type of sleep paralysis that happens just before falling asleep. During the episodes, one could experience tactile or hypnagogic hallucinations. The goal of the project is to see if stress has an effect on inducing or even slightly intensifying the occurrence of sleep paralysis, and how to manage sleep paralysis by lessening the intensity of the episodes or getting rid of it entirely. The study was conducted by inducing sleep paralysis, allowing the participant to regain complete consciousness, and documenting the results. The subject will next record all of the information on the stressed worried minds recorder or modern tempered minds recorder. These data sheets had all of the information, and the subject was also examined on Likert scales ranging from one to ten. The data was then organized into charts and graphs for a more visually appealing portrayal. The concept was accepted because stress can exacerbate or induce bouts of sleep paralysis. The data was collected to verify or disprove whether stress played a role in exacerbating or causing sleep paralysis. Expand on this project there can be EEG machines used ECG machines used multiple sleep latency tests melatonin sampling etc.

10ME810

Maguire, Ian; Logsdon, Cole

Wakefield High School

The Impact of Chest Exercises on Heart Rate

This independent scientific inquiry explores the nuanced and acute impact of chest exercises on heart rate, aiming to contribute to our understanding of exercise-induced modifications in cardiovascular function. The study adheres to standardized protocols, involving three chest exercises – Bench Press, Pec Flys, and Chest Press – with a focus on immediate cardiovascular responses. The hypothesis, suggesting that exercises engaging larger muscle groups and greater range of motion have a greater effect on heart rate, is tested through a rigorous experiment with safety measures in place. Analysis involves the average heart rate and the difference from resting heart rate, leading to unexpected findings that challenge the initial hypothesis. The discussion acknowledges potential errors and suggests avenues for future research, emphasizing the study's potential in guiding tailored chest exercises for various fitness goals.

11ME811

Mohanty, Anna

Washington-Liberty High School

Alcott: A Convolutional Neural Network to Predict Drug Target Binding Affinity in HIV-1 Neural Infection Treatment

Microglial cells have the ability to engulf HIV-1 infected glial cells by binding to neuronal blebs, effectively stopping the subsequent encephalopathy. However, two HIV-1 accessory proteins –Nef and Fyn– can relocalize the Th cell recruiting protein CD59 to the cell membrane, limiting its function and inciting immune evasion. This is achieved via the formation of a Nef/Fyn polyproline helix utilizing glycine rich motifs, similar to how spider silk is twisted by golden orb weaver spiders. This experiment aimed to investigate if the enzymes used by golden orb weaver spiders to untwist their silk could be used to limit the Nef-Fyn complex function. First, Alcott, a convolutional neural network was created in order to determine binding affinity from peptide alignment motifs based on sequence oligomerization capacity and degree of conservation. The oligomerization capacity was determined via the logP sum of each tokenized amino acid to determine solubility, and entropy was a function of the peptide's Gibbs Free Energy. The system was trained on 5,000 data points and showed a 0.92 accuracy. From this, the enzyme Cathepsin L was determined to have the highest binding affinity to Nef, and gel electrophoresis was used to measure the degradation of Nef when digested with Cathepsin L, which was shown to be significant in glycine rich alignment motifs. Therefore, binding affinity predicted based on alignment motifs could be useful in improving enzyme therapy success rates and Cathepsin L could be used as a low-cost treatment component for reducing HIV-1 neural proliferation.

11ME812

Schiaffino, Elizabeth

Wakefield High School

Comparing Laceration Repair Techniques

Due to the doctor shortage, physicians and health care workers are being overworked. It is predicted that the shortage will only grow due to the burnout caused by these shortages. More efficient care is needed to be given to patients to decrease the need for follow up care. This issue can be considered within one of America's most common practices: sutures and staples. Which leads to the question, which solution is the least likely to break or have complications? To figure this out, the stability of suture types and staples must be tested. To test the max force able to be applied, the skin sample, once sutured, would be pulled until it broke. In order to specifically apply force to the suture itself, clamps were used on both opposing sides of the laceration to maintain pressure in the center. Through this test process, it was found running sutures could withstand the most tension, followed by staples then the horizontal mattress stitch. However, in an emergency setting it is also worth noting the amount of time each takes. Staples took the least, then the running stitch, and finally the horizontal mattress stitch took the most. Sutures and staples also have a different healing process when considering cosmetic matters. It is also worth mentioning staples require follow up care to be removed. So in order to repair a laceration efficiently, a running suture is the strongest and is the least likely to require follow up care due to breakage.

12ME813

Bartrum, Olivia

Wakefield High School

Harnessing the Signalosome to Enhance Ex-Vivo Generation of Tumor Antigen-Specific T Cells

The adoptive transfer of tumor antigen-specific T-cells (ASTs) can serve as an effective immunotherapy against solid tumors of the central nervous system (CNS). However, current methods of T-cell engineering are time-inefficient (4 weeks). With prolonged treatment inactivity, tumoral genetic diversification may occur, resulting in immunotherapeutic resistance. Understanding this, attempts were undergone at hastening cell-therapy manufacturing techniques through ligands of the signalosome (SLs), en route to the manufacture of tumor-ASTs. It was anticipated that by stimulating T-cells with SLs, they may be developed as memory-trained, producing an immune response. The cytomegalovirus (CMV) pp65 antigen was of focus, serving as a model for future experimentation with CNS-tumor antigens. Donor-derived PBMCs of varying CMV-serostatus were expanded with CMV-pp65 and a combination of SLs (ICAM-1/CCL21/OKT3/UCHT-1). Cells were stimulated in-vitro with subsequent analysis of interferon-gamma secretion. Short-term expansion (6 days) of CMV-seropositive cells with pp65/CCL21 resulted in CMV-ASTs. Expansion with pp65/ICAM-1 additionally produced CMV-ASTs. Thus, time-based immunotherapeutic manufacturing efficiency increased significantly with signalosome-associated proteins. Phenotypic characterization via flow cytometry revealed a relatively higher proportion of CD8-T-cells in expanded CMV-seropositive-cells.

Demonstrating the ability to effectively develop CMV-ASTs with SLs, RNA-seq differential-expression-analysis was performed to determine immunogenic antigens-of-interest, targeting CNS tumors. Data was stratified by tumor reference-specificity to examine differential-expression between tumor site-specific and generalized healthy control tissue of the CNS. Consistently-upregulated genes were sequenced and underwent predictive MHC-peptide bond-strength-analysis to determine respective immunogenicity. TOP2A and CCNB2 were identified as promising antigens-of-interest in the future development of immunotherapeutics for CNS tumors.

7MI900

Caparas, Paige

Williamsburg Middle School

The Effect of the Type of Natural Antibiotic on the Area of Inhibition Against *Escherichia coli*

Escherichia Coli (E. Coli) is a gram-negative bacterium that can occur in contaminated food such as under-cooked meat. The medical community has treated infections from E. Coli by using synthetic antibiotics such as penicillin. However, the overuse of synthetic antibiotics has created antibiotic resistance and decreased its efficacy over time. A potential solution is to utilize natural antibiotics which have been found to be effective in inhibiting bacterial growth without resulting in antibiotic resistance. It was hypothesized that melaleuca (tea tree) oil would most significantly inhibit the growth of E. Coli. This experiment tested six natural antibiotics: apple cider vinegar, garlic extract, ginger extract, manuka honey, oregano oil, and tea tree oil, along with a control (no substance was added) against the strain E. Coli K12 to determine which would have the most significant area of inhibition. The efficacy of each natural antibiotic was tested by a disk diffusion method in which agar mediums and antibiotic sensitivity disks were used. The areas of inhibition against E. Coli K12 were monitored and assessed every other day for a week. After a week, the experiment revealed that garlic extract had the most significant area of inhibition against E. Coli K12. Therefore, the hypothesis that tea tree oil would have the most significant area of inhibition was rejected. The experimental data suggested that garlic extract and other natural antibiotics can serve as viable alternatives to synthetic antibiotics in inhibiting the growth of E. Coli K12.

8MI901

Ghosh, Sid

Williamsburg Middle School

The Effect of Temperature on the Brightness of Bioluminescent Bacterium *Aliivibrio fischeri*

The purpose of this project was to determine how bioluminescence, a lighting-emitting biochemical process, can be used to replace modern-day lighting technology. This is important because electrical lighting contributes to climate change and light pollution. The bioluminescent bacterium Aliivibrio fischeri was tested at 4 different temperatures: 5º, 15º, 25º, and 35ºC, to see which temperature produces the most glow. Additionally, another factor that was tested was if subculturing the bacteria allows for greater bioluminescence, or if just refrigerating the bacteria beforehand is better. The bioluminescence was tested by taking photos of the bacteria and analyzing the mean pixel luminosity of each photo. The hypotheses were that the 25ºC plate would glow the brightest, and that subculturing the bacteria would result in greater light intensity. Both hypotheses were proven correct, because the subculture put at 25ºC glowed the brightest. In addition, the data shows that although subculturing the bacteria beforehand results in greater light intensity at 25º, the subcultures did not glow very much at any of the other temperatures. Also, it is evident that refrigerating the bacteria without subculturing it results in a less intense, but more consistent glow across the temperature range. However, none of the bacteria glowed nearly as bright as electrical lighting, barely able to be captured on camera. Although this project provides a lot of important information about the nature of bioluminescence and A. fischeri, in order for bioluminescence to be implemented as a light source for society, more research needs to be conducted.

