



Arlington
Public
Schools



VERITAS COLLEGIATE
— A C A D E M Y —

NORTHERN VIRGINIA REGIONAL SCIENCE AND ENGINEERING FAIR

Wakefield High School

March 1, 2025

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7 AS 100

Yarker, Iris

Francis C. Hammond Middle School

The Effect of Food on Ant Speed

There are over 10,000 species of ants that are all slightly different, in my experiment I used Western Harvester Ants. Their body has a red tint and has a claw-like mouth for picking up food and defending themselves. For my experiment I wanted to know if ants would travel faster to an artificial sugar like an oreo or natural sugar like melon. In my experiment I changed the food in the maze from an oreo (artificial sugar) to a piece of melon (natural sugar) and compared if an ant would travel faster to one type of food and not the other. I thought that if I put Melon in the maze then the ants would travel faster to it than if there is Oreo in the maze. The results were that ants will travel a considerable amount faster to an oreo then to a chunk of melon. Showing not only that ants prefer an Oreo over melon but a small advance in keeping ants as a pet. I also connected this to human behavior because if someone called out there is melon over here you would probably go slowly as you're not worried someone will take it all but if someone called out there is an oreo over here you would go much faster in case someone takes it all.

7 AS 101

Baterdene, Misheel; O'Connor, Caitlin

H-B Woodlawn Secondary Program

Brine Shrimp: Wanted Dead or Alive

For our project, we researched and experimented to find the best salinity percentage for brine shrimp hatch rate. In four Petri dishes we divided 200 ml of water, and put 0, 1, 2, and 4 percent salt in each. We believed that the two percent salt would have the best hatch rate. Brine shrimp are a minuscule species of shrimp that are at the bottom of the food chain. Because of this, they are mainly used as food for other aquarium fishes. They can be found in many lakes and rivers, but are mainly found in The Great Salt Lake. The results showed that the two percent salt did have the best hatch rate for brine shrimp. So, our hypothesis was proven correct.

8 AS 102

Matthews, Oliver

George Washington Middle School

Does PBIS Work?

The purpose of this experiment is to test if positive reinforcement on Madagascar Hissing Cockroaches affects the time it takes to complete a maze. My hypothesis was If cockroaches are given a reward for completing a maze, then there will be no change in time of completion. I tested by using 12 Madagascar Hissing Cockroaches half were labeled with nail polish to differentiate them as the experimental group and the unlabeled half were the control. Then I ran them each 7 times through the maze to collect the data on how long in seconds it took to complete. I rejected the hypothesis because the control took almost twice as much on average. This gives us insight on how positive reinforcement affects cockroaches and could have insights into how positive reinforcement affects students in a school setting.

9 AS 103

Sundqvist, Marek

Arlington Tech/Career Center

The Effect of Substrate Grain Size on Antlion Larvae Funnel Building Efficiency

After antlion larvae were observed in Georgetown, Delaware with the Smithsonian Young Entomologists club, an experiment was conducted to answer these questions. How do these insects create their funnels, and can they build them in different soil types? Four different substrates were collected to test them in. These were play sand, native sand, dirt, and small pebbles. After seven antlion larvae were collected near the researcher's house, they were brought back and contained for one day. Then the experiment was conducted. Each antlion was timed for its speed in funnel building. After observing the ending times of each larva, it was found out that the play sand worked the best for antlion funnel building efficiency. These times can be explained by the grain size that made up the play sand. These grains had the lowest average size which made for easier movement in the sand. The P-value from the data analysis shows a greater statistical difference from the data. This experiment was conducted for personal curiosity and to answer questions that were created after these insects were observed. Observing how antlions build their funnels in such a way could also prove useful in future engineering. Following this experiment it could be researched more on how the effect of antlion size affects funnel size. By completing this experiment, entomology took place on a great scale and taught the researcher more about the insect world.

9 AS 104

Waggy, Charlotte

Arlington Tech/Career Center

The Effect of Natural Repellents on Isopod Presence

The purpose of this experiment is to discover if any natural repellents repel isopods, and if so, which. This is important as it could help many gardeners when managing pests in the garden. To conduct the test, an experiment zone is created and prepared with dirt and food. Isopods are then placed in the zone and offered treats through tubes containing each of the scents. This procedure is repeated for ten days. After the experiment had concluded, the results for each day were averaged. Orange had the lowest, with an average of 2.6 isopods in their original container. Then came Rosemary and Control, with 2.9 and 3.4. Peppermint ended up the most successful, with an average of 4.6 isopods in the original container. These results were put into an Anova: Single Factor test, and the P-value was found. As the P-value was less than 0.05, the data was significantly different. In addition, the statistics and data found supported the original hypothesis, as Peppermint performed the best. In conclusion, this experiment ended with Peppermint repelling the most isopods on average, and Orange repelling the least. One reason for these results could be due to the large amounts of methanol that peppermint oil contains. This creates a very strong scent, and could have disrupted the isopods antennae, making it a successful repellent.

9 AS 105

Weber, Ryan

Alexandria City High School (includes Minnie Howard)

Are White-throated Sparrows Adapting to Urban Noise

The background noise of a city is a very low frequency. It is difficult for songbirds to hear and to be heard when attracting a mate by singing due to the noise interference of the city. To counteract this, birds have raised their pitch when singing to be heard and differentiated from the background noise. In rural areas where there aren't low frequency city sounds, the birds have had no need to adapt to this change and therefore have lower pitch. Human activity has disrupted the natural environment to an extreme level. While some species are declining due to this, other species have been able to adapt to these changes. I want to find out whether White-throated Sparrows are adapting to urban noise. I went to 3 different locations, each with a different amount of urban noise; low (<45 dBa), medium (45-60 dBa), and high (60+ dBa). Then I will record 3 White-throated Sparrow singing from each location and display the sound on a spectrogram. I will then compare the pitch of each audio recording. From this, I found out that White-throated Sparrows have adapted to urban noise, and raised their pitch to combat low frequency urban noise.. This project connects to the real world because it determines whether the species tested are adapting to human activity.

10 AS 106

Burks, Thomas

Alexandria City High School (includes Minnie Howard)

Using Event-Based Cameras to Image Mouse Whiskers

I used event-based cameras to view the whisking movements that mice make when they are exploring a previously unknown area with new (to them) objects (usually food). This project addresses two main questions: can the movement of the mouse's whiskers be captured using an event-based camera, and is this whisker movement predictable (similar frequency) and measurable above background activities. From measured experimental data, there is a known frequency range for mouse whisking, and the whisking frequency spike is higher than either background frequencies or other mouse movements. I found an average hertz of whisking between 10-30 and all having a signal to noise ratio of at least two.

7 BE 200

Miller, Audrey; Maya Harris, Miona

H-B Woodlawn Secondary Program

Make, Bake, Cake: Price Vs. Percieved Quality

This experiment tested how price affects perceived quality. The hypothesis was that the more expensive the cake, the better quality people will think it is. Other studies have found mixed results. Some found that it did, some found that it didn't. Two of the same cakes were made. Signs were put in front of each cake. One said \$10 and the other said \$5. Participants tried each cake and were asked which one was better. The results were recorded. It was found that the hypothesis was correct and the majority of people thought that the \$10 cake was better.

8 BE 201

Brooks, Johnna-Averi

Francis C. Hammond Middle School

Listen To Your Heart: How Does Music Affect Human Emotions?

Have you ever heard a selection of music so invigorating, it gave you chills? Maybe not, but some people experience a phenomenon called musical frisson, which activates goosebumps when they hear certain music. Simply put, music can affect people very deeply, emotionally and physically. Several people wish they could hear their favorite song for the first time again, because of how it made them feel, indicating how music is tied to memories, nostalgia and emotions. Another common sentiment from individuals is that their lives simply wouldn't be the same without music. Millions of dollars are made from fans who would likely pay any amount of money to experience the thumping bass, electric atmosphere and freeing exhilaration of a live performance. The familial energy of millions of people coming together to listen to someone they like can also lead to making new friends, or feeling truly at home and where you belong. Music has proven to have numerous health benefits, having been used in emotional and physical therapy. Having always relied on music to improve my mood, help me concentrate and channel my energy and creativity when composing, I realized music has a huge impact on my life. When my favorite, only music app got removed from the app store, myself and friends of mine who used it quickly went crazy from the lack of musical stimulation we needed. I quickly wished to see if other people experienced the same connection to music I felt, and thus, my project was born.

9 BE 202

Henton, Estella

Alexandria City High School (includes Minnie Howard)

The Color of Emotion

The purpose of this experiment was to measure the mood felt depending on the colors people see and if the warm and cool tones of those colors also effect the mood they feel. To help collect the data, people judged how they felt on a mood scale from 1-10 (1- Sad/down, 2- angry/mad, 3-anxious/ worried, 4- annoyed/irritable, 5- indifferent/neutral, 6- satisfied/ content, 7- calm/peaceful, 8- happy/positive, 9- energetic/excited, and 10- Joy/ecstatic) (1-4 is the negative emotions, 5 is the neutral emotions, and 6-10 is the positive emotions) which helped us know how people felt when they viewed a color. During the experiment, participants answered how they felt initially (control) and then answered how they felt using the mood scale when they saw each color. My research contributes to helping people understand more about colors and the effects they have on our emotions. It helps people know what colors to choose for room decor, color schemes, or product design that will help to achieve a targeted feeling from individuals viewing something or buying a product. This research will also help people use color as a way to help cope with depression or uncontrollable feelings without medication or harmful substances.

9 BE 203

Sexton, Morgan

Arlington Tech/Career Center

The Effect of One's Confidence Level for Detecting AI Images on How Well They Actually Detect the AI Images

The purpose of this experiment is to see the relationship between confidence level and detecting AI images. This can help with seeing if people are accurate in how they think about AI. Ten AI images and ten real ones were gathered for the experiment. The images were randomly put into a Google Form where participants would record their guess. There was no pattern found between confidence level and ability to detect AI. This is because people's confidence is not a good way to measure ability.

9 BE 204

Tarpley, Summer

H-B Woodlawn Secondary Program

Does Risky Behavior in Teens Predict Suicidal Ideation?

Teen suicide is one of the leading causes of death in adolescence. To help save lives, it is important to understand the risk factors contributing to suicidal ideation in teens. Using the Youth Risk Behavior Surveillance System (YRSSS), the largest public health surveillance system in the United States monitoring health related behaviors among high school students, this experiment correlates data regarding suicidal ideation with risky activity such as the use of alcohol, marijuana, vapes, and cigarettes. The knowledge that teens with suicide ideation are more or less likely to engage in risky behaviors, this could help inform parents, friends, and caregivers of risk factors for youth, and save lives.

9 BE 205

Stouffer, Audrey; Wolf, Nina

Alexandria City High School (includes Minnie Howard)

Is Stress Contagious?

Is stress contagious in classrooms? For our science fair, we wanted to do our project on something that could be used in schools to benefit students. From statewide tests to quizzes in classrooms, when large groups of students are put together in a room taking the same test, anxiety is high and can affect students' scores. As students, we face issues with anxiety and stress a lot, especially during these tests. We tested this by having a fake student or our "placebo student" act visibly stressed while having a second real student taking a test and looking at the real student's scores. To do this, we had them each take an emotional survey before the test, take the test in a small, quiet room, and then complete another emotional survey once they were finished. The variable levels were having the fake student act very stressed, moderately stressed, or the fake student wasn't there at all. Our results proved our hypothesis correct by having the students who took the test by themselves score better by 5% on average than the students who took the test with the very stressed fake student. This information shows how important it can be to have calm testing environments. By reducing these stress factors, students perform better on the tests.

10 BE 206

Shiu, Walter

Yorktown High School

The Effect of Different Promotional Discounts on Purchasing Rates

This experiment tested which promotional discounts on products most effectively increased customer purchasing rates. This was done through survey form, with each survey having 3 questions. There were two forms which asked the subject to evaluate the likelihood to purchase a particular product. The products and final prices were identical between forms, so the only factor that changed was that Form A had no discount tag, and Form B had a different discount tag for each question. Question 1 tested a base 50% discount, question 2 a buy one get one free (BOGO) discount, and question 3 a 50% discount upon joining the company's rewards program.

The 50% discount caused significant boosts in purchasing rates, with a 40.85% increase between forms, jumping from a likelihood score of 4.28 on Form A to 6.03 on Form B. The 50% discount with the rewards program saw similar results, with a 38.98% increase, rising from 3.17 to 4.4 from Form A to B. The BOGO offer actually saw a 6.03% decrease, going from 7.91 to 7.43 from Form A to B, however, the high .47 P-value indicates the change between forms may have been negligible. The BOGO discount may have performed poorly because people oftentimes do not want an extra product when they only need one. The reason for the extreme increase for both 50% discounts is due to the sense of urgency discounts create, which make customers think emotionally rather than logically.

10 BE 207

Hao, Alvin; Lu, Haotian; Wang, Xiaohan Sophie

Veritas Collegiate Academy

The Influence of Human-AI Collaboration on Classroom Learning in High Schools: From the Exploratory/Exploitative Learning Perspective

In the era of artificial intelligence (AI), humans are not the only learner to generate knowledge anymore. With the rapid development of AI, various types of AI tools have been adopted to facilitate classroom learning. How to adapt to such changes and improve learning effectiveness through human-AI collaboration has become a frontier question. Given that classes in high schools are intrinsic organizations, this study focuses on organizational learning and explores the influencing mechanisms of human-AI collaboration from the exploratory/exploitative learning perspective by the use of a multi-agent simulation approach. Through model establishment, this study finds that: (1) the incorporation of AI tools can influence organizational learning. While high-learning-ability AI can substitute exploitative learning, it weakens the needs for exploratory learning. (2) human-AI collaboration influences the effectiveness of organizational learning in a non-linear way. When organizational learning is more exploitative oriented, the growth rate of knowledge level will slow down with the increase of AI learning capability. However, when organizational learning is more exploratory oriented, high AI learning capability can help enlarge accumulated knowledge base, but the knowledge uniqueness of members will be reduced. (3) Environmental uncertainty affects human-AI collaboration in organizational learning. When the uncertainty level is high, high-learning-ability AI complements members' learning. More specifically, AI can generate high-quality knowledge and subsequently members leverage the knowledge rapidly to cope with challenges. Findings of this study suggest that taking advantage of the human-AI collaboration practices, classroom learning in high schools can be enhanced.

10 BE 208

Li, Hejin; Wu, Jianing; Yan, Xinyu

Veritas Collegiate Academy

Analysis of Changes in the Prevalence of Depression Among Adolescents and the Impact of Socioeconomic Conditions in Countries Before and After the Epidemic

Adolescent depression has become a major global public health challenge, with growing attention on adolescent mental health issues, especially after the COVID-19 pandemic. This study compares the differences in adolescent depression prevalence before and after the pandemic between China and Western countries, exploring the impact of socio-economic factors, cultural backgrounds, and public health responses on adolescent depression prevention and treatment. The study finds that depression rates among adolescents in Western countries significantly increased post-pandemic, particularly among females, while the increase in China was smaller. Through regression analysis, the study further reveals the profound impact of economic instability, lack of social support, and academic pressure on adolescent mental health. This research aims to provide scientific evidence to policymakers, promote improvements in global adolescent mental health interventions, and offer insights for policy innovations in China.

11 BE 209

Brodsky, Anna

H-B Woodlawn Secondary Program

The Impact of Climate Change on Educational Outcomes: A Global Analysis

Researchers and policy makers have expressed concern about the effects of climate change on educational outcomes. Climate change drives variations from historical temperature norms and increases the frequency and intensity of natural disasters. Using publicly available data sets, this project analyzes the impact of these indicators of climate change on educational outcomes across 140 countries. Newly released data describing globally comparable standardized test scores -- combined with those for average annual temperatures and natural disaster prevalence -- enabled the analysis of both high- and low-income countries, the latter often more susceptible to the effects of climate change but insufficiently studied in previous research. This project confirms some elements of policy conversations that associate lower test scores with hotter countries, since statistical analysis of these data identified a negative correlation between temperature and test scores in three content areas, with reading showing the strongest relationship. However, this project demonstrates that a simple understanding of temperature and educational outcomes is impossible. The data did not show a correlation between temperature and test score variations during the period 2000-2017, but most countries that showed an increase in mean temperature over the time period also showed improvements in test scores. The data on natural disasters are similarly complex. Further research must be conducted to better comprehend the multifactorial effect of climate change on educational outcomes. A more nuanced understanding will be critical to shoring up and improving student learning, especially in the lowest-income countries.

12 BE 210

Wallin, Carson

Yorktown High School

The Uncanny Valley: Exploring Psychological Discomfort

The uncanny valley effect has gained attention, particularly in movies like *The Polar Express*, where the characters evoke an uneasy feeling due to their almost-human appearance. Moreover, as roboticists develop more lifelike robots, this resemblance to humans often unsettles us. In my experiment, I studied participants' reactions after viewing three images, a clown, a monster, and a robot representing the uncanny valley, to see which created the most uneasiness and disturbance. My hypothesis was that participants would choose the uncanny valley robot image as the most unsettling and would be more likely to say “no” to the question about interest in a personal assistant at-home robot. I surveyed 100 participants, recording their age, gender, and responses. Of the participants, 37% said the clown was the most unsettling, followed by the uncanny valley image (35%), and then the monster (25%), weakening my hypothesis. However, 39.7% of the participants said “no” to wanting a personal assistant at-home robot after choosing the uncanny valley image as the most unsettling. This was higher than the rates of the clown (34.9%) and the monster (25.4%). A correlation with age emerged so that as the participants got older, they were more likely to select one of the other two images (the clown or the robot) as the most unsettling and tended to say “yes” to the personal assistant at-home robot. This study has implications for robotic design as it relates to the future of robot-human interactions.

7 BI 300

Lakhani, Leela

Dorothy Hamm Middle School

What Keeps Strawberries the Freshest for the Longest?

This experiment was conducted over a five day period in which I used four different strawberries with different freshness-inducing items to see how long each fruit could stay fresh. I used four different tactics for each strawberry: a Ziploc bag, food freshness paper (this uses a special spice to help fruit stay fresh), refrigeration, and left out in the open at room temperature (68-69 degrees). While doing this, I took notes and observations about what I saw every day around the same time (8-8:30am). I believe this experiment was important because it was driven by the problem of food waste, and I wanted to prove some of the most efficient ways to preserve perishable items through this experiment. This goes along with my purpose for people to help see the problem of food waste and take action at smaller levels, like I did, just by performing a simple yet effective experiment.

8 BI 301

Meyer, Evan

Kenmore Middle School

The Effect of the Variation in Species of Aquatic Plant on the Disintegration of Calcifer Shells.

Carbon dioxide is known to destroy the ozone layer of earth's atmosphere. However, about 31% of carbon emissions are absorbed into oceans. The carbon dioxide which gets absorbed into the ocean affects the pH of the water, causing calcifer organisms to start disintegrating in the acidic water.

Aquatic grass uses carbon dioxide to perform photosynthesis, thus decreasing carbon present in ocean environments. But what species of seagrass are most beneficial for oceans? The researcher tested this by placing four clam shells into four jars. Each jar also holds different species of seagrass, along with sand. The jars sit for one week, each day the shells are weighed, and carbonated water is added to increase the amount of carbon in the water.

If the researcher puts shells in jars with different species of aquatic grass in carbonated salt water, then the shells will gain weight on the first day, because shells absorb water, but then lose weight because carbon disintegrates the shells. The jar without any seagrass will lose the most weight since the water is unable to absorb the carbon dioxide.

After one week of observation, the shells absorbed water at the start of the experiment, but then decreased in weight as the carbon was added. The jar with the sea lettuce decreased the most, followed closely by the control jar with no aquatic life. However, the control shell had the second highest average weight lose, which can conclude that the aquatic life helps support the improvement of aquatic habitats.

9 BI 302

Gottshall, Daniel

Arlington Tech/Career Center

The Effect of Different Biological Materials on Their Electrical Resistance

This project explores the effect of various biological materials on their conductive properties to understand their electrical resistance and potential implications for biotechnology. Electricity and biological materials are increasingly integrated in fields such as medical devices and sensors. Since water is a key conductor in biological tissues, foods with varying water content can serve as useful analogs for different tissue types. Uniform 3 cm samples of carrots, bread, raw chicken, raw beef, and human fingers were tested using a simple circuit with a multimeter, with five trials per sample to ensure reliability. The results indicated that carrots exhibited the highest resistance, likely due to their high cellulose and lignin content, followed by bread, where resistance was influenced by air pockets and starch composition. Human fingers demonstrated even higher resistance than all tested food samples, suggesting that skin acts as an effective insulator. Among meat samples, chicken had a higher resistance than beef, potentially due to differences in water content and sample structure. These findings highlight the relationship between biological composition and electrical resistance, offering insights into how organic materials interact with electrical currents. Understanding these properties can aid in the development of biosensors, implantable medical devices, and other biotechnology applications that require precise electrical interactions with biological tissues.

9 BI 303

Thulson, Samuel

Alexandria City High School (includes Minnie Howard)

The Effect of Ultraviolet Radiation on DNA Quality

My project was seeing how UV radiation affects the quality of DNA. I did this because it can totally change the results of a DNA related experiment if you degrade the DNA, so I thought I could see for myself whether UV actually damages the DNA. I investigated whether DNA would be degraded by UV. I first extracted my DNA from a saliva sample, and then purified it. Then, I exposed it to varying amounts of UV radiation (0 min, 5 min, 10 min). To measure whether it had been degraded, and if so how much, I tested it using a technique called gel electrophoresis. This is when you separate DNA by how big they are by way of an electric current. In the end, I found that, although there wasn't a huge difference in values (typically about 50-100 base pairs), the UV did degrade the DNA. In the end, I did meet my objective; I figured out whether or not UV degrades DNA, and got quantitative results proving that.

10 BI 304

McGlinchey, Quinn

Alexandria City High School (includes Minnie Howard)

Iron Absorption in Coffee, Tea, Orange Juice, and Water

This science fair project was based on the effects different liquids have on iron. Iron is an essential mineral in human diets. Iron's ability to be effectively absorbed, however, depends on other active ingredients found in the digestive tract. Coffee and tea contain tannins, which bind to iron and inhibit its absorption. Ascorbic acid, found in orange juice, enhances iron absorption.

The purpose of this project was to observe the effect these different liquids have on iron absorption. For this experiment, a liquid iron supplement was added to coffee, tea, orange juice, and water. It was then measured using iron colorimetric test strips. The data provided by the test strips was compared in order to find the differences in iron absorption. Coffee had the greatest inhibiting effect, with an average of only 8.75 mg/L iron found. Next, water contained 20 mg/L iron, and tea contained an average of 27.5 mg/L iron. As predicted, the greatest amount of iron was detected in orange juice, which had an average of 50 mg/L iron. This science fair project demonstrates the impact substances have on iron absorption. Therefore, if someone is diagnosed with anemia, or iron deficiency, they should take iron supplements with foods high in ascorbic acid such as orange juice.

10 BI 305

Pfautz, Tesla

Washington-Liberty High School

The Effect of Chemical Treatments on Blue- Green Algae

Cyanobacteria, or blue-green algae, is a harmful aquatic organism that releases dangerous toxins as its cells degrade. These toxins can damage aquatic environments, harming both animals and humans. An experiment was conducted to discover which of three chemical treatments worked most effectively to remove Cyanobacteria from contaminated water. The chemical treatments used in this experiment were kaolinite, hydrogen peroxide, and copper sulfate. It was hypothesized that the kaolinite, a clay-based treatment, would remove the most Cyanobacteria because its structure allows for efficient flocculation. During the experiment, each chemical treatment was added to a water sample of 250ml from a Virginia lake suffering from a Cyanobacteria bloom. Measurements of phycocyanin (a pigment in Cyanobacteria) were taken using spectrophotometric techniques after 10 and 30 minutes. In addition, the pH as well as other measurements were taken to evaluate potential environmental impacts. It was found that kaolinite had the greatest impact on reducing phycocyanin, and therefore, Cyanobacteria. An ANOVA test was conducted and the resulting p-value suggested the results were significant. Also, copper sulfate had the greatest negative impact on the environmental variables. Financial research suggests that kaolinite would be the most expensive to treat an average-sized water body, followed by hydrogen peroxide and copper sulfate. Future work includes the exploration of more clay-based and mechanical, non-chemical treatments. Also, the experiment could be observed at a molecular level for an increased understanding of a treatment's removal process.

10 BI 306

Thulson, Benjamin

Alexandria City High School (includes Minnie Howard)

Can Soft Tissue Really Be Extracted From Fossil?

I always want to do my science project on something I'm interested in but I had trouble finding a good topic this year. Then I read an article in the Smithsonian Magazine. A scientist had extracted soft tissue from T. Rex fossils. Nobody thought it was possible, but she did. I immediately wanted to do my project on this. My project builds on hers, experimenting on the best size fossil for soft tissue. I formulated my hypothesis, that bigger fossils would yield more soft tissue. I set up the demineralizer she used, (EDTA) and soaked the mosasaurus fossils in the EDTA for 7 days, changing the solution each day. In the end, it turned out that 0.2 grams of fossil yielded soft tissue more consistently. As the weight went up past the 0.2 grams however, the yield declined. Only 1 in 5 runs produced soft tissue for 0.4 grams and 0.5 grams. The reason this happened was most likely because the EDTA had enough time to dissolve the smaller fossils, but did not have enough time to dissolve the larger ones.

11 BI 307

Hoffman, Lilah

Washington-Liberty High School

The Effect of Temperature on the Reaction Rate of a Lipase-Catalyzed Reaction, As Measured by Change in pH Over Time

Several studies have concluded that temperature increase of a lipase-catalyzed reaction is positively correlated with reaction rate, until the optimal temperature for the enzyme is reached, where it will then denature and lose activity. While measuring pH change overtime is a less common method for determining reaction rate, it was used to measure and visually see the point of denaturation of the lipase. The purpose of this study was to test for the reaction rate and therefore enzyme activity at varying temperatures. The experiment was conducted using 5% lipase concentration and whole milk, using a water bath to heat the milk. A pH probe was used to measure each solution immediately following the addition of lipase concentration for each trial. After five minutes, the final pH for each trial was measured. In addition to initial and final measurements, the change in pH was graphed and recorded throughout the reaction via a pH probe. It was reported that from 20°C to 30°C there was an increase in reaction rate, then at 37°C the reaction rate peaked. From 47°C to 60°C the reaction rate exhibited a significant decline, showing a denaturation of lipase when exposed to these extreme temperatures. These findings reveal a correlation between temperature and enzymatic activity. This correlation is significant in relation to biomedical processes and can have a significant impact in pharmaceuticals. Though not a common way to measure, these findings clearly show that measuring reaction rate by pH change over time is a viable technique.

11 BI 308

Yavuz, Arzu

Washington-Liberty High School

What is the effect of temperature change on lactase enzyme activity measured through glucose levels?

Lactase is an enzyme that hydrolyzes lactose into glucose, with its activity influenced by temperature. This study investigates the effect of temperature on lactase activity by measuring glucose concentration using glucose test strips at five temperatures: 0°C, 10°C, 20°C, 30°C, and 40°C. Lactase was added to a lactose solution (3% milk), and glucose levels were recorded at each temperature to determine enzymatic activity. Results showed that lactase activity increased with temperature, peaking at 40°C, where the highest glucose concentration was detected. Lower temperatures (0°C and 10°C) resulted in minimal glucose production, likely due to reduced molecular motion and enzyme-substrate interactions. These findings align with the general enzymatic trend of increasing activity with temperature up to an optimal point. The use of glucose test strips provided a simple and effective method for assessing enzyme activity. This research has implications for optimizing lactase use in dairy processing, enzyme supplementation, and lactose intolerance management. Future studies could explore enzyme stabilization strategies to maintain lactase efficiency across a broader temperature range (observe denaturation)

6 CH 400

Hayes, Reagan; Gola, Rose; Hayes, Sloan

Swanson Middle School

Measuring the Acidity of Different Fruits

In the beginning, we weren't sure what project to do, then Sloan suggested we do something about acidity, because our group leader, Reagan, was having stomach/chest problems. So, we decided to become a trio and research more about acidity to help Reagan and anyone else with similar problems. We did this by highlighting the solution to acid reflux.

The fruits we did were lemons, limes, kiwis, mangos, and clementines, and our procedure is that with half of a fruit, we juiced the fruit into a bowl, then we dipped a pH strip into the bowl. Afterwards, we compared the strip to get the results. Lastly, wash the materials, then repeat the steps with the same type of fruit 9x and move onto the next fruit (different type) and repeat those steps.

