

# NORTHERN VIRGINIA REGIONAL SCIENCE AND ENGINEERING FAIR



Arlington  
Public  
Schools



EPISCOPAL  
HIGH SCHOOL

Wakefield High School

March 4, 2023

## TABLE OF CONTENTS

<b>(AS) Animal Sciences .....</b>	<b>2</b>
<b>(BE) Behavioral and Social Sciences .....</b>	<b>9</b>
<b>(BI) Biochemistry.....</b>	<b>18</b>
<b>(CH) Chemistry.....</b>	<b>23</b>
<b>(EN) Engineering .....</b>	<b>43</b>
<b>(EV) Environmental and Earth Sciences .....</b>	<b>68</b>
<b>(MC) Mathematics and Computer Sciences.....</b>	<b>108</b>
<b>(ME) Medical and Health Sciences.....</b>	<b>112</b>
<b>(MI) Microbiology.....</b>	<b>121</b>
<b>(PH) Physics and Astronomy.....</b>	<b>131</b>
<b>(PS) Plant Sciences.....</b>	<b>147</b>

Lorenzen-Schmidt, Luca

*George Washington Middle School*

*Teacher: Breslin*

### How Wolves Adapt to Different Environments

The purpose of the lab is to investigate the difference adaptation wolves make . To conduct this experiment the following procedures were used: I found an online data set and then I coded the data. The data does not support the hypothesis because no adaptation was better, they all did as good as they needed to to find success in the environment. The data show all adaptations sooted their environment. For example, the tundra on the graph shows that They have different adaptations than if it was the desert. Based on the results each environment has different adaptations.

Tregaskis Gordon, Karsten

*George Washington Middle School*

*Teacher: Breslin*

### Observations of Squirrels in an Urban Habitat Without Disruption

The purpose of the lab is to investigate how the two habitats, urban and rural, affect how bold a squirrel is. However, when the experiment was conducted it was too cold for the squirrels in the rural habitats, so the lab was changed to investigate what types of stimuli affect how a squirrel reacts. To conduct this experiment the following procedures were used:

1. First go to the same urban location and take notes on the squirrels with pencil and paper.
2. Then repeat the process at the same time every day for 5 days.

The data does not support the hypothesis because the squirrels reacted to both the humans and other things. The data shows that every time there was a human or car the squirrels reacted. The data also shows that the squirrels reacted to the dogs every time, but never paid any attention to the cars.

Weber, Ryan

*Francis C. Hammond Middle School*

*Teacher: Kochis*

### Does Temperature Affect the Migration Routes of the American-Golden Plover?

The American-Golden Plover is a shorebird that is on the Yellow Watch List which means that their populations are declining. A lot of their habitat is also declining. With the rising temperatures, things aren't getting better. I wanted to find out if the temperature had an effect on the migration routes of the American-Golden plover. From my research, I learned that the plovers migrate in the central flyway in the spring from South America to the Arctic. In the fall, they fly over the Atlantic Ocean from the Arctic and back to South America, occasionally stopping at islands like Bermuda. After my research, I came up with my hypothesis. If the temperature is lower than the monthly average, American-Golden Plovers are more likely to migrate there. For my experiment, I took 3 tracking data of 3 American-Golden plovers migrating South in 2018. I found the average temperature of the month of the location they were recorded. I also found the actual temperature of the day that they were recorded being at a specific location. I compared the average and actual data. From this, I learned that the plovers generally like warmer breeding grounds but have no preference while wintering.

Komlodi, Kira; Seyran, Zeynep

*Thomas Jefferson Middle School*

*Teacher: Holland-Shuford*

### The Effect of Global Warming on the Percent Loss of Honeybee Colonies

The researchers conducted this experiment to find out the effect of temperature increase on the percent loss of honeybee colonies. The independent variable was temperature, and the dependent variable was the percent loss of honeybee colonies. There was no control. The researchers were interested in testing it because bees are critical to America's economy, specifically crop production, and they wanted to see if global warming had any effect on their population. The hypothesis was tested by comparing the temperature to the percent lost of honeybee colonies (all data referring to temperature was provided by NOAA and all data referring to honeybee colony loss was provided by USDA). Because the data was quantitative, projections were included by taking the expected temperature rise for 2100, 2075 and 2050 and comparing it to the unit rate. The researcher's hypothesis was accepted.