8MI902

Ghosh, Sophia

Williamsburg Middle School

The Effect of the Type of Substance Used to Sterilize Water on How Much Bacteria it Kills

The purpose of this experiment was to find the safest, most effective alternative to chlorine that can be used to sterilize pools. Although chlorine is a very well known substance that can sterilize pool water, when mixed with body waste it can create a dangerous chemical called chloramine. The independent variable is the type of substance used to sterilize the water and the dependent variable is how much bacteria that substance kills. The levels for this experiment are chlorine, salt, and UV-C light. 3 trials were conducted for each level and the dependent variable was measured by counting the number of bacterial colonies on each plate. The hypothesis for this experiment was that the salt would kill the most bacteria. This experiment had 19 procedures and used 3 Petri dishes of pre-plated E. Coli K 12. The experiment was conducted by splitting each of the plates into 3 sections for the trials, then exposing each plate of bacteria to one of the 3 substances. The plates were then placed in an incubator at 37ºC. After 24 hours had passed, the plates were removed from the incubator and evaluated under a microscope where the number of bacterial colonies were counted separately for each trial. The results of this experiment were that the salt and UV-light killed all of the bacteria on both of the plates and the chlorine did not kill all the bacteria. Therefore, it can be concluded that both salt and UV-light would be very effective alternatives to chlorine.

9MI903

Coyle, Hannah

Washington-Liberty High School

Does the Distance from a Street Affect the Level of Bacteria in a Stream?

The purpose of this experiment was to test the effect of the distance from the street on the level of bacteria in the stream. The hypothesis was if the distance from the road increases, then the bacteria levels will decrease. The group with the highest bacteria concentration was Location A. The group with the lowest bacteria concentration was the control. Tap water had a bacteria level of 2 compared to Location A at 9. This shows there was a big difference between the bacteria level of Location A and the control group. It was hypothesized that the closer to the street the samples were collected, the higher the bacteria level. The results supported the hypothesis because Location A, which was closest to the street, had the highest level of bacteria. An ANOVA test and a T-test were conducted in this experiment and the results were less than 0.05, which makes the data significant. The null hypothesis stated that if the distance from the street changed, then the level of bacteria also wouldn't change. Therefore, the null hypothesis was not supported.

9MI904

Garcia Jimenez, Zoe

Alexandria City High School (includes Minnie Howard)

Yeast Balloons

This project was trying to answer the question of which material (glucose, sucrose, salt, or flour) would be best as food for baker's yeast, Saccharomyces cerevisiae. The hypothesis for this experiment was that if flour is used as food for baker's yeast, then it will create the biggest circumference on a balloon of yeast produced CO_2. This hypothesis was proven wrong. This project was done by putting yeast into a flask with different solutions then putting a balloon on top of a yeast-filled flask to catch the CO_2 produced. The CO_2 was how the activity of the yeast was measured. The constants in the experiment were taken from previous experiment done. The data collected showed a pattern of the two sugars having the biggest circumference across all the trials with glucose having an average circumference of 28.6 cm and sucrose having an average of 29.2 cm. The circumference average for the flour was slightly bigger than water, which was the control. Salt had the smallest circumference throughout all the trials. This experiment means that sugars are a simple carbohydrate for yeast to break down. Knowing optimal growth conditions for yeast is important because yeast is incredibly important in everyday life. Yeast is used to make many bioproducts, beverages, and breads.

9MI905

Hengst, Sadie

Washington-Liberty High School

The Effect of Different Natural Antibacterial Agents on *Escherichia coli*

Concentrated animal feeding operations (CAFOs), commonly known as factory farms, are a large contributor to the spread of antimicrobial resistance (AMR) due to the unsanitary, overcrowded conditions livestock are kept in and the excessive use of antibiotics in their feed to prevent disease. The purpose of this study was to find the natural antibacterial agent that was the most effective against Escherichia coli, a species of pathogenic bacteria commonly found in chicken intestines that has evolved multiple antibiotic-resistant strains. The antibacterial agents tested were garlic extract, oregano essential oil (EO), cinnamon EO, and cumin EO, while the control was no antibacterial agent. It was hypothesized that the garlic extract would be most effective due to the consistently high antimicrobial activity of allicin, a molecule prominent in crushed garlic. The experiment was conducted by inoculating Petri dishes with E. coli bacteria, then treating each colony with a different antibacterial agent and measuring the diameter of the zones of inhibition after 48 hours of incubation. The results showed that the oregano EO and cinnamon EO were most effective against E. coli, with the same mean zone of inhibition of 3.5 cm. Conversely, the control had 0 inhibition. The data collected suggests that while all four antibacterial agents were effective against E. coli, the oregano EO and cinnamon EO had the highest and most consistent levels of inhibition. This provides further insight into the best alternatives to antibiotics for factory farms to add to animal feed.

9MI906

Normington, Beckett

Washington-Liberty High School

The Effect of Anti-Acne Treatments on the Zones of Inhibition of *Staphylococcus epidermidis*

This experiment quantified the inhibition of Staphylococcus epidermidis by different topical anti-acne treatments. The hypothesis stated that the group treated with filter paper discs containing 5% benzoyl peroxide topical wash would have the greatest mean zone of inhibition. Sterilized filter paper discs were treated with 5% benzoyl peroxide topical wash, salicylic acid 2% anhydrous solution, 100% tea tree oil, and distilled water. Petri dishes were prepared and inoculated 48 hours later. The discs were applied to the dishes, and the plates were incubated for 48 hours. The mean diameter for each quadrant of each dish was recorded from three directions through the center of each disc and compiled into a data table. The summative data table includes the mean diameter of the measurements for each group. The standard deviations of each group were calculated and recorded, along with an ANOVA test of all groups and a t-test between two groups. The data are statistically significant and do not support the hypothesis. The group treated with 100% tea tree oil had a mean zone of inhibition of 4.83 millimeters, followed by the 5% benzoyl peroxide topical wash group with a zone of inhibition of 2.72 millimeters, the 2% salicylic acid anhydrous solution with a zone of inhibition of 0.26 millimeters, and finally the distilled water control group at 0 millimeters. Thus, 100% tea tree oil had the greatest impact on bacterial growth. The experiment could be improved by getting forms of the treatments without additives to reduce error sources.

9MI907

Olson, Ula

Arlington Tech/Career Center

The Effect of Natural Antiseptics on *Escherichia coli* Bacteria

This experiment was conducted to find the best natural antiseptic because in recent years many people have been turning to them over traditional substances such as rubbing alcohol. The experiment began by plating bacteria into 20 petri dishes. Then, filter paper discs were dipped into five different kinds of homeopathic substances, and one was placed into the center of each petri dish. There were five petri dishes per antibacterial substance. The dishes were subsequently placed in an incubator at 37 degrees Celsius, and left for 48 hours. Upon returning to the lab they were inspected and the kill zone was measured around each disk.

The honey killed almost all the bacteria in the dish, with an average kill zone of 13.07mm. The garlic and lemon were in the middle; lemon had a kill zone of 6.54mm and garlic had a kill zone of 6.23mm. However the most surprising finding was that the turmeric grew bacteria. It was not just in one petri dish, but in all five, the turmeric seemed to encourage growth. It was surprising that honey killed the most bacteria; however, it makes sense. Honey contains a lot of sugar while also having a low moisture content. It acts as a hypertonic solution and sucks all the water from the bacteria, killing them. In research done by the National Institutes of Health, it was found that turmeric actually was more effective at growing bacteria rather than killing it. The data supported and rejected my hypothesis.

9MI908

Putchakayala, Dylan

Yorktown High School

The Effect of Cleaning Agent on Bacterial Growth

This microbiology project involving E. coli k-12 bacteria investigates the best of three different cleaning agents. Solving common household and personal safety problems, the experiment results indicate a solution, and also bring forth further questions. Some of the results showed an abnormality that was entirely unexpected based on extensive prior research. Performed using cultured bacteria and using the disk assay method for experimentation.

10MI909

Hassen, Nadia

Washington-Liberty High School

The Effects of Natural Ingredients Found Commonly in Natural Toothpaste on Corynebacterium

This experiment conducted the effects of natural ingredients found commonly in natural toothpaste on the growth of Corynebacterium. It was hypothesized that if natural ingredients are tested measuring the highest zone of inhibition, then xylitol would dominate because it has antibacterial properties enabling it to kill high amounts of Corynebacterium and it also has antimicrobial effects. Corynebacterium is a type of mouth bacteria that is commonly found in the mouth, specifically in cavities and is often combined to form dental plaque. Additionally, it's seen to cause little harm to humans. The experimental groups in this experiment were calcium, coconut oil, cranberry extract, and xylitol. There were 16 trials conducted per each experimental group with the control group having four trials. All the trials had bacteria swabbed on the petri dishes and after being treated with the independent variable, were measured for the zone of inhibition.

An ANOVA test was also conducted and it showed a p-value of 0.387 which was greater than the critical value of 0.05, meaning that the null hypothesis couldn’t be rejected. Therefore, there was no significant difference between the experimental groups. This was not the expected results as it was predicted that there would be significant difference between these experimental groups. Due to the fact that the ANOVA test was not significant, it meant that the results were inconclusive. To conclude, this experiment is important in helping natural toothpaste users look out for specific ingredients in their toothpaste that will help with bacterial prevention.