To conclude, our project was all about measuring the acidity in fruits, and to highlight the solution of our problems. Our hypothesis was that "if we changed the different types of fruit, then lemons would be the most acidic because they make you have a sour expression." This was proved wrong though, because limes were actually the most acidic followed by lemons, mangoes and clementines, and kiwis. By the way, the more concentrated hydrogen ions are in a substance, the more acidic that substance is. All in all, we did this experiment because we wanted to learn more about a problem that one of us had, and that others have too.

7 CH 401

Downs, Samuel

Dorothy Hamm Middle School

What is the Effect of the Type of Salt on the Loss of Mass in Meat?

For my project, I wanted to find out what type of salt made pork lose more mass, therefore preserving it better. The salts that I chose were himalayan pink salt, table salt, kosher salt, and flaky salt. I portioned out the pork and coated each piece in one type of salt. I put the pork in a fridge for ten days, then rinsed it off and hung it for 5 more days. Then, I weighed each piece of pork and found the average mass for each type of salt. The pork with flaky salt averaged the most mass loss out of all the salts, with 38% lost. The pork with the table salt lost the least mass, with 25% lost. There was a correlation between the weight lost from the meat, and the size of the salt crystal. Flaky salt had the largest crystals by far and lost the most weight. On the other hand, table salt had the smallest crystals and lost the least weight.

7 CH 402

Lee, Isabel

Dorothy Hamm Middle School

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

Global warming is melting glaciers and icebergs on Earth at an alarmingly fast rate. The purpose of this experiment was to learn about the melting process of glaciers and icebergs in polar regions such as the Arctic. This experiment investigated what effect the shape of ice has on how fast ice melts. Four shapes were tested: cube, rectangular prism, sphere, and cone. This experiment involved 59mL of tap water, ice molds, and a stopwatch. To start the experiment, the materials were gathered. The ice molds were filled and set in the freezer for approximately twelve hours. Once frozen, the ice shapes were set on the counter and melted. The stopwatch was stopped every time a piece melted, and this was repeated for all four shapes. In conclusion, my hypothesis was incorrect because I believed that if the shape of ice was a sphere, the amount of time it takes the ice to melt would decrease because there is a smaller surface area. Interestingly, the results were the opposite, and the rectangular prism melted the fastest even though it had the largest surface area. The second fastest was cone, then cube, and finally sphere. I found that if a shape had a larger surface area, it would melt faster because it is exposed to more heat. This experiment helped show me how the melting process works for glaciers and icebergs. However actual ice formations have more complex shapes than those in the experiment.

7 CH 403

Rouland, Sophia

Dorothy Hamm Middle School

The Perfect Pop: The Effect of Juice Type on the Spherical Consistency of Popping Boba

Popping boba is juice encased in a gel-like exterior and is commonly used in beverages and frozen yogurt. Designing an experiment to investigate the impact of different juice pH levels on the formation of popping boba could reduce food waste by minimizing the production of unsuccessful boba pearls that fail to form correctly due to pH variations. To explore the relationship between pH levels and boba pearl formation, I hypothesized that orange juice, initially at a pH of 3.8 and elevated to 4.5 with sodium citrate, would produce the most spherical pearls since the optimal pH for boba creation lies between 4 and 6. I tested various juices, including lemon, grapefruit, orange, Sprite, and Fanta, modifying their pH with sodium citrate while using calcium chloride and sodium alginate to form the pearls. Fanta and orange juice produced the roundest pearls, 14 out of 15 pearls in a spherical shape. Sprite yielded slightly less spherical pearls, lemon juice only created one 1mm example, and grapefruit juice formed the least spherical pearls. These results partially supported my conclusion. I identified the volume of liquid dispensed as a factor affecting pearl size, and future experiments will standardize this for more accurate results.

7 CH 404

Stuppy, Maya

George Washington Middle School

The Effect of Different Types of Flours on the Density of a Muffin

The purpose of this experiment was to observe the effects that different types of flours have on the density of a muffin. I tested three different flours; bread, all purpose, and whole wheat. When making muffins you want them to be airy and fluffy instead of really dense. When researching how flour affects density I found out that the more protein in the flour, the more elastic the dough will be, which makes the dough more dense. Also I found out that bread flour has more protein in it than all purpose and whole wheat. To conduct my experiment I first had to bake the muffins. After they were made I had to figure out the density, but since muffins are an irregular object I had to do a water displacement test and weigh its mass. After I did the displacement test and weighed the mass I had to divide the mass by centimeters squared to find the volume. After that I could get my results. The data supports my hypothesis because bread flour ended up being the most dense. For example the bread flour on the graph was bigger than the whole wheat and all purpose. Also the graph shows that whole wheat is the least dense.

7 CH 405

Adams Rothrock, MJ; McCormick, Cecelia; Moline, Emma

Francis C. Hammond Middle School

Which Lengthens Best Drug Store Vs. High End?

We believe that higher end mascara will lengthen your eyelashes better than lower end mascara. There are many different ingredients when it comes to lengthening mascara. There is Castor oil which is found in only some mascaras and it moisturizes the eyelashes as well as thickens them. Floral is a much more popular ingredient which is found in the majority of mascara brands. It waxes the glycerin and the eyelashes which helps protect them. We have concluded that it mostly depends on what type of look you're going for because both lower and higher end mascaras have good ingredients. Though higher end mascara costs more it can last longer throughout the day. While the CVS mascaras are affordable, they don't deliver the same quality as the higher end mascara brands. So it always comes down to what's your budget, what look you are trying to go for and how long-lasting you want your mascara to be .

We took five different types of mascaras all ranging from different costs. The first mascara, was the Elf Lash X-tender, which was seven dollars. The second mascara we used was the famous Maybelline Sky High mascara being fourteen dollars. Next our third mascara was Tower 28 costing twenty dollars. Then we have our fourth mascara which was the Ilia Limitless Lash mascara which was twenty-eight dollars. Lastly, the Dior Iconic Overcurl mascara was thirty-three dollars.

7 CH 406

Nigal, Ayush; Chu, Theodore

Thomas Jefferson Middle School

Egg-Squisite Crystals

This experiment aimed to determine the effect of soaking eggshells in alum solution for varying periods on crystal growth. Alum powder, a compound composed of potassium and aluminum, is known for its cleansing and deodorizing properties and has been traditionally used in cooking and preserving foods. In this study, eggshells were coated with glue and alum powder, then submerged in an alum-water solution for 12, 24, 48, and 72 hours. The hypothesis was that longer soaking periods would result in larger crystal growth due to extended reaction time between the alum powder and the calcium carbonate in the eggshells. The experiment involved boiling alum powder in water, cooling the solution, and pouring it into four containers with the prepared eggshells. After designated soaking times, the eggshells were removed and dried for observation. The results showed that while crystal growth occurred, the differences in size between the different soaking times were minimal. The experiment concluded that the amount of time eggshells are soaked in the alum solution does affect crystal growth, but not significantly. This study underscores the intersection of chemistry and geology and demonstrates the fascinating process of crystal formation using everyday materials. The results suggest that extended soaking time does not lead to substantial differences in crystal size, providing insights into efficient resource usage for educational demonstrations.

7 CH 407

Perez-Lopez, Miriam; Strauss, Charlotte

George Washington Middle School

Stain Removers: Do They Really Need Chemicals to Clean?

Many people get permanent markers on their clothes, and it is very difficult to know what product to use to get it out. When preparing for the experiment, we hypothesized that Oxiclean would clean the permanent marker the best. We hypothesized this because Oxiclean was the only product that we tested that was solely a stain remover. For our project, we put the same amount of water in five different bins. We then put Tide original, Tide Free & Gentle, Cleancult, and Oxiclean White Revive into each bin and kept one of the bins with just water. We then put four squares of white t-shirt that were half colored in with permanent markers in each bin. After they were done soaking and drying, we looked at which product had faded the marker the most. When we examined the swatches, we determined that Oxiclean cleaned the best, then Tide Free & Gentle, then Tide original, then Cleancult, then water. In the field of environmental sciences our project shows that while the eco-friendly stain remover and detergent market is growing, it still needs some improvement so that it works for more purposes.

8 CH 408

Baker, Jaime

Kenmore Middle School

The Effect of Different Natural Antacids on the PH of Vinegar.

People get stomach aches all the time and some get acid reflux. Both ailments can be extremely painful. Natural antacids can help lower pH. This helps with stomach aches, but which ones work the best? The goal of this project was to determine how well natural antacids raise the pH of vinegar. Vinegar represented stomach acid. The levels of the independent variable were baking soda, ginger, nothing, melon, and banana. The natural antacids were tested by filling bowls with the same amount of vinegar and then putting in each of the natural antacids. The natural Antacids were then left in for 10 minutes. After the ten minutes were done, a pH test strip was put into the vinegar and then compared to a chart to determine how much the natural antacid raised the pH of the vinegar. The hypothesis for this experiment is: if the baking soda is added to vinegar then the pH level of vinegar after 10 minutes will decrease the most because it is the least acidic natural antacid, and is a 8.1 on the pH scale. My hypothesis was supported because the results showed that baking soda raised the pH of the vinegar up 4 levels. The melon and the banana raised the pH level up 1 level and the ginger and control did not change the pH level at all. This experiment shows that ginger will not make a significant difference for people with acid reflux while melons, bananas, and baking soda will.

8 CH 409

Beckner, Cayleigh

Swanson Middle School

The Effect of Different Types of Oils on the Melting Point of a Lipstick

Palm oil is the most commonly used oil in cosmetic products, but its production contributes to deforestation and habitat loss. This experiment aimed to determine whether there were more sustainable alternative oils, and oils that are comparable to palm oil from a manufacturing perspective. Three oils were used: palm oil (control), coconut oil, and soybean oil. They were then melted down in order to test for the melting point. I initially thought palm oil would perform the best, due to it being the favorite of cosmetic companies. Contrary to my hypothesis, coconut oil performs the best, with an average melting point of 93.1°C, followed by palm oil at 91.9°C, and soybean oil at 87.4°C. However, coconut oil also exhibited the most variability in melting point of the three. This suggests that coconut oil may be a potential alternative from a manufacturing perspective. But, further research suggests that while it performs very similarly to palm oil, it is less effective at a large-scale level due to not being as effective of a crop as palm oil. This project shows the importance of sustainability in the cosmetic industry and aims to educate people on the importance of sustainably sourced palm oil.

8 CH 410

Brosnan, B

Swanson Middle School

What Is the Effect of Hydrochloric Acid on Different Types of Migraine Medicines

This project investigates the dissolution rates of various migraine medications in hydrochloric acid, simulating stomach conditions. The study aims to identify the fastest-acting medicine, providing valuable insights for individuals suffering from migraines. The medications tested include Dual-Action Advil, regular Advil, and caffeine pills, each with different outer layers affecting their dissolution rates.

My hypothesis is that pills with thinner or no sugar coatings will dissolve faster than those with thicker coatings. The experiment involved immersing the pills in a hydrochloric acid solution and timing their dissolution. Results indicated that the caffeine pills, lacking a sugar coating, dissolved the quickest, followed by Dual-Action Advil and regular Advil.

This research is significant for both medical professionals and people who suffer from migraines. Understanding the dissolution rates can help in planning treatment for patients and managing daily activities for people with migraines. The findings suggest that the outer layer composition of pills plays a crucial role in their effectiveness, potentially leading to the development of faster-acting migraine medications.

8 CH 411

Carney, Abigail

Dorothy Hamm Middle School

Rust Oxidation Prevention in Ocean Water

I conducted a quantitative analysis experiment looking at how well common household anti-rusting coating agents prevent oxidation on the surface of iron. I wanted to see which ones perform best in salt water exposures similar to bridges and iron structures on the coastline or submerged in ocean water.

I started my experiment in a controlled environment using identical plastic containers, salt water solution concentrations, and 10x10cm uncoated iron sheets. I performed 3 trials for each coating agent over an 8 hour interval. I calculated the average score for each independent variable every 2 hours.

For my data collection and analysis, I measured the amount of rust oxidation within a 10x10 grid method (100 1x1cm squares per iron sheet). A percentage score was measured for each sheet every 2 hours and 3 trials were performed. A line graph compares the data for the control and the 2 different coating agents.

My hypothesis was that WD40 would perform better than Polyurethane in rust prevention. However, my experiment concluded that they both prevented oxidation equally well. While the sheets with no coat had over 75% rust covering them within two hours, both WD40 & Polyurethane exhibited no oxidation at the 8 hour mark. In conclusion, both household items equally prevent rust for extended periods of time.

8 CH 412

Dannes, Avelyn

Williamsburg Middle School

The Effect of the Type of Sunscreen on the Duration of Effectiveness

The purpose of this project was to determine which type of sunscreen protects skin the most against harmful UV (ultraviolet) rays that can lead to skin cancer. For this project, 6 skin protectants (zinc, mineral, oil, chemical, spray, and no sunscreen) were tested by placing $\frac{1}{2}$ of a teaspoon of each type of sunscreen on a laminated plastic sheet. Then the sunscreen on the sheet was spread around evenly and a UV test card was placed underneath the sheet. Then, the sheet was placed under a UV lamp and was tested in 10 minute increments until the UV test card showed signs of ultraviolet light. The hypothesis chosen for this experiment was that if the type of sunscreen is zinc, then it will provide the most protection against the sun because it is a physical blocker. The most effective variable was zinc sunscreen with an average of 36 minutes of protection and the least effective variable was no sunscreen with an average of 0 minutes. The least effective sunscreen was oil sunscreen with an average of 6 minutes. The variable with the smallest range was no sunscreen with a range of 0 minutes and the variable with the largest range was both mineral and zinc sunscreen with a range of 30 minutes. The hypothesis for this experiment was supported because zinc was the most effective sunscreen.

8 CH 413

Desai, Maliya

Dorothy Hamm Middle School

The Effect of Different Weights of Paper Cups on How Well They Insulate Heat

The purpose of my science experiment is to see which weight of a paper cup will insulate heat the best. To measure this, I used three different weights of paper cups which are 17.2g, 25g, and 27.2g. To conduct this experiment, I started by pouring one cup of hot water into each cup. I measured the temperature of the water at 1, 5, 10, 15, and 20 minute intervals. I repeated this process 3 times. Lastly, I found the average temperature for each cup at each time interval. My hypothesis is that the cup that weighs the most will insulate heat the best. However, the data I collected did not support my hypothesis.

The data is represented in a triple line graph. From looking at the data, the 25g cup kept the water at the warmest temperature at the 20 minute mark. This was surprising because the 27.2g cup weighed the most, so it should've insulated the heat the best. One factor that might have led to this was to use cups that had more of a weight difference. Doing this might have resulted in more accurate results.

8 CH 414

Grigorescu, Ana

Williamsburg Middle School

The Effect of Different Cleaning Techniques on the Color of Silver

Silver tarnishes easily due to common and natural chemicals like sulfur, moisture, chlorine, and one's own skin's acidity level. The purpose of this experiment was to find out which cleaning technique cleans silver (removes tarnish) the best. One way you can tell if silver is clean is by checking the color of silver and comparing it to the normal RGB color of silver, 199 199 199. The experiment focused on four different methods for cleaning: baking soda salt and aluminum, lemon juice and olive oil, Dawn soap and water, and silver polish (the constant). By using a color finding app called Color Name AR to find out the color of the silver, it was found that the color for the four methods of silver was closer to sterling silver than before. The method with the highest results was soap and the method with the lowest results was baking soda. This contradicts my hypothesis that baking soda and aluminum create a chemical reaction with the tarnish and turn it back to silver, pulling the sulfur part away from the silver and on to the aluminum foil instead. In conclusion, all four methods were successful but dish soap was the best.

8 CH 415

Hengst, Vivienne

Williamsburg Middle School

The Effect of the Metal Composition of Cookware on How Much Material Leaches Into Boiling Water

The purpose of this experiment was to help people know which cookware may be leaching metals into food when cooking. One example of the dangers of leaching are a group of manmade chemicals known as PFAS (perfluoroalkyl and polyfluoroalkyl substances). Despite their usefulness when coating various consumer products, even small doses of PFAS can cause cancer. This experiment tested for leaching generally, which could indicate whether PFAS had leached into the food. The independent variables were four pots made of different materials: stainless steel, aluminum, cast iron, and non-stick. First, the baseline metal content of the water was measured with Brio Safe Home Ultimate Water Quality Test Kit (Brio Test Kit) strips, and set on the stove to boil. After the boiling and cooling process, the metal leaching indicators were measured using the Brio Test Kit strips. The data in this experiment did not support the hypothesis that the stainless steel pot would leach the least. Instead, the results showed that the water boiled in the cast iron and non-stick pots had the least change. The data showed changes in several indicators, but despite this, the results were inconclusive because the data indicated no change in copper and iron, which were the primary metals that were tested, and some of the results were contradictory to published research. However, the results of the aluminum pot, which seemed to have the most leaching, did align with the published research, which also indicates that the aluminum pot would leach the most.

8 CH 416

Minor, Aidan

Swanson Middle School

The Effect of Different Fire Starters on Burn Time

Having an effective fire starter is extremely important in making a good campfire that burns for a long time and fully utilizes all the fuel. This experiment will test four different fire starters: Dryer lint, Excelsior Fire starter, Sasquatch rope, and twigs. The reason why I'm doing this project is for my Scout troop to decide what type of fire starter we should bring on our next camp out. The way I conducted my experiment was I measured out nine grams of each material and lit them with a match in an aluminum pan under a fume hood in my science classroom. Some safety precautions that I took because my project involved fire included having a bucket of water to extinguish the flames at all times and having tongs to grab the burnt remains to throw them away. My findings indicate that the Excelsior fire starter performed the best and burned the longest because it had the longest average burn time, of about 480 seconds and the single longest burn time on a trial lasting about 555 seconds. My findings also indicate that the twigs performed the worst with the shortest average burn time of about 9 seconds. The other materials the dryer lint and Sasquatch rope both performed worse than the Excelsior fire starter but burned a lot longer than the twigs.

8 CH 417

Podolsky, Hayden

Francis C. Hammond Middle School

pHeeling Sour?

After drinking lemon juice does your stomach hurt? So does mine! In this experiment I figured out the best way to neutralize the acidity of lemon juice, so when you drink lemonade your stomach will feel normal. To start off I hypothesized that baking soda would be the best at neutralizing the lemon juice. I read that honey, baking soda, and water were successful at neutralizing lemon juice so I had to get all three of them.. After that I had to conduct the experiment by separating all the lemon juice and testing the ph levels before and after the add-ins. Finally I recorded the results and combined all of the information to make this project board.

8 CH 418

Roske, Quinn

Swanson Middle School

The Effect of Electrolyte Drinks on Conductivity

Athletes use sports drinks to improve their performance and to stay hydrated, but how well do these drinks actually work to stabilize electrolyte levels? This experiment measures the conductivity of different electrolyte drinks to determine which drink would be the best option to hydrate athletes. I tested Gatorade, Liquid IV, and Vitamin Water because they are popular drinks that athletes use to refuel their electrolyte levels during exercise. My control was Distilled water because it does not contain any electrolytes. Sodium and Potassium are examples of electrolytes that conduct electricity, or conductivity, that are essential for the nervous and the muscular system. With this information, I inferred that if the electrolyte drink contained more sodium, then, the conductivity would increase. To collect my data, I used the Pasco Conductance Meter along with the Sparkvue app. I measured conductivity in MicroSiemens per centimeter (us/cm). Each trial consisted of dipping the Conductance meter 20 mm into each cup containing 100 mL of liquid for 3 seconds. My data concluded that Liquid IV had the highest conductivity, averaging 7,879.33 us/cm. Next, Gatorade averaged 2,235.35 us/cm, and Vitamin Water averaged 1,939.71 us/cm. The data proves my hypothesis correct because Liquid IV contained the highest amount of sodium and conductivity, followed by Gatorade, then Vitamin Water. This information can help athletes to stay hydrated and proves that Liquid IV is the best option to replenish electrolyte levels.

8 CH 419

Shattuck, Maia

Kenmore Middle School

Out,-Out Darn Spot: The Effect of Different Commercial Stain Removers on Different Types of Stains

This study tested different commercial stain removers on three different types of stains. An organic stain (tomato), an inorganic stain (blue pen ink), and a combination stain (chocolate sauce). The stains were each cleaned by a commercial stain remover that claims to best remove organic stains, another commercial stain remover that claims to best remove inorganic stains, and a control stain remover which is a noncommercial household product. Twelve pieces of white fabric were stained with tomato, while 12 pieces of white fabric were stained with chocolate sauce, and 12 pieces of white fabric were stained with blue pen ink. Then 4 from each group were cleaned with the commercial stain remover that claims to best remove organic stains, the next 4 from each group were cleaned with the commercial stain remover that claims to best remove inorganic stain, and the last 4 from each group were cleaned with the control stain remover which is a noncommercial household product. The results showed that the commercial stain remover that claimed to best remove inorganic stains removed both the inorganic and organic stains best, while the commercial stain remover that claims to remove organic stains best removed the combination stain best. Therefore, what the cleaning product claimed to clean wasn't accurate.

8 CH 420

Bagai, Saira; Ebikwo, Eden

Dorothy Hamm Middle School

The Effect of Different Amounts of Sugar and Water on Eggshells

Teeth play a vital role in an individual's life. Hence, it's important to know how certain foods affect them, especially sugar. Eggshells have the same structure as teeth making them an efficient, and successful substitute for science experiments. While conducting this experiment, the independent variable was the amount of sugar in the water, and the dependent variable was the height at which the eggshells cracked. To begin the experiment, sugar was boiled with water, which left a pure sugar solution; as a result of the water boiling out. After that, the previous sugar solution was mixed with different amounts of water. Once those steps were completed, the eggs were placed in the sugar solutions for 48 hours and the whole procedure was conducted three times. To test out the amount of damage on each egg, the eggs were dropped from different heights. The eggs that cracked at a lower height were determined to be more damaged and weak, rather than the ones that cracked a higher height. The results conveyed that the eggs soaked in the mixtures with a higher sugar content were more damaged; which correlates with our original hypothesis. Although testing the height in which the egg breaks is a very resourceful idea, it is not the most reliable data. Another idea could have been to make a color key that represented the damage spectrum on the eggs or purchasing a certain device that would measure the thickness of the eggshell.

9 CH 421

Culbertson, Vincent

Arlington Tech/Career Center

Storing Batteries At Varying Temperatures

Storing batteries at different temperatures shortens battery lifetimes. There were 3 different batteries used and there were 3 different temperatures used to see which affects battery life the most. Colder temperatures drain batteries mostly on a straight line until the 40 hr mark then they die completely afterward. Temperature affects battery efficiency, and lithium ion batteries are the best choice because they lasted the longest so they are the best choice for varying temperatures outside.

9 CH 422

Majano, Allison

Washington-Liberty High School

The Effect of Whitening Toothpaste Brands on Tooth Stain Removal

The purpose of this experiment was to test out the effectiveness of different brands of whitening toothpastes on tooth stain removal. The hypothesis for this experiment was, if different brands of whitening toothpastes are used to remove teeth stains, then Crest 3D White toothpaste will remove the stain the best, because it includes an abrasive called Hydrated Silica that removes surface stains for whitening. The tested groups were stained eggshells treated with 4 independent variables: water (control), Crest 3D White toothpaste, Colgate Optic White toothpaste, and Sensodyne Extra Whitening toothpaste. The experiment was conducted by using eggshells as models for tooth enamel. Each egg was brushed with one of the four independent variables for ten trials in a span of fourteen days. An ANOVA test was done to determine whether a statistically significant difference existed among the means for the three toothpastes. The calculated p-value for the three toothpastes was 0.06146469, which is greater than the critical value of 0.05. This result means that the null hypothesis cannot be rejected, indicating no statistically significant difference in the effectiveness of the three whitening toothpastes. These results indicate that Crest 3D White toothpaste did not outperform Colgate Optic White or Sensodyne Extra Whitening toothpaste. Overall, these three brands are all great options when consumers are looking for whitening toothpastes for tooth stain removal.

9 CH 423

Park, Tommy

Yorktown High School

The Effect of Potential Difference on the Rate of Galvanic Corrosion

The purpose of this experiment is to investigate if the potential difference between two metals, which come into electrical contact through an electrolyte, affects the rate at which galvanic corrosion occurs. I hypothesized that a greater potential difference between the two dissimilar metals would lead to a faster rate of galvanic corrosion.

The incorrect combination of metals can lead to significant degradation and complete failures of an infrastructure. However, understanding how galvanic corrosion occurs will allow an individual to mitigate the risks involved. In my experiment specifically, I chose to explore the impact of varying metal pairings on the rate of galvanic corrosion. The materials are as follows: aluminum alone (control), zinc with aluminum, and zinc with copper. Each of these combinations has a different potential difference, thus allowing me to test how potential difference will affect their rates of corrosion.

Fifteen 177mL plastic cups were prepared with a 4.23% saltwater solution by dissolving 2.5mL of salt into 59mL of water. The metal pairs were then connected by using an alligator clip, while ensuring the clips stayed above the water line. An electronic stopwatch was used to keep track of the rate of galvanic corrosion.

My results showed that galvanic corrosion increased more significantly when the potential difference of the metal pairing was higher. My findings supported my hypothesis that a larger potential difference leads to a greater rate of galvanic corrosion. This study brings to light the effects of galvanic corrosion, where corrosion prevention is extremely important.

9 CH 424

Saperstein, Margaret

Washington-Liberty High School

The Effect of Colloidal Silica Concentration in a Biodegradable Gel on Flame Retardation

Biodegradable flame retardants promote the protection of structures and possessions during significant fire events and the safety and well-being of the environment during recovery. Water serves as a bio-friendly retardant, but it evaporates at low temperatures providing only short-duration flame retardation. This experiment tested the effect of silica concentration on extending a biodegradable gel's flame-retardant duration. Colloidal silica particles (CSP) are biocompatible, have a high melting point, and are insoluble, making them a compelling additive to a water-based hydrogel. Upon exposure to flame, water evaporates from the gel, and the CSP forms an aerogel, creating an insulating barrier layer. To promote biodegradability, this experiment had the CSP in a 1% by weight methyl 2-hydroxyethyl cellulose hydrogel. CSP concentration was varied between 0%, 2.5%, 5%, and 7.5% by weight. The gel mixture was applied to a popsicle stick and subjected to direct flame from a butane torch at $>1000^{\circ}\text{C}$, which exceeds the temperature of wildfires, $\sim 800^{\circ}\text{C}$. Performance was measured by the time to combust the stick after flame application. The testing results show 5% CSP offered the highest mean time of 22.8 seconds, relative to 7.8 seconds at 0% CSP or 1.9 seconds for water application. A t-test p-value of 0.174 between results for 5% and 7.5% CSP indicates insignificant performance difference with increased concentration above 5%. Also, at 7.5% CSP, the gel noticeably thickened. Given the importance of spray-on applications, follow-on experiments could test additives to optimize the gel's mechanical properties.

9 CH 425

Waziri, Maryam

Alexandria City High School (includes Minnie Howard)

What Melts Ice Faster Salt, Sugar, or Sand?

This experiment was based on what substance melts the ice faster. By doing this experiment I got a lot of information about ice and how it melts. For example when I sprinkled salt in the ice, after a minute it started to melt. Like it starts disrupting the bond between molecules. I chose this topic because it's related to the world of chemistry and it's a fascinating topic doing it in the winter time. This topic is related to the real world like de-icing the road. My hypothesis was, salt has the most effect in ice and it melts faster than sand and sugar. My results support my hypothesis that salt is a common factor used to melt ice, because salt lowers the freezing point of depression. This experiment also shows how salt affects our environment while leaving the negative world.

10 CH 426

Barry, Fatoumata

Alexandria City High School (includes Minnie Howard)

Acid vs Tylenol: Which Liquid Makes It Dissolve Faster?

Sometimes when we're in pain and take a Tylenol, we wish we could skip the wait and make it take effect immediately. Could it work better if the pH levels in our stomachs were different? In this science fair experiment, I will be asking myself the question of whenever Tylenol dissolves faster in liquids with higher acidity and testing the rate Tylenol dissolves in different liquids ranging from a pH of 2-13. First, I filled five cups halfway with a different liquid (independent variable). They were coke, orange juice, water, soapy water, and bleach. I then put on a stopwatch and marked the time each Tylenol completely broke down (dependent variable). I then repeated the experiment 2 more times. My hypothesis was that if the acidity of the liquid is higher, then the Tylenol will dissolve at a faster rate. After completing the 3 trials, I found out that Tylenol is more soluble in liquids with a more neutral pH but is faster at dissolving in liquids with a lower pH than a higher one which did not support my hypothesis. The Tylenol dissolved the fastest in coke and the slowest in orange juice. This experiment showed that the acidity of a liquid doesn't affect the rate of dissolving as much as I thought.