Finnegan, Sean

*Swanson Middle School*

*Teacher: Hu*

### The Effect of Different Scents on Worms' Activity

In my experiment I tested the effect of different scents on worms' activity. I measured the worms activity by timing how long it took the worms to travel 50cm towards the scent. My hypothesis was that if I exposed the worms to the orange zest, then they would travel towards the scent fastest. I did my experiment by putting a worm at one end of an enclosure, marking 50cm down the enclosure, and putting a bowl of scented substance past the mark. I then took a video to see when the worm crossed the mark. When I did my experiment, I found that the worms took 91-150 seconds to travel to the orange zest, 318-590 seconds to travel to the water, and 638-955 seconds to travel to the chicken broth. This proves my hypothesis as correct, as the worms traveled to the orange zest much faster than they traveled to the water or to the chicken broth. Because I videoed my experiment, it helped cut down on human error, and because there were no outliers, I believe that my data was not a fluke. However, all of the worms in my experiment came from one farm, and all of the worms in that particular farm were descended from a single batch of Pet Smart red wigglers. In the future, it would be best to test worms from different farms and different species.

Ellis, Christabel

*Alexandria City High School*

*Teacher: Riley*

Watch your Step!

This project will focus on a specific group of arthropods called micro-arthropods. Micro-arthropods are exactly how it sounds, they're a type of arthropod that is very small to capture and look at. A way to observe these microorganisms is to use a berlese funnel. For starters, a berlese funnel is a tool specifically used to withdraw insects from soil samples. The way this works is that a light resource (ex: a lamp) is used to dry up the soil to force the insects out of the ground into a preserved container.



Gooden, Elisha

*H-B Woodlawn Secondary Program*

*Teacher: French*

### Bird Call Frequency Variations Within Five Common Eastern Songbirds

This experiment aimed to observe if birds were affected by the growth of urban areas. Through the sound analysis of different bird calls, within eastern songbird species, it was seen that altitude has a similar correlation with frequency. This was an unexpected result. Further research by taking a closer look at the specific frequencies and altitudes within a species needs to be done to look more into this correlation. This can be done by using a more specific database as well as sound analysis software that has better analysis capabilities.

Hazlett, Amelia

*George Washington Middle School*

*Teacher: Owens*

### Name That ... Color??? Testing the Stroop Effect

Does conflicting information slow down brain processing time? Answering this question is important because it may illustrate that trying to focus on two things at once is distracting, giving us insight into the potential dangers of multitasking.

I hypothesized that if the ink color in which a word is written is different than the color that the word is spelling, then participants in the experiment will take longer to identify the correct ink color because it takes longer for the brain to process conflicting information.

To conduct this experiment, I prepared cards with a series of words spelling specific colors. For some cards, the words were printed in ink matching the color the words were spelling. For other cards, the words were printed in ink different than the color the words were spelling. The color of the ink in which the words were printed was the independent variable. The participants were required to identify the color of the ink of the words written on each card, and I recorded the amount of time it took them to read through the set of cards with matching colors and the set of cards with non-matching colors. The time they took to name the color was the dependent variable. The results show that for every subject, it took longer to name the color of the ink when the color of the ink did not match the color the word was spelling. My conclusion is that conflicting information does slow down brain processing time.