10MI910

Madison, Kaitlin

Washington-Liberty High School

The Effect of Conjugation Time on Area of Bacteria Growth

Antibiotic resistance is a critical issue that poses a significant threat to the medical community worldwide. Despite the advancement of modern medicine, the misuse of antibiotics has led to an alarming increase in antibiotic resistance. The purpose of this experiment is to provide valuable information to medical professionals regarding the length of time it takes bacteria with resistance to two of the most used antibiotics, ampicillin and tetracycline, to conjugate and pass along antibiotic resistance. It was hypothesized that if tetracycline resistant Escherichia coli and ampicillin resistant Escherichia coli were left to conjugate, then at ten minutes, the area of growth would be the greatest because when bacteria replicate, which can happen at a minimum of approximately four minutes, they spread their genes. With more bacteria, the frequency of conjugation will increase and thus the area of bacteria containing antibiotic resistance will also increase. This experiment was conducted under professional supervision in a National Institutes of Health laboratory, where conjugation was tested at one, two, three, four, five, and ten minutes. The results obtained from the experiment support the hypothesis as the mean area of colony growth was proven to be the highest at ten minutes. Data also showed that the difference between bacterial growth at five and ten minutes was statistically significant, thus showing that once antibiotic resistance occurs, it will spread rapidly.

10MI911

McPhillips-DeFilippi, Bellum

Washington-Liberty High School

The Unfiltered Truth: How Effective Different Methods of At-Home Water Purification Are at Removing Bacteria From Stream Water

This experiment aimed to determine the efficacy of different at-home water purification methods. The hypothesis was that boiling would be the most effective method of water purification, but in a scenario where boiling water is not an option, xylem filtration would also be effective at removing bacteria from water. This hypothesis was influenced by the principle that high heat kills bacteria, and by a 2021 study, conducted by MIT, which showed that gymnosperm wood can effectively filter water at a low cost.

The groups tested in this experiment were water purified by boiling, xylem filtration, solar distillation, and bleach. After water samples were treated, they were swabbed onto agar plates, and left to inoculate for 2 days. Then, the area of bacteria grown for each sample (8 per experimental group) was recorded. It was found that boiling, bleach purification and solar distillation were effective methods of purification. A t-test between the xylem filter and the control had a p-value of 0.0686, which is not statistically significant. A t-test between the bleach and the control had a p-value of 0.0264, which is statistically significant. However, the bleach was not as effective as the boiling and solar distillation, which both killed all bacteria present in the water. An ANOVA test yields a p-value of 1.41 x 10-8, which is significant. Thus, the null hypothesis can be rejected, and the hypothesis can be accepted. The solar distillation was not able to be completed, which may have led to inaccurate results.

10MI912

Mohamed, Aya

Alexandria City High School (includes Minnie Howard)

The Rise Of Bread

What does baking powder, baking soda, and yeast do to bread? Does the leavening agent you put in bread affect how much it rises? The experiment will be done with 11 ml of baking soda, baking powder, and yeast to find out which produces the higher/fluffier bread in centimeters. This information would be useful for bakers that want to try new recipes. To find out which leavening agent works the best I made 15 loaves of bread with 5 of each type using the same amount of every ingredient. Yeast was the tallest at an average of 8.8cm baking powder coming 2nd in 4.4cm and baking soda coming 3rd at 2.8cm. This science fair project will help with new recipes that might be written that only want a little bit of rise or a lot of rise.

6PH1000

Garcia, Ethan

Gunston Middle School

The Effect of Friction on a Hovercraft

This experiment is designed to show how friction affects a hovercraft. This information could help us develop amazing new technologies that will change the way we travel across our planet. The goal of this project is to find which surfaces a hovercraft will travel over the fastest. The procedure used involved getting identical ramps with different surfaces on them and measuring the time it took for a hovercraft to travel over them. The data showed that the roughest surface had the longest time of 1.51 seconds and the smoothest surface had the shortest time of 0.85 seconds. This experiment contributes to engineering by telling what surface affects a hovercraft the most. In conclusion this will make hovercraft designs more efficient.

7PH1001

Ayalew, Maedot

Kenmore Middle School

The Effects of Seasonal Variation on the Kinematics of Coronal Mass Ejections Using the Solar and Heliospheric Observatory Satellite

Every day, multiple enormous bursts of plasma come from the outermost layer of the Sun, the corona. This violent phenomenon is called a coronal mass ejection (CME). CMEs are extremely destructful, yet, they are full of mystery. The more scientists find about the properties and behavior of CMEs, the better people can protect satellites and provide safety to people during space exploration. This project looks at which season (independent variable) the kinematics (dependent variable) of CMEs are the greatest. The SOHO LASCO CME catalog is a database that has coronagraphs (videos of CMEs). The positions of features in 60 coronagraphs were measured. The data was then used to calculate the velocity and acceleration of the CMEs for each month from 2018-2022. The hypothesis was that during fall and spring, the kinematics of the CMEs will be the greatest. The results supported the hypothesis by showing that the velocity(m/s) was greatest in the fall, followed by spring, and the acceleration(km/s^2) obtained the opposite results. As stated above, CMEs are extremely harmful to various things, one of which is satellites. People use satellites for services like communication, GPS, weather forecasting, and financial transactions. CMEs and geomagnetic storms, which are caused by CMEs, can damage satellites. Additionally, an obstacle for space exploration is the harmful effects solar events would have on humans on missions that go beyond Earth's magnetic field. By knowing what seasons have the greatest kinematics of coronal mass ejections, scientists can avoid those time periods.

7PH1002

Hatchl, Carly

Swanson Middle School

The Effect of Friction Force on the Maximum Weight Interleaved Sticky Notes Can Support

I chose this project because I saw a MythBusters video that tests the claim that it is impossible to separate two interleaved phone books by pulling on their spine. In this project I replaced phone books with sticky notes. The independent variable for this project is the number of pages interleaved. The levels are 10, 20, 30, and 40 pages. The dependent variable is the maximum weight the interleaved sticky notes can support before they pull apart. My hypothesis was, if there are more interleaved sticky pages, then there will be a higher maximum weight until the sticky notes pull apart. This is because the more pages interleaved will create a greater amount of normal force that will keep them from pulling apart. To make the pages separate, the weight had to exceed the friction force, which is the normal force times the coefficient of friction. My hypothesis was supported by the data because the weight increased as the pages increased. The variability of the maximum weight also increased as the pages increased. I performed linear regression to characterize the relationship between the independent and the dependent variables. The r value showed a moderate positive correlation. I tried a linear, exponential, and quadratic model on my data and the exponential model fit the best according to its r^2 value.

8PH1003

Garcia Mogollon, Miranda

Gunston Middle School

The Effects of Weights on a Magnetically Levitated Train

From Marty McFly's incredible flying DeLorean in 'Back to the Future' to the thrilling flying speeder bikes found all over the 'Star Wars' franchise, the concept of futuristic transportation has always captivated our imagination. This project explores one of the closest real-world equivalents, focusing on magnetic levitation trains (or "maglev" trains), and the effect of weight on a maglev train's ability to float. In this experiment, a maglev train model built using wood, plastic, tape and magnetic strips carried sets of pennies (that incremented by 5 pennies per set) while hovering above its track. The goal was to measure the maximum amount of weight that the train could carry without touching the tracks below it. The hypothesis, based on Newton's 3rd law, suggested that as the weight on the train model increased, the train would hold the weight until it reached a point where it was no longer being supported by the magnetic force between the train and the track, causing it to descend. The data gathered confirmed this hypothesis, displaying a 5 millimeter decline per 5 penny set, until the train touched the tracks at 110 pennies. This data also supported the connection between the hypothesis, Newton's 3rd law, and its application to real maglev trains, that could pave the way for more energy-efficient and environmentally friendly transportation. For this reason, other scientists can and should apply whatever knowledge is gained from this experiment to actual maglev trains, to better understand magnetic levitation and how it could be utilized.

8PH1004

Herrick, Sam

Swanson Middle School

The Effect of Magnet Density on Magnetic Levitation

My experiment explores the forces generated by varying the number of magnets and the mass on a levitating platform. By adjusting magnet placement and mass, this experiment aims to understand how these factors influence magnetic levitation. Magnets, regardless of shape, have north and south poles. Similar poles repel, while opposites attract. This repulsion can levitate objects, as forces push against each other. I used this principle to construct my apparatus. To conduct this experiment, I used a single type of magnet at varying intervals along a platform. I then increased the mass in increments of 500g and measured the distance the platform was levitating off the base after each addition of mass.

The data I collected by carrying out my procedure showed that the platform levitated higher above the base when it had more magnets closer together. It also showed that the amount of mass needed to sink the platform by one millimeter rose exponentially the closer it got to the base, indicating that in a perfect system, the amount of mass needed to get the two boards to touch would be infinite.

I learned a lot about forces a magnet exerts on other magnets. My experiment shows just one way to apply magnetic forces. A strong enough magnetic force can be used to power maglev trains, electric motors and even launching projectiles.