10 CH 427

Calam, Ethan

Wakefield High School

The Effect of Solutes on the Freezing Point of Water

This study examined the influence of common solutes like salt, sugar, and food coloring on the freezing temperature of water. The hypothesis claimed that addition of a solute would lower the freezing temperature of the solution due to hindrance of ice crystal formation. The study determined that salt and sugar, added in 15% by weight, lowered the freezing point of water to expected levels. The freezing temperatures for the salt and sugar solutions were -10.5°C and -1.2°C , respectively, close to the theoretical values of -11.22°C and -0.96°C . The food coloring did not cause any measurable effect because it was present in small amounts well under 5% weight.

The study also noted that salt lowered the freezing point of water more than sugar, although both solutes were present in equal weight concentrations. This is mainly because salt has a lower molecular weight and it dissociates into two ions, producing more dissolved particles, while sugar remains a molecule. The freezing point depression of these compounds correlates well with the theoretical equation, according to which the effect is directly proportional to the ionization of the solute and its molality. These findings are significant in environmental and food sciences. For example, solutes greatly influence the freezing of lakes and oceans, salt is applied during winters on roads for de-icing purposes so that ice does not form, and freezing point depression is used in ice cream-making and food preservation within food sciences. Knowledge of these principles can enhance practical applications.

10 CH 428

Flashberg, Natalie

Washington-Liberty High School

The Effect of the Quantity of Eggs on the Cross-Sectional Height of Cupcakes

This experiment tested the impact of different egg quantities on the structure and texture of cupcakes, focusing on their height and content. It was conducted to determine whether the number of eggs used in the cupcake batter influences its volume and density. The independent variables were the quantity of eggs added into the batter which were 0, 1, 2 (control), and 5. The dependent variable was the height of each cupcake which was measured in centimeters. It was hypothesized that the cupcakes with fewer eggs would be denser, while the cupcakes with more eggs would be the most voluminous. This was hypothesized since the role of eggs in baking is to provide structure and stability. However, the results contradicted the hypothesis. The cupcakes with no eggs rose the most and were the driest, while the cupcakes with five eggs were the shortest but the most moist. Statistical analysis revealed there was a significant height difference between the group with no eggs and the group with five eggs revealing that the egg quantity significantly affected the structure of the cupcakes. The results suggest that eggs contribute to the moisture content of cupcakes but will reduce the height. The increased moisture in the group with five eggs could be due to the fat and lecithin in the yolks, while the absence of egg allowed more rise probably due to the baking powder's effect without interference of another leavening agent such as eggs. This experiment explores eggs' complex effects on texture and volume.

10 CH 429

Knepper, Abigail

Washington-Liberty High School

The Effect of Different Cooking Methods on the Depletion of Vitamin-C in Vegetables

The purpose of this project was to show how easy it is to unintentionally suffer from a lack of Vitamin-C and the importance of discovering healthier cooking methods in order to prevent this. This was to benefit people who are susceptible to Vitamin-C deprivation and suffer from diseases like scurvy. The different methods of cooking were boiling, steaming, and roasting. The hypothesis was that if boiling is the method used, then the amount of Vitamin-C will decrease the most compared to the other methods because Vitamin-C is water soluble and temperature sensitive. After collecting the results, it was found that the boiling had the greatest amount of Vitamin-C, with an average of 0.59 mL of juice added, and the roasting had the lowest amount of Vitamin-C with an average of 0.9 mL of juice added. An ANOVA test was conducted, and it was found that the p-value was $5.1416E-13$. This proved that this project had significant differences between the control and the different methods. It was found that higher temperatures have a larger effect on Vitamin-C depletion in shorter periods of time, rather than water-solubility. This means that the roasting method experienced the greatest amounts of Vitamin-C loss and the boiling method experienced the lowest amounts of loss. It was also found that the control was inaccurate because of the color of the green chili pepper juice and not enough wait time for each drop. In conclusion, boiling was found to be the preferred cooking method.

10 CH 430

Parker, Jayce

Alexandria City High School (includes Minnie Howard)

The Natural Way: Shiny As A Brand New Penny? The Power Of Hydrogen And Its Effect On Homemade Cleaners

Many eco-friendly cleaners have been developed to aid in our daily cleaning practices to have less harsher alternatives on the market compared to mainstream cleaners such as Clorox Bleach and Lysol. These products have been known to be harsh on surfaces, cause skin irritation and even respiratory issues. At the height of the Covid-19 Pandemic, it was a challenge to find cleaning products in general and now with inflation many families are having to cut back on the necessities or find alternatives. Many eco-friendly cleaners have ingredients that are found in our household cabinets such as vinegar, salt, lemon juice and baking soda. My approach and goal for this project was to see if I combine and make 15 different household cleaning agents of varying mixtures, can they be used to clean a regularly exchanged item like a penny. It has been proven that using things like baking soda, lemon juice and even vinegar on countertops can cut down on germs but what will it do to something like a penny? Can dirt, corrosion and even the overall appearance be improved by using these ingredients since we exchange money daily and it has been proven that money can have a lot of bacteria and viruses living on its surface. By making these different mixtures my results showed that these mixtures did in fact clean the pennies to varying degrees. The results of my research can potentially increase how or the range in which more people choose to use these ingredients.

10 CH 431

Parment, William

Wakefield High School

The Type of Nut with the Most Calories

This experiment was done to determine the effects of certain types of nuts on a person's health by measuring the amount of calories. Of the nuts tested, macadamia nuts had the most amount of fat, and because of that, it was hypothesized that they would have the most calories, as fats have the highest caloric density. The procedure was done by using fire to convert calories (stored energy) into heat energy using a long-handled lighter. The nut would catch fire leading to the water suspended above it in a can heating up. Since water has a specific heat capacity of 1 calorie to heat up 1 milliliter of water 1 degree celsius, it is easy to calculate the amount of calories in an object. It was found that the hypothesis was correct, with macadamia nuts having the highest amount of calories, followed by almonds, pistachios, and then peanuts.

10 CH 432

Wang, Yihe; Tang, Botao

Veritas Collegiate Academy

Optimization of Surface Hydrophilicity and Hydrophobicity of Digital Microfluidic Chips and Its Applications

Digital Microfluidics (DMF) is an advanced microfluidic technology that utilizes the manipulation of tiny droplets (typically on the nanoliter scale) to enable chemical reactions, biological assays, and sample processing. Unlike traditional continuous-flow microfluidic technologies, DMF allows for the individual manipulation of discrete droplets, offering high flexibility and diverse functionality. This makes it widely applicable in precision medicine and biosensing. To address issues of uneven hydrophobic coatings and poor adhesion in chip surface modifications, this study focuses on key challenges in surface chemical modification of microfluidic chips. First, by adjusting the spin-coating speed, we analyzed surface contact angles, coating integrity, and the suitability of the modification process. Experimental results showed that Cytop coatings spin-coated at 2000 rpm exhibited the best hydrophobicity. Additionally, using an APTES monolayer as an adhesion layer for Cytop successfully improved the bonding strength of the hydrophobic Cytop layer to the chip. Finally, we explored a method combining plasma cleaning and PET masks to modify circular areas at the micron scale on the chip surface. Streptavidin was successfully immobilized on the chip surface. This study provides a reliable foundation for the surface design of functional microfluidic chips and their application in biomolecular reactions. The optimized modification methods significantly improved the performance and stability of the chip surface, offering technical and solutions for the application of microfluidic chips in nucleic acid detection and precision medicine. Future work will focus on exploring more coating material combinations and modification processes to meet the demands of multifunctional chips in high-throughput biological assays.

11 CH 433

Weber, Jackson

Yorktown High School

The Effect Of Energy Drink Brand On Accuracy Of Reported Caffeine Content

The accuracy of reported caffeine content in energy drinks has significant implications for consumer safety and product reliability. This study aims to evaluate the accuracy of caffeine content as reported on the labels of various popular energy drink brands. It was hypothesized that the caffeine content would be lower than the content reported on the cans. To accurately determine caffeine content of the energy drinks a iodometric back titration. This procedure involves titrating energy drinks with a standardized iodine solution and using starch as an indicator to measure the actual caffeine content. The materials and equipment include a ring stand, burette, Erlenmeyer flask, pipette, filter paper, and various chemical solutions including starch, iodine, hydrochloric acid, and thiosulphate. Popular energy drinks such as Monster and Red Bull, along with their zero-sugar counterparts, will be tested. The experiment will be conducted in three replicates to ensure accuracy and reliability of the results. Safety concerns during the experiment involve handling chemicals, broken glass, and eye hazards, with appropriate safety measures in place. This study is essential as it ensures that energy drink manufacturers provide accurate information, thereby protecting consumers from potential health risks associated with inaccurate labeling. The results of this study will provide valuable insights into the reliability of caffeine content information and suggest regulatory measures for better consumer protection.

11 CH 434

Wan, Hamo; Lu, Mirabelle; Mao, Zehang

Veritas Collegiate Academy

Study on the Performance of Machine Learning-Assisted Nanocomposite Dielectrics

We did a comprehensive study on the preparation and properties of BZT Al₂O₃ nanoparticles and their core-shell structured BZT nanoparticles. We synthesized nanoparticles with micromorphology and chemical structure by using high-energy ball milling and sol-gel methods. Through scanning electron microscopy, transmission electron microscopy, energy dispersive spectroscopy, Fourier transform infrared spectroscopy, and X-ray diffraction, the microstructure and chemical composition of particles were revealed in detailed characterization. The experimental results indicate that the incorporation of BZT nanoparticles can significantly improve the dielectric properties of the polymer matrix, while the Al₂O₃ shell helps maintain a high direct current breakdown strength, thereby enhancing the overall electrical performance of the material.

Additionally, this study explored the energy storage performance of the materials, validating the potential of nanoparticle doping to increase the maximum energy storage density. We found that by precisely controlling the dispersion and surface modification of the nanoparticles, we could effectively enhance the energy storage efficiency of the composites, which is of great significance for the development of high-performance dielectric materials.

Furthermore, this study introduced a Transformer-based deep learning model to analyze and predict the impact of different nanoparticle doping ratios and surface treatments on the properties of composites. By learning from a vast amount of experimental data, the model successfully predicted key performance parameters such as the dielectric constant, breakdown strength, and energy storage density of the materials. The introduction of this model significantly improved experimental efficiency and reduced material development costs, providing powerful computational support for the design of high-performance dielectric materials.

7 EN 500

Lao, Naomi

Kenmore Middle School

The Effects of Architecture on Airflow

The world is slowly collapsing around us as we continue to burn fossil fuels. One of the most prominent uses of fossil fuels in the world is air conditioning. To reduce their use, scientists have been researching passive cooling, a way to regulate the internal temperature of a structure without air conditioning, mainly using airflow. This study looks into the airflow of termite mounds, as well as traditional Iranian homes, which both make use of passive cooling. Two models were made, one for the termite mound, and one for the traditional Iranian house. The airflow was measured by evaporation of water in weight. The hypothesis predicts that if models of a termite mound and a traditional Iranian home are built, then the model of the termite mound results would have stronger airflow. The results did not support the hypothesis, as they showed that the model of a traditional Iranian home lost 0.3 grams more than the termite mound, or 17.6% more. These results can help the world transition to more eco-friendly architecture, which is extremely necessary because air conditioning consumes a large amount of energy that could be saved. The more energy is used, the worse the climate becomes, with increasing amounts of air pollution, and natural disasters. This is also useful because traditional Iranian homes use cheaper materials, and their lack of air conditioning also lowers the cost, which may be able to help the housing crisis in the U.S.

7 EN 501

Hsu, Amelia; Hart, Laura

Dorothy Hamm Middle School

The Effect of Filtration Material on Filtrate Recovered in Water

In our experiment, our aim was to determine which filtration material was the most effective when filtering dirty water. The four filtration methods we tested were cotton fabric, a colander, coffee filters, and gauze pads. After conducting the experiment, we analyzed the results. Coffee filters were the most effective filtration material, while the colander was the least affixing filtration material. In addition, gauze was the 2nd most absorbent filter, yet it had very similar results to the coffee filter as a filtration material. On the other hand, in our hypothesis, we inferred that cotton fabric would be the best filter because of its thick texture. Therefore, this experiment answered our testable question by demonstrating the effectiveness of different filtration materials that we tested in our experiment.

7 EN 502

Komlodi, Lea; Grignon, Elspeth; Thompson, Lilia

Thomas Jefferson Middle School

The Effect Of Different Materials On the Cleanliness Of Water

The researchers conducted this experiment in order to find out the effect of different materials such as charcoal, cotton balls, and polyfil in filters on the cleanliness of water. The independent variables were charcoal, cotton balls, and polyfil, and the dependent variable was how clean the water was. The control group was the size of the filter, the amount of each material, sand, gravel, pebbles, and the unfiltered water. This experiment was done to determine which accessible material would filter water the best. This research could help people in places that have dirty water because of problems such as natural disasters. The hypothesis was if three different filters are made with either cotton balls, polyfil, or charcoal, then the filter made with charcoal will have the cleanest water. This is because the charcoal will purify the water through adsorption. The hypothesis was tested by creating three different filters with either charcoal, polyfil, or cotton balls and then filtering dirty water through them. Once the water was filtered through the different filters, the researchers decided which filter had cleaned the water best. The filter that ended up producing the cleanest water was the one made with cotton balls, which meant that the hypothesis was rejected because the hypothesis was that the charcoal filter would produce the cleanest water.

7 EN 503

Van Duyn, Ben; Van Lare, Julian

H-B Woodlawn Secondary Program

Need for Speed

Our project was about how fast we could make a nerf dart go through a blowgun. We started with one foot and added one foot of length each time until we got to five feet. We timed the shots using a stopwatch and wrote the times in order. We used the formula “speed = distance/ time” to find the speed of the darts in feet per second. For this project, we asked “how fast can we shoot a nerf dart through a blowgun?” Our hypothesis came to be that the longer the tube was, the faster the dart would go. When we do this for fun, we experiment with different lengths and see which hurts the most. Some of our results were that the longer the tube was, the faster the dart went. However, if we had more time, we would have tested more lengths and gone longer to see if there was such thing as too much length.

8 EN 504

Atewologun, Corsen

Thomas Jefferson Middle School

Wind vs Fire, Which Can Charge a Phone Faster?

The purpose of this experiment was to build two distinct electric generators to find out which one can charge a phone faster. The independent variable was the two different electric generators. Each one will use a different energy source—one will rely on wind, and the other will use fire. The control variable is the phone and charging cord. The dependent variable was the amount of time it took to charge the phone. Using the research the hypothesis was: If 2 different power sources (wind turbine, and thermoelectric generator) both attempt to charge a phone, then the thermoelectric generator will do better because it has a more consistent energy supply. This experiment will test which is the superior generator. The results showed that the thermoelectric generator produced more energy than the wind turbine, but not enough to charge the phone. The data shows that the hypothesis is true. The results of this experiment show that the thermoelectric generator can produce more energy than a wind turbine.

8 EN 505

Cocuzzi, Sophia

Kenmore Middle School

How Does Arch Curvature Affect Load Carrying Capacity

In this study, different arch shapes are tested to determine the strongest shape and how much load each shape could carry. The researcher hypothesized that if a bridge has a parabolic arch, then the load carrying capacity will increase because it produces the most thrust at the base. By using arches of the same height in a test setup in which a shadow was cast to see a failure point, the researcher placed weights on the arches until they bent. In this project, the researcher used segmental, flat, parabolic, and "A" arches. Photos are provided. The result showed that the hypothesis was correct, and the parabolic arch held the largest load. In the conclusion, the researcher mentioned multiple mistakes made, a large one being human error. The researcher also mentions possible ways to improve this project.

This is important to real life because there are many bridges in the world that need to support a lot of weight, and this project is a model for how to figure out the best way to support a bridge.

8 EN 506

Horowitz, Helena

Gunston Middle School

The Effect of the Distance From the Highway on Sound Wall Effectiveness

I chose to study the effectiveness of sound walls, because noise pollution that is generated from highways affects more than 18 million people in the U.S. Noise pollution can make it difficult to concentrate, converse, and keep a normal heart rate. Some children who grow up near busy streets and airports suffer from problems with stress, attention, memory, and reading. For this project, I tested the effectiveness of sound walls based on their distance from the highway. I used a distance measuring laser to determine the distance between the sound wall and the first lane of travel on the highway near my house. An app helped me measure the decibels on either side of the wall. I used the percent decrease formula to calculate the sound reduction and took the averages of my data. I found that as the distance from the sound wall to the highway increases, the effectiveness of the sound wall decreases. The sound reduction was greater when the sound wall was placed closer to the highway. My hypothesis was the opposite, so I'm glad I did the experiment! If I were to do the experiment again, I would take measurements every day for a week, so that I would have more decibel readings to verify my conclusion.

8 EN 507

Lashley, Addison

Gunston Middle School

Solar Panels: Do More Lumens Affect the Amount of Time It Takes to Charge a Cell Phone?

The title of my project is “Solar Panels: Do More Lumens Affect the Amount of Time It Takes to Charge a Cell Phone?” My hypothesis is that when the amount of lumens are adjusted in a light bulb, the greatest amount of light will charge the phone the fastest. To conduct my experiment, I first put the solar panel together according to the instructions. Secondly, I would charge my phone to 85% before each experiment. Next I would select one of the five bulbs and put it in the lamp. Also, I would cover the bulb with construction paper in a tee-pee like shape (through trial and error, I found that shining the light directly onto the panel generates better results). Then I set up the solar panel and turned the lamp on, recording the amount of volts and amps. After that, I would plug the cell phone in to see how much time it would take to charge, but the time was always the same. I thought that was curious because the brighter bulbs would still produce more amps and volts. I discovered that if you multiply the amps by the volts by the time, you get electric energy. If brighter bulbs made more electric energy, then how come it didn’t charge the phone faster? That’s because solar energy is converted into power banks, which I also discovered after the experiment. Even though my results didn’t support my hypothesis, they still showed that more luminous bulbs produce more electricity.

8 EN 508

Leighton, Arden

Williamsburg Middle School

The Effect of Water on the Strength of Polylactic Acid (PLA)

Polylactic acid (PLA) is a chemically, biodegradable plastic that is very commonly used in 3D printers because of its overall strength for most projects. This project was developed to test the strength of PLA when exposed to water. The hypothesis was that a PLA sample soaked in water for one month will be the weakest because it will have absorbed more water and more decomposition will have taken place. To test this hypothesis, PLA samples were exposed to water for zero hours, one day, one week, two weeks, and one month. The samples were subjected to an increasing force with a winch that pulled them to failure and the force in Newtons (N) was measured at the moment of failure. The higher value of N indicates more strength. Testing showed that the samples with no exposure to water were the strongest with a mean force of 82.3 N. The weakest samples were those soaked for one day with a mean force of 41.2 N. The PLA samples that were in water for one month were the second weakest with the mean force measuring at 49.2 N. This project showed that water does affect the strength of PLA, which is important to understand when using PLA in designs that will be exposed to water. Further experiments could clarify how water exposure over longer periods and UV exposure alter the strength of PLA

8 EN 509

McNally, Lucy

Swanson Middle School

The Effect of Type of Sea Wall On Millilitres of Water Splashed Over the Structure

The title of my experiment is The Effect of Type of Sea Wall On Milliliters of Water Splashed Over the Structure.

I built the tank, sea wall structures, and the paddle from scratch with acrylic, super glue, and waterproof silicone sealant.

The purpose of this experiment is to help better understand how wave defense systems work, and how the effectiveness of each structure varies. The structures used in this experiment are based on real examples of wave defense systems all over the world, which are designed by researchers studying seismic activity, meteorologists, engineers, and physicists. My hypothesis for the experiment was, “if you change the type of structure deflecting waves, then the slope/incline with a curved wall will have the least amount of water washed over the structure, because the crest of the wave will take the shape of the curve and be deflected back into the water.” This hypothesis was made using the observation that when waves form, they begin to collapse over themselves. Using this information, it can be predicted that the slope with a curved wall will keep the most water away from the wall because it reshapes the crest of the wave, and uses the wave’s form to deflect itself (Britannica School).

After the trials were completed, the data showed that the hypothesis was supported because the curved wall with the incline had the least number of milliliters of water splashed over the wall, proving it to be the most effective in defending coastal areas.

8 EN 510

Sibley, Kayla

Kenmore Middle School

The Effect of Different Machine Learning Models on the Ability to Predict Market Success of a Book Using Cover Art

The goal of this experiment was to determine whether it is possible to judge a book by its cover using machine learning models to predict the success of children's books on Amazon. The hypothesis was that a more advanced model (neural network) analyzing cover art would outperform a simpler model (linear regression) using book attributes such as price and page count. Two datasets were created: one with cover art and the other with attributes. Machine learning models including linear regression, decision trees, random forests, XGBoost, and neural networks were trained and tested on each dataset. The accuracy of predictions was found using mean absolute error (MAE), rank/Spearman correlation, and scatter plots. Results showed that simpler models struggled with cover art, while neural networks performed the best after fine-tuning (adjusting epochs, dropout layers, and batch size). The results supported the hypothesis: neural networks using cover art outperformed linear regression using book attributes. This experiment highlights that you can judge a book by its cover. Machine learning can predict a book's performance based on cover design. These insights may help authors and publishers to design more appealing covers, encouraging young readers to develop a love for books.

8 EN 511

Smith, Edward

Dorothy Hamm Middle School

The Effect Of The Type Of Insulation On How Long It Holds Heat

This experiment measures how different insulation materials with different densities can hold heat. This is important so that researchers can better understand what types of materials are better at being insulators and saving energy along with the cost of heating and cooling. The experiment used a homemade insulator to test thermal conductivity and heat transfer for seven different insulation materials over a two-hour long period.

A glass jar of water was heated to 100°F and put it in a 10-inch by 10-inch cardboard box with 1 of 7 different types of insulation materials in it, and the temperature was measured every 5 minutes for 2 hours. The trial was repeated 3 times for each of the 7 different materials.

Through the results from this experiment the materials with higher densities on average performed better than the materials with lower densities. This means that out of the 7 materials that were tested the results showed that the hypothesis and testable question were both correct. The wood used in this experiment was plywood and is an outlier because it had the highest density but performed the second worst.

The only material that performed worse than plywood was no insulation. This project shows that the type of insulation used and how long it holds heat has a direct correlation.

8 EN 512

Sylwester, Garrett

Gunston Middle School

The Effect of the Amount of Fuel Used in a Rocket Launch on the Rocket's Heat Plume

The size and temperature of a rocket's heat plume may be able to be used to calculate either a safe distance from a particular rocket launch, or the amount of fuel in an unknown rocket. To determine whether correlations between propellant mass and both the size and maximum temperature of a heat plume exist, I launched rockets with varying amounts of propellant and took video of them using an infrared camera. Next, I broke down each video into individual frames to later be analyzed. During experimentation, I used five different amounts of propellant, but also used two different types of rockets, Estes Gnome™ and Bandit™, to find whether the type of rocket affected the size or maximum temperature of its plume. Afterwards, I found the maximum temperature present in every video and devised a method to find the size of the heat plume released in all of the launches. After I analyzed the data, the results showed that there were positive correlations between the mass of propellant and both the size and maximum temperature of the heat plumes. As an additional finding, the Bandit rockets always gave off a smaller heat plume than the Gnome rockets when an equal amount of propellant was put into each.

8 EN 513

Talbot, Grayson

Dorothy Hamm Middle School

How Does Altitude Affect the Performance of a High Altitude Weather Balloon

High altitude weather balloons are used by NOAA to predict weather conditions varying from mild storms to high winds. These balloons typically are quite slow and expensive to operate. I want to see how the vertical speed of my design is affected by altitude. My prediction is the higher the altitude the faster the weather balloon will climb.

9 EN 514

Gravelle, Jameson

Arlington Tech/Career Center

The Effect of Materials on Capacitance

Over the past decade physical buttons have been phased out because of the benefits of using capacitive touch sensors. Knowing the effects of materials on capacitance is important for product design and cost. This project is about the effect of materials on capacitance. Several test materials were placed on an Arduino Nano based test rig. The rig used a capacitance library to measure the capacitance of a 10cm by 10 cm sheet. Each material was placed on the rig and touched. The results were recorded as a series of 5 numbers. The aluminum had, on average, the highest result. These results were higher than the control which was unexpected. The plastic and paper had mostly the same result and the felt had the lowest result. The purpose of this experiment was to analyze the effect of different materials on capacitance. The results supported our hypothesis that the metal would be the most capacitive. We believe that the project was a success and provided useful and consistent information. A way we could have improved the experiment was having more tests to get a more reliable outcome. This experiment may explain why most companies use metal for their touch capacitive sensors

9 EN 515

Heredia, Paul

Arlington Tech/Career Center

The Effect of Design of Tail Fin on Aerodynamics of a Rocket

I chose this project because in my engineering class we made paper rockets and the only thing that really differentiated between each rocket was the tail fin designs. How I made the rocket was I 3D printed the nose cone and tail fins. Next I glued both onto the carbon fiber body. How I made the air tunnel was I made a frame of plywood. Next I cut out pieces of masonite and plexi glass for the walls. Finally I drilled the masonite walls and the plexi glass walls onto the frame. Once the data was collected the overall best design was rectangular tail fins, they were the best and quickest to correct itself towards the wind. The P-value for this experiment was 0.0029 which meant that the data was statistically significant and that it supported my hypothesis. I got these results due to surface area: the surface area of the rectangular tail fins was the greatest of all three tail fins which is why the rectangular tail fins were the best.

9 EN 516

Madha, Mahasin

Alexandria City High School (includes Minnie Howard)

Wind Turbines

The purpose of this experiment was to determine which type of wind turbine produced the most electricity for future needs. To experiment, four different types of turbines were built, each connected to a torch light bulb. Using a fan, airflow was directed at each turbine, causing the light bulbs to illuminate. then using a lumen meter the brightness of the light bulbs was measured. By applying a formula to convert lumens to watts, the amount of electricity produced was calculated. The hypothesis stated that the Wind-cup turbine would generate the most electricity. However, the results revealed a different outcome: the Multi-bladed turbine produced the most electricity. In conclusion, the turbine that generated the highest amount of electricity was the Multi-bladed turbine.

9 EN 517

O'Neil-Vira, Ishaan

Alexandria City High School (includes Minnie Howard)

The Effect of Flywheel Size on a Lego Vacuum Engine

A Lego Single Valve System (SVS) Vacuum Engine is a simple lego engine that uses the negative pressure created by a vacuum to pull a piston up. The flywheel, attached at the front, provides the rotational momentum needed to complete the turn, pulling the piston back down. This cycle repeats itself thousands of times per minute. A laser tachometer and a piece of reflective tape at the center of the wheel measures the Revolutions-Per-Minute(RPM). This project studies the effect of the size of the flywheel on the rotational speed. Increasing the size and weight of the flywheel should decrease the amount of RPMs, as the bigger wheels should require more energy to turn the heavier mass, but the smallest wheels might not have enough weight to cause the engine to turn over. Five different sized flywheels were used, weighing from 3.52g to 68.76g. Each flywheel was spun for 20 seconds on the vacuum engine. The result was recorded by the laser tachometer, and then an average was taken for each size. The results showed that as the mass of the wheel increased the RPMs decreased, with the tiny wheel averaging 1961RPMs, the very small wheel averaging 1683, the small wheel averaging 1648, the medium wheel averaging 1640, the large wheel averaging 1505, and the very large wheel, which averaged 1473. This was partially expected, as more weight means more energy needed to turn the wheel, and the smallest wheel's weight was sufficient to turn the engine over.

9 EN 518

Slapar, Charlotte

Arlington Tech/Career Center

The Effect of Truss Bridge Design on Weight Bearing Capacity

The purpose of this experiment is to explore which truss bridge design has the highest weight-bearing capacity. This matters as it can identify which truss bridges are the strongest, and should be implemented in the world.

To conduct the test, 5 of each type of bridge were made using 3.5” wooden craft sticks. The designs were Pratt, Howe, Warren, and K-truss bridges. The bridges were placed between two 12 x 46.5” wooden planks, which were placed between two sawhorses. They were tested by placing half-pound sandbags every ten seconds into a plastic bin on top of the bridges until they broke. This process was repeated for each bridge.

After the experiment had concluded, the results were averaged. The Pratt held the least amount of weight, at 16.7 pounds. Then came the Howe and K-truss, at 19.1 and 22.7 pounds. The Warren truss was the most successful, having the highest weight-bearing capacity with an average of 25.2 pounds.

The results were put into Anova: Single Factor test, and the P-value was 0.00240039. As the P-value was less than 0.05, the data was significantly different. This meant the null hypothesis was rejected, and the alternative hypothesis was accepted.

In conclusion, the experiment ended with the Warren having the highest weight-bearing capacity, and Pratt with the lowest. The reason the Warren performed the best was likely due to it being composed of equilateral triangles, meaning that the loads were evenly spread out along the sides.