Wondim, Noemi

*Thomas Jefferson Middle School*

*Teacher: Holland-Shuford*

### How Do Different Types of Music Affect a Person's Concentration

The purpose of this project was to determine how different types of music would change/affect a person's concentration. The different types of music used in this experiment are pop music, heavy metal, and classical. It will also have a control group which will listen to no music. This project was used to see which genre/type of music would be better for when someone is doing something that requires concentration and memory (which also asks for concentration). Research shows that classical music is best for concentration because of the slow tempo, increases positive mood, and there is nothing distracting within the music. The way this experiment was conducted was first I had 5 people play a memory/ concentration game with pop music, then another 5 with heavy metal, another 5 with classical music, and lastly without any music at all. The data was collected by using a stopwatch to see how long it took on average for each group of 5 people. Lastly, the groups average of each of the two trials were subtracted from each other to find the difference. With the difference it was much simpler to compare the groups. The results were pop music coming in first with -1, classical second with -3, no music third with -10, and heavy metal with -12. The conclusion is that pop music is the best for concentration purposes. Classical coming in close with second best.

Dudley, Deveneir; Tejan-Bah, Amad

*Patrick Henry K-8 School*

*Teacher: Geddes*

### Sleep, Music, and Mood

The purpose of our experiment was to examine the relationship between music and mood. Music can relax someone, make someone emotional and cause an overall change in mood. The reason we think people should care about because it can help you find which music you can sleep to and give you the best mood.

To test our question we fell asleep to different genres of music and over the course of 8 days recorded our moods the next morning.

Our data showed that pop was the best music to sleep to. It also showed that Broadway/classical music caused an overall bad mood.

In conclusion, music affects our moods by changing our dopamine depending on what feeling the music is giving. Music affects your secretion of dopamine and in turn your mood.

Kiamie, Faris

*Williamsburg Middle School*

*Teacher: Warden*

### The Effect of the Amount of Flights at IAD on the Amount of Accidents / Incidents on the Road

The experiment was titled “The Effect of the Amount of Flights at IAD on the Amount of Accidents/Incidents on the Road”. The goal was to find a correlation between the two variables, and to see if a certain day of the week was prone to having more incidents/accidents on the road, so that effects of it (such as people missing flights, injuries or death, toll price increases, road congestion, etc.) could be prevented. The hypothesis was that more flights would cause more accidents on the road, but after testing every day from 6am to 6pm for 4 weeks, the results were more complicated than expected. The main hypothesis didn't have a strong correlation, but on weekends (where there were less flights), there was a drop in accidents, showing that weekends are days to expect safer roads than weekdays.

LaGarde, Cate

*Thomas Jefferson Middle School*

*Teacher: Bridges*

### The Effect of Different Music Genres on Concentration

The researcher conducted this experiment in order to find out the effect of listening to different music genres on concentration. The independent variable was the different music genres (ballad, rock and classical). The dependent variable was how well the participant could concentrate (by testing their ability to memorize an arrangement of cards). The control group was the participant listening to no music. This purpose was tested because the researcher was interested in finding out if listening to music helps or hurts concentration and how different music genres have an effect on concentration. The researcher's hypothesis was that if 8th graders listen to classical music then more than half of them will do best on the memory test then the ones that do best on the ballad/rock tests because classical music does not have lyrics that could potentially distract the subject. The hypothesis was tested by having 9 eighth-grade participants listen to each music genre and the control while memorizing different arrangements of cards. The results showed that most participants did best on the task while not listening to any music and that most participants didn't do very well on the task while listening to the ballad. At least half of the participants did better while listening to classical music over the ballad and rock music, so the hypothesis was proven.

Lester, Siena

*George Washington Middle School*

*Teacher: Matthews*

### The Effect of Age on the Accuracy of Eyewitness Testimony

In this experiment, I attempted to find what age group is the most reliable and accurate eyewitness. I did this because there are many cases where people of different ages will witness a crime and have different accounts on what happened. This experiment helps authorities know which age is more likely to accurately recall what happened. An eyewitness testimony is an account given by someone about an incident that they witnessed (usually a crime of some sort). To answer my question, I created a survey that included a video and questions about what occurred in the video. I sent this survey to 30 people in total and had 10 from each age group (13-18, 20-45, and 65-75). My hypothesis was that the middle aged group would be the most reliable eyewitness because studies have proved that memory decreases as you age and is still developing when you're younger, but my results proved my hypothesis wrong and I found that the youngest age group did the best on my survey.