8PH1005

Hii, Ung-Ben

Williamsburg Middle School

The Effect of The Type of Material on How Fast an Ice Cube Melts

The purpose of this experiment was to determine which type of material would be the best at melting an ice cube in the shortest amount of time. This experiment is important because the research could be used to make melting road ice faster and more efficient. There were four levels of independent variable that were tested for the experiment, and they are salt, sugar, baking soda, and control. The data was collected by placing ice cubes in small bowls, and then starting the timer after the material was poured onto the ice cube. The data was recorded, and the timer was stopped after the ice cube fully melted. For the case of the control level of IV (independent variable), there was no material poured onto the ice cube, and the timer started right when the ice cube was placed into the small bowl. The hypothesis of the experiment was that salt would melt the ice cube faster than all the other materials because of its higher melting power which is caused by salt's ability to disrupt water molecules better than sugar or baking soda. The results of the experiment showed that salt was the fastest at melting the ice cube, and the control was the slowest at melting the ice cube. This reveals that the hypothesis was supported and helps to prove that salt is indeed better than sugar, baking soda, and control at melting ice.

8PH1006

Lorenzen-Schmidt, Luca

George Washington Middle School

Will It Break?

Which wall is the strongest is it a running bond, stacked bond, stacked horizontally, and flemish? I hypothesize that If the running bond wall gets hit by the ball in the side it will be able to withstand more force than the stacked bond, stacked horizontally wall, the flemish, and the stacked horizontally. I will be making out of Lego four different brick walls with different patterns running bond, stacked horizontally, stacked bond, and flemish. After that, I will drop a tennis ball connected to a string that is taped to the edge of the table to simulate a wrecking ball against a wall and drop it ten times against the wall and repeat for every different wall type which is stacked bond, running bond, stack horizontally and flemish. I have learned that certain wall patterns are stronger than others due to the overlapping of bricks and core strength. This helps support the wall by giving a strong base and foundation. By my hypothesis, the running bond which is a wall with an overlapping style like the flemish also is the wall with the biggest chance of being the strongest. All walls have their design and style. The flemish wall and running bond are both walls with an overlapping style with minor differences; the flemish has incorporated the 2x2 in overlapping bricks and the running bricks only overlap the 4x2. And the stacked and stacked horizontally stacked styles were stacked and the stacked horizontally 2x2 stacked over each other and

8PH1007

Oberkirsch, Purvi

Gunston Middle School

The Effect of Solubility on the Conductivity of a Salty Solution

Have you ever wondered if there is more to salt than flavoring your food? Salt solutions are an important part of many battery types, and this depends on a salts ability to dissolve into water creating a strong electrolyte. This experiment tests a variety of chloride salts to determine the effect of solubility on the conductivity of a salty solution. To do this, salt was dissolved in distilled water. Then, using a simple circuit made from a 6-volt battery and copper wire, a current was passed through the solution. The current, measured in amperes, was read on a multimeter. The solution that read the highest current was determined to be the most conductive. The hypothesis of this experiment was that the Calcium Chloride solution would have the highest conductivity because it has the highest solubility in water (74.5g/100ml). The hypothesis was proven wrong by showing that the Ammonium Chloride solution had the highest average conductivity (1.78 amperes) even though it has a lower solubility (37.2g/100ml) than Calcium Chloride. The experiment also showed several interesting effects: salty water is very conductive and very corrosive; Calcium Chloride is highly exothermic (raising the temperature of the solution by 56 degrees Celsius), and Ammonium Chloride is highly endothermic (lowering the temperature of the solution by 15 degrees Celsius).

8PH1008

Totten, Credence

Dorothy Hamm Middle School

Does More Resistance Mean Higher Volume?

The invention of the electric guitar pickup revolutionized music in the mid-20th century. Electric guitar pickups utilize thousands of wire-wraps around an electromagnetic coil to produce their sound, each wrap adding to the strength of the pickup. I wondered, would it be counterintuitive to add wraps to the coil if those additional wraps also add resistance? I experimented with differing numbers of wraps in a single-coil pickup to see how it affects the volume of an electric guitar. The experiments show that volume increases with the number of wraps, peaks and then falls off, with a gradual rise back up. This nonlinear curve is unexpected, inconsistent with my hypothesis, and warrants further research into why.

8PH1009

Vajjhala, Kavya

George Washington Middle School

Elevated Energy: How Does Altitude Affect the Amount of Cosmic Rays?

High-energy, charged particles, called cosmic rays, constantly bombard Earth. Cosmic rays are of extraterrestrial origin, so studying them can lead to discoveries about the universe. Cosmic rays are usually invisible, but a DIY cloud chamber makes them visible to the human eye. At different elevations, I recorded the number of cosmic rays that passed through the cloud chamber. The data shows that as the elevation increased, the amount of cosmic rays also increased, which proves the hypothesis correct. At sea level, there were about 3.3 cosmic rays a minute. At a 30-foot elevation, there were approximately 4 cosmic rays per minute. There were 6.2 rays at 500 feet and 8.2 cosmic rays at 1000 feet. In summary, There are more cosmic rays at higher elevations because there is less protection from cosmic radiation due to the thinner atmosphere.

8PH1010

Williams, James

Swanson Middle School

The Effect of Earth's Position in Relation to the Sun on North America's Temperature

The purpose of the experiment was to determine how much the temperature of a given point on a spinning sphere differs based on the effect of it's tilt in relation to a heat source. This experiment was conducted using a heat lamp and two 5 inch diameter globes printed from PLA filament. When conducting this experiment I placed a globe 5 inches away from the heat source, the globe had a motor which made it spin and after 3 minutes I would record the temperature of a spot on the globe representing North America using a celsius thermal camera. The globe was made to face the heat source in a way that represented the earth's Vernal and Autumnal Equinoxes and Summer and Winter Solstices. The control was a globe with no tilt and the results were that the Summer Solstice was hotter then the other positions and the Winter Solstice was colder then the other positions.

8PH1011

Yassin, Haya

Francis C. Hammond Middle School

Stick Or Swim

During my experiment, I tested the effectiveness of waterproof bandages and regular bandages when resisting water. The aim was to determine if waterproof bandages perform better than regular bandages when wet. To conduct the experiment, I used a grapefruit, as it resembles human skin in texture. I placed a bandage on the grapefruit and sprayed it with water ten times to observe the performance of the two types of bandages. Results revealed that waterproof bandages adhere better to the surface than regular bandages, even a few minutes after getting wet. This confirmed my hypothesis that waterproof bandages would perform better than regular bandages. Based on my experiment, it is recommended to use waterproof bandages if you require long-lasting protection from water. While regular bandages can be worn, they are not as effective as waterproof bandages.

8PH1012

Wendell, Benjamin; Hailey, Preston

Swanson Middle School

Nerf or Knock Off?

Do you remember when you used to have Nerf wars around the neighborhood? You'd battle and have fun with your friends. Suddenly, one of your friends jumps out of their cover, you aim, and fire! But, you missed him!? Well, maybe it's not your fault!
In this experiment we will test the effect of different types of Nerf darts on accuracy when shooting at a target that is 3 meters away from our Nerf gun. The dependent variable is distance away from the center of the target measured in centimeters. The independent variable is the brand of Nerf dart, we tested 7 different brands. The purpose of this experiment was to see which nerf dart was the most accurate. Our hypothesis was that the Nerf engine dart will be the most accurate because it was engineered to be the most accurate out of our choices.

After the experiment the data supported our hypothesis that Nerf Accustrike was the most accurate. The least accurate was the Rebelle Nerf Darts. The average distance from the center for Accustrike was 3.11cm and Rebelle was 13.19cm. Interestingly the second most accurate was Adventure Force with an average of 4.02cm. The reason I am bringing this up is because Adventure force is significantly cheaper than Accustrike. Accustrike costs about 26 Cents per dart, while Adventure Force costs about 5 Cents per dart.

9PH1013

Barua, Preontee

Wakefield High School

The Effect of Barriers on Magnetism

The question that was asked in this experiment is “What is the effect of barriers between magnets on the amount of distance it takes for them to connect?”. The hypothesis based on this question was “If there is a barrier such as aluminum foil or plastic between magnets, then the amount of time it takes for the magnets to connect and the distance it takes will remain the same as two magnets without a barrier because magnetic fields cannot be blocked, and only two classes of materials can be affected by magnetic fields (ferromagnetic and paramagnetic), to which plastic isn’t and aluminum is weakly paramagnetic.”

To test this question, two magnets were set apart at a distance of 1ft on the ends of a ruler. One magnet was wrapped in aluminum foil, and then plastic (after the foil was trialed three times). The magnet not wrapped in anything was slowly moved towards the other magnet until they connected, the distance at which they connected was then recorded. The control group had no barriers used yet followed the same process. The results of this experiment minimally proved this hypothesis false as the results showed an average difference of 2.1 cm between magnets with a barrier and without a barrier and the difference between the two barriers averaged 0.2 cm.

9PH1014

Burks, Thomas

Alexandria City High School (includes Minnie Howard)

Thermo Micro-Fluidics

For my project, I decided to perform an experiment on thermo micro-fluidics, which is the manipulation of small droplets of liquids with heat. I wanted to see if there would be a correlation between the ΔT (the temperature gradient) and the movement of the liquid droplets. This topic is important because thermo micro-fluidics can be used for cell analysis, diagnosis, and biosensing. This project has only been performed by a few researchers, and I wanted to fill gaps that they may have missed in their testing. My findings show that there is correlation between the temperature gradient and the movement of the liquid droplets, although the droplets do not always move as predicted. I believe that to definitively show the correlation I originally hypothesized, I would likely need to do another 10 days of trials, which is something that I do not have the time to do. If I were to do this project again next year, I would do more trials and try to have conclusive results.