9 EN 519

Soronzonbold, Orgil

Washington-Liberty High School

The Effect of Weight on Piezoelectric Electricity Output

The purpose of this project was to explore Piezoelectricity as a feasible future energy source. The research question that was tested was if total weight or mechanical stress affected Piezoelectric electric output. The IV of this experiment was the total weight (lbs), the DV was the voltage output of the Piezoelectric disks. The experiment included four groups of 11.4 (control), 19.7, 31.3 and 39.0 lbs. The experiment involved putting the different weight groups on top of the generator and reading its voltage with a multimeter. The hypothesis was if the weight of mechanical stress is greater, then there will be a greater voltage output. The null hypothesis was: If the Piezoelectric generators are exposed to different levels of mechanical stress, then there will be no significant difference in the output of the generators. The results and findings of the experiment show a positive relationship between total weight and electrical output. The findings indicate that when the weight was increased, then the output increased as well. The P-value of the data was 2.06×10^{-19} which is less than the critical value of 0.05, meaning the null hypothesis can be rejected with a 95% certainty and above. The results and data of the experiment, coincide with the given research already done. The experiment is important because renewable energy sources are taking more importance in a world with finite energy. Piezoelectricity could become a feasible and renewable alternative to energy in the future with more engineering advancements.

9 EN 520

Dementi, Kye; Silva, Christian-Delfin

Alexandria City High School (includes Minnie Howard)

Which Airfoil Produces The Most Lift?

Many people take flying for granted, unaware that a secret science is happening right beside them. This secret is explained by Bernoulli's Principle, which states that when air moves faster over a curved surface on top than underneath, it creates a difference in pressure that generates lift. The purpose of this experiment was to test which type of airfoil generates the most lift, Flat-bottomed, Symmetrical, or Reversed Flat-Bottomed. To test the experiment, we created a Flat-bottomed, Symmetrical, and Reversed Flat-Bottomed airfoil out of cardboard and paper. We attached the ends of the airfoil to the sides of a box fan with a string while also holding a ruler vertically next to the fan. We let the fan run on full speed for 10 seconds, allowing the airfoils to fly for a short period of time. We gathered the data by recording the experiment with a camera and we recorded the max height that the airfoil reached. The hypothesis was, if a Flat-bottomed airfoil is used, then it will produce the highest lift. The results showed that the Flat-bottomed airfoil on average flew the highest out of the 3 and the Reversed Flat-bottomed flew the lowest. In conclusion, the Flat-bottomed Airfoil generates the most lift while the Reversed Flat-bottomed Airfoil, although showing similar results to the symmetrical airfoil, generates the least amount of lift.

9 EN 521

Gunter, June; Munipalla, Megha

Alexandria City High School (includes Minnie Howard)

Magnets for Motion: Designing a Speed Control System Using Magnets

Speed control is important to prevent accidents on the road. A common way of slowing cars down is speed bumps, but these pose risks to drivers and vehicles. The purpose of this experiment was to mimic the effects of a speed bump on cars, but using magnets to do so. Magnets have strong magnetic fields, and will attract or repel each other depending on their orientation. This allows magnets to affect the speed of objects because attracting poles will pull a magnetic object quickly to touch the other magnet, and repelling poles will stop the object before they touch. In this experiment, magnets of three different strengths were placed on a track. Then, a model car with a repelling magnet on the bottom went down the track, and the speed of the car was measured after going over the track magnet. The data was very conclusive and clearly showed that the magnets slowed the car down, and the stronger ones affected the car much more than the weaker ones. However, because the force was vertical, it caused the car to jerk up, and this disruption is what caused it to slow. In this configuration, the magnets would create security risks. In order to create a working system, magnets would have to be placed horizontal or diagonal to each other, preventing this jerk while still slowing the car. The result of this experiment is that magnets could definitely be used in traffic safety, but some adjustments would need to be made.

10 EN 522

Berger, Owen

Arlington Tech/Career Center

Effects of Epilam Use in Watchmaking

Epilam is a substance designed to increase surface tension on an object. The epilam coats the surface of an object in a thin hydrophobic film. If there is a specific area that is free of epilam, a drop of oil will want to stay in that place and avoid the surrounding hydrophobic film. Epilam is used on bearing surfaces in the escapement and balance of a watch. It prevents the oils from migrating so that the lubrication remains effective for longer periods of time without maintenance. People argue over the value of using epilam. Some suspect it has an adverse effect on the performance and accuracy of a watch mechanism. In this experiment, I will be putting this to the test.

10 EN 523

Josephine, Brooke

Yorktown High School

Bubble It Up

My project investigated the effectiveness of adding bubble wrap to insulating material to increase efficiency. Four glass containers were filled with 100 ml of water heated to 45 degrees Celsius and placed in four cardboard boxes (one without any insulation, one with fiberglass insulation, one with newspaper as insulation, one with newspaper insulation, and one layer of bubble wrap). The boxes were placed in a room at 11 degrees Celsius. After ten minutes, I removed the glass containers and recorded the temperature of the water. Based on the temperature change and the amount of water, I calculated the energy lost in Joules. I performed five trials. One layer of bubble wrap increased the efficiency of the newspaper insulation by 4.3%. Based on this, often discarded bubble wrap could be combined with other insulating materials to improve the efficiency of the insulation, saving energy while repurposing something frequently destined for a landfill. More investigation is needed to determine the effectiveness of multiple layers of bubble wrap with other insulating materials.

10 EN 524

Clemence, Idris

Alexandria City High School (includes Minnie Howard)

Space Sprouts

This project investigated the potential for growing plants in space-like conditions using a clinostat to simulate microgravity. By comparing the growth of cress seeds under regular gravity and simulated microgravity, the aim was to understand how space conditions impacted plant development using my Arduino-clinostat, agar solution and Petri dishes. The results revealed that while plants could grow in simulated microgravity, their growth was more erratic compared to those grown under regular gravity. These findings show that plants can adapt to microgravity but rely more on light cues for directionality. This research contributes to the development of sustainable plant growth systems for long-term space missions. This continued exploration could greatly contribute to space agriculture, ultimately supporting the human exploration of space.

10 EN 525

Hurst, Mark

Yorktown High School

Effect of Blade Angle on Power Production

The goal of this project is to discover the relationship between blade angle and power production of flat blade wind turbines. The expected outcome was for there to be an ideal angle for maximized efficiency. This hypothesis was proven correct by a variety of tests influencing not only blade angle, but also blade size and wind speed.

The multimeter was able to measure the voltage output from the motor, leading to the output being measured in volts. The ideal angle fell around 20 degrees, as this produced the highest voltage and the highest wind speeds. However, when the blade angle was higher, the blades were able to start spinning more easily, especially at low wind speeds.

This information may help to maximize the efficiency of real turbines, making wind energy more viable.

10 EN 526

Ostrowski, Devin

Arlington Tech/Career Center

The Effect of Different Materials on Magnetic Fields

This seeks to understand why certain materials dampen or completely reduce magnetic fields. Findings could be used to select ideal materials to prevent magnetic interference, which can severely limit or damage functionality, in cars, electronics, and other consumer products. A Gauss Meter was created to measure whether magnetic fields can be prevented or dampened by certain materials of roughly the same thickness. The lighter and less dense materials, in general, yielded the highest averages in Gauss and millivolts. Cardboard was an exception, demonstrating the second lowest average. The mid-weight and mid-density materials yielded the second highest and lowest Gauss and millivolts averages. The heaviest and most dense material demonstrated the third lowest Gauss and millivolts average. Statistical analysis of the experiment data showed an extremely low p-value. This affirmed that the experiment was valid by showing significance in the experiment, thus rejecting the null hypothesis. Some of the variance in data was due to the fact that the Gauss meter was very reactive, as it was built with basic circuitry. In addition, the experiment was conducted in a house rather than a lab. This resulted in the Gauss meter reacting to other ongoing electro magnetic fields. However, the Gauss meter yielded results, and the hypothesis was rejected because a couple of the denser materials had higher Gauss value averages than the less dense materials.

10 EN 527

Tarpley, Michael

H-B Woodlawn Secondary Program

Robotic Arm Using Arduinos and Servo Motors

Amputees or persons with a congenital hand differences face challenges in their daily life which can be solved with a prosthetic hand. This project is focused on the modeling, design and construction of a robotic arm that mimics the movements of a human arm and can be used as the building blocks for a prosthetic hand. A robotic arm was 3D printed from light weight, durable, eco-friendly carbon-fiber reinforced polylactic acid and consists of ten modular components including arm, forearm and hand. The robotic arm has been designed and developed to mimic the normal biological arm. It is controlled by analog output used to capture physical data such as bending the fingers and elbows. The movements are interpreted by software programmed through an Arduino to control the robotic arm. The design of the 3D printed robotic arm aims for the aesthetics, functionality and cost-efficiency.

10 EN 528

Vasisht, Janak

H-B Woodlawn Secondary Program

Disrupting Renewable Energy with AI

Wind turbine blades are efficient, but can be further optimized to produce more energy. Through this optimization, one could achieve drastically more affordable energy and far more savings for the country.

To provide some context for my project, roughly 99% of wind farms are built in rural regions of the United States. This has been seen to bring economic booms to many of these local regions through a surplus of jobs in such areas, and decrease in energy expenses. Wind energy also accounts for roughly 10% of the nation's energy portfolio, meaning that even a marginal increase in wind turbine performance can lead to large monetary savings. With this being said, the necessity of wind turbines for the future of energy is very clear.

My project, "Disrupting Renewable Energy with AI," utilizes complex artificial intelligence to accurately create a new wind turbine shape and validate its performance. This is through the use of the AI models, CAD softwares, and computational fluid dynamics simulations, I was able to create a wind turbine blade that has the ability to generate 30% more energy than a standard blade of the same size. This surplus in energy would account for \$12.4 billion dollars in further savings for the nation, and the rural communities the wind farms are located in.

6 EV 600

Levene, Hannah

Kenmore Middle School

The Effect of Filter Materials on the Turbidity of Water

The purpose of this experiment was to test different ways to clean water and to investigate water filtration. This experiment is important because it can help clean water. Everyone in the world (including animals) needs clean drinking water to stay healthy. Humans also need clean water to grow plants for food. The goal of this project was to find the effect of different materials with a variety of densities on the turbidity of water. The researcher used a homemade water filter to test how effective the different materials were at filtering. The four materials (shells, fabric, feathers, and charcoal) were each tested with the controls (rocks, sand, and cotton balls). After the materials were used to filter dirty water, the turbidity was measured in JTUs. The shells had the best turbidity of 30 JTUs and highest density of 0.81 g/mL, while the charcoal had the worst turbidity of 100 JTUs and a density of 0.56 g/mL. The feather's turbidity was 45 JTUs with a density of 0.03 g/mL, and the fabric had a turbidity of 50 JTUs with a density of 0.04 g/mL. The material's density alone did not appear to affect its performance when used to filter water. Other properties of the materials, such as structure, affected the turbidity. This experiment is helpful to the environment because animals and plants need clean water to survive.

6 EV 601

Lim, Jilliane

Patrick Henry K-8 School

Save the Earth With Compost

My research question is 'What is the best temperature to turn food scraps into compost?' I really want to help the environment by giving the soil more nutrients and making my backyard healthier for the plants. My hypothesis was if the temperature was warmer it would make scraps turn into compost fastest because, during my background research it states that hot temperatures are the quickest way to make compost. To test my hypothesis, I measured the weight of my food scraps and created two piles containing the same types of food scraps. Then, I set up the area making sure the ranges of temperatures are correct and not overlapping. Next, I put one pile outside where it was cold and another indoors with the heater on. I recorded my observations every other day for two weeks. The best result came from the pile in the cool room as it had almost completely decomposed. Compared to the pile indoors it was more compressed and also had more weight. My hypothesis was disproved because when I left the pile of food scraps outside many microorganisms were attracted to the cold pile which then led to the quick decomposing of the pile. Also rain and moisture in the air contributed to the weight which also altered the results. If I conducted my experiment without any limitations then the pile indoors where would have showed greater change due to the fact that the warmer temperatures would 'energize' the bacteria and make it more productive.

7 EV 602

Caffrey, Luke

Gunston Middle School

Are “Flushable wipes” Actually Flushable?

This project is important because it demonstrates that some claimed flushable wipes aren't flushable while others are. This can be a huge problem for the sewers because if wipes don't break down, they could get stuck. The question that this experiment is testing is do different kinds of materials react differently than the others.

The hypothesis is if different materials are used then they will break down differently

This is testing if flushable wipes are truly flushable and testing if they don't break down or do break down in water.

The materials were Toilet paper, Good wipes, Cottonelle wipes, Pampers wipes and 4 jars of water

The procedure was to fill 4 jars with tap water, insert toilet paper, flushable wipes, and non-flushable wipes, shake the jars and observe, wait for 2 weeks and observe, shake the jars again and observe, take the wipes and toilet paper out of the jar, measure the remaining pieces, graph the data, draw conclusions, and present data

In conclusion, the wipes broke down terribly while the toilet paper broke down well. The range for the breaking down process is undefined because the toilet paper broke down into too many pieces. The toilet paper broke down almost immediately while the wipes hardly showed any reaction to the water. After the experiment was conducted, it was found that the data did support the hypothesis because they reacted differently.

7 EV 603

Mellen, Connor

Francis C. Hammond Middle School

What Are the Effects of Worms on Mushroom Growth

The project started by putting the spawn in the log and putting the worms in the containers. After doing that, the Containers got sprayed 8 times a day to keep them moist. Once the project was finished, an analysis was made on the logs after they were dug out of the containers. The final analysis concluded that the containers with no worms showed more growth than the containers with worms.

7 EV 604

Pearson, Amelia

Swanson Middle School

What Are Cost-effective and Efficient Ways of Filtering Polluted Water?

Contaminated water is a huge global issue; just in Africa alone, 400 million people lack access to clean water. An estimated two children die every minute due to consumption of contaminated water. Here in the U.S., when floods occur contaminants leach into water, causing toxicity. In this experiment, I sought to find a cost-effective and efficient method to clean water using filtration. My focus was an easily-made home filter, consisting of: activated charcoal, gravel, sand, paper and cotton balls. In this experiment, each part was staged. There were four different treatments: prefiltration, paper filter - stage 1, coarse filter (gravel, sand, and cotton balls) - stage 2, activated charcoal - stage 3. Multiple contaminants were added to the experiment sample including: lead, nitrate, copper, zinc, manganese, sulfate, and sediment. Contaminant levels for each sample were tested through the four treatments sequentially, and the results statistically analyzed. After all three stages, it was found that lead, copper and suspended sediments were removed. However, nitrate, zinc, and sulfate levels were unchanged. I conclude the filtration method only partially worked, but such filtration could definitely be a solution to contaminated water. Activated charcoal was shown to be the most important ingredient, it is able to absorb certain heavy metals, as well as organic compounds. If I were to continue, I would test for bacteria. Bacteria are a critical contaminant of water and source of illness and mortality. I am also interested in testing reverse osmosis, to see if it is effective without excessive cost.

7 EV 605

Villwock, Eliana

Williamsburg Middle School

The Effect of the Environment on the Water Quality in It

My project focuses on how water quality is impacted by its surrounding elements. This topic interests me because I believe the physical conditions we put ourselves in can have various effects, health and physical wellbeing being one of them. Additionally, this can be applied to the way we treat our environment and what can happen as a result of our actions. For my project, I tested how water quality changed based on the environment it was in, and ended up seeing some interesting results. For instance, I found that several of my samples had a very high alkalinity but very low pH. I concluded that the pH levels were so low because alkalinity is the water's ability to dissolve it. All in all, my project interested me and helped me gain useful knowledge about water quality.

8 EV 606

Capiaux, Flora

Kenmore Middle School

The Effect of Polluted Water on the Health of Buckwheat and French Radishes

For this study, the goal was to see how different kinds of water, including polluted water, would affect two different kinds of plants, French radishes and Buckwheat. The researcher hypothesized that rainwater would be the most effective at growing the plants because of the increased amount of supposed minerals in the water. The researcher conducted this experiment by having 3 trials and six different pots of plants. The experiment was conducted on 1 French radish and one buckwheat plant per trial. The trials were Polluted Lubber Run Water, Rainwater, and Tap Water. The experiment showed that the tap water was the most efficient at growing both the radishes and buckwheat. The researcher did have to restart the project twice due to outlying issues with where the project took place. The researcher continues to talk about this and more in the conclusion of this experiment. The real-world importance of this experiment was that everywhere in the world, humans are dealing with pollution, and it isn't always known how it can affect agriculture itself, which leads to us. The radishes were used to represent a common food source that we as humans and animals eat for nutrition and the buckwheat was used to represent another common plant. Both of these plants are native to Virginia, showing that pollution is closer than some may think.

8 EV 607

Choi, Olivia

Dorothy Hamm Middle School

The Effect of School Vs. Urban Location on the Amount of Lead in Soil in Arlington and Pennsylvania

Lead is a harmful chemical that can be emitted into the environment from industrial sources and contaminated sites. Prolonged exposure to lead can lead to brain damage, seizures, and death. Recently the Environmental Protection Agency (EPA) changed the safe level from 100 ppm to 400 ppm. As a result of the policy, it is crucial to know the relationship between city areas and lead levels. I hypothesize if the location is more urban, then it will have a higher amount of lead, because it has lots of buildings, construction and exposures. Locations for this study were chosen based on how urban they are. They ranged from a rural school to a city.

Lead levels were determined by exposing the soil to a rhodizonate reagent which caused testing strips to turn different colors based on the amount of lead. The most urban area had the most amount of lead. These results show that the soil in the most urbanized area had an unsafe level of lead. Its amount was higher than the EPA threshold for a safe amount of lead. This can help us to know where to focus decontaminating efforts and keep Arlington and other communities safe.

8 EV 608

Cordova , Rossybell

Kenmore Middle School

The Effects of Greenhouse Gasses on the Temperature of Air

The purpose of this experiment was to determine how various greenhouse gases impact the temperature of air. Greenhouse gases are known to trap heat in the earth's atmosphere, contributing to global warming. Despite the awareness of the dangers of greenhouse gases, little action is being taken to reduce emissions. This issue is critical because we as humans are not trying to reduce it or stop it, which is leading to rising greenhouse gas levels. The greenhouse gas levels cause global temperatures to increase, which causes more widespread environmental consequences. The purpose of this experiment was to analyze the effects of greenhouse gases, specifically carbon dioxide, methane and air as a control group. The researcher hypothesis was that an increase in greenhouse gases will result in higher air temperature. Among the gases tested, carbon dioxide was expected to have the most significant effect on the air temperature.

The experiment was conducted using jars to create controlled environments for each gas. Each jar was filled with one of the greenhouse gases (carbon dioxide, methane, water vapor, and air). The temperature inside the jar was measured after the gases were released and exposed to the heat source. Each setup was tested in three trials to ensure accuracy. The results show water vapor had the most significant impact on air temperature. Methane and carbon dioxide also raised the temperature but to a lesser extent. Air had barely any effect compared to the other results from the greenhouse gases.

8 EV 609

Fern, Harper

Kenmore Middle School

Digging Deeper: The Effect of Type of Soil Environment on Amount of Microorganisms

Soil is an important resource, structural support, and habitat for microorganisms. The study focuses solely on the last point, soil being habitat. Soil is commonly found to be a habitat for numerous microorganisms, such as acidobacteria, actinobacteria, proteobacteria, and verrucomicrobia. These microorganisms are identified as bacteria and fungi. The following particular bacteria and fungi are considered completely harmless if an individual were to make contact with it. This experiment test which soil houses the most amount of microorganisms. The soil tested were from a bike path, the researchers front yard and the local park. It was hypothesize that the soil from the local park would house the most amount of microorganisms compared to the other soils tested for the experiment, 1 tablespoon worth of soil was collected at each location and then placed in petri dishes for protection. The soil was mixed with 3 tablespoons of distilled water, and put under a slide to be seen under a microscope. The amount of microorganism seen were counted and compared. The hypothesis was not supported, with the front yard having the most amount of microorganisms. Looking at these results, it can truly be seen how important soil is to microorganisms everywhere.

8 EV 610

Ganzorig, Aranz

Swanson Middle School

The Effect of Sand Particle Size on Phosphorus Removal in Water Filtration

Harmful algal blooms (HABs) are one of the most pressing environmental issues caused by excess phosphorus in water systems. These blooms disrupt ecosystems, decrease biodiversity, and threaten water quality, ultimately impacting human health. Phosphorus, commonly introduced through agricultural runoff and fertilizers, fuels algae growth, creating widespread ecological problems. This project aimed to evaluate the effectiveness of different sand particle sizes in removing phosphorus from water, potentially reducing conditions that lead to algal blooms.

The experiment investigated the effect of coarse, medium, and fine sand in a gravity-driven filtration system, with a control group using only filter paper. The independent variable was sand particle size, and the dependent variable was the percentage reduction in phosphorus, measured in parts per billion (ppb) using a test kit. A phosphorus-rich solution was prepared by dissolving ground Osmocote fertilizer in tap water, and ten trials were conducted for each filtering material.

Results demonstrated that fine sand removed the most phosphorus, with an average reduction of 25.4%, followed by medium sand at 18.1%, and coarse sand at 7.1%. The control group removed only 2.8%. These findings support the hypothesis that smaller sand particles provide a more effective filtration barrier, reducing phosphorus levels more efficiently.

This research addresses phosphorus contamination, contributing to the prevention of harmful algal blooms and offering insights into low-cost, accessible water filtration methods. Future work could explore multilayered filtration systems or compare sand with other natural filtration materials to enhance phosphorus removal and further mitigate algal blooms.

8 EV 611

Troost, Danny

Swanson Middle School

The effect of solar energy on different types of solar panels

This project evaluated the performance of different types of solar panels by measuring their power output over 10 trials. Solar panels generate electricity using photovoltaic cells made of silicon, which consist of two layers: an n-type layer with extra electrons and a p-type layer with fewer electrons. These layers are doped with materials like phosphorus and boron to create conditions for electron movement. When sunlight strikes these layers, photons excite the electrons, causing them to flow and generate direct current (DC). Mono-crystalline panels are designed to allow easier electron movement, making them more efficient than other types.

The experiment compared mono-crystalline, polycrystalline, and thin-film panels. The panels were tested in full sunlight on a wooden sheet, connected to a voltmeter. Current and voltage readings were taken every 5 minutes to calculate wattage. Results showed that mono-crystalline panels had the highest average output at 7.67 watts, followed by polycrystalline panels at 4.97 watts. Thin-film panels produced the least energy.

The hypothesis that mono-crystalline panels would perform better due to their black color attracting more sunlight was partially correct. While these panels were the most efficient, their performance was attributed to their structural design rather than color.

Additional components like solar glass and back sheets play crucial roles in panel function, while a junction box ensures safe energy transfer. Future research could explore whether a solar panel with a tracking system generates more energy compared to a stationary panel.

8 EV 612

Zee, Rebecca

Kenmore Middle School

The Effect of Cadmium Selenide Quantum Dot Diameter on Photocatalytic Water Purification Efficiency

The global water crisis damages billions of lives, with toxic organic dyes such as methylene blue significantly contributing to water pollution through improperly detoxified industrial wastewater. As the number of people living in areas without safely managed water continues to grow, the need for a sustainable and effective solution becomes increasingly vital. This study aims to assess the capability and effectuality of Cadmium Selenide (CdSe) quantum dots (QDs) as photocatalysts for water purification, and how the size of the QD impacts photocatalytic efficiency. The hypothesis predicts that as the size of the QD decreases, the QD's photocatalytic efficiency will increase. Three different sizes of CdSe QDs were selected (2 nm, 5 nm, and 10 nm) and tested for their ability to degrade methylene blue in water, or, for their photocatalytic efficiency. This efficiency was determined by calculating the percent decrease in the absorbance of the contaminated water across different wavelengths, and these absorbance numbers were found through colorimetry. Results indicate that the size of a QD has a significant impact on its photocatalytic capability, with smaller QDs initiating a greater absorbance decrease, likely due to the quantum confinement effect and their larger surface area-to-volume ratio. However, the observed degradation efficiency suggests that further research in this field is required before practical applications. Even considering the current research gap, this study illustrates the potential of nanotechnology in environmental purification processes, and poses as a possibility to address industrial wastewater, and the global water crisis, more effectively.

8 EV 613

Barad, Tara; Goel, Shivani

Dorothy Hamm Middle School

Investigation of Water Quality in Donaldson Run, tributary of the Potomac River

We live in Northern Virginia near the Donaldson Run tributary. The Donaldson Run tributary runs through residential backyards, and we wondered if runoff from gardening and landscaping chemicals might affect the pH level of Donaldson Run. The hypothesis was that as distance from the Potomac River increased, the pH level of the tributary would decrease because of increased acidic runoff. We measured the pH of the Potomac River at 7.15, and then measured the pH of various locations along Donaldson Run (0.3 and 0.5 km from the Potomac River). A PASCO wireless pH probe was used to measure the pH of water samples from the three locations. We conducted three independent trials. The average pH level of the water farthest away was 6.57, the middle spot was 6.40, and it was 7.15 at the Potomac River. The data shows that the pH of water in Donaldson Run is more acidic than water in the Potomac River. Some of the results were confusing. For example, the pH of the water sample in the middle had the lowest pH of all samples.

8 EV 614

Chowdhury, Fathimah; Chitalkar, Sae; Hossain, Anusha

Thomas Jefferson Middle School

The Effects of Differences Between the Properties of Biodegradable and Nonbiodegradable Plastics on the Environment.

We are investigating the differences between biodegradable and non-biodegradable plastics, as well as their environmental impacts. Our goal is to gain a deeper understanding of the advantages and disadvantages associated with these two types of materials. Our research indicates that both biodegradable and non-biodegradable plastics can release contaminants into the environment. However, biodegradable plastics tend to occupy less space in landfills. We aim to compare the extent of these differences to better understand the ecological implications of each type of plastic.

8 EV 615

Kelley, McKenzie; D'Amico, Alessandra

Swanson Middle School

Purifying Salt Water Using Thermal Desalination

The purpose of this experiment was to try to create an alternative way to desalinate saltwater using more accessible materials. Many countries have an insufficient amount of water and are therefore experiencing water scarcity. We also wanted to test if by doing this experiment, we were creating a harmful byproduct of saltwater with dangerously high salinity.

We built a device that by using thermal energy from a heat lamp, evaporated water from salt water of different concentrations and collected the purified water. We then measured the conductivity of the remaining un-purified water.

The hypotheses were if the salinity of the saltwater solution is lower, then the amount of purified water will be greater and the salinity of the saltwater, as measured by conductivity, will increase after desalination due to the higher ratio of salt to the remaining water in the basin. The results showed that the device was successful at purifying water, but was inefficient. While the water produced was potable, it would not meet the daily water requirements for a human. After five hours under the heat lamp at most 5% of the water was purified.

In the future, we could expand this project by using solar energy to power our device which would be more accessible to use, or to change the saltwater to sea water, which would be more realistic, as it would have the same minerals and salts. We also have a large supply of seawater. These are just a few ways to continue this project.

9 EV 616

Do, Lan-Madeleine

Arlington Tech/Career Center

The Effect of Water Barriers on Water Damage and Erosion

The experiment was performed due to the increasing amount of water damage and floods in coastal areas that have been heavily affected by urbanization and the destruction of natural structures. The results from this experiment are able to inform others of the most effective natural structure for preventing water from damaging the coast. The experiment started with creating the model, and setting up the three simulations for wetlands, coral reefs, and plant roots with wires and sponges. The tests included spinning a water wheel and measuring the water that was collected. The results showed that the wetlands simulation let through an average of 7.67 oz of water to the shore, the coral simulation let through 6.83 oz of water, and lastly, the plant root simulation let through 8.33 oz of water. An ANOVA test was conducted and revealed a P-value of less than .05 meaning there was a significant correlation between the results. The coral simulation allowed the least amount of water to reach the shore because the wires were able to disrupt the motion of the waves. The wetlands simulation was the second most effective because it was able to soak up some of the waves that approached, but couldn't fully intake all of the water that was propelled. The plant root simulation performed the worst due to mostly preventing the erosion of soil, not water from reaching the land. In conclusion, the coral simulation was the most successful simulated natural water barrier tested against waves.