9PH1015

Coulby, Lillian

Alexandria City High School (includes Minnie Howard)

Performance of Composite versus Aluminum Bats

I researched how the composition and location of impact on a bat affected how far a softball traveled. For my project I used both aluminum and composite bats and also measured where the ball hit the bat in order to get more concise results. For my experimentation, I hit the softball 5 times in each three sections of the bat, end, middle, and inside, for a total of 15 hits per bat and 30 hits overall. Then I measured the distance in feet for each hit. I hypothesized if you hit the ball with a composite bat in the middle of the bat, the ball will go the farthest. My hypothesis was proven correct when the composite bat hit an average of 9 feet farther than the aluminum bat. This is because composite bats incorporate a reinforced carbon fiber polymer unlike aluminum bats, allowing more energy to be exerted back onto the ball. The graphs also show that when a ball hits the middle of the bat, it travels the farthest which aligns with the second part of my hypothesis. If I were to perform this experiment again for more accurate results, I would use a pitching machine to more accurately depict how the different bats might perform in an actual game as well as using different variables to test the bats on different levels. In the end, my experiment proved that using a composite bat to hit a softball makes the ball go farther.

9PH1016

Mathew, Nicholas

Washington-Liberty High School

What is the Effect of the Temperature of Water on the Rate of Cooling?

This experiment was conducted to see if the Mpemba effect exists or if it is a result of errors. The hypothesis for the experiment was that if the starting temperature of water is increased, then the rate of cooling will increase because hot water freezes faster than cold water due to a phenomenon known as the Mpemba effect. The null hypothesis stated that if the starting temperature of water is changed, there will be no difference in the rate of freezing between the different levels. The groups tested were the following temperatures: 50°C, 75°C, 100°C, and the control group of 20°C. The dependent variable in this experiment is the time it took for the water to reach 0°C. The water was heated up to the required temperature and then put into the freezer with a timer to see when it hit 0°C. Results were compiled into a graph showing the mean rate of cooling in minutes per °C, and a graph showing the mean time it took each temperature to reach 0°C in minutes. Standard deviation was calculated as well as an ANOVA test. The data that was collected was statistically significant as shown with the p-value of 2.7154E-18 and 7.1156E-17. These were found for both the time for each temperature to reach 0°C and the rate of cooling respectively. This means that the data rejected the null hypothesis and supported the hypothesis that if the temperature of water is increased, then the rate of cooling will increase.

9PH1017

Moran-Uriona, Tomás

Washington-Liberty High School

The Effect of a Conductor's Thickness on the Strength of Induced Eddy Currents

The purpose of this study was to determine the relationship between the thickness of a conductor and the strength of induced eddy currents. The research hypothesis states that if an aluminum tube's wall thickness is increased, then the strength of induced eddy currents will follow a pattern of decelerating growth where the critical point of the function will be located at 0.08 inches, the critical thickness of aluminum. The independent variable was the thickness of the aluminum tube and the dependent variable was the time taken by the magnet to fall all of the way through. The null hypothesis stated that the wall thickness of an aluminum tube will have no effect on the strength of eddy currents produced. The groups tested were aluminum tubes with wall thicknesses of 0.035, 0.05, 0.065, 0.08, and 0.095 inches. The control group was no tube. A 0.5 inch spherical magnet was dropped through each tube a total of 15 times; the mean millijoules produced by the eddy currents induced within each tube were then calculated. The standard deviation was calculated for each group, results were placed in a summary data table, an exponential regression was performed, and a correlation was observed: y=(-5.8(0.0066)^14.008x)+5.8. An ANOVA test was performed and the p-value observed was 1.513 E – 150, below the critical value of 0.05. Thus, the null hypothesis was rejected. Data from the experiment supports the research hypothesis.

9PH1018

Parment, William

Wakefield High School

The Design of Paper Airplane that Flies the Furthest

The purpose of this experiment was to explore aerodynamics and to investigate concepts relating to the field of aerodynamics and fuel efficiency. Lower fuel consumption through a more efficient design would be beneficial for the environment and reduce the impact of climate change. It was known that paper airplanes are a common toy for children and are made from materials found in almost any school or home. Teaching children about science through play will help develop the next generation of aerodynamics engineers.

The hypothesis for this experiment was that a design with high amounts of wing area combined with a streamlined design would be the best design. In this experiment, the “Star Sprite” appeared to be the best candidate. However this proved to be wrong, as it was concluded that a streamlined design was best for distance. Large wing area was found to be less important.

The procedure used was to build the paper airplanes and then throw them from a set line in the ground with the same amount of force. The next step was to measure the distance from the fixed launching point to the closest point of the landed airplane. The launch was then repeated five times for each plane, which concluded the first batch of trials. Two more batches of trials were then completed for a total of 45 throws. Data was then entered into a spreadsheet program and graphs were generated.

10PH1019

Chistolini, John

Yorktown High School

The Impact of the Type of Inorganic Pyrotechnic Composition on Illuminance as a Result of an Exothermic Reaction

My project investigates inorganic pyrotechnics by finding the lux and reliance of different compositions commonly used in flares through similarities in trials. I conducted this experiment using magnesium, lithium, potassium, and strontium compositions in a lit burner and used a lux meter to calculate the number of photons expelled. My findings revealed that magnesium-based compositions are the brightest, supported by their high average and range of lux. However, research points out that the dangers of magnesium compositions in flares may outweigh the benefits. Burning at high temperatures, magnesium creates a higher probability of igniting combustible material and causing burns. This shows the desirability of having strontium or potassium-based flares instead because they burn 46% cooler than magnesium causing risks to drop. In addition, strontium, magnesium, and potassium all had insignificant p-values showing that using them is a possibility. Given that all three showed similar illuminance, safety and reliability measures should be used to select the "best" material. Strontium turned out to be 75% more consistent between magnesium and potassium, leading me to promote it as a better and safer use for compositions in all high-illuminance flares. Although we see data supporting our hypothesis the research provided shows it to be false due to heat having no relation to lux produced. This experiment proves you can apply common pyrotechnics to military applications, and help reduce the risk of severe service-related injury.

10PH1020

Iov, Sebastian

Alexandria City High School (includes Minnie Howard)

The Effects of Magntic Configuration on Velocity in a Linear Magnetic Accelerator

The purpose of this study was to analyze the dynamics of linear magnetic accelerators to discover the best configuration for velocity. The hypothesis was that the tighter the magnets were clumped up, the greater velocity would occur. This was tested by first researching hypothetical configurations for velocity in a magnetic accelerator. Then, several configurations were then tested by arranging a track along an array of magnets for a ferromagnetic ball to travel through. The magnets were aligned on opposite sides of the track with one side being north and the other south. The average velocity from the beginning to the end of the track was calculated. The results showed that velocity increased when the distance was lowered, with the greatest velocity achieved when the magnets were as close as possible. This data can be used increase general understanding of linear magnetic accelerators and for the assembly of future demonstration models. Furthermore, continued research ideas could be the use of electromagnets in replacement of standard magnets or testing of a non-linear track.

10PH1021

Kaldahl, Julia

Wakefield High School

What Solar Panel Produces the Most Power?

The purpose of this experiment was to determine which type of solar panel generated the most energy per unit area. The three types of solar panels investigated were monocrystalline, polycrystalline and amorphous solar cells. Monocrystalline panels were hypothesized to generate the most energy per unit area because they are made of pure silicon, which was predicted to make them more efficient than the other cells that are made from a mixture of silicon and other materials. For the procedure, the cells were tied to a board and placed in an area where they will receive the same amount of sunlight. All cells are individually connected to a voltage and current probe and data is recorded for each of the three different cells. The results found that monocrystalline consistently had slightly higher power per unit area than the other cells. The polycrystalline was found to have varying power per unit throughout the tests, but ultimately its average was slightly lower than that of the monocrystalline. Thin film solar cells were found to be the least effective, however, they are the most affordable and environmentally conscious.

10PH1022

Leighton, Declan

Yorktown High School

The Effect of Voltage and Nozzle Size on the Force Generated by Radial Magnetohydrodynamic Drive

Magnetohydrodynamic drive (MHD drive) is an effect that uses Lorentz force to accelerate a fluid. MHD drive performs this by using a magnetic field and an electric current, but no moving parts which makes it virtually silent. Hypothesis A was if the voltage increases in a radial MHD drive, the force generated will increase at a nonlinear, plateauing rate because the electrolysis reaction will surpass that of the Lorentz force effect and result in a plateau of the generated force. Hypothesis B was if the nozzle throat size is decreased, then the force generated by MHD drive will increase because the nozzle will accelerate the fluid as it exits the radial MHD drive increasing the force. Using a custom designed and 3D printed radial MHD drive, the experiment was conducted and 60,000 data points were collected. The following conclusions were drawn:
1) Hypothesis A was confirmed with a P value of <0.01.
2) Hypothesis B was disproved because the force decreased when the nozzle throat diameter was decreased. Additionally, a P value of 0.19 was recorded leading to less confidence in the data.
3) The MHD drive was able to produce a max force of 0.116 newtons at 30 volts without the nozzle. This indicates that further research could show that a radial MHD drive has the potential to revolutionize oceanic transport and nanotechnology.