9 EV 617

Ghosh, Sid

Yorktown High School

The Effect of the Type of Algae on the Change in Water Quality Through Phycoremediation

The purpose of this experiment was to determine how well different types of algae can “phycoremediate,” which is to remove pollutants from contaminated water. This is important because polluted stormwater, through eutrophication, has detrimental effects on aquatic ecosystems, but algae has the potential to remove pollutants in water treatment applications. Three genuses of algae, Closterium, Chlorella, and Synedra, were introduced to polluted water. The removal of phosphates, nitrates, and dissolved oxygen (DO) was tested by measuring the mg/L concentration of each compound in the water before the algae was introduced and after a four day algal growth period. The hypothesis, which stated that Chlorella would remove the most phosphates and nitrates because it grows fast and is commonly used for bioremediation, was rejected because Chlorella removed the least amount of phosphates out of any of the algae types. The dissolved oxygen did not decrease in any of the trials, indicating that microalgae has the potential to remove pollutants from water without greatly affecting dissolved oxygen. Additionally, there was no change in nitrates among any of the genuses, possibly because the intervals for the test were not sensitive enough. An ANOVA test was conducted with p values of 0.155404 for phosphates, 1 for nitrates, and 0.629738 for DO. The null hypothesis was accepted; there were no statistically significant differences in phycoremediation viability between algae types. However, further research could be conducted to determine if these results stay true at higher pollutant concentrations and longer periods of phycoremediation.

9 EV 618

Guttridge, Ari

Arlington Tech/Career Center

The Effect of Different Materials in Aquifers on the Efficiency and Effectiveness of Water Filtration

This experiment tests The Effect of Different Materials in Aquifers on the Efficiency and Effectiveness of Water Filtration. Aquifers are one of the most important sources of fresh water, used worldwide by many people. The cleanliness of the water depends on what materials are in the aquifers, which is why the experiment is taking place. Four materials (Sand, Dirt, Gravel, and Big Stones) were placed into four plastic bottles. 370 milliliters of water from Four Mile Run River was poured into each bottle, and filtration time was measured. The Before and After results were tested in a Spectrophotometer, then a Safe Home® Bacteria in Water Test Kit, and finally a Safe Home® 12-in-1* Drinking Water Test Kit. The bacteria and water quality tests did not have a significant difference of results. Therefore, no statistical analysis was needed for the water quality tests or the bacteria tests. For the spectrophotometer tests, no statistical analysis was possible because there weren't enough repetitions of the test. Overall, most of the materials made the water less clean, with the absorbance being high while the transmittance is low. For further study, samples could be tested with more sediment and contaminants, such as copper, nitrate, iron, etc., to achieve more significant differences in the results. The higher turbidity (sediment) observed in some spectrophotometer tests is likely because the dirt and gravel aquifers had sediment initially, which washed out during testing and contaminated the results.

9 EV 619

Leaning, Alexandra

Wakefield High School

Precipitation and Pollution: Analyzing Water Quality Before and After Rain Using Digital and Manual Measurement Modalities

This experiment investigated the impact of rainfall on the water quality of three local rivers: the Anacostia, the Potomac, and Four Mile Run. The purpose was to determine how rain affects parameters such as temperature, total dissolved solids (TDS), electrical conductivity (EC), pH, and coliform bacteria. It was hypothesized that rainfall would worsen water quality by increasing dissolved minerals, introducing harmful bacteria, and altering pH levels beyond the safe range for aquatic life. Water samples were collected from five sites before and after three rainstorms. Measurements were taken using digital tools for TDS, EC, temperature, and pH, as well as manual test strips and coliform detection kits. Results showed that TDS and EC consistently decreased after rainfall, likely due to the dilution of pollutants. The pH levels became slightly more acidic but remained within a safe range. Mineral concentrations also reduced, and there was no consistent pattern in coliform bacteria presence. Observations revealed that turbidity increased visually after rain, though it was not measured digitally. Contrary to the hypothesis, rain improved overall water quality by diluting existing pollutants. Data from Four Mile Run highlighted the impact of a sewage treatment plant, which increased TDS levels downstream. Tidal changes were identified as an unaccounted variable that may have influenced results. This shows the dynamic relationship between rainfall, urban infrastructure, and river ecosystems, emphasizing the need for continued monitoring and improved pollution management.

9 EV 620

McGeorge, Tyler

Yorktown High School

The Effect of the Water Filtration Method on the Amount of Contaminants Removed

Access to clean drinking water is a critical global challenge, with over 4.4 billion people lacking safe household water. This project investigates the effectiveness of five water filtration methods: reverse osmosis, water distillation, alkaline filters, paper filters, and activated carbon filters in removing contaminants from stream water. The hypothesis proposed that reverse osmosis would outperform other methods due to its semipermeable membrane's ability to eliminate microscopic particles and dissolved solids. The experiment measured contaminant levels using a Total Dissolved Solids (TDS) meter before and after filtration. Each method was tested with five 1-liter water samples, and results were analyzed for mean, median, and range of contaminant removal rates. Statistical significance was determined using a One-Way ANOVA test. Results confirmed the hypothesis: reverse osmosis achieved the highest mean removal rate (98.08%), followed by water distillation (97.42%) and activated carbon filters (96.7%). Alkaline filters showed a negative removal rate (-34.7%), indicating they added minerals rather than removing contaminants. Paper filters were minimally effective (0.052%). The low p-value (0.0001) showed significant differences between methods. Reverse osmosis and water distillation proved highly effective at removing contaminants, making them well-suited for heavily polluted water. Future studies could investigate their performance with various water sources, target specific contaminants, and assess scalability for broader use.

9 EV 621

Wells, Cassidy

Yorktown High School

The Effect of Different Color Wavelengths on the Power Output of Different Solar Cells

I tested 5 types of colored light against three different types of solar cell. I used Red (LED), and Yellow, Green, Blue, and Violet were all Fluorescent. The 3 types of solar cell that I used were Perovskite, Monocrystalline, and Polycrystalline. To simply sum up my project, I used a metal reflect box with screwed in light bulbs inside to change the color of light and then placed it upon my solar cells that I built. I tested every combination of color and cell. The combination that did the best was Red LED with Perovskite and Polycrystalline. The reason red did the best is because it absorbs more light instead of reflecting light like the color blue. A higher energy wavelength (Blue) needs to absorb less solar energy. A lower energy wavelength (Red) needs to absorb more and therefore produces more power from solar light. This project is really important to me and to the world because of global warming. There needs to be more sustainable options for energy and power.

9 EV 622

Zanni, Celia

Yorktown High School

The Effect of the Type of Hydrogel on the Amount of Water Absorbed

Hydrogels, composed of cross-linked polymers, are able to soak up massive amounts of water. This absorption can prevent issues like eutrophication and runoff. If hydrogels are put into soil, they can soak up excess water and slowly release it to the plants. In this experiment, three different types of hydrogels (Agar, Hydroxyethyl Cellulose [HEC], and Agar + HEC) were tested to compare which type would have the best absorption capacity in one hour. The hypothesis was that the combination hydrogel would soak up the most water because, with the structure of Agar combined with the flexibility of HEC, the Agar + HEC hydrogel created the most effective net to trap the water molecules. During the experiment, each type was made out of simple biodegradable materials, weighed, and then placed into bowls with water. After an hour, their weights were recorded again, and the difference was calculated. Out of the three bases, the Agar + HEC base was able to absorb the most amount of water in grams (g), and the null hypothesis was rejected. The p-value was <0.0001 , and there was a significant statistical difference between each type.

10 EV 623

Butzer, Allison

Washington-Liberty High School

Which Material can Clean Up an Oil Spill Most Effectively

This experiment was conducted to compare the effectiveness of different types of material on how well they would clean up oil. It was hypothesized that human hair would be able to pick up the most amount of oil, because hair is adsorbent rather than absorbent, so the oil molecules will attach to the surface of the hair. Additionally, human hair can adsorb up to five times its weight. The four groups tested in this experiment were human hair, straw, sawdust, and y-per oil pads.

Seven trials per group were tested by simulating an oil spill on a smaller scale. 100 milliliters of water were poured into a container, 30 milliliters of oil were then poured onto the water, and 4.25 grams of the material was used per each trial. An ANOVA test was conducted, which reported a p-value of 1.42×10^{-6} . The statistical tests showed that the research hypothesis was supported, and the null hypothesis was rejected. However the statistical results were not able to show which material was the most oleophilic as the results for hair and straw had the same results.

10 EV 624

Klein, Florence

Alexandria City High School (includes Minnie Howard)

Wacky Water Filtration

This experiment focuses on types of media in a multi-media water filter. According to A Study on The Estimation of Hardness In Ground Water Samples By EDTA Titrimetric Method, “Water with high concentration of minerals is hard water. Water is essential for life. But water with very high degrees of hardness is harmful to health” (1). Three different types of media were used in a multi-media filter to filter out water hardness (measured with PPM, or parts per million) of Potomac River water. Sand, charcoal, and gravel were placed in that order in a water bottle acting as the body of the filter. In the control, the same amount of each media was used, and in the three trials the amount of sand, charcoal, or gravel was increased. It was hypothesized that the more sand there was, the better water would be filtered. In the control and trial with more sand, the water hardness went from 120 (PPM) to 50 (PPM), while in the trials with more charcoal and gravel, the hardness stayed at 120 (PPM). This indicated that sand was more effective in filtering water hardness, granting the hypothesis correct.

10 EV 625

Mitzen, Julia

Wakefield High School

Heat Conduction and Retention of Metals

It is clear that with the growing global population and the increased need for a sustainable and energy efficient future, the materials in which we use to urbanize communities is vital. With the intention of using non-renewable resources in the most impactful way, it is imperative that when constructing new buildings, the materials used are appropriate in the focus to conserve thermal energy from the sun or dissipate that energy. The purpose of this experiment was to investigate the effect of a light/heat source on different types of metals' ability to retain that energy in the form of increased temperature. Samples of aluminum, bronze, brass, zinc, copper, and steel were measured on their ability to conduct and retain heat energy. It was hypothesized that if copper is exposed to the same amount of a light/heat energy as other metals, then it will show the highest capacity for thermal energy absorption and retention. A light source was placed 1 meter above each sample metal and temperature was measured every 5 minutes until 30 minutes elapsed, then the light source was turned off and the sample was measured every 5 minutes for an additional 30 minutes. According to the data, copper showed the highest capacity for heat conduction and steadily retained that heat compared to the other metals. On the other hand, bronze showed the least amount of heat conduction and zinc and brass retained the least amount of heat.

10 EV 626

Mulder, Malena

Alexandria City High School (includes Minnie Howard)

Comparison of Print Methods on Image Fading Due to UV Light Exposure

This project tested the effects of UV light on images produced using different printer methods. The researcher printed images of colored bars using home inkjet and laser printers and a professional photo lab. Images were then exposed to full-spectrum grow lights for 21 days with a portion of each image covered with UV protective plexiglass. After exposure, the researcher used Adobe Photoshop to compare the color saturation values to a non-exposed control image.

The hypothesis was if the print comes from a professional photo lab, then it will fade the least when under UV light exposure, and if UV protective plexiglass is placed over the print, then the degree of fading will be reduced. The hypothesis was proven incorrect as the inkjet and photo lab prints showed more fading than the laser prints and the plexiglass increased fading in a number of trials.

10 EV 627

Ondias-Souna, Oyane

Washington-Liberty High School

Portable Water Filter to be used in Refugee Camps

This experiment was conducted to determine the effectiveness of a homemade portable water filter in removing contaminants from different water samples. It was hypothesised that the water filter, consisting of gravel, sand, activated charcoal, cotton cloths, and plant xylem, would be able to successfully remove contaminants. The independent variable in this experiment was the contaminated water samples, which were collected from five different sources. The dependent variable for this experiment was the filtered water, which was measured by the pH, lead, hardness, and nitrate levels. The pH was measured in logarithmic units, while the lead, hardness, and nitrate levels were measured in parts per million (ppm). The control group was tap water for this experiment, and the experimental groups were four samples from the Potomac River, Anacostia River, Carlin Springs Creek, and the Lincoln Memorial Reflecting Pool. There were six samples taken from the first four locations, and five samples taken from the fifth location. The preliminary tests were done one each sample, gathering their pH, lead, hardness, and nitrate levels. Once the water was filtered, each sample was tested again for their pH, lead, hardness, and nitrate levels. An ANOVA test was done to determine if a statistically significant difference existed among the means for the tested groups. The calculated p-value was 1 which is greater than the critical value of 0.05 which means that the null hypothesis can be rejected. The statistical test deemed the experiment to be inconclusive, as the results were statistically insignificant.

10 EV 628

Ruiz Castro, Davian

Alexandria City High School (includes Minnie Howard)

(C₆H₁₀O₅)_N Cellulose

My interest in arts and crafts started with paper.

I had previously attempted to recycle it and with further research, I was able to successfully recycle my first batch of paper.

I used three materials and made a project based on their strength. My ultimate problem was the inefficiency of my technique.

I realized that per material I would tend to use about two to three sheets of un-recycled paper just for one sheet of recycled paper, losing value and wasting materials.

With the help of many other people's blogs, posts, experiments, and failures, I learned various strategies to recycle and came up with my own solution to my problem.

My results after ironing and flattening the paper came out to be more efficient, using less paper than the normal test in which I just meant to fill the mold.

Overall I want to clarify that I am not taking away from the wonders of recycling, but instead this project is a personal goal that I was able to learn about and turn into a project that can serve as inspiration towards creative minds who can be inspired and make use of recycling in their daily lives.

10 EV 629

Schofield, Caroline

Alexandria City High School (includes Minnie Howard)

Biodegradable Hydrogels and Water Conservation

Water scarcity and conservation are two of the biggest issues in the environment today, and researchers are frequently testing ways to successfully reduce water usage when growing plants. This project looks at how biodegradable hydrogels can help conserve water in soil and decrease the amount of water that is needed. A hydrogel is a water-based polymeric gel that can hold up to 400 times its own water weight, and can be used to store water for extended periods of time. In the experiment, three types of biodegradable hydrogels, one made with agar powder, one made with hydroxyethyl cellulose (HEC) powder, and one made with both agar and HEC powders, were placed in soil and given 50g of water. The control was a pot with only soil and water. Over a week, the pots were weighed every other day and measured to see which one lost the least amount of water. My hypothesis was that the pot with the hydrogels made from agar and HEC powders would lose the least amount of water. The experiment results refuted my hypothesis, as the results showed that the pot with HEC hydrogels lost the least amount of water, as it lost an average of 40.5 grams in comparison to 44g, 48g, and 50g lost from the agar + HEC, control, and agar hydrogels. This experiment showed that HEC powder hydrogels do help conserve water in soil.

10 EV 630

Martin, Maya; Latifi, Mursal

Alexandria City High School (includes Minnie Howard)

How Do Different Straws Biodegrade Over Time

During our project, our main goal was to figure out what materials best broke down when placed in a ground-like environment. Based on previous research, we were able to hypothesize that the paper straw would break down the most effectively. Our project was set up using 5 different types of straws, which included paper, plastic, bamboo, plant and sugarcane. We then placed them into solo cups filled with soil and then left them for 10 days in between each data collection period. We wanted to test the rate of how each material would break down. This would help us to find out what material is the safest when disposed of in nature that will not disrupt or damage the ecosystem. After our final data collection, we were able to conclude that the paper straw did break down the most. Some of the other materials we thought would break down faster as well were the plant and sugarcane straws. However, these two straws didn't break down very well and it was actually the bamboo straw that had the 2nd most change in weight from start to finish. In sum the most biodegradable type of straw is paper, because when it is placed in soil, it is able to break down efficiently even over the short course of 40 days. This project will play an important role in finding more sustainable, as well as eco-friendly materials that can be used for future inventions for everyday use like straws.

10 EV 631

Zee, Rachel; Rahman, Sumra

Wakefield High School

The Effect of Fertilizers With Different NPK Levels on Eutrophication

The intent of this experiment is to find which fertilizer causes the most algal growth and which is the closest to the control. Each fertilizer has a different concentration of nitrogen, phosphorus, and potassium, three of which have a high concentration of one individual nutrient and one of which has a balanced concentration of each. 2 grams of algae and 5mL of fertilizer stock solution were added to 200mL of water and grown/monitored for 10 days, until they were filtered and measured. The fertilizers with high concentrations of one nutrient were all harmful to the algae (significant increase or decrease), phosphorus providing the most growth. The 10-10-10 fertilizer saw algae growth that was the closest to the control, and the healthiness of the oxygen levels corresponded with the amount/healthiness of the algae.

11 EV 632

Ackleson, Emma

Washington-Liberty High School

Comparing the Carbon Sequestration Efficiency of Algae and Diatom Phytoplankton in a Replicated Epipelagic Environment Under Simulated Climate Change Conditions

This study evaluated and compared the carbon sequestration efficiency of four photosynthetic microorganisms: Bacillariophyceae phytoplankton *Cyclotella meneghiniana*, and *Chaetoceros gracilis* and Chlorophyta microalgae *Chlorella* sp., and *Isochrysis maritima*. It was hypothesized that *C. meneghiniana* and *C. gracilis* would sequester more CO₂ in a simulated epipelagic environment in various light intensities due to Bacillariophyceae phytoplankton's unique silica-based frustules which enhance light absorption and photosynthetic efficiency and their higher surface area-to-volume ratios, compared to Chlorophyta microalgae.

The organisms were cultured in appropriate sterile, saline, nutrient solutions with an initial inoculum of 2 mL under controlled light and temperature conditions. Growth conditions included light intensities of 10,000 lux at a 14-hour light/10-hour dark cycle to simulate current average ocean temperatures (22°C), and 30,000 lux (27°C) to model predicted future ocean conditions in 2125 under the effects of climate change. After a 5-day growth period, the biomass was quantified via spectrophotometric absorbance measurements at 680 nm, the wavelength associated with chlorophyll a absorption. The results demonstrated that Bacillariophyceae phytoplankton exhibited significantly higher growth rates and CO₂ sequestration potential, compared to the Chlorophyta microalgae throughout both light intensities. Statistical tests indicate that the research hypothesis was supported and the null hypothesis was rejected. These findings highlight the potential of Bacillariophyceae phytoplankton as an effective biological tool for mitigating the effects of climate change through marine-carbon sequestration.

11 EV 633

Fiorino, Anthony

Washington-Liberty High School

The Effect of Liquid Medium Aeration on the Decolorization of Crystal Violet by *Trametes versicolor*

Crystal violet, a triphenylmethane dye widely used in the textile industry, often contaminates aquatic ecosystems through manufacturing effluents and is moderately toxic. Biological decolorization methods that use ligninolytic metabolic pathways, such as those used by *Trametes versicolor*, are effective in degrading xenobiotics such as textile dyes. This investigation evaluates how aerating liquid mediums enhances *Trametes versicolor*'s ability to decolorize crystal violet. Three agitation methods were compared: stirring, aeration, and no agitation. Absorbance measurements at 590 nm were taken 2 weeks after inoculation and compared to pre-inoculation samples. In addition, *Triticum aestivum* seeds were germinated in each group's filtrate to assess phytotoxicity levels through germination rates, serving as a practical measurement of decolorization. The greatest change in absorbance was observed in the aerated group (26.2%), followed by the still (21.5%) and then the stirred group (18.7%). In the phytotoxicity analysis, aerated solutions exhibited the greatest germination rate (93.6%), followed equally by the still (83.2%) and stirred groups (82.4%). These findings indicate that aeration significantly increases *Trametes versicolor*'s decolorization efficacy and serve to improve the efficiency of bioreactors used to treat textile effluent and remediate dye-polluted ecosystem

11 EV 634

Mukhtar, Ayah

Wakefield High School

Solar Energy: The Effectiveness of Solar Powered Water Desalination

This experiment was designed to test and compare the efficiency of solar desalination devices with light and dark bottoms. Knowing the importance and relevance of this topic I asked the question: Can solar energy effectively desalinate water? I hypothesized that the device with the black-colored bottom will be more effective in the desalination process and have a higher condensate yield and conductivity because darker colors are able to absorb more sunlight in comparison to darker colors, making the desalination process more efficient. To put my hypothesis test, I built two solar desalination devices with different colored bottoms (one black, one white), and placed each device under direct sunlight for four hours. After four hours in the sun I measured the amount of condensate yield produced from each device and tested the saltiness of the condensate to measure the effectiveness of the devices. At the end of the experiment, I found that my data did support my hypothesis. While both devices produced relatively similar amounts of condensate, the device with the black bottom had an average condensate yield of 1.93 mL and slightly less salty water. With my hypothesis being proven right, solar desalination can be an effective way to produce healthy drinking water, specifically in the developing world with limited access to fresh water, aiding communities towards growth and prosperity.

11 EV 635

Torg, Carrie

H-B Woodlawn Secondary Program

Hidden Contaminants: Quantifying Microplastics in Common Proteins

Multiple studies in recent years have shown the continued rise of micro and nano plastics found in ecosystems, food products, and humans themselves. Scientists have yet to establish a concrete system to quantify and analyze microplastics within food samples. This experiment was conducted in order to attempt to quantify and compare relative microplastic particulate counts within samples of ground chicken and ground beef. Through observing these samples under a microscope, this experiment was able to approximate the amount of particles in samples of each protein, and through this, approximate the amount of microplastics found in suggested serving sizes in terrestrial meats. This experiment identified more MP particles within ground chicken than in ground beef. The work done in this experiment provides a foundation for future research to determine the impacts of ingesting microplastics. At the same time, this research may spur consumer awareness and lead to more meaningful health guidance.

11 EV 636

Qadir, Zaineab; Hardwick, Katie

Yorktown High School

Hydrogen From Sunlight: Creating Clean Fuel With Artificial Photosynthesis

This project aimed to find a clean way to produce energy to reduce the effects of climate change. Industrialization has increased environmental damage due to fossil fuels. While current methods of creating hydrogen fuel involve fossil fuels, research indicates hydrogen fuel could be made cleanly using solar energy.

In the experiment, we tested if cathode materials impacted hydrogen production. Hydrogen fuel can power various things, and it was believed hydrogen production would be greatest when using aluminum as the cathode material because aluminum allows easy flow of electrons. We used electrolysis and artificial photosynthesis, where an anode (positive electrode) and a cathode (negative electrode) are connected to a power source, drawing out oxygen and hydrogen to the cathode. A solar panel acted as the power source to simulate photosynthesis.

Our second experiment tested if temperature affected hydrogen production, with four different temperatures tested. It was believed that at forty degrees Celsius, more hydrogen production would occur because warmer water allows atoms and molecules to flow more freely, enabling hydrogen and oxygen to migrate to the cathode or anode.

The results supported the hypotheses. Aluminum was the most effective material for producing hydrogen, and forty degrees Celsius was the most effective temperature in the second experiment. Therefore, using aluminum as the cathode at forty degrees Celsius provides the most efficient way to produce hydrogen through artificial photosynthesis.

11 EV 637

Xu, Yuesi; Huang, Tianxiao; Wu, Chenfan

Veritas Collegiate Academy

Directed Evolution Enhances the Activity of Polyethylene Terephthalate (PET) Degrading Enzymes

Polyethylene terephthalate (PET) has found extensive applications in various fields, particularly in the packaging industry, due to its superior physical and chemical properties. However, plastic pollution is becoming an increasingly severe environmental issue. Currently, biological degradation, especially enzymatic degradation, has emerged as a highly feasible and environmentally friendly method for PET treatment. To investigate the effect of random mutations on PETase enzyme activity, we synthesized the ICCM gene and cloned it into the pET28a vector for heterologous expression in *Escherichia coli*. Subsequently, we constructed a mutant library, randomly selected one clone, and compared its activity with that of the wild-type ICCM enzyme. We found that activity of PETase had changed by 36%, indicating that this method can be used to modify enzyme activity and lays the foundation for further screening of PETase variants with higher activity and stability.

7 MC 700

Sarkar, Ayan

Francis C. Hammond Middle School

AI Detectability in Writing

Since the inception of Consumer Generative AI back in 2022, many Schools and Colleges were having a hard time figuring out if their assignments were done using the help of AI. Have you ever wondered if computers could tell when text is written by AI or by humans? I have tested three popular AI writing tools - ChatGPT, Claude, and Gemini - to see how easy it was to spot their writing. I ran three different tests on each one using a special computer program called "GPTZERO" which uses deep learning and deep analyzers to check if writing is done by AI. I found out that Claude was the hardest to catch, with only 15-41% of its writing being spotted as AI. ChatGPT and Gemini were much easier to catch, with their writing being spotted as AI 100% of the time in most tests, though sometimes they did better and were harder to catch. This research helps us understand which AI writes more like a real person and how well AI detector tools work at spotting AI-written text.

8 MC 701

Russell, Nolan; Wagnon, Tim

Swanson Middle School

The Effects of Data Age on Accuracy of a Predictive Model

Our science project is about the Effect of Data Age on Accuracy of a Machine Learning Model. Our hypothesis is that we think if the data age increases, then the accuracy of the predictive model will decrease because data has changed over time that the model is unaware of. For our project, we used one year of USGS water gage data to train a Random Forest ML model, which we then analyzed the accuracy of predicting dissolved oxygen one day, one week, and four weeks in the future. For the machine learning (ML) model, there are three categories: supervised, unsupervised, and reinforcement learning. Since we are predicting numerical values (dissolved oxygen) based on factors (Temperature, Turbidity, pH, Specific Conductance, and Current Dissolved Oxygen) we chose a supervised model. A supervised model works by inputting a labelled dataset, which means that each input has a corresponding output. From the types of supervised models, we are using a random forest model. Random forest models are good for regression, which is what we will be using it for. They work by having decision “trees” where the model takes a datapoint down one branch of a tree based on the factors. After running the experiment, we concluded that our hypothesis was supported, and that the model did become less accurate the older the data got. However, the Flatlick Branch data was overfitted to the data, and had slightly different results.

9 MC 702

Kuoh, Michael

Yorktown High School

The Effect of Seasonal Conditions on the Effective Reproduction Number of COVID-19 in Maryland

This experiment tested the effect of temperature and absolute humidity on the effective reproduction number (R_{eff}) of COVID-19, using Maryland infection and vaccination data from 2021 to the present. It predicted that if R_{eff} is found for April through August from 2021-2023, and also found for November through March for 2021-2024, in the 10 most populous Maryland counties, then the R_{eff} for the colder and drier months will be higher than the warmer and more humid months. I used a SEIR compartmental model to model COVID-19 transmission and found a specific mathematical equation for R_{eff} . Using python, daily infection and vaccination data was processed for each of the counties and for each of the six time periods, and numerical integration methods and nonlinear regression methods (Least Squares Lost Function) were used to find infectious curves that “best fit” the real-world data. The “best-fit” R_{eff} values were then derived from the “best-fit” curves. 30 trial results were obtained for the control group (summer months) and 30 trial results were obtained for the experimental group (winter months). Result of the Pair-T test showed a statistically significant difference between R_{eff} for the colder and drier winter months (one-tailed $p=0.003$, two-tailed $p=0.006$, mean difference of -0.2537). Pearson correlation analysis showed a moderate correlation ($r=0.419$) between temperature and R_{eff} and a moderate correlation ($r=0.406$) between absolute humidity and R_{eff} . These results confirmed my hypothesis that R_{eff} increases in the colder and drier months, but only moderately.

9 MC 703

Seyran, Zeynep

Washington-Liberty High School

eZpython ©, A Higher Level Programming Language, on the Relationship Between the User and Microcontroller.

eZpython © is a higher level programming language, designed to improve user-microcontroller interaction by reintroducing hardware aspects, such as 12C connection, debouncing, and display handling. Replacing redundant code blocks with transferable functions makes development more efficient for advanced programmers and understandable for a beginner. By lowering the barrier to entry, eZpython expands accessibility of the computer science field to invite marginalized individuals.

A series of 4 programming tasks: Debouncing, initialization, basic image load, and advanced image load, were executed using the traditional libraries - derived from the official Adafruit website for the sh1107 - and the eZpython functions to determine the hypothesis: If eZpython module functions were utilized, rather than the standard functions for a circuit python board, then eZpython method will require the least amount of lines because of the effect of eZpython's functions on the lines of code required.

Results supported the hypothesis that eZpython would require less lines to execute all programming task groups. Exact results: Initialization (14:18), debouncing (26:31), basic image load (16:22), and advanced image load at 17:29. A Mann-Whitney U test yielded a statistically significant P value of 0.01208.

eZpython retains program sophistication while simplifying syntax, allowing transferability across models, customizability, and significantly lowering the line count. To drive impact eZpython hosts an educational website, open source Github library, and the eZpak - a microboard setup kit. A solid foundation and proof of concept for eZpython to grow from a wrapper language into an self-sufficient offshoot, gaining recognition within the developer community.