10PH1023

Monroy, Sebastian

Washington-Liberty High School

The Effect of Pitch Angle on an Airfoil's Lift

The purpose of this experiment was to find the most efficient pitch angle of a wing model to allow it to produce the most lift. If the pitch angle of an airfoil is changed to 25 degrees, then the amount of lift created will be the greatest because there will be a larger pressure difference resulting in more lift, but not too high an angle that the wing doesn't generate lift at all, based on the Bernoulli Principle. The null hypothesis was if the pitch angle of an airfoil is changed, there will be no effect on the amount of lift generated.

This experiment was conducted using a homemade wind tunnel, a 3D-printed wing model, and a coin scale where the wing model would be set to be tested. In total, 8 angles were tested (independent variable): 0 degrees (control), 10, 20, 22, 25, 27, 30, and 45 degrees. The dependent variables were the weight reduction in grams and the weight reduction in percentage, all collected from the original weight of the wing.

After the experiment was conducted, it was found that as the pitch angle increased, so did the weight reduced (lift). The rate at which the weight would reduce significantly decreased between 20 and 30 degrees, but greater weight reduction continued up to the 45-degree trials. The results did not support the hypothesis, however, the null hypothesis cannot be accepted and must be rejected because there was a difference in the lift produced based on the pitch angle.

10PH1024

Vena, Allegra

Wakefield High School

The Effect of Altitude on Muon Flux

Muon events are ones that can cause damage on impact. They can cause “bit flips” or data conversion in electronic device memory, mechanical errors and even mutations in DNA. When muons travel from the ozone layer to the surface of the Earth, they have only a short time before they decay into photons. As muons, their mass and energy can cause the damage mentioned above. It is hypothesized that more muons will be detected at higher elevations than at lower elevations. This would show higher risk to computer data and humans at higher elevations. Muon flux data for three approximately 20 hour periods was collected from seven sites across the world which was accessed from the internet site, Quarknet.org. The muon events (flux) were then averaged over those three periods, and compared to the average elevation at each site. A graphical comparison of elevation vs. flux was then graphed, and a linear regression performed. The correlation coefficient (r2) was calculated to be 0.933–a value which implies an extremely significant correlation result. This implies that the null hypothesis can be rejected, and that muon flux is indeed related to elevation on Earth. It is predicted that computer data systems will work ever harder to protect bits from flipping and crashing systems. The continued use of expensive ECC (error correction code) will drive down the cost, so that modern technology can use more compact storage and still be protected from single event upset.

7PS1100

Capiaux, Flora

Kenmore Middle School

The Effect of the Concentration of Neem Oil on Fungi Infected Crape Myrtles

Should neem oil be used to cure a fungi-infected tree? How much should should be used? These are some of the questions asked if someone wants to begin this project using neem oil, but you need to know how much. The goal and purpose was to cure the fungus-infected Crape Myrtles in a backyard. The hypothesis was, that if the concentration of the neem oil increases and uses two tablespoons, it's believed that the two tablespoons will be the most efficient. So, put various amounts of neem oil into the solutions. The solution included one gallon of water, one teaspoon of dish soap, and 1, 2, or 3 tablespoons of neem oil based on the tree. The researcher then sprayed and poured the solution over the trees one time every week. The result of the experiment is that the solution with two tablespoons worked the best on the trees, but since they didn't do it for enough time, the fungus wasn't completely gone but it improved the tree's health. The experiment was important, because the trees needed to be saved, and we still need more healthy trees. In conclusion, now is it known that 2 tablespoons of neem oil in the solution is the most efficient way to cure a fungal infection on Crape Myrtles during the winter/fall.

7PS1101

D'Amico, Alessandra

Swanson Middle School

The Effect of Liquid Type on Plant Germination and Growth

Agriculture consumes a large amount of resources therefore putting a strain on earth's finite resources such as water and land. To feed a growing population, we need more efficient and sustainable farming methods that use less of these valuable resources. The system of hydroponics is an innovative method of farming that efficiently uses water, space, and nutrients. However, hydroponic systems are costly, complicated and hard to maintain. My experiment tests whether it is possible to use simple and easily available resources to grow food using liquid but no soil, similar to hydroponics. The experiment looked at the impact of 5 different liquids; one cup each of tap water, spring water, water exposed to electrolytes, and ground coffee, as well as distilled water as the control. The experiment showed that Arlington tap water was the most effective source of nutrients and minerals, which my research also confirmed. Although the experiment was successful, I observed rotting in the beans after around 6 days. This rotting is referred to as root rot in hydroponics and is caused when the water source is contaminated, highlighting one of the main issues of hydroponics. This issue is a result of the water going straight into the plant without any sort of filter, and the entire harvest getting root rot because they all share the same water source. Future experiments could use different growing media such as coconut coir, vermiculite, perlite to filter the water while also letting through more minerals and air.

7PS1102

Hirschfield, Leyla

Kenmore Middle School

The Effect of Different Types of Fertilizers on the Height of Radish Plants

Many people say to use fertilizers on your plants to help them grow, but do fertilizers work? The goal of this experiment was to find the effect of different types of fertilizers (none, inorganic, organic) on the height of radish plants. There were five trials for each level of the independent variable. Each seed was watered every two days and placed in an area where they got at least six hours of sunlight a day. Each plant was measured once a week. The data was then recorded on a data table. The hypothesis was if the organic fertilizer is used, then the radish plant will grow taller because the minerals and nutrients will linger in the soil longer, providing a longer source of nutrients and minerals. The results of this experiment did not support the hypothesis because they show that the inorganic fertilizer helps plants grow the tallest with an average height of 8.6 cm. The plants with no fertilizer had an average growth of 6.1 cm. The plants with organic fertilizer did not grow at all. In conclusion, this data can be very beneficial to many communities because they will then know what type of fertilizer to use.

7PS1103

Nunez, Annabela

Kenmore Middle School

The Effect of Different Colored Lights on Lima Bean Height

The purpose of this experiment was to determine what colored light would be better to make a Lima bean plant grow taller. This project looks at 3 different types of colored lights: red, blue, and green with the control being sunlight. The goal of the project was to find the effect of different colored lights on the height of a Lima bean plant. First, dirt was poured into all 12 plastic cups. Then, the lima bean seeds were planted in each cup. Then, the colored lights were put inside 3 boxes. Then, 3 cups were placed under each box. Lastly, the plants were watered weekly for five weeks. Lima bean plants that received sunlight had an average height of 46.5 cm. The Lima bean plants under the red light had a mean of 39.17 cm. The Lima bean plants under the blue light had a mean of 21.33 cm. The Lima bean plants under the green light had a mean of 34.5 cm. This science fair experiment showed that the red colored light did better than any other color for making a plant grow higher. This experiment would help botanists understand if plants respond differently to different light colors.

7PS1104

Tran, Y-Lan

Williamsburg Middle School

The Effect of the Soil Additive on the Height of the Plant

In the far future, we may need to terraform planets for human habitation. Plants will need to be grown in soil that may be completely sterile on arrival, which could lead to poor growth and crop failures. One method by which to ensure an earth-like environment to promote plant growth for food and oxygen production would be to introduce microbes to the sterile soil. The different options for introducing these microbes may be easier or harder for space travel and better or worse at growing plants. By identifying and testing growth using multiple microbe sources, scientists can better plan for terraforming. This project focused on growing a common, beneficial crop plant (beans) in soil that was sterilized to mimic a terraformed planet as a control, and in sterilized soil that was amended with three different microbe sources: worm castings, oak leaf litter compost, and probiotic tablets. The growth of the bean plants was measured at 7 days after planting. Results showed the oak leaf litter was the most successful soil additive in promoting growth. Possible errors and future research are discussed.

7PS1105

Asnake, Harott; Gonzalez, Alison

Patrick Henry K-8 School

Plantastic Growth

The purpose of this project is to investigate how different fertilizers affect the growth of plants. This project can have a wide impact on society because it can help everyday people and large-scale farmers and producers make informed decisions about the type of fertilizers they use based on their desired plant growth. By testing different fertilizers we are also able to see the negative and positive impacts fertilizers have, how they affect the wider environment, and help researchers understand what fertilizer is best for plants without intoxicating or even drying them. Our hypothesis was that Vigoro fertilizer is the best brand of fertilizer to grow healthy plants. To test this, we started with three plants, all at the same height. Then, we kept one plant as the control and added Vigoro fertilizer to one plant and Miracle-Gro fertilizer to the other plant. We waited for 21 days and then measured the height again to get our final result. In conclusion, this experiment showed us that Vigoro is the best plant fertilizer because it helps plants grow tall and healthy. By these results, we now know that Vigoro is a healthy fertilizer for plants, and can suggest the fertilizer to anyone growing a plant.

7PS1106

Kirwin, Nandini; Hernandez, Miqueas

H-B Woodlawn Secondary Program

Poop and Plants

The purpose of this experiment was to test the effects of different types of animal poop as a fertilizer on plants. We conducted this experiment by filling 12 cups with soil, 4 of which contained Guinea pig poop, another 4 cups contained bunny poop and the remaining 4 cups were the control, containing no poop. The control did the best in the end, the average height being 22.5 inches, the bunny poop was a close second with 21 inches and last the guinea pig poop with an average of 10.5 inches. Our hypothesis was that guinea pig poop would grow the highest because guinea pigs eat their poop sometimes because it still has nutrients, but our hypothesis did not prove to be correct. The findings of this experiment can help people find a more eco-friendly way to dispose of their guinea pig or bunny poop.

7PS1107

Yoon, Alex ; Scott, Sylvia

George Washington Middle School

Make It Rain: What is the Effect of pH Levels in Water on Plant Growth?

This experiment is designed to study the effect of pH on plant growth, and it aims to simulate that effect on kidney bean plants. If the pH levels of the water decrease, then the plant growth will be negatively affected, because most plants cannot survive in an acidic environment. The converse is true for alkaline plants because nitrogenous fertilizers are alkaline. The experiment used equal amounts of water, acid water, and alkaline water to measure the height change in kidney bean plants. Contrary to our hypothesis, alkaline watered plants were not healthy, and the control plants were the tallest. This result corroborates the pre-existing data that acid and alkaline-watered plants are less healthy than plants watered with normal water.

8PS1108

Gallagher, James

Swanson Middle School

The Effect of Apple Type on Sugar Content

For my Science Fair project I chose to measure the different sugar contents of apples. This information can be used to improve people's health, or to allow people suffering from ailments such as Diabetes to enjoy a snack. My hypothesis was that the sweeter the apple was, the less Brix% it would have. Brix% is the percentage of a substance that is made up of sugar, and it is measured using a sugar refractometer. In order to get the substance I first had to juice my three Independent Variables which were Granny Smith, Honeycrisp, and Red Delicious apples. In the end my results reflected my hypothesis, with all apples having steadily decreasing averages (means) Red Delicious had 12.95%, Honeycrisp had 11.45% and Granny Smith had 11.1%.

8PS1109

Gunter, June

George Washington Middle School

Nitrogen versus Potassium: What is the Best Type of Fertilizer?

There are several types of chemical fertilizers used in farming: nitrogen, phosphorus, and potassium. These fertilizers help plants grow faster and better, but can also be very expensive and bad for the environment, especially nitrogen fertilizers. The purpose of this experiment was to determine whether or not nitrogen fertilizer is worth the extra cost by comparing a nitrogen fertilizer and a potassium fertilizer. My hypothesis was that the nitrogen fertilizer would be better than the potassium one. To test this, I gave five elephant bush plants water, five 3-1-2 (nitrogen) fertilizer, and five 1-1-3 (potassium) fertilizer. The ratio stands for the mixture of nitrogen, phosphorus, and potassium in the fertilizer, so a 3-1-2 would be 3% nitrogen, 1% phosphorus, and 1% potassium. To do this experiment, I cut 15 stems off of one big plant, planted them in dirt, put them under a grow light, and gave each one five squirts of liquid each day. As I mentioned earlier, five were given plain water, five were given 1-1-3, and five were given 3-1-2. Every 2 weeks, I measured the mass of each plant in grams (including the soil). Additionally, in the beginning and end of the experiment, I measured the mass of each plant without soil, to get a more accurate measure of growth without the humidity playing a role.

8PS1110

Karlton, James

Swanson Middle School

The Effect of Caffeine on Plant Growth

This project is on the effects of caffeine on plant growth. This project could definitely prove to be useful, for example it could inform plant owners on whether they should keep caffeine away from their crops, or use it as a super fertilizer. Another way this project could be used is to inform people about whether caffeine will help their household plants or not. This experiment could also show the effect of caffeine on living things, making it a good source of information if someone were to do their own experiments on the effects of caffeine on human growth.

8PS1111

Normington, Catherine

Thomas Jefferson Middle School

The Effects of Nitrogen-Fixing Bacteria on Clover Roots

This project is about the effect of Rhizobium fertilizer on the number of root nodules in clover plants and the mass of the clover roots. The research from this product could aid in the use of yet another source of natural fertilization, bacteria. The use of bacteria is already a part of agriculture. However, with added research done, it could help influence greater numbers of farmers to partake. The hypotheses for this project were that the addition of the Rhizobium fertilizer would increase the number of nodules and increase the mass of the roots. To complete the study, the researcher would grow 8 clover plants, half with the Rhizobium, then collect data on the number of root nodules and root mass. The results of this project were that the Rhizobium did not have an immediate effect on the number of nodules or the mass as predicted. This could be a consequence of an external factor that affected the experiment. The Rhizobium pots had a combined total of 3 nodules, while the control had a total of 2 nodules. To note, the roots without the Rhizobium had an increase in mass. The control had an average mass of 0.76g, while the Rhizobium had an average mass of 0.33g. The results from this experiment show that the Rhizobium fertilizer did not significantly alter the number of nodules or the mass of the roots.

8PS1112

Phi, Duc

Williamsburg Middle School

The Effect of Type of Soil on Radishes

A general rule of thumb for growing plants is to grow them in the soil they grow best in. So then what is the best type of soil for growing radishes? This project looks at what type of soil is best for growing cherry belle radishes by looking at the height of the radishes. The radishes were grown in silty, sandy, clay (mixture of 90% silt/sand/clay, and 5% each for the other two) and loamy (mixture of 40% sand, 40% silt, and 20% clay) soils (independent variable). Then the radishes were measured each day until the end of the experiment by centimeters (dependent variable). Each plant received the same amount of water and sunlight each day. My hypothesis was that the loamy soil would grow the radishes the best because it offers all of the positive qualities of sand, silt and clay because it is a more balanced mixture. The experimental results supported my hypothesis by showing that the radishes in loamy soil grew the best and had the highest height even from day one and reached 10.2 centimeters by the end of the experiment. The experiment also showed that the silty soil radishes grew the second best at 9.8 centimeters, and that the sandy and clay soil radishes grew the worst at 7.3 centimeters by the end.

8PS1113

Purdy, Elijah

Swanson Middle School

The Effect of Different Wavelengths of Light on the Growth of Plants

Soil, water, and light are three key requirements for plant growth. This experiment focuses on light; the purpose of the project was to find the effect of different wavelengths of light on the growth of plants. I used three different lights with varying wavelengths: a grow-light with a broad wavelength in the visible spectrum, a LED light with a narrow wavelength in the visible spectrum, and a UV type A light in the ultraviolet spectrum. I planted 60 radish seeds into 30 cups, and then placed 10 cups into 3 different closed boxes that were illuminated with the different lights. Each box received 10 hours of light per day, and I let them grow for 21 days. After watering weekly and measuring the height of each radish sprout daily, I found that the radishes grown under the grow light grew the tallest on average. I think this is because the grow light had the broadest range of light, which helped the plants grow taller and healthier. Finally, this research could be used to understand how plants can be grown in environments without access to sunlight such as in outer space, or on the surface of the Moon or Mars.

8PS1114

Puri, Leikha

Dorothy Hamm Middle School

The Effect of Water pH on the Height of Radishes

In a world where climate change is causing periods of drought, it is important that we grow our plants efficiently. To do this, we have to grow them under the right conditions. To test the right conditions, I decided to give radishes water with different pH levels to find the ideal pH for growing radishes. pH is the measure of how acidic or basic a substance is. A pH of 1 is the most acidic, and a pH of 14 is the most basic, while a pH of 7 is neutral. According to research, radishes grow best in slightly acidic to basic soil. Knowing this, I chose pH levels that were slightly acidic to basic: 6, 6.5, and 7. My control group was watered with tap water, which has a pH of 7.5. I grew my radishes for 22 days, and I measured their height in centimeters every three days. By the end of the experiment, the radishes watered with tap water (pH of 7.5) grew the tallest, while the radishes given water with a pH of 6.5 were the shortest. Additionally, the radishes that had been given water with a pH of 7 grew taller than those watered with a pH of 6. From these results, I concluded that radishes grow best when given water that is slightly basic to neutral.

8PS1115

Camey Gomez, Sarai; Baba, Nina

Thomas Jefferson Middle School

The Effect of Aquatic Animals in a Hydrophonic System

The researchers conducted an experiment to determine how aquatic animals affect a hydroponic system, which is a method of plant cultivation that doesn't involve soil. Instead, plants are grown in a growing medium and provided with nutrient-rich solutions, water, and oxygen. This technique allows for faster growth, higher yields, and better quality. When animals such as snails are introduced to a hydroponic environment, it becomes an aquaponic system. An aquaponic system is a closed-loop system that combines plant cultivation and aquatic life in a self-sustaining ecosystem. The system uses a biofilter to break down waste into nutrient solutions that are ideal for plant growth and fish food, creating a mutually beneficial relationship between the two. In the experiment, the independent variable (IV) was the presence of aquatic animals in a hydroponic system, while the dependent variable (DV) was the average root growth of each plant. Studying this topic is important because it can help explore topics such as water conservation, organic farming, and waste reduction. Understanding how aquaponics works can also help further understand its relationship and impact on the natural environment. This is because aquaponics eliminates the need for synthetic chemical fertilizers and pesticides. Aquatic animal waste provides plants with essential nutrients to grow, resulting in chemical-free produce that is safer and healthier for both consumers and the environment. With further research and development, aquaponics has the potential to revolutionize the way we grow and consume food.