10 MC 704

Clarke, Tess

Alexandria City High School (includes Minnie Howard)

Using Machine Learning to Diagnose Breast Cancer

My project uses a K-NN Machine Learning Model (K-Nearest Neighbors - a supervised branch of machine learning) to diagnose benign and malignant breast cancer tumors. The premise was to adjust this model to have the most accuracy in its diagnoses. In such a rapidly growing field, where artificial intelligence/machine learning is being used for almost anything, it's important to consider where it can be most meaningfully applied and hone in on its accuracy in those tasks. Using this machine learning to diagnose tumors will save time and eliminate human error in diagnosis. The specific question my project posed was: how can we best train this model for accuracy by adjusting its K-Value? (The K value being the number of nearby pre-existing points on a graph, considered in the machine's diagnosis of a new one.) I guessed that the most accurate K-Value would be 5. To test this, I had the model diagnose tumors with K-values 1-450, and report back the accuracy score for each. (Measured as correct predictions/total predictions.) What I found is that the machine is most accurate when K is equal to 2 and 4, with steadily declining accuracy as the K value increases. This is due to the nature of the machine, in that as it considers more and more neighbors on the graph, they become less relevant and begin to conflict with each other, so as more neighbors are considered, the accuracy is naturally decreased.

10 MC 705

Cohen, Gabriel

Yorktown High School

Binary Classification of Human and AI-Generated Music Using a Convolutional Neural Network

There is a growing need to develop accurate methods to detect AI-generated music. Tools for written text exist, such as ZeroGPT and CopyLeaks, but a sufficient tool does not exist for music. This research involved creating a machine learning pipeline to distinguish between AI-generated and human-composed Electronic music. The pipeline processes audio files by converting them into a series of Mel Frequency Cepstral Coefficients (MFCCs) and analyzing one-second segments of audio with a convolutional neural network. The neural network includes five convolutional blocks and one dense layer. The training dataset comprises 284 songs: human-created music from Bandcamp, Battle of the Bits competitions, and original compositions (148 songs), along with AI-generated music from the platforms Suno and Udio (116 songs). The validation dataset comprises 60 songs: 30 AI songs (from services other than Suno and Udio), and 30 human songs. The model achieved 97.9% training accuracy and 81% validation accuracy when all 1-second segments were pooled. The model evaluated full songs by calculating an "AI-generation confidence score" - the percentage of one-second segments classified as AI-generated within the song. The confidence cutoff was 60%, which was chosen before the evaluation. The model had 83.33% sensitivity (rate of true positives, where the positive class is 'AI-generated') and a 90.00% specificity rate (rate of true negatives). The model is effective for detecting AI-generated Electronic music and generalizes to detect a variety of AI music-generation services that were not in its training set.

10 MC 706

Hazari, Jasmin

Washington-Liberty High School

Effect of Low-Resource Languages on Automatic Speech Recognition Pre-Trained Datasets

This experiment was conducted to investigate the effects of training datasets on different languages, specifically high and low-resource languages. A high-resource language has abundant data resources available for natural language processing, while a low-resource language has limited data. The hypothesis was that increasing training data for a low-resource language would decrease the Word Error Rate (WER) of the Automatic Speech Recognition (ASR) system, as the software learns through repeated training. The independent variables were the languages: English (control, highest resource), Filipino, Gujarati, and Marathi.

Each language was tested with 10 phrases, each containing 30-40 words. Proper nouns were excluded to eliminate the possibility of cognates. Audio files of the phrases were processed by a self-developed speech-to-text transcriber, which interpreted the spoken phrases and displayed them as text. An ANOVA test showed a p-value of 2.50×10^{-24} , rejecting the null hypothesis that decreasing training data for a low-resource language would result in no difference in WER. Data supporting the hypothesis was evident in each trial's results. For Marathi, the initial trial had a WER of 0.72, which decreased to 0.56 in the final trial. While the WER for Marathi was higher compared to English, it demonstrated that more training data reduced the WER in each trial.

This experiment is significant for the preservation of low-resource languages in digital formats. It could potentially be enhanced to provide access for speakers of marginalized languages who are excluded from technological use due to language barriers.

10 MC 707

Sirak, Sam

Alexandria City High School (includes Minnie Howard)

TumorRiskEdu: A Machine Learning-Based Application for Brain Tumor Detection and Education

According to the National Brain Tumor Society, “In 2023, it was estimated that one million Americans were living with brain tumors, with 94,390 receiving a diagnosis.” Brain tumors typically arise from abnormal and uncontrolled cell growth within the brain or its surrounding structures. Early detection is critical to improving patient outcomes, and imaging techniques such as MRIs have proven effective. However, brain tumors often go undetected for extended periods, partly due to the costly and time-consuming process modern-day evaluation techniques require. Additionally, reliance on radiologists, who typically review 30–40 MRIs per day, increases the likelihood of human error. The shortage of trained neurologists in developing countries also limits access to timely and accurate diagnoses, worsening health outcomes. In response to these challenges, I developed TumorRiskEdu, a machine-learning-based application integrating an image classification model and a chatbot utilizing Natural Language Processing (NLP) to improve early detection rates and enhance brain tumor education. The image classification model was trained on publicly available brain tumor datasets, while the NLP chatbot was designed to provide accurate and easily accessible medical information. After much iteration and fine-tuning, the imaging model boasted an accuracy of over 95%, and the NLP component achieved a BLEU score exceeding 0.4. TumorRiskEdu has the potential to be a transformative tool, improving brain tumor screening and education globally, particularly in regions with limited medical resources.

10 MC 708

Yimer, Sabrina

Washington-Liberty High School

Utilizing a Random Forest Model for Glaucoma Diagnosis Through Gene Expression Profiling

Glaucoma is the leading cause of vision loss worldwide, and it is often diagnosed after identifying pre-existing damage to the optic nerve. Additionally, Glaucoma treatment only slows or stops the progression of the disease and cannot restore lost vision. Therefore, early diagnosis is crucial for Glaucoma patients. This project was created to diagnose glaucoma patients, given their gene expression data from the human optic nerve head astrocyte, including gender, age, and race. The hypothesis was that if an AI model is given the gene expression, gender, age, and race of an individual, it can diagnose Glaucoma with up to 80% accuracy because it is a multifactorial disease that is impacted by these factors. The model was created using gene expression data with a p-value lower than 0.05; therefore, the model provides a relevant analysis. The model's data came from the Gene Expression Omnibus dataset GSE9963. A Random Forest Model, a machine learning model built under the concept of decision trees, can successfully recognize underregulated and upregulated gene expressions; therefore, it was utilized. The results showed an accuracy of 92% in a test set of 25 with two false positives, and it also stated that Gene DMPK had the largest impact on the diagnosis in the model. In future studies, one can collaborate with scientists to access large datasets of gene expression data to create a more complex machine learning model.

11 MC 709

Lach-Hab, Nadia

Washington-Liberty High School

Mathematical Interpretations and Diagnoses of EEG Seizure Data: Highly Accurate Mathematical Model for Automated Diagnosis of Pediatric Seizures from EEG Data

The purpose of this experiment is to examine the mathematical relationships that exist within electroencephalogram (EEG) data and to determine if those relationships can help diagnose pediatric seizures. There is currently no cost-efficient automated way to detect seizures solely based on EEG data. This research aims to find a reliable way to detect seizures by determining the relationship between the discrete energy differences of pediatric seizure EEG data and pediatric non-seizure EEG data. A neural network was coded to analyze the discrete energy differences and classify EEG data into seizure and non-seizure groups with an 87% accuracy. The discrete energy differences between the two groups were statistically different, so the null hypothesis was rejected. Non-seizure data had higher discrete energy values, indicating that the EEG graphs for the seizure group's discrete energy differences were smoother overall and had less distinct changes between the relative minimums and maximums. This project highlights the importance of examining mathematical properties, such as discrete energy, to indicate seizure activity. This project was the first to successfully apply discrete energy to medical research. This neural network could be expanded to help automate seizure diagnosis in pediatric patients in real-time, assisting healthcare professionals. Notably, since the project was developed at no cost, it can also be applied to low-income communities, ensuring broader access to essential healthcare technology.

11 MC 710

O'Reilly, Brendan

Yorktown High School

An Investigation of Discretization of Differentiable Scalar Fields, as a Means of Procedural Generation Without Artifacts

The goal of my project was to create a C++ program that autonomously generates voxel-based video game worlds and allows a player to explore them. Through this project I was able to teach myself complex procedural generation algorithms, as well as numerous advanced math and computer science topics. My program also automates the arduous process of handcrafting game worlds, allowing it to be used as the foundation of a larger game.

For this project, I coded my own algorithms that analyze and combine many white noise, Perlin noise, and fBM noise maps to procedurally generate unique worlds for each starting seed chosen from over two billion options. These worlds are then generated and rendered around the player dynamically using the multithreaded chunk system, allowing the player to explore these near infinite worlds as they please.

My project contains over 3,500 lines of interconnected C++ code, working together to generate these worlds and let the player explore them. These worlds feature mountains, plains, beaches, and lakes, as well as decorations such as plants and trees. My code is published online for anyone else to use under my GitHub: github.com/BrendanO123. If I had more time to work on this project, I would like to experiment with more generation algorithms and add more detail to the terrain through features such as rivers, caves, and diverse biomes.

11 MC 711

Elmagraby, Mya; Khalifa, Tarek

Washington-Liberty High School

Creating a Tool That Transcribes and Summarizes Lectures Into an Adaptable, Notes Format

This project aimed to streamline the note-taking process in educational settings by using machine learning. The end result was a machine learning based tool with the ability to transcribe speech onto the text editor, and summarize it, atomizing the note taking process. The language model used to summarize utilized the block-based text editor features such as tables, headers, and equations. An experiment was conducted comparing two customized language models with and without the help of the tool on online video lessons, and their performance over 50 trials on practice quizzes. Statistical analysis revealed p-values around 0.01, and results showed 28 points more for the model using the summarized notes provided by the tool than the points for the model using the raw transcribed audio from online video lessons. Due to the data, the hypothesis “if the tool is used, higher effectiveness and understanding will be displayed by the model with the summarized notes” was found to be true. The primary goal of this tool was to increase efficiency and accessibility for students in class, giving them the ability to focus more on critical thinking and engagement rather than the mechanics of note-taking. By harnessing modern AI capabilities in language modeling and neural networks, the tool successfully addresses the need for more adaptable and inclusive educational technology, setting a foundation for future development and broader application.

12 MC 712

Shi, Ziyi; Li, Meipan; Peng, Ho Ming Tim

Veritas Collegiate Academy

Anti-aging Effect of WGX-50: A Comprehensive Experimental and Theoretical Study

WGX-50 is a tested drug candidate for Alzheimer's disease derived from *Zanthoxylum bungeanum* Maxim, or the so-called "Sichuan Pepper". Ever since the discovery of its potential beneficial treatment for the disease, its pharmacological actions for long-run benefit of human health had been extensively investigated. However, regarding its anti-aging effect, limited studies demonstrate a direct correlation between the two counterparts for reference. Thus, this work explores the effect of WGX-50 in extending lifespan in *C. elegans* and its impact in conducting to heat shock proteins longevity pathway, in which key genes like *hsf-1*, *hsp-16.2*, and *hsp-90* were transcriptionally unregulated. Four novel hits, namely F44E5.4/.5, sri-40, F59B2.12, K09C6.9 revealed by RNA sequencing, were first tested to be irrelevant to the lifespan extension effect of WGX-50 through RNA interference. The gene *hsp-90* was identified as a potential target for WGX-50 through molecular dynamics(MD) simulations. Density functional theory calculations revealed that WGX-50 acts as an efficient •OH radical scavenger. We also performed extensive all-atom MD simulations on amyloid- β protein ($A\beta$)₄₂ oligomers in the presence and absence of WGX-50 molecules. The binding of WGX-50 with $A\beta$ ₄₂ is mainly through hydrophobic and hydrogen-bonding interactions. Moreover, WGX-50 disrupted the β -sheet structure and K28-A42 salt bridges, leading to a $A\beta$ ₄₂ aggregation inhibition, which may pave the way for the design of more effective drug candidates as well as the utilization of cocktail therapy using WGX-50 for the treatment of Alzheimer's disease. Overall, our findings provided primary insights for the medical use of WGX-50 in anti-aging and long-term healthcare.

7 ME 800

Wagman, Garrett

George Washington Middle School

How Do Different Beverages Affect Tooth Enamel Simulators?

Many people don't stop to consider that what they drink can affect their teeth and overall health. This experiment relates to the real world because approximately 93% of all beverages sold in the United States can cause tooth decay. This experiment investigated the effects of six commonly available beverages, tap water (control), Coca-Cola, cold brewed coffee, Earl Grey tea, apple cider vinegar, and red Gatorade, on a model of tooth enamel, using hard boiled eggs. It was hypothesized that the acidic beverages would cause both staining and weight loss in the eggs' shells due to acid-induced erosion. Egg weight and color changes were measured using a visual tooth whitening scale and an electronic kitchen scale, respectively, over three days. Results indicated that most of the hard-boiled eggs gained weight, whereas the eggs immersed in apple cider vinegar lost weight. All the eggs, except for the control eggs, were stained, especially the eggs immersed in Coca-Cola. These findings suggest that while beverage acidity plays a role in staining and weight variations of the eggs, other factors such as the chemical composition of beverages may also affect experimental results. This experiment relates to life science because it reemphasizes how beverage choices can contribute to overall health and highlights the importance of mindful beverage consumption as a component of maintaining oral health.

8 ME 801

Arul Palaniraj, Vishnuvardhini

Thomas Jefferson Middle School

The Effect of Radioactive Iodine Treatment for Thyroid Cancer on the Risk of Second Primary Malignancies

The purpose of this research was to determine whether or not RAI treatment for Thyroid cancer patients would cause them to be more prone to an SPM. Using three studies from the National Library of Medicine, a data study was conducted to find TC patients who took RAI and TC patients who did not. The SPM rates were taken and constructed into graphs that display which group had the highest SPM rates. The graph was analyzed. The graph shows enough evidence needed to prove that RAI treatment does induce a higher risk for an SPM. This proves that my hypothesis was indeed correct.

8 ME 802

Caparas, Paige

Williamsburg Middle School

The Effect of Various Treatments on Managing the Progression of Childhood Myopia (Nearsightedness)

Myopia (nearsightedness) is a visual condition predicted to affect 50% of the world's population by 2050. Myopia occurs when an eyeball is elongated or the cornea is too curved, causing light to refract in front of the retina rather than on it. Axial elongation length (AEL) measures the progression of myopia by measuring the eyeball in millimeters from the cornea to the retina. This experiment analyzes the efficacy of four myopia treatments to determine the most effective treatment in managing the progression of childhood myopia. Of the four treatments, low-dose atropine eye drops were hypothesized to be most effective. The three other treatments researched were orthokeratology, DIMS Technology spectacles, and dual-focus soft contact lenses. A control trial with no treatments was also researched to determine whether the myopia treatments were effective at all. The four treatments and control group were analyzed using twenty-five published clinical trials. Five trials were researched for each by measuring the AEL over the course of a year. The most effective treatment would produce the smallest AEL. Data revealed the spectacles were the most effective treatment with an average AEL of 0.15 mm, followed by orthokeratology (0.18 mm), soft contact lenses (0.20 mm), and atropine eye drops (0.23 mm). All treatments were more effective than the control (0.31 mm), supporting the efficacy of myopia treatments. In conclusion, this research aims to bring awareness to the projected alarming increase in myopia and various treatments to manage childhood myopia.

8 ME 803

Chen, Avery

Dorothy Hamm Middle School

How Different Factors Increase Cancer Risks: Smoking and Genetics on Scratch

This experiment investigates the relationship between environmental and genetic factors and the risk of getting cancer by using a Scratch code to model the average number of cell cycles that occur before cancer cells develop.

Cancer is the uncontrolled growth of abnormal cells in the body. In 2020, of the 63.5 million deaths worldwide, 10 million were from cancer. Although cancer can be hereditary, hereditary factor cases makeup only five to ten percent of cases. The other ninety to ninety-five percent of cancers are caused by environmental factors. The hypothesis is that if a person smokes or inherits a genetic mutation, then their risk of developing cancer is higher than for a patient with no risk factors.

The Scratch code was run 100 times per level of independent variable (control/no factors, smoking, genetic factor, smoking and genetic factors), increasing the mutation rate used for each level according to presumed risk of developing cancer.

The control patient, with no risk factors, had the highest number of cell cycles before developing cancer. The patients who developed cancer the fastest were the ones who smoked, followed by the ones who smoked and had the genetic factors. The results for patients who smoked and had the genetic factor separately support the hypothesis as the average number of cell cycles for both levels of IV described were lower than that of the control model.

8 ME 804

Eberhart, Jr., Darien

Thomas Jefferson Middle School

Unmasking the Unhealthy Fats: Their Role in Liver Disease

Many people consume unhealthy fats without realizing all of the harm it can cause to their bodies, especially the liver. This project investigates how different types of oils/fats, such as polyunsaturated and monounsaturated lipids, impact liver health. By studying how these fats affect the liver's ability to work properly in processing waste and cleaning the blood, we can better understand their role in leading to liver disease. Since liver diseases are becoming more common, I hope that this project teaches others about the dangers of unhealthy fats and how it can help prevent serious health problems. This research is to raise awareness and encourage healthier dietary choices to protect your liver functions and overall choosing healthy life style choices.

9 ME 805

Carpenter, Kylie

Yorktown High School

The Effect of Moisturizer on Shrinkage of Jell-O

The Effect of Moisturizer on Shrinkage of Jell-O is an experiment designed to test the effectiveness of different brands at preventing transepidermal water loss. This experiment is targeted towards the elderly and teens on acne medications, but could apply to anyone with dry skin. The teenage brain is very susceptible to "popular" or "trending" products that might not work as well as less common brands. This experiment works by applying moisturizer to the top of a petri dish filled with jello with daily weight checks. As the weight steadily decreases over two weeks, it can be seen how much water evaporated through the moisturizer. The results of this experiment was that Aquaphor retained the most water with a final weight of 59.56 grams. Bubble came in second (51.79), CeraVe in third (50.83), and finally Nivea in a close fourth (50.78). These values clearly show the difference in high petrolatum concentrated moisturiser instead of low. I had a final P value of 0.001187 which rejects the null hypothesis. An extension to this experiment would be to add in another petrolatum based product like vaseline to further compare it to Aquaphor. This experiment has the potential to help people of all ages achieve healthy and hydrated skin in dry winter months.

9 ME 806

Jolly, Avaani

Yorktown High School

The Effect of Cleaning Techniques on Food Allergy Presence

Food allergies must be taken seriously, regardless of severity, as even minor cross-contamination can lead to hospitalization or worse. This study evaluated the effectiveness of different cleaning techniques in reducing allergen cross-contact, focusing on egg, a common allergen. Cross-contamination occurs when allergens are unintentionally transferred between foods or surfaces, posing serious risks, especially in public spaces like restaurants.

The experiment tested four cleaning methods to determine their effectiveness in allergen removal: no cleaning (control), dry paper towel, wet paper towel, and a soapy water solution. An egg batter was applied to a silicone mold, cleaned using each method, and then coated with flour to simulate a new dish. The flour was analyzed using AlerTor sticks to detect residual egg protein. A positive result on the AlerTor stick indicated the presence of allergens and ineffectiveness of the cleaning method.

Results showed that the soapy water solution was the most effective, reducing allergen presence to 20%. In contrast, dry and wet paper towels left behind 60% of the allergen, while unclean surfaces (control) retained 100%. These findings highlight the importance of proper cleaning practices in minimizing cross-contamination risks and creating safer environments for individuals with food allergies. Future research could explore additional cleaning methods and other allergens.

10 ME 807

Fitzgerald, Maya

Alexandria City High School (includes Minnie Howard)

Radiation Separation: The Effects of SPF Level and Sunscreen Type on UV Radiation

Ultraviolet radiation can cause great damage to the human body and most directly to the skin. The skin is the body's first line of defense and it is key to protect and prevent it from unnecessary harm. The purpose of my experiment was to test how SPF level and sunscreen type affects the amount of UV radiation detected from a UV/blue light. My hypothesis was that if three different amounts of SPF in sunscreen lotion and spray are tested, then sunscreens with the highest level of SPF will prevent the most amount of UV radiation exposure and the lotion sunscreens will block more UV radiation than the spray. I completed a total of 18 trials across two types of sunscreens (lotion and spray) and three levels of SPF (30, 50, and 70 SPF). For each trial, the amount of UV radiation from the light was recorded before and after applying the sunscreen. The average amounts of UV radiation recorded from each type and level of SPF were the following: SPF 30 Spray: 4.66, SPF 30 Lotion: 2.66, SPF 50 Spray: 3.16, SPF 50 Lotion: 1.66, SPF 70 Spray: 1.33, SPF 70 Lotion: 0.33. In summary, my hypothesis was proven correct by the data that states the amount of UV radiation recorded decreased as the level of SPF increased and when sunscreen lotion was used instead of sunscreen spray.

10 ME 808

Fan, Jerry Jiayu; van Linden, Maria

Veritas Collegiate Academy

One-pot Assay for Rapid Detection of Hepatitis B Virus by Combining RPA and CRISPR/Cas12 in Saliva

Hepatitis B caused by the Hepatitis B virus (HBV) remains a global public health problem, with statistics indicating that 254 million people worldwide will be infected in 2022, causing 1.08 million deaths. Chronic HBV infection is very common in the Western Pacific region, especially in China. Currently, HBV testing detects HBV surface antigen (HBsAg) in the blood, which requires patients to visit a specialized facility to be tested, which limits people's ability to learn about their health in the early stages of the infection, and the low sensitivity of antigen detection test strips, which undermines confidence in their use. Moreover, there is no specific drug for treating hepatitis B, and existing therapies cannot eradicate the virus. Therefore, early detection of hepatitis B virus, so that patients can understand their infection as early as possible, is an important way to control the source of infection and cut off the transmission pathway. Therefore, it is meaningful to develop a rapid and convenient detection system with high sensitivity. Here, we constructed a rapid HBV detection system using RPA and CRISPR/Cas12a and self-developed hardware, which is simple, inexpensive, and highly sensitive, and can be used for rapid HBV detection at home, especially in low-income countries.

11 ME 809

Madison, Kaitlin

Washington-Liberty High School

Investigating the Relationship of Ataxia Telangiectasia Mutated (ATM) and BRCA via the DNA Repair Pathway

Ataxia Telangiectasia Mutated (ATM) encodes ATM kinase, a signaling protein within the checkpoint kinase pathway, a cellular mechanism needed for the detection and repair of DNA double strand breaks (DSBs). Without this pathway working correctly, DNA DSBs are falsely repaired, resulting in three life-limiting symptoms of the disease: progressive ataxia-causing neurodegeneration, immunodeficiency, and cancer susceptibility. Currently, there is no way to prevent the mutation of the ATM gene due to its genetic makeup. ATM is located on chromosome 11 and is a sex linked gene. It is a very large gene that codes for a multitude of proteins, thus having the potential to create many mutations. Significantly, mutations are scattered throughout the coding region making it difficult to identify mutation rich areas. This creates a problem for researchers trying to prevent cancer as gene therapy is mutation specific. However, similar genetic research has proven useful. BRCA mutation, which is the mutation of either the BRCA1 gene or the BRCA2 gene (both tumor suppressor genes), increases the risk for breast cancer. The similarities between the two stem from ATM's phosphorylation and activation of several downstream effectors for apoptosis, cell cycle arrest and DNA repair, including CHK1, CHK2, BRCA1/BRCA2, CtIP, p53, Mdm2, RPA, c-Abl and Rad51. Thus, this experiment aims to determine if a type of molecular consequence is increased in BRCA and ATM in patients where the mutation caused breast cancer. Its intent is to also show the interactive roles of ATM and BRCA in the DNA-damage response.

11 ME 810

Uddin, Maqsuda

Wakefield High School

The Effect of Photonic Stimulus Duration on Retinal Image Persistence and Neural Adaptation in Visual Perception Mechanisms

The human visual system relies on retinal and neural adaptation to process light stimuli. Afterimages occur when photoreceptor cells in the retina become overstimulated, resulting in a lingering visual impression after the stimulus is removed. This study investigates how the duration of light exposure affects afterimage persistence and intensity. We hypothesize that longer exposure times will produce more persistent afterimages due to increased retinal adaptation and neural processing. Participants were exposed to a light source in a controlled dark room at distances of 1–2 feet. Exposure durations varied across five trials (3, 5, 7, 10, and 15 seconds), with a 30-second recovery period between each. After each exposure, participants closed their eyes and reported afterimage duration, intensity, and any perceptual changes. Preliminary observations suggest that increasing light exposure duration leads to longer-lasting and more intense afterimages. Participants reported that afterimages were more vivid and took longer to fade following extended exposure. These findings support the hypothesis that retinal photoreceptors require more time to return to baseline activity after prolonged stimulation. This study enhances our understanding of visual perception and neural adaptation mechanisms. The results may have implications for treating visual perception impairments and contribute to research on sensory processing disorders. Future studies could explore variations in light intensity and color to further elucidate the relationship between stimulus properties and afterimage effects.

11 ME 811

Zhang, Lingyue Joyce; Du, Qingyou

Veritas Collegiate Academy

Portable Multi-Target Detection for Colorectal Cancer (CRC) via ncRNA and cfDNA (PMT-CRC)

Colorectal cancer (CRC) is the second leading cause of cancer-related deaths, with approximately 930,000 deaths projected in 2024. Current screening methods such as colonoscopy, FOBT, and FIT face challenges like invasiveness, inconvenience, and dietary restrictions, leading to low compliance. To address these issues, we propose a rapid, portable, non-invasive detection system targeting CRC biomarkers, including cell-free DNA (cfDNA) and non-coding RNAs (ncRNAs), which are abundant in body fluids and strongly linked to CRC progression.

Our platform combines Branched Rolling Circle Amplification (BRCA) and CRISPR-Cas12a technology to achieve high sensitivity and specificity. Using a padlock probe for target binding, BRCA amplifies the signal, while Cas12a-mediated fluorescence activation provides visual readouts. This isothermal assay operates in 10–20 minutes with simple hardware, making it suitable for at-home CRC screening.

Validation experiments demonstrated sensitivity comparable to qPCR and RT-qPCR, with additional advantages in speed and accessibility. Specificity tests confirmed reliable discrimination against non-target sequences, including mutations. A cost-effective hardware prototype with LED fluorescence detection and automated sample processing further supports multi-sample analysis. This innovative system integrates molecular precision with hardware simplicity, providing a promising tool for early CRC detection. Future efforts will focus on clinical validation, cost reduction, and broader integration to enable widespread adoption.

12 ME 812

Chopra, Naya

H-B Woodlawn Secondary Program

Targeting CEACAM-1 Using Small Molecules to Develop Novel Cancer Immunotherapies

Cancer, a pervasive and complex disease, poses a significant challenge to global public health, affecting millions worldwide. Recent advancements in immunotherapy have revolutionized cancer treatment by utilizing the immune system to target tumors. CEACAM-1 (carcinoembryonic antigen-related cell adhesion molecule 1) plays a significant role in tumor progression and metastasis. It is a type I membrane protein involved in immune modulation and cell adhesion. Recent studies highlight its potential as a therapeutic target in cancer immunotherapy. The shift towards small molecules as alternatives to antibodies addresses limitations such as poor tissue penetration and immunogenicity, offering improved pharmacokinetic properties and the ability to target intracellular proteins. Binding sites in CEACAM-1 were analyzed using computational tools, including Prankweb, Protein Plus, and ZincPharmer. These were then docked using SwissDock to predict binding affinities. These findings may contribute to the development of more effective cancer treatments, addressing the urgent need for innovative therapeutic strategies in oncology. In conclusion, our study underscores the potential of CEACAM-1 as a target for cancer immunotherapy. By identifying a lead compound with a ΔG score of -9.45 kcal/mol, we provide a promising starting point for the development of CEACAM-1-targeted therapies. This compound's strong predicted binding affinity suggests it may effectively modulate CEACAM-1 function, potentially enhancing anti-tumor immune responses. However, experimental validation is crucial to confirm the efficacy and safety of the identified compounds. This research highlights CEACAM-1 as a promising target for cancer immunotherapy and identifies potential small molecule inhibitors. Future work should focus on biophysical screening and cellular validation to

12 ME 813

Mohanty, Anna

Washington-Liberty High School

RNA Knot: Topological-Based Prediction of Proviral DNA Expression

The topology of viral RNA determines the presentation of m6a methylation modification sites to enzymatic writer complexes. In the context of HIV-1 neurocognitive disorders, m6a epitranscriptomic tagging promotes immune evasion of gag protein coding regions, causing neuroinflammation. This is facilitated by the RBM15 protein recognizing and binding to knot-like tertiary features of U-rich regions so it can act as a site marker for methyltransferase. Therefore, in-vivo RNA deformation agents like microRNA are promising drug candidates. However, current RNA tertiary structure prediction softwares rely on free energy minimization, which does not apply to intermediary functional states that emerge during accessory protein interactions. The software presented instead works by converting the atomic coordinate map of an oligonucleotide to a spherical planar knot, where the weights of each node are defined by the nucleic acid base. Sequences of Reidmeister moves and randomized canonical base pairing are iterated to optimize the Laplacian curvature of the knot so that multiple primer binding sites can be simultaneously expressed. An energy density heat map is then generated, from which high binding-affinity sequence sites are extracted. Furthermore, RNA Knot simulates the effects of sequence-specific ligand binding by inducing downstream stem loop formations to stabilize docking. This approach identified a region of methylome Peak 12 in the HIV-1 genome (base 8450-8480) as a target for microRNA-mediated inhibition. The model showed an 88.2% accuracy rate and an 83% sequence validity. Overall, RNA Knot could identify viral RNA drug target loci for both neural and drug resistant infections.