9PS1116

Ameer, Adil

Alexandria City High School (includes Minnie Howard)

Comparing Different Types Artificial Light on Plant Growth

My project is about Comparing Different Types of Artificial Lights on Plant Growth.The purpose of doing this project is to see which artificial light helps the plant grow better because as global warming is happening scientist are finding new ways to grow plants indoors although we have greenhouses we still need to find more better and efficient ways to grow plants indoors.Another purpose of doing this project is that me and my mom love to grow plants,they are fine in the summer and spring but as fall begins and the temperature gets colder our plants die so me and my thought to grow them indoors and find which artificial light would be best form the health and growth of the plants.So for my experiment I will take ten same type of plants (money plants) and place five under white tube light and the other under colorful wire light,giving them 236 milliliters of water three times a week for a month and recording their data once a week. The hypothesis is that If the plants receive artificial light from the white tube light they will grow healthier.If you`ll have a look at the data you'll notice that the white tube light has better growing results than the colorful wire light.The conclusion is that the results supports the hypothesis and if I was to do this project again I would have more different types of artificial lights and plants

9PH1117

Heatherington, Declan

Alexandria City High School (includes Minnie Howard)

The Effects of Water Salinity on Seed Germination

The purpose of this experiment is to see the effects of water salinity on seed germination. The reason for this is because with global warming causing sea levels to rise and droughts to be more frequent, crops will come into more contact with salt. I tested how much time a seed would take to germinate compared to normal, if at all. My independent variable was water salinity and my dependent variable was seed germination. Water salinity was measured in grams of salt per liter of water, with the 4 groups being 0 g/l (control), 15 g/l, 25 g/l, and 35 g/l. My hypothesis was the saltier the water, the worse the germination. The results showed only the control group grew, supporting my hypothesis. Future studies should keep temperature levels static for the entire experiment. Sample size should be increased as well. Future experiments should also use more variable levels, such as 5 g/l.

9PS1118

Hogan, Connor

Washington-Liberty High School

The Effect of Increased Gravitational Force on Seed Germination Percentage

The purpose of this experiment was to see how increased gravitational force affects seed germination percentage. The hypothesis was if plant seeds are subjected to four times the gravity on Earth (4g) then the overall germination percentage of the seeds will be less than the control group because the seeds will have been damaged by the G-force. Sixty seeds were spun at 150 rotations per minute (rpm) 6 cm,11 cm, and 17 cm away from the center of the rotor—the equivalent of 2g, 3g, and 4g. Having them spin for 2 minutes would put stress on the seeds equivalent to that which they would experience on a real rocket launch. The sixty seeds plus an additional twenty for the control group were then germinated for four days. The results were put into a table and the germination percentage was calculated for each group. An ANOVA test was performed and standard deviation was calculated. The P-Value of the ANOVA test was 0.00452578763120694 which meant the data was statistically significant. The data from the experiment agreed with the hypothesis: if plant seeds are put under increased gravitational force then the germination percentage will be less because they will be damaged by the G-force. The control group had the highest germination percentage of 85.00%, followed by 2g with 70.00%, 3g with 50.00%, and lastly 4g with 35% germination. The control group and the 2g group were the most similar having a 15% difference.

9PS1119

Schofield, Caroline

Alexandria City High School (includes Minnie Howard)

Graywater and Lima Bean Plants

In this experiment I tested the effects of different types of greywater on lima bean plants, which is important to help conserve water in households and urban environments. To test this, I grew lima beans in four different types of greywater and measured the height in centimeters after ten days. I used washing machine greywater, shower greywater, sink greywater, and dish washing greywater. My hypothesis was that the lima bean plants watered by washing machine greywater would grow the tallest. My results showed that the plants watered with shower greywater grew the tallest with the average height being 4.1 centimeters. After that, tap water and sink greywater use resulted in the next highest growth rates at an average of 2.6 and 2.2 centimeters respectively. Dishwashing greywater had an average height of 1.6 centimeters, and washing machine greywater had the lowest average growth rate at 0.6 centimeters. An error that occurred was mold growth on a few of the plants during the experiment. The results were different then hypothesized because it was thought that the washing machine greywater was cleaner than the other types, which therefore would make the plants grow taller. Some potential improvements to the experiment would be to add more types of greywater and use a different type of plant to test the effects of greywater on that plant.

9PS1120

Schwentker, Claire

Washington-Liberty High School

The Effect of Lower pH Levels on *Cucumis sativus* Germination Rate

The purpose of this experiment was to determine which varieties of Cucumis sativus (cucumber) seeds had the highest germination rate in an acidic environment over a 10-day period. The hypothesis was that cucumber varieties with larger seeds would have faster germination rates, as the higher surface areas may give them more protection, allowing them to perform better in stressful conditions. The null hypothesis stated that there will be no statistical difference in how many seeds of different C. sativus varieties germinate when put in an acidic environment.The independent variable was the variety of seed. The varieties used were ‘National Pickling,’ ‘Lemon,’ ‘Straight Eight,’ and ‘White Wonder.’ The dependent variable was the average number of seeds, out of 10, that germinated after 10 days. Each group of seeds were watered every two days with 0.4 mL of a 4.5 pH solution. An ANOVA and t-test were conducted, with p-values of 0.98519544 and 0.5552919, respectively, suggesting that there was no statistical difference, accepting the null hypothesis. Despite no statistical significance, National Pickling, the largest seed, had the highest germination rate of 100%, while White Wonder, the second largest seed, was lowest, with 80% of seeds germinating. The Lemon and Straight Eight seeds both had 95% germination rates, an average of 9.5 seeds per dish. The data does not support the theory that larger seeds germinate faster and more consistently, as the order of germination rate does not correlate to mass.

10PS1121

Fiorino, Anthony; DelVecchio, Caleb

Washington-Liberty High School

The Effect of Light Malt Extract Concentration in Agar Recipes on the Growth Rate of *Pleurotus djamor* Mycelium

The purpose of this experiment was to identify the optimal concentration of light malt extract in agar solutions for culturing mycelium. The species of mushroom used in this investigation was the pink oyster mushroom (Pleurotus djamor). 7 plates were poured for each of the following concentrations of light malt extract: 0g/L, 10g/L, 20g/l, 30g/L, and 40g/L. It was hypothesized that the group containing 30g/L would promote the fastest growth rate. 30g/L is a commonly used concentration of light malt extract for the cultivation of mushrooms.

A region of growth was marked 3 days after inoculation with liquid monoculture. The plates were left to colonize for an additional 3 days, and new growth was measured. After data collection, ANOVA tests were run to identify statistical significance, resulting in a p-value of 3.7543 x 10-5. T-tests conducted between each group identified statistical significance when comparing the group containing no light malt extract with all groups containing light malt extract. Results were inconclusive when comparing all groups containing light malt extract. Observational data indicated a difference in hyphal density between the groups containing light malt extract and those containing none. The group lacking light malt extract exhibited minimally visible mycelium when compared to the denser, whiter mycelium of the other groups. The findings from this experiment aim to serve cultivators and researchers by identifying the optimal concentration of light malt extract in agar recipe solutions for the growth of mycelium.

10PS1122

Soisuvarn, Daisy; Duss, Nadja

Alexandria City High School (includes Minnie Howard)

Grow Your Hair, Grow Your Plants

Most people pay little attention when a strand of hair falls out into their brush. However, salons contribute significantly more to this, and all this hair waste ends up in landfills that emit greenhouse gasses, contributing to climate change. Scientists have sought ways to recycle hair, and they found that it has potential as a plant fertilizer due to its proteins and nutrients. To test this method of reducing waste, we decided to use human hair as fertilizer in pea plants. We hypothesized that if the percentage of hair in the soil is increased, the pea plant growth will accelerate. To start, a control pot filled with soil was weighed in grams. This starting weight was used to calculate what 2.5% of that mass is, then we filled another pot up with that weight of hair, and adjusted the soil to only 97.5% of the initial mass, to keep the weight equivalent to the control. This was repeated for the final pot, doubling the hair to 5%, with soil adjusted accordingly. Three pea seeds were planted in each pot. After caring for the plants for twenty days, our data on the growth revealed that the average height of the 5% hair trials was 3.2 centimeters, closely followed by the average of 3 centimeters in the 2.5% trials. The control averaged 0.5 centimeters in height. To conclude, the data supported our hypothesis, indicating that pea plants grow taller with the increase of human hair in soil.

11PS1123

Dezfulian, Luka

Yorktown High School

The Effect of Different Substrates on Oyster Mushroom Growth

The aim of this project is to educate amateur mushroom growers about affordable and accessible methodology and substrate choice. My experimentation consisted of three different substrates: hardwood sawdust, wheat straw, and a mix of the two. My sawdust was pre-sterilized as it can be cumbersome to work with without expensive equipment such as an autoclave or well-equipped pressure-canner. My wheat straw substrate was pasteurized using a method known as oven pasteurization. All surfaces and equipment used during mushroom inoculation were sterilized. Appropriate ratios of substrate and mushroom spawn were added to mushroom grow bags. The grow bags were sealed and allowed to inoculate without light exposure for 2 weeks. After 2 weeks of inoculation the grow bags were placed inside an unused space in my house. The space was equipped with a humidistat, bedroom humidifiers, a small fan, and a light source on a 12 hour timer. The humidifiers and fan were attached to the humidistat in order to maintain 70% humidity and allow for airflow. After 12 days the mushrooms were harvested. Unfortunately during the inoculation phase 4 blocks did not fully inoculate and 2 did not fruit during growth. Wheat straw yielded an average of 12g, sawdust yielded an average of 29g, and the mix yielded an average of 21g. My data yielded a p-value of 0.69 and did not reject the null hypothesis. Though my data was not significantly different, I hope my project can be used as a guide to future amateur mushroom growers.