9 MI 900

Baba, Nina

Washington-Liberty High School

The Effect of Different Plant Extracts on the Growth of *E. coli*

Antibiotic resistance is a growing problem. By studying the effectiveness of natural compounds against bacteria, scientists can apply this knowledge to the modern medicine world. The purpose of this experiment was to determine the effect of different plant extracts on the growth of *Escherichia coli*. The independent variables tested were different types of plant extracts, and the dependent variable was the average diameter of the zone of inhibition. The plant extracts used were garlic, ginger, and clove, while water was used as the control. It was hypothesized that if garlic were introduced to *E. coli*, then the *E. coli* samples treated with garlic would have the largest zone of inhibition because of the antimicrobial agents (allicin, ajoene, and allyl sulfides) garlic possesses. The results showed that garlic had the largest zone of inhibition, with an average diameter of 3.47 cm. However, a T-test conducted between the garlic and clove extract groups showed no statistical significance. Therefore, the hypothesis was rejected. The null hypothesis was if *Escherichia coli* is treated with different plant extracts, there would be no difference in the growth of *Escherichia coli*. An ANOVA test conducted showed that the p-value was 3.57×10^{-4} , which is less than the critical value of 0.05, meaning that the null hypothesis was also rejected. The data collected indicates all three plant extracts are successful in inhibiting the growth of *E. coli*. This agrees with other research- that plant extracts contain chemical groups exhibiting antimicrobial activities, which contribute to the growth inhibition of pathogens.

9 MI 901

Chudiwale, Arya

Washington-Liberty High School

The Effect of Natural Compounds on the Growth of *Escherichia coli* Strain 12 as a Model for Cancer Cell Suppression

The purpose of this study was to investigate the effects of natural compounds on the growth of *Escherichia coli* strain 12 as a model for cancer cell suppression. Cancer treatments often have harmful side effects, and natural compounds may provide safer, more accessible alternatives. It was hypothesized that compounds such as curcumin, turmeric extract, green tea extract, ginger extract, and cinnamon extract would inhibit the growth of *E. coli*, as these compounds have been shown to induce apoptosis and inhibit cell proliferation in cancer cells. The experiment measured the diameter of the zones of inhibition around filter paper discs treated with each compound on nutrient agar plates inoculated with *E. coli*. Results indicated that turmeric extract produced the largest average zone of inhibition (2.89 mm), followed by cinnamon extract (2.82 mm) and ginger extract (2.63 mm), while green tea extract showed the smallest zone of inhibition (0.82 mm). An ANOVA test revealed a statistically significant difference among the groups (P-value was less than 0.05). Pairwise T-tests further identified significant differences between specific compounds, such as green tea vs. cinnamon and green tea vs. cumin. These findings support the hypothesis that some natural compounds can inhibit *E. coli* growth and suggest their potential as anticancer agents. Future research could explore higher concentrations of these compounds, their effects on different bacterial strains, and their mechanisms in cancer cell models. This study contributes to the growing body of evidence supporting the use of natural compounds in cancer treatment.

9 MI 902

Fuelling, Addison

Washington-Liberty High School

The Effect of the Type of Vinegar Used to Make Oxymel on *Staphylococcus epidermidis* Growth

The project investigated the antibacterial effectiveness of oxymels—mixtures of honey and vinegar—against *Staphylococcus epidermidis*. To see if the properties within the vinegar and honey combination have the chance to fight off this bacteria in a natural way, three oxymels were prepared using white vinegar, pomegranate vinegar and apple cider vinegar. The oxymels were 50:50 ratios of honey to vinegar. The bacterial reduction was measured in three directions in centimeters (cm) after growing the bacteria on agar nutrient plates in an incubator. There was a statistically significant reduction in bacterial growth across all oxymel treatments compared to the control (no oxymel used). Based on two t-tests, at the .05 confidence level, there also was a higher degree of bacterial inhibition with pomegranate vinegar and apple cider vinegar oxymels compared to white vinegar oxymel. This suggests that the (unremoved) fruit components in the pomegranate vinegar and apple cider vinegar oxymels contribute to enhanced antimicrobial properties. The ANOVA test that was conducted in this project showed a p-value of 3.14×10^{-26} , supporting the hypothesis that the fruit vinegars may have a synergistic effect with the honey that may increase the antibacterial efficiency. The mean zones of inhibition measured 1.3 cm for white vinegar, 1.7 cm for apple cider vinegar and 1.9 cm for pomegranate vinegar. The results concluded that both fruit vinegars were superior alternatives to the white vinegar for home remedies in treating bacterial infections from wounds, which may fight the issue of antibiotic resistance.

10 MI 903

Abdelbagi, Amna

Yorktown High School

The Effect of the Distance of the UV Radiation on *Saccharomyces cerevisiae* Growth

When yeast is growing, an alternative to kill the fungus is by utilizing UV radiation wavelengths. While this can be better for consumption, it can also kill the cells. This experiment aimed to find the optimal distance of UV radiation light for yeast growth. It was hypothesized that if yeast solutions are distanced differently, the 30 cm distance solution will grow faster due to less cell damage. The independent variables were the distances of UV radiation light; the dependent variable was the yeast cell count. The experimental groups were no UV exposure, 20cm, and 30 cm distances. Three labeled test tube racks contained 10 test tubes, with each test tube receiving 0.6g of yeast, 0.5g of sugar, and 20 ml of water , wrapped with parafilm. The sugar and yeast were measured using a gram scale and the water was measured using a 90 ml beaker. The yeast solution grew for three days before UV light exposure began. Each trial was positioned according to tis experimental group, and after 30 minutes of UV exposure, yeast cell data was collected. Solutions were diluted 10% with 2.5ml of the solution, 22.5 ml of water, and food dye. Samples were taken and observed under a microscope to gather data. The results indicated that the no exposure trials were the most successful at growing yeast. Although the 20 cm and 30 cm distanced UV radiation lights grew, they were less effective due to cell damage from the UV light.

10 MI 904

Desai, Suhani

Yorktown High School

The Effect of UV Light Wavelength on *E.coli* K-12 Growth

This study examines how different wavelengths of ultraviolet (UV) light affect the growth of *E.coli* K-12. UV light can damage the DNA of microorganisms, with the extent of damage varying by wavelength. In this experiment, *E. coli* K-12 was exposed to UVA, UVB, and UVC light. The growth of the bacteria was measured by counting colonies on agar plates. Results showed that for all tested wavelengths, the bacterial colonies grew too numerous to count. This indicates that the UV light exposure was not sufficient to inhibit bacterial growth under these conditions. These findings suggest that factors beyond just the wavelength, such as exposure time and intensity, are important for effective microbial control.

10 MI 905

Elfar, Jada

Washington-Liberty High School

Which High School Bathroom Stall is the Dirtiest?

This study explores bacterial contamination levels in six high school bathroom stalls to identify the dirtiest stall and assess potential risks to public health and safety.

Motivated by concerns about sanitation in high-traffic areas, the research focused on *Serratia marcescens*, a bacterium known for its opportunistic pathogenicity and ability to thrive in moist environments. The presence of this bacterium was used as an indicator of contamination, with measurements taken from nutrient agar plates prepared under strict safety protocols to ensure accuracy and minimize risks to students, staff, and researchers.

The methodology included swabbing each stall, incubating samples, and measuring bacterial growth in millimeters. Despite the hypothesis that the third stall would exhibit the most bacterial growth due to higher usage, statistical analyses, including ANOVA and T-tests, revealed no significant differences between stalls. These findings suggest that stall cleanliness is not solely dependent on usage patterns and highlight the importance of evidence-based cleaning protocols.

By addressing potential health risks and emphasizing the need for targeted sanitation efforts, this research contributes to the understanding of public restroom hygiene and provides a framework for improving safety in school and other communal settings. The results emphasize the importance of proactive measures to reduce bacterial contamination and promote healthier environments for all users.

10 MI 906

Hengst, Sadie

Washington-Liberty High School

The Effect of Different Natural Prebiotic Foods on *Bacillus subtilis*

Probiotics, beneficial bacteria found in the human intestines, have recently gained much publicity as a method of remedying conditions such as irritable bowel syndrome (IBS), symptomized by diarrhea, abdominal pain, and other issues. These helpful bacteria can be supported by the consumption of prebiotics, which are compounds that encourage the growth of certain bacterial species and naturally occur in common foods such as those used for this experiment: garlic, chicory root, and leek. The purpose of this study was to determine which of these three prebiotic foods caused the most growth in the probiotic species *Bacillus subtilis*. It was hypothesized that the chicory root would be most effective due to its high content of a category of prebiotics known as fructans, which is significantly higher than that of garlic and leek. The experiment was conducted by inoculating plain agar Petri dishes with a mixture of *B. subtilis* and one of the experimental groups and incubating for 48 hours each, with the control group having no prebiotics added. The data collected afterward showed that the garlic caused the highest mean growth, at 1.99 cm², and leek had the second highest, 1.33 cm². This did not support the hypothesis, as the chicory root was found to have the least growth, apart from the control, which yielded none. These results suggest that garlic and leek could potentially be consumed along with probiotics in order to help with inflammation and other symptoms of IBS.

10 MI 907

Lyons, Momoka; Thomas, Morgan

Washington-Liberty High School

The Effect of Wet and Dry Foods on Bacteria Transfer

This microbiology experiment investigates whether more bacteria from the floor transfer onto foods with dry or wet surfaces. The experiment explores the themes of bacteria and hygiene, which have garnered heightened attention since the COVID-19 pandemic. This study aims to raise public awareness on the consequences of bacterial consumption from the floor. The hypothesis was that wet foods, like strawberries and grapes, would gather more bacteria than dry foods, such as cookies and bread, due to their often favorable environment for bacterial growth. Petri dishes were prepared with sterilized Nutrient Agar that solidified at room temperature overnight. The food samples of each independent variable were cut into eight 2cm by 2cm squares. These were placed on a sectioned-off area of the classroom floor for 30 seconds before being swabbed onto the dishes. The bacterial growth was measured by the surface area that the bacteria covered on the dish. The results indicate that the Cookie food group had the largest mean bacterial growth at 10.84 centimeters. An ANOVA test yielded a p-value of 0.906 (greater than 0.05), indicating that the null hypothesis cannot be rejected. This indicates no statistical significance, which was further supported by T-tests. Two T-tests were conducted between Group 1 (Strawberry) and Group 3 (Cookie), and Group 2 (Grape) and Group 4 (Bread). T-test 1 deducted a p-value of +/- 0.598 and T-test 2 calculated a p-value of +/-0.964. The experiment shows that potentially dangerous bacteria can transfer onto food surfaces within thirty seconds.

11 MI 908

Allyn, Noah

Washington-Liberty High School

The Role of DNA Repair Systems in Antibiotic Resistance Acquisition: Using CRISPR-Cas9 to Compare HDR and MMEJ in *Escherichia coli* K-12

Antibiotic resistance is currently a major challenge in healthcare. A better understanding of resistance acquisition is needed in order to develop more effective antibiotics. This study investigated how DNA repair systems in *Escherichia coli* K-12 contribute to antibiotic resistance development, using streptomycin as a model aminoglycoside antibiotic. Bacteria fix naturally occurring breaks in their DNA either using homology-directed repair (HDR), where a DNA template is inserted to repair the break, or microhomology-mediated end joining (MMEJ), where small random sequences of free-floating nucleotides are inserted into the break, creating random mutations. This study evaluated these two DNA repair systems in the *rpsL* gene, which encodes for the binding site of streptomycin. Using CRISPR-Cas9 technology from a commercial kit, targeted DNA breaks were induced in the *rpsL* gene of *E. coli*, and two distinct repair approaches were implemented: (a) template-present editing: triggering HDR to insert a synthetic DNA template that had a known resistance-conferring mutation, and (b) template-absent editing: allowing MMEJ to take over and create random mutations. Bacteria were then grown on streptomycin media to assess the efficacy of the repair mechanisms. Results demonstrated that template-present modification inducing HDR yielded, on average, 11x higher colony formation on streptomycin media than the template-absent approach ($p < 0.05$). Even though template-absent modification showed very limited success, it revealed that random genetic mutations through MMEJ could still confer antibiotic resistance. These findings have major implications for developing more effective strategies to combat antibiotic resistance.

6 PH 1000

Gross, Thomas

Gunston Middle School

The Effect of Density on Radiation Blocking Capabilities

In this experiment I tried to find a suitable non-lead alternative radiation blocker. Lead blocks radiation but is extremely heavy and toxic. I tested five alternative radiation blockers: Aluminum, Bismuth, Iron, Titanium, and paper.

My hypothesis was that as the density of the radiation blocker increases, the amount of radiation blocked also increases.

The effectiveness of each blocker was tested by placing the blocker between a Geiger counter and the radiation source (Americium-241 from a smoke detector). The smoke detector releases primarily alpha particles and a few low-level gamma rays. This radiation is not strong enough to harm a human at all, as the radiation cannot penetrate human skin.

The next step was to record the 1-minute average of the radiation dose in $\mu\text{rem/hr}$.

The results showed that the density of a material has a significant effect on the amount of radiation it can block.

This means that dense metals with a low toxicity, such as Bismuth and Iron, make the best substitutes for lead as a radiation blocker.

6 PH 1001

Moore, Mihret

Patrick Henry K-8 School

Ball vs Texture

I chose this experiment because I was interested in learning about how fast or how far a ball can roll on different textures so I chose wood, concrete and carpet. My hypothesis was that if I roll the ball on smooth flooring it would glide more quickly and smoother because of not having any ridges or bumps. To conduct this experiment first get a softball, a ramp, stopwatch, and a meter stick. Second go to the wood flooring and place the meter stick down so the ball can roll past it. Third place the ramp 20 cm up from the floor. Fourth put the ball at the top of the ramp and let it go the same time you start the stopwatch. Fifth stop the stopwatch when it passes one meter. Sixth put your data that you have collected into a data chart. Seventh repeat with different flooring. After following those steps my hypothesis was disproven because the flooring that I thought wasn't going to roll the farthest/fastest, concrete ended up going the farthest/fastest. I think my results came out this way because when doing concrete it was a little windy so my results are not 100% accurate. In the future I would go on a less windy day.

6 PH 1002

Zelenovic, Alec

Gunston Middle School

Better Bats, Better Hits: What Material Matters in High Flying Performance?

In youth baseball, some kids do not have good hitting power and do not feel confident at the plate. The goal of the experiment was to find out which baseball bat material is better for hitters who want additional potential to hit the ball farther.

A batting mechanism was put together to hit baseballs equally with the same force in order to create same conditions for each bat. One composite, two aluminum (1pc and 2pc) and one wood bat were included in this experiment. All these bats were put in the mechanism's bat holder ready to hit the ball. Each hit was recorded for speed and distance.

The composite bat was proven to be the best for being the one with the highest hitting distance, and almost shared the top exit velocity with the wood bat. Based on the experiment, composite material can add 25 percent more power than other materials for the same batter.

This was an important experiment because according to the research by Huei-Min Lin, Kai-Cheng Huang and Ching-chih Tsai, published in the Smart Learning Environments December 2024 journal entitled, "Causal Relationships between Baseball-Team Participation and Academic Performance among Students", good youth baseball players may perform better in school. The final results of the experiment showed that young hitters can have much more power with composite bats. Powerful hitting can lead to more confidence which can contribute to higher academic skills in school.

7 PH 1003

Carpenter, Kara

Williamsburg Middle School

The Effect of the Color of Fabric on the Amount of Ultraviolet Light Absorbed

Ultraviolet burn, otherwise known as sunburn, is a type of ultraviolet radiation that affects numerous individuals across the globe. This damage ranges from irritation to permanent complications. Understanding the results of the effect of the color of fabric on the amount of ultraviolet light absorbed can benefit those with a higher probability of developing conditions related to ultraviolet damage.

Using a UV lamp that produced UVC and UVB rays, I tested the mW/cm (milliwatts per centimeter) reaching my UV testing cards with the same type of Ultraviolet light primarily produced from the sun. White, red, and black fabric was placed as a buffer between the card and the bulb. The testing cards then displayed how much light passed through the fabric.

Results confirmed that the card under the black fabric worked the best, absorbing 0 Mw/cm. The red fabric showed results only in the range of 1-10 mW/cm. The white fabric was in the range of 1-50 mW/cm, and my control (no fabric), was consistently in the range of 1-150 mW/cm.

Researching this project concluded the color of clothing isn't the sole determiner on the amount of Ultraviolet damage that reaches the skin, but the fabric type can be a big factor. Repeating this experiment with different fabric types would be a great extension. Not only will I use this information for the coming summer, but I hope to educate my peers on the harm of UV damage.

7 PH 1004

Carstens, Kaeli

George Washington Middle School

Stay Tuned

The purpose of the lab is to investigate the effects of different types of guitar strings on the length of time a guitar stays in tune. The following procedures were used:

For each guitar string type, the D string was strung onto the guitar. With a tuner placed near the guitar, the guitar was tuned before conducting the experiment for each type of string. Using a stopwatch to record the time, and a metronome to keep a consistent time, the D string was plucked repeatedly (using bends) at an even pace. Once the tuner showed the guitar fell 20 cents out of tune, the timer was stopped and the time was recorded. This procedure was repeated with the same type of string five times, and the entire procedure was repeated using three different types of guitar strings.

The data does not support the hypothesis, because the 80/20 bronze stayed in tune the longest, rather than the phosphor bronze. The data shows that the 80/20 bronze stayed in tune for as long as 19 minutes, and the phosphor bronze two minutes. For example, the graph shows on its first trial, the 80/20 bronze took 11 minutes and four seconds, while the phosphor bronze took one minute and five seconds. The 80/20 bronze lasted 10 minutes longer than the phosphor bronze. Based on the finding, 80/20 bronze guitar strings stay in tune longer than both the silk and steel and phosphor bronze strings.

7 PH 1005

Gamache, Brielle

Dorothy Hamm Middle School

The Effect of Draw Weights on an Arrow's Speed

The reason that I did this project is because I am an avid archer and I wanted to see how fast my arrows went. I tested how fast it went by shooting through a chronograph. My hypothesis was if I use the 20 pound draw weight the arrow will go fastest. The reason that I made that hypothesis was because the faster something is launched then the faster it goes. The materials that I used were a bow and arrow and a chronograph. My bow was a compound bow so it is easier to shoot. My procedure was to step up my chronograph and shoot through it. The next step was to record the speed.

7 PH 1006

McClinch, Evaleen

Williamsburg Middle School

The Effect of Thickness of Body Protector on Force of Impact

The purpose of this experiment was to determine if the thickness of equestrian body protectors reduced the G-force experienced on impact. The international equestrian sport of eventing is in the top ten most dangerous sports in the world, requiring Olympic athletes and the United States Pony Club, as of 1996, to wear a body protector in the cross country phase of competition. However, as of 2024, while body protectors have been rated by the British Equestrian Trade Association (BETA), the American Society of Testing Materials (ASTM), and the Safety Equipment Institute (SEI) as "safe" with different degrees of protection, there are no published metrics on the amount of impact reduction provided by this equipment.

This study hypothesized that body protectors with a greater thickness of foam would have a reduced G-force on impact because thicker material absorbs a greater degree of shock. However, after repeated testing of thin, medium, and thick body protectors this hypothesis was rejected because the body protector with medium thickness produced the lowest average G-force (mean 20.2 Gs), the thickest body protector model had the second lowest average G-force (mean 23.68 Gs), and the thin body protector had the highest (mean 27.6 Gs). The results of this experiment were unusual because research conducted on tennis shoes indicated a direct relationship between foam thickness and reduced impact force. With different designs in vests, it is possible that more or less rigid support helped to reduce G-force through something other than foam thickness.

7 PH 1007

McQuillan, Gabriela

Williamsburg Middle School

The Effect of the Type of Flooring on the Loudness of the Tap Shoe

The purpose of this experiment was to find a louder tapping surface for performing on stage. This experiment was conducted to find the effect of the type of flooring on the loudness of the tap shoe.

The tap shoe was held 1.2 meters above the floor. The tap shoe was then dropped and the loudest sound the decibel meter registered was recorded.

Wood had the highest results with a mean value of 109.32 decibels. The next highest was tile with a mean value of 99.86 decibels. Finally, marley had the lowest mean value of 98.02 decibels. The level of IV with the highest variation was plastic with a range of 15.3.

This experiment was to determine the effect of the type of flooring on the loudness of the sound of the tap shoe. The tap shoe was dropped from four feet and the loudest sound was recorded. Wood had the loudest sound but plastic had the largest range of variation. This experiment will benefit tap dancers as well as other dancers and musicians.

7 PH 1008

Rahman, Tasnia

Francis C. Hammond Middle School

The Effects of Different Wavelengths of Light on the Interference Pattern of the Double-Slit Experiment

In 1801, the double-slit experiment was first performed by Thomas Young to determine whether light was a particle or wave. The result was: light is a particle which acts like a wave, each one knowing where to go, existing in a superposition. However, the wavelength of the laser is usually overlooked, though it could affect the fringes of the interference pattern. This current experiment was performed to determine the effect different wavelengths have on the experiment's interference pattern (pattern of alternating light and dark bands which appear when the experiment is conducted). I hypothesized that the longer the wavelength, the farther spaced the fringes would be. Three different colored lasers were aimed individually at a time through two slits onto a blank screen, and the distance between the fringes of the interference pattern was measured. With the red laser, the distance between the fringes was 3.06 mm for all three trials, 2.5 mm in all trials, for the green laser, and the distance with a blue/violet laser was 1.91 mm. This experiment demonstrated: the higher the wavelength, the farther spaced the fringes will be. The fringes are where individual particles go with a wave-like behavior, and can help us further explore how light operates. This helps determine what particles may go where or how far depending on the wavelength, and also includes examples of measurements which can help in the vast exploration of quantum technology as everything down to the smallest precise detail matters.

7 PH 1009

Thuma, Aidan

Williamsburg Middle School

What is the Effect of Different Types of Surfaces on How Fast a Puck Moves?

This project has researched whether different types of surfaces affect the speed of a hockey puck. This experiment was to figure out what types of surfaces work the best for practice. The researcher shot a puck on different surfaces using the same force and recorded the data.

After the data was tested the results were recorded and the level of IV with the highest variation was carpet with a range of 8 KPH. However synthetic ice and wood had the lowest amount of variation with both having a range of 3 KPH. Synthetic ice had the highest results with a mean value of 10.4 KPH. In contrast, carpet had the lowest mean value of 1.6 KPH.

The results of this experiment were as expected because according to Britannica School, 2018 carpet had the most friction and the puck traveled the slowest and synthetic ice had the least friction and the puck traveled the fastest. However with the variation in range from this experiment the data is most likely unreliable

7 PH 1010

Garcia, Ethan; Remus, William

Gunston Middle School

The Effect of the Solute in Water on its Ability to be Supercooled

This experiment was made to show how different solutes affect if water can be supercooled in a certain amount of time. This experiment can give scientists different solutes into a beaker with water and surrounding it in ice and then measuring the temperature at 10, 20, and 30 minutes. The data shows that the pure water sample did get the coldest at -2 Degrees Celsius and most of the other tests landed at 0 degrees or above. This information about the supercooling process which is a process that could greatly improve the shelf life of organs making it easier to store them for transplant. The goal of this project was to find the effect of different solutes on the time it takes for water to be supercooled. The procedure for this experiment involved putting various amounts of experiment contributed to the medical industry by providing information that could help sustain organs for transplant.

8 PH 1011

Ayalew, Maedot

Kenmore Middle School

The Effect of Solar Magnetic Flux and Spatiotemporal Interplanetary Magnetic Field Variations on Space Weather Prediction Accuracy

Panic often spreads across regions due to power outages caused by space weather events that damage satellites, disrupting communication, scientific data collection, and financial transactions. Space weather forecasting plays a key role in mitigating the impact of these events. However, forecasting models are prone to errors due to the variability of space weather. This study aims to reduce these errors by identifying which events and their characteristics are most difficult to predict. The analysis compares predicted and actual solar magnetic flux variations and spatiotemporal interplanetary magnetic field (IMF) fluctuations of solar flares, coronal mass ejections (CMEs), and geomagnetic storms through calculating the relevant error. These factors help assess how well the models predict the effects of space weather on both space and Earth. The hypothesis predicts that if the solar magnetic flux variations and fluctuations in the interplanetary magnetic field of solar flares, CMEs, and geomagnetic storms are tested, then the accuracy of space weather prediction will decrease the most when predicting coronal mass ejections. Data supported this, showing the highest standard deviation in predictions for CMEs, indicating the greatest deviation from actual values. The model predicted IMF fluctuations with greater accuracy than solar magnetic flux variations, except for one event in 2022. Based on the results of this study, a new CME prediction model was created with lower error than those used by agencies like NOAA. These improvements enhance the accuracy of space weather forecasting, providing better protection against the harmful effects of space weather events on critical infrastructure.

8 PH 1012

Butler, Helen

Swanson Middle School

The Effect of Counterweight Mass on Trebuchet Projectile Distance

The purpose of this experiment was to see how an increasing or decreasing counterweight mass would affect the projectile distance of a marble launched from a tabletop trebuchet. My independent variable levels were 665g (control), 500g and 830g. Using a tape measure that was 7.62 meters long I launched the marble 10 times per group and measured where the marble initially landed on the ground. It was predicted that if the counterweight mass increases so will the projectile distance. The results showed a positive correlation between the IV and DV in the scatter plot, they also showed a big difference between the levels and fairly consistent data in the dot plot. My scatter plot showed a strong positive trend upwards between the counterweight mass and projectile distance. This supports my hypothesis because the marble went the furthest when the counterweight mass was the heaviest. This is because the more potential energy held by the counterweight leads to the more kinetic energy of the projectile, which causes the projectile (marble) to go further.

8 PH 1013

Hirst, Anders

Gunston Middle School

The Effect of Temperature on Magnetism

I have always loved playing with magnets and noticed that their strength changed in different environments. Magnets play an important role in everyday products such as electric motors, microphones, speakers, electronic and medical devices. Figuring out what changes in magnetism happen at different temperatures could be beneficial because, if a magnet in a motor or generator changes temperature, then it could change how effective it is, or if it would work at all. The goal of this project was to identify the effect of temperature on magnetism. I approached this problem by collecting 30 neodymium magnets, the strongest magnets available, then dividing them into 3 different groups: room temperature, cold and hot. I measured the starting temperatures and magnetism of all of them, then I left one group of magnets out to be room temperature (group A). I put another group of magnets in the freezer (group B), then the last group, I heated in a pan with some water (group C). When all of the magnet groups reached their desired temperature, I recorded the end temperature and magnetism again for all of the magnets. The results were not what was expected: my control group magnetism changed slightly. The magnetism of group B got stronger, and the magnetism of group C had fallen a lot. In conclusion, when magnets are placed in a cold environment, they become stronger, and when placed in a hot environment they lose strength.

8 PH 1014

Rathod, Ishaan

Swanson Middle School

The Effect of Speed on Electric Voltage Produced by Cars

This project investigates the effect of speed on the electric voltage generated by cars using piezoelectric sensors. Piezoelectric sensors convert mechanical strain from vibrations or pressure into electrical energy. The hypothesis is that higher speeds will produce more voltage due to increased pressure and vibration.

To test this, a makeshift road with two lanes was created, and an RC car was used to simulate different speeds. Piezoelectric sensors were embedded in the road, and a speedometer ensured consistent speeds of 3 mph, 6 mph, and 9 mph. The voltage generated was measured using a voltmeter. Ten trials were conducted for each speed.

The results confirmed the hypothesis: higher speeds generated more voltage. This experiment demonstrates the potential of piezoelectric technology to harvest energy from vehicle vibrations, offering a sustainable energy source. The findings suggest that integrating piezoelectric sensors into roadways could contribute to green energy solutions, reducing reliance on fossil fuels and promoting environmental sustainability.

8 PH 1015

Wondimagegn, Beza

Francis C. Hammond Middle School

Cosmic Impact

Cosmic Impact is all about understanding the impact meteorites have on different surfaces. Meteorites come in all shapes and sizes, ranging from large rocks weighing up to 60 tons to tiny pieces of debris, and they hit Earth every single day. This project is designed to study how a meteorite impact forms, and how different factors of each surface influence the size and shape of the crater. In addition, studying meteorite impacts can help us understand Earth's history and the craters formed by many meteorites in the past, and it can also help scientists predict how large a crater will be. My interest in space and astronomy is what lead to this project.

9 PH 1016

Gallagher, James

Yorktown High School

The Effect of Wind Speed on Water Temperature

For my Science Fair Project I chose to measure the effect of wind speed on water temperature. My hypothesis was that as the wind speed increased, so would the rate of temperature loss of the water. In the end my hypothesis was proven right, with an overall average decrease of 2.506 degrees Fahrenheit in the control, 3.966 degrees Fahrenheit with 5.5 mph winds, 4.24 degrees Fahrenheit with 7.3 mph winds, and 4.624 degrees Fahrenheit with 9.1 mph winds. I also ran both a One-Way ANOVA and Correlation statistical tests on my numbers and received an r value of 0.9957 and a P value of $<.0001$, which means that my results are almost certainly real and not a product of chance. In the end, my hypothesis was proven correct through both data and statistical tests, which could allow my experiment to help inform people of the dangers of wind chill, and prevent them from experiencing surprise temperatures that could lead to serious conditions such as frostbite.

9 PH 1017

Herrick, Sam

Yorktown High School

The Effect of Temperature on the Strength of a Magnetic Field

The goal of this experiment is to examine how temperature affects magnetism. In this experiment, a Hall effect sensor, integrated into a circuit, was used to measure the magnetic field strength of four different magnets: neodymium, ceramic, alnico, and flexible at four different temperatures: -19.4°C , 18.8°C , 100°C , and 260°C . The hypothesis predicted a decreased strength at higher temperatures and an increased strength at lower temperatures, with the neodymium magnet the least sensitive to temperature and the flexible magnet the most sensitive to temperature.

All magnets demonstrated a drop in strength at high temperatures, and the neodymium magnet reached its Curie point (loss of magnetism) at 260°C . Below 0°C , the strength of the alnico magnet increased and the strength of the neodymium magnet and flexible magnet remained relatively unchanged, but the ceramic magnet exhibited an unexpected decrease in strength due to its brittle crystalline structure limiting domain mobility. Additionally, the neodymium magnet was the most sensitive to temperature as it was the only one that completely lost its magnetism. The strength of the flexible magnet remained the most steady through all temperature ranges.

There are many applications for magnets, from motors, to transportation, to data storage. Temperature changes can alter the properties of magnets and cause failure in devices that rely on magnets. This experiment provides valuable insight into the temperature-dependent behavior of different magnets. Research like this can help us understand magnetism more, so we can develop safe and efficient materials with customized uses.

9 PH 1018

Shaw, Ryan

Washington-Liberty High School

The Effect of Density and Stiffness on the Speed of Sound through Different Mediums

This experiment was conducted to show how the stiffness and density of materials affect how fast the speed of sound is through different materials. The hypothesis for this experiment is that the speed of sound through a material that is the most rigid and has the least density will be the fastest. Materials that are the most rigid and have the least density will allow sound to travel the fastest. The experimental groups tested, to determine what materials sound will travel the fastest through, were steel, wood, and ice.

For each experiment group the material was set up so that a sound wave could be generated on one end of the material and picked up on the other end with a piezoelectric pickup. The elapsed time for the sound wave to travel through the material was measured using an oscilloscope. The speed of sound was computed by using the measured distance between each end of the material and the measured elapsed time. An ANOVA test showed that the experimental group was statistically significant with a p-value of 1.5747×10^{-16} . Each experimental group was tested at least five times to ensure that the groups were statistically significant. The experiment found that, for the materials used, the speed of sound was fastest in steel.

9 PH 1019

Wilson, Alex

Yorktown High School

The Effect of the Type of Fin on the Height a Rocket Travels

The goal of this project was to see whether a rocket with elliptical fins, swept fins, rectangular fins, triangular fins, or no fins would fly the highest. This was done by attaching fins of similar size and weight to the same rocket. This rocket was then launched with an even amount of force applied onto the launcher for all 15 trials of each of the 5 different fin types. A video was filmed of the launch, and it was rewatched to find and measure the rocket's peak height. The rocket with no fins performed the worst, only traveling 212.5 cm high. This is because it had no stability and was constantly tipping over. Stability is created by fins that grab onto the surrounding air and use it to hold the rocket in place. Since the finless rocket didn't have any fins to do this, it was more likely to tip over and fall. The rocket with the elliptical fins performed the best, traveling 267.5 cm high (over 15 cm higher than any other fin shape). This is because it interacted with the air just enough to stabilize the rocket, while not rubbing against it too much and creating minimal drag. Drag is created when an object rubs against the air, slowing it down and causing it to travel less high. Since the elliptical fin is curved, it had a perfect balance of creating minimal drag while still supporting the rocket.

9 PH 1020

Vajjhala, Kavya; Hutchinson, Genevieve

Alexandria City High School (includes Minnie Howard)

Satellite Science: The Effect of Speed on Satellite Trajectory

Today, thousands of satellites orbit Earth, and the parameters of a satellite drastically affect how it works. So, the experiment aimed to determine the effect of speed on satellite trajectory. We used items such as a paper towel roll, a cookie sheet, and modeling clay to simulate a satellite in motion. Then, we changed the elevation of the paper towel roll to reflect different satellite speeds and altered the height of the cookie sheet to represent Saturn's and Jupiter's distinct gravitational pulls. We observed how far the arc deviated from a straight line. The results showed that when there was no planet and no gravitational pull, a quicker satellite produced a larger arc. When there was a planet, a slower satellite created a larger arc; the hypothesis only supported the no-planet data set. In addition, Saturn and Jupiter had larger arcs overall. Saturn's results were much closer in number than those of Jupiter. On balance, the evidence suggests that a slower satellite may create a bigger arc because the slow satellite takes longer to counteract gravity, leading to a more prominent deviation.

10 PH 1021

Barua, Preontee

Wakefield High School

What is the Effect of Varying Magnetic Field Shapes on Magnetism

The research question of this experiment is: “What is the effect of different shapes of a magnetic field/wire on surrounding, and/or approaching objects?” The hypothesis based on this question is: If magnets with different magnetic fields are approached, and, or surrounded by another magnetic object, then a bar magnet will have the greatest attraction of those objects because of its magnetic field being more spread out compared to a current wire and also having a more outward or externally forced field. And while bar and solenoid magnets display similar formations, the outer field of a solenoid magnet is weaker. Therefore, due to the greater external force of a bar magnet, it will display greater deflection of surrounding magnetic objects than a solenoid, looped, or current magnet.

To test this question, 3 types of magnetic field lines (solenoid, bar, current) were replicated in the form of electromagnets, excluding the bar magnet. Each magnet was set apart by 30.48 cm, then inched closer to a constant bar magnet. The distance at which the attracting force between the two magnets began was noted. The results of this experiment proved the hypothesis correct as the bar magnet had the greatest average distance of 3.23 cm, followed by the solenoid with 110 coils (0.93 cm), the current wire (0.8 cm), and the solenoid with 55 coils (0.37 cm).

10 PH 1022

Chinoy, Eric

Yorktown High School

The Efecct of Shell Shape on the Speed of an RC Car

Reducing aerodynamic drag is key in the design of cars to make them more efficient, saving time and fuel. The easiest way to do this is by creating a smoother outer surface and reducing the size of this surface. This experiment was meant to test how the smoothness and profile of an RC car's shell affected its speed. To do this, 3 varied shells were 3D printed and attached to the RC car, before sending it along a test track to measure a difference in speed. The hypothesis for the experiment was that shells with a smoother and smaller profile would produce a faster car due to the reduction in drag. Testing supported this hypothesis, however a myriad of problems with testing leads to the results being questionable, even if they seem to match the prediction. Further research could be done with larger scale or more complex models to test more realistic examples of drag reduction in cars.

10 PH 1023

Mathew, Nicholas

Washington-Liberty High School

The Effect of Color on the Absorption of Radiant Energy

This experiment was conducted to test if color has an effect on the absorption of radiant energy. The hypothesis for the experiment was that if the color of an object is darker, then the object will absorb more radiant energy and become hotter, because darker colored objects absorb more wavelengths of light, thus generating more heat and raising the temperature. The null hypothesis stated that if the color of an object is changed, then there will be no significant difference in the amount of radiant energy absorbed by that object. The tested groups were the different colors of construction paper, which were white, green, blue, light blue, red, yellow, and black. The dependent variable in this experiment was the temperature in °C and the number of photons emitted per second. The construction paper was put into sunlight for 10 minutes and the temperature was taken using an infrared thermometer. Calculations were done on the averages of the temperatures to determine the number of photons emitted per second. Those results were compiled into a graph. Standard deviation was calculated as well as an ANOVA test, and T-tests. The data collected was statistically significant as shown with the p-value of 1.28×10^{-21} . This means that the data rejected the null hypothesis and supported the research hypothesis. This project has practical applications when considering what colors should be used for roofs and asphalt to maximize the energy reflected or absorbed.

10 PH 1024

Shewchuk, Abigail

Alexandria City High School (includes Minnie Howard)

"Hide And Go Stealth"

Modern-day military technology is all about who can get there first. Competition drives advancement, and so competing groups will either improve upon innovations or work to counteract them. By continuing to research how we can advance our own technology, we can stay ahead of our opponents and drive scientific discovery.

An example of this today is stealth technology. Stealth jets are designed to evade any sensors that are made to identify the plane. My project investigated what wing shape best evades sensing. I hypothesized that planes with rounded wings would be “seen” the least.

To test this, I selected ten wing shapes, then constructed the wings. Afterwards, I built the planes and bought a radar sensor. I then mounted my planes, and began conducting my trials. I placed each plane in three different positions (flat, head-on, and on their sides) at one, ten, and twenty feet away from the sensor. After positioning the planes, I checked to see if the sensor saw them, and recorded the result.

After testing, I reviewed my data. I noticed that the trend only partially proved my hypothesis. This is because a few of the least seen planes had rounded wings, but one did not. That suggested that I should look for another common factor among the least seen wings. In the end, I determined that the wings that protruded the least from the plane body were overall the most invisible to the radar.

11 PH 1025

Leighton, Declan

Yorktown High School

The Analysis of the Effect of Input Power on the Efficiency of a Magnetoplasmadynamic Thruster Using Magnetic Deflection and Phosphor Screen Emission

In modern spacecraft, hydrocarbon-based rockets can only reach a Specific Impulse (Isp) of 300-400s. This relatively low efficiency will be an issue on future, long-distance space missions where the spacecraft cannot carry the amount of propellant needed to produce the change in velocity (ΔV). A possible solution to this is electric propulsion.

Magnetoplasmadynamic thrusters (MPDTs) use the Lorentz force to accelerate a plasma to very high velocities resulting in potential Isp's of up to 4,000s. Currently, electric power sources onboard spacecraft are quite limited, so finding the optimal input power is key to maintaining a high efficiency. The hypothesis of this experiment was that if the input power to a radially configured magnetoplasmadynamic thruster is increased, then the efficiency will increase and then begin to decrease because after a certain power input the inefficiencies will result in diminishing returns. To test this hypothesis a new MPDT and vacuum chamber were designed and created. Several prototypes were constructed, with each iteration solving issues present in the previous. To date, the MPDT system, although not able to produce data, was able to produce and rotate plasma. Additionally, the phosphor screen data collection system was determined to be functioning as intended, making the project a successful work in progress.

6 PS 1100

Co, Juna; Mahoney, Mallory

Patrick Henry K-8 School

Rainbow Plants

We wanted to learn if growing a plant in different colored lights other than sunlight would affect a plants growth? Our hypothesis was if we grew a plant in a purple (violet) light then it will grow the tallest out of all the plants because we learned that the color purple (violet) has the shortest wavelength so it has much more energy/ power. In our experiment we planted bush bean seeds in 8 cups. We put 3 bush bean seeds in each cup and watered the seeds every other day. We watered the seeds with 1/4 cups of water and let the LED lights on for 12 hours. To be accurate we put a timer on the lights for it to turn on and off at 7 a.m. to 7 p.m. We measured the plants in centimeters, and we measured them everyday. This experiment took 15 days to complete. Our results were astonishing but pleasing in the best ways possible. Our results were that the plants grew taller under the red lights versus the purple (violet) lights. Even though the plants that grew under the sunlight did not grow as tall, they were definitely the healthiest plants of all. They were the healthiest out of all the plants because they were green unlike the other plants, their leaves were green and weren't crumpled, and stood straight up.

6 PS 1101

Dihn, Nhi; Ahmadzai, Hajira

Patrick Henry K-8 School

Growth of a Plant Depending On Its Liquid

We wanted to know what liquid would help a plant grow the tallest. So, we decided to make an experiment all about different liquids watered on plants. We did this because it could help people find out which liquid is best for growing plants. Our hypothesis was "If we feed 4 of the same type of plants 4 different liquids, then the plant that gets watered with carbonated water will grow the tallest because the other liquids don't have nutrients for the plant to grow. Our IV for this experiment was the type of liquid each plant got, our DV is the height of each plant, and our CV is temperature, amount/type of soil, amount of liquid, type of seed, and that each plant consistently get's the liquid it got before. The materials we used were tomato seeds, clear containers, ruler, measuring cup, and the liquid types. Our procedure was, we first got clear containers and named them by numbers. Secondly, we planted and watered the plants. Our results were recorded in 4 weeks. These results showed that the plant that was watered with carbonated water grew the tallest because it grew to a height of 6.5 centimeters. In conclusion, we found out our hypothesis was correct and carbonated water helped to grow plants the tallest. These results stated that if we water our plants with carbonated water, then they will grow tall with nutrients to help them grow. This could impact an experiment we do in the future.

7 PS 1102

Birdsall, Lillianna

Williamsburg Middle School

The Effect of the Type of Natural Fertilizer on the Height of the Lima Bean Plant

How does natural fertilizer type effect lima bean plant growth? Gardeners want a natural, low cost, easy to acquire, and environmentally safe fertilizer producing the best growth. This experiment tested 3 natural fertilizers to determine the effect of the type of natural fertilizer on the height of the lima bean plant: used coffee grounds, grass clippings, and organic soil. Using 15 pots, the experiment consisted of five 4 liter pots for each fertilizer type. The plants were watered 3 times per week with 250ml of water. The growth was monitored each week. If the type of natural fertilizer is used coffee grounds, then the height of the lima bean plants will be the tallest because used coffee grounds maintain the pH of the soil at a neutral 6.8 (Kim Pokorny, 2023). This hypothesis was rejected because the mean height of the lima bean plants for used coffee grounds was 0.2 cm while the mean height for the organic soil was 38.5 cm and 19.4 cm for the grass clippings. The used coffee grounds had the least growth. The results were unusual because used coffee grounds are “used to improve soil and kill slugs” (Kim Pokorny) but in this experiment, the used coffee ground plants had minimal growth, while the plain organic soil produced the best results and the grass clippings produced medium results. Future experiments should include changing the amounts of the fertilizers, testing the pH of the soil, and refining the details of the experiment.

7 PS 1103

Fuenmayor, Christopher

Gunston Middle School

The Sound of Growth: Exploring the Effect of Music on Plants

This study explores the effects of sound, specifically classical and electronic music, on plant growth and development. Conducted over several weeks, the experiment assessed variables such as plant height, leaf count, leaf size, and health across three groups: a control group (no music), a classical music group, and an electronic music group. The findings revealed that plants exposed to music grew more consistently and exhibited better overall health than those in silence. While both types of music generated similar benefits, external factors such as fluctuating temperatures and inconsistent watering, presented challenges, impacting growth outcomes. Despite these challenges, the research highlights the implications of using external stimuli, such as sound, to enhance growth, providing valuable insights for both scientific understanding and practical applications, including sustainable agricultural and horticultural practices, offering alternatives to improve plant health and productivity.

7 PS 1104

Scanlon, Harper

Jefferson-Houston PreK-8 School

Which Type of Flower Changes Most from Dye?

This experiment will determine which kind of flower exhibits the most color change when placed in dyed water. I compared 3 different kinds of flowers in order to observe which one's petals showed the most color change.

My approach for this investigation was to put white roses, tulips, and carnations in glasses filled with water, and three drops of FD&C Blue No.2 dye. Then I observed and recorded the color changes each day.

I found that the carnations always showed the most color change. I ran 3 trials to make sure I obtained accurate results. The 3 trials all produced the same results: the carnations reached the darkest shade of blue, while the tulips always stayed the palest.

My science project accurately reached a conclusion using my design criteria. This will help my area of study by informing individuals who want to dye flowers for loved ones on holidays, or arts and crafts projects. Now they will know which kind of flower will yield the most colorful results.

8 PS 1105

Hirschfield, Leyla

Kenmore Middle School

The Effect of the Amount of Table Salt in Water on the Height of Radish Plants

What happens when salt gets into farmers' crops? Do the plants stop growing or do they grow better? The goal of this experiment was to find the effect of the amount of table salt in water on the height of radish plants. There were five trials for each level of the independent variable (No Salt, 14 tsp, 12 tsp). Each plant was watered every two days with 2 tablespoons with the corresponding amount of salt dissolved into the water. All plants were 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 and turned into a graph. The hypothesis was that when salt is added to water, then the radish plants will not grow as tall because when roots are exposed to high sodium concentration it blocks the plant's uptake of water and causes the tissues of the plant to become dry and discolored. The results of this experiment supported the hypothesis because they show that the plants watered with no salt grew the tallest, with an average height of 8.74 cm. The plants watered with 14 tsp of salt and 12 tsp of salt did not grow at all. This data can be very beneficial to many communities because then they can make sure that they are not planting their crops in soil where it will not thrive.

8 PS 1106

Metwaly, Alaa

Thomas Jefferson Middle School

The Effect of Salinity on Arugula

In this project I will be using arugula plants. This plant grows well in the Fall and Spring. If arugula gets exposed to salinity the plant will face discoloration, stunned growth, and may even lead to the plants death. In the first plant I will use a small amount of salt in the after , a moderate portion on the second, and a high level on the third. These levels are enough to cause the soil to mold and create salt crystals. Salinity can cause negative consequences on important factors like the quality of the vegetable or crop and the aesthetic traits on arugula plants. Arugula can stand up to moderate salt levels. Meaning the plant of focus is going to be the high salinity level plants. I will be keeping the plants inside the apartment in case it rains or snows in the future. This plant should take 20 to 50 days untie we are able to harvest it's leaves.

8 PS 1107

Szeto, Michael

Thomas Jefferson Middle School

The Effect of Hornwort (*Ceratophyllum demersum*) on the Absorption of Nitrates from Organic and Synthetic Fertilizers in Water

The purpose of this experiment was to see if hornwort (*Ceratophyllum demersum*) would filter nitrates more quickly from synthetic or organic fertilizer pollution. This would identify which fertilizer's nitrates are easier for plants to filter out before the development of harmful algal blooms. Synthetic fertilizer and organic fertilizer were mixed with pond water in separate containers in order to make water samples with a nitrate concentration of 80 ppm. The mixture sat for a week to allow bacteria to convert the nitrogen to nitrates. 6 glass jars were used: 4 of them with hornwort and 2 without hornwort. Two jars with hornwort and one without had the synthetic fertilizer solution. The other three had the organic fertilizer solution. The amount of nitrates was measured using Aquarium Multi Test Strips every day for a week and recorded.

The hornwort filtered out the synthetic fertilizer more quickly than the organic fertilizer by two days. The synthetic fertilizer came in the form of urea, which released ammonium that could be converted into nitrites and nitrates through the nitrogen cycle, while the organic fertilizer came from amino acids and peptides that had to be broken down before being converted to nitrates. Therefore, the synthetic fertilizer nitrates were filtered out of the water more quickly than the organic fertilizer, suggesting that nutrient pollution from synthetic fertilizers is easier for plants to extract than organic fertilizer pollution.

8 PS 1108

Tran, Y-Lan

Williamsburg Middle School

The Effect of the Type of Greywater on the Height of a Plant

This experiment measured the impact of greywater on plant growth to evaluate its potential use in agriculture. Reusing greywater, which is wastewater from washing hands, dishes, or laundry, would not only help to conserve fresh water, but would also reduce the burden of treating certain wastewater types. Greywater was simulated by using solutions of water plus castile soap (sink greywater), dish detergent (dish greywater) and laundry detergent (laundry greywater), with tap water as a control. The dependent variable was the height of the plant (bean plant) measured at two weeks. The results showed that sink greywater produced the tallest plants, with a mean height of 9.78 cm. This was greater than tap water (mean = 7.14 cm), laundry grey water (mean = 3.58cm) and dish greywater (mean = 1.66cm). High variability in the results indicates issues with the reliability of the data. The hypothesis that sink greywater would produce results similar to tap water was partially supported, since sink greywater outperformed the control. It's possible sink greywater positively influenced growth due to the properties of castile soap. Dish greywater and laundry greywater produced lower growth, indicating a possible negative impact on plants from synthetic surfactants. The high range may indicate inconsistent seed quality. In addition, the experiment used simulated rather than real greywater. Future studies could explore the effects of natural versus synthetic surfactants, analyze actual greywater components, and evaluate varying concentrations of greywater. This experiment shows that greywater has potential for sustainable cultivation of plants.

8 PS 1109

Williams, John

Swanson Middle School

The Effect of Light Color on Plant Growth

The experiment was conducted to discover the light color that would achieve the quickest growing time of a plant. The independent variable levels were, red UV light, blue UV light, yellow UV light, and UV light. I measured this by measuring the heights of the plants in each group in centimeters every two days for a span of twenty days. If looking at the averages for the final day of raising the plants it seems like the color had an affect on plant growth. However, when looking at the heights of plants in each group individually the heights of the plants on their twentieth day of growth it is shown that many of the plants from different groups had similar final heights showing that the plants absorbed the different light colors equally making a low difference in the plants' individual growth overall. This experiment ended with inconclusive results not supporting the hypothesis that the blue light would make plants grow the tallest.

8 PS 1110

Stern, Charlotte; Salerno, Ella

George Washington Middle School

The Growth Is Shocking: The Effect of Electroculture on Plant Growth

Does conducting more electricity around the plant make it grow higher? In this experiment we tested two types of growing methods on red russian kale plants, growing with electroculture and without electroculture. We wanted to determine how electroculture affects the growth of plants and test the theory that it stimulates higher plant growth. Electroculture can be used as a way to grow plants without the use of pesticides. It is also a more environmentally friendly approach to stimulate plant growth. However, over the course of the experiment, the plants grown without electroculture averaged 3.04 centimeters more growth, proving the theory of electroculture wrong.

9 PS 1111

Camey Gomez, Sarai

Arlington Tech/Career Center

The Effect of Fertilizers on Plant Survival During a Drought

This study investigates the role of fertilizers in plant growth, emphasizing their benefits and drawbacks, and highlighting their indispensable role alongside water. The goal was to determine if fertilizers significantly improve plant survival during drought conditions. The experiment involved growing radish plants in two groups: one receiving fertilizer and the other not. Both groups were subjected to a simulated drought to observe the effects. Data showed that fertilized plants had an average survival time of 16.67 days, while unfertilized plants lasted 11.67 days. Higher humidity levels also helped all plants survive longer. The results suggest that fertilizers enhance plant health and productivity, but cannot replace the essential role of water. Fertilizers and water together ensure optimal plant growth and survival.

9 PS 1112

Karlton, James

Arlington Tech/Career Center

The Effect of Nicotine on Plant Growth

The Purpose of this experiment is to demonstrate the harmful effects of nicotine on developing organisms, like teens, by compiling a visualization of data and images. It is hoped that this experiment can deter teens from smoking, vaping, etcetera. Thirty Zeya Mays Indentata (Dent Corn) were planted in 30 separate containers and split into three groups of ten. Group A was given no nicotine each week, group B was given 0.5ml of liquid nicotine each week, & group C was given 1ml of liquid nicotine each week. Of the three groups the plants in group B grew the highest. This rejected my hypothesis that due to the observed harmful nature of nicotine on human children, if plants are given more nicotine, then they will grow at a lower rate. I used ANOVA to analyze my data. What I found was that there was no statistical, significant difference between the data in the different groups. It would be interesting to retry this experiment with either different drugs or higher levels of nicotine.

10 PS 1113

Lehn, Rachel

Wakefield High School

The Effect of pH on African Violet Root Growth

For this experiment the research question that was asked was what is the effect of pH level on the root growth of African violets. Five liquids with differing pH levels were tested over two trials. The pH levels were vinegar with a pH of 2, vinegar diluted with water with a pH of 4, water with a pH of 7, laundry detergent diluted with water with a pH of 9, and laundry detergent with a pH of 11. The hypothesis for this experiment was that if African violets are in fact impacted by pH level, then vinegar diluted with water that has a pH of 4 will have the largest growth because African violets do best in slightly acidic soil. The data was collected by root growth in centimeters. Water had the highest height (8 cm in trial 1 and 7 cm in trial 2) compared to diluted vinegar (0.15 cm in trial 1 and 0.1 cm in trial 2), thus making the hypothesis incorrect.

10 PS 1114

Lester, Siena

Alexandria City High School (includes Minnie Howard)

Boiling Point Revival

The purpose of my experiment was to determine which water temperature most effectively revives hydrangeas. This research is valuable for florists and plant owners, as it can help extend the lifespan of flowers, reduce waste, and save money. In my experiment, I gathered three vases with different water temperatures. One vase contained cold water, one vase contained warm water, and the final vase had boiling water. I placed a flower into each vase for an hour, measuring the flower height before and after. My hypothesis was that the boiling water would be the most effective in reviving hydrangeas and after three trials, I was proven to be correct. The boiling water sent the flower into heat shock, which caused it to rejuvenate and grow taller. These findings suggest that boiling water can be a practical method for reviving cut hydrangeas, offering a simple solution for flower preservation.

10 PS 1115

Shoffner, Sophia

Washington-Liberty High School

The Effect of The Plant Type on Root Height When Placed in a Microgravitational Environment

This experiment explored if the type of plant grown in a microgravitational environment made a difference in its height. It was hypothesized that watercress would have the highest root height because it has greater amounts of lignin, a plant polymer. The null hypothesis was that the type of plant would have no effect on the height. The experiment was conducted by placing the plant seeds on agar plates and spinning the petri dishes on an electric turntable placed at a 90° angle. Meanwhile, the control groups were the same seed types grown horizontally. The seed type with the overall greatest height in both horizontal and vertical levels was the cabbage, with a mean vertical height of 1.53 cm and a horizontal height of 1.24 cm. An ANOVA test was run for the vertical groups and the null hypothesis was not rejected, likely due to systematic error. However, an ANOVA test was run for the horizontal groups with a p value of 3.96×10^{-5} meaning that the null hypothesis could be rejected for the horizontal group, so there was a significant difference. This supports the hypothesis that horizontal groups would grow better than vertical. It also showed that cabbage was the most successful in growing in different environments. In the future, this data could be used to help future researchers determine what plants they should or should not grow in a microgravitational environment (space).

10 PS 1116

Vargas, Jennifer

Alexandria City High School (includes Minnie Howard)

Growth of Tomato Plants With Fertilizers

In this project we will explore the topic of how the use of fertilizers may affect the growth of plants. To understand this process better, we used the strategy of experimenting to see how fertilizers can significantly impact plant growth by providing essential nutrients that plants require for development, such as nitrogen, phosphorus, potassium, and others. With this we can get into the growth and development of plants and conclude that fertilizers enhance soil fertility and improve production, but also understand that the excessive use of fertilizers may lead to nutrient imbalances, soil degradation, and even environmental issues, like water pollution.

10 PS 1117

Dalton, Arthur; Tesfai, Essam

Alexandria City High School (includes Minnie Howard)

The Future Of Sustainable Agriculture Hydroponics and Beyond

Sustainability is a big focus for people around the world wanting to live their lives so others can do the same, but how does sustainability and agriculture interact? The purpose of this experiment is to investigate different kinds of sustainable agriculture and its effects on watercress. In today's work sustainable agriculture practices are crucial to a better world and by using household materials this project seeks to make agriculture accessible to more people. Using household items like plastic bottles we will create containers and then use these containers to house our plants. We will run the experiment using three sustainable agricultural methods: hydroponics, aeroponics, and direct seeding. The results show that by far the best way to sustainably grow watercress using sustainable materials is hydroponics. The next best way is traditional seeding and finally aeroponics. The data shows that hydroponics final measurement was 9.9 cm, direct seeding's measurement was 9 cm and aeroponic's final measurement was 6 cm. This supports our thesis by directly predicting the outcome of the experiment. This project contributes to wider society by giving everyday people a chance to grow their own food and to do so using items they most likely already have in their house. With this project people now know that hydroponics is the best way to grow watercress with everyday items. Extra work or changes to the experiment would include more tests, testing with different plants, and using other sustainable methods.