Singh, Aman; Cocker, George

*Williamsburg Middle School*

*Teacher: Woodbury*

### The Effect of Age on Reaction Time to a Visual Stimulus

According to the Guinness Book of World Records, Pekka Luodeslampi holds the fastest reaction time at 0.186 seconds. Our project sought to understand the differences in visual stimulus reaction time between age groups. Reaction time is very important, because it can help avoid injury to you or another person. We hypothesized that the 16-25 year old age group would have the fastest average reaction time because at that age the nerve signal speed and nerve fibers are the most developed.

In order to evaluate our hypothesis, we tested the reaction time assessment on justpark.com, studying five different age groups ranging from 6-11, 12-15, 16-25, 26-50, and 65-80 years old. We conducted five trials with five participants from each age group and analyzed the average reaction times.

Our results indicated that the 12-15 year old age group had the fastest reaction time of 0.3182 seconds. This was 0.00008 seconds (0.08 milliseconds) faster than the 16-25 age group. The 65-80 age group had the slowest average time of 0.3204. Based on these results, we concluded that our hypothesis that the 16-25 age group would have the fastest average reaction time was not supported. One potential error from our experiment was collecting participants from only a few specific ages, rather than throughout the age group. Lastly, one way we could expand this project in the future is by testing on different gender or on different ethnicity.



Marcy, Ava

*Alexandria City High School*

*Teacher: Lay*

### How Music Affects Testing Speed

The speed in which the brain works and completes assignments is a factor in the education process that varies among many. Attempting to find something that alters test taking speed and even improves it is what this experiment tackles. The question was "Does music genre effect testing speed?". I had four factors in the experiment, which consisted of a control (no music played). The results showed that upbeat pop had the fastest results, followed by none, then classical, and lastly, heavy metal. These results make sense, however they do not follow my hypothesis which was "If classical music is played for students taking a test, they will have the fastest results". Though pop music is not typically considered when completing work, playing music that a person is familiar with and likes releases serotonin to the brain and makes brain speed increase. Overall, the data collected for the procedure was useful information that could make future education systems more efficient and practical. Playing upbeat pop, and other faster uplifting music could make a difference in classrooms for future generations.

Stroud, Lanyi

*Yorktown High School*

*Teacher: Mower*

### A Cross-Racial Study of Level of Confidence in Federal Government Management of COVID-19 Vaccines

Existing research has shown that the early adoption rates of COVID-19 vaccines differ for people of different races. In this project, I study the cross-racial differences in survey respondents' confidence level in the federal government's handling of COVID vaccines. My analysis shows that Asian and White respondents tended to have higher confidence in the federal government's handling of COVID vaccines than Black respondents. This difference in confidence level could be a potential reason for the relatively high early COVID vaccine adoption rates by Asian and White people compared to Black/African American people.

Siddiqi, Husna; Assadi, Rayhana

*Francis C. Hammond Middle School*

*Teacher: Kochis*

### Slimy Glue

We love making slime, Which made us curious to see what kind of glue could make the stretchiest slime. We will test 3 different Elmer's glues and do 3 trials on each glue and test which one is the stretchiest slime.

Thulson, Benjamin

*George Washington Middle School*

*Teacher: Gray*

Does Rough Treatment Of DNA Samples Cause the Fragments to Be Shorter in Gel Electrophoresis?

Long strands of DNA are usually essential for any DNA lab procedure. My experiment will find out whether shaking will cut up the DNA. This is relevant because DNA is the staple of life itself. It is very important to find out more about it. This includes many processes, and all of them need high quality DNA.

Casadaban, Lorraine; Stout, Lily

*Williamsburg Middle School*

*Teacher: Warden*

### The Effect of Different Acne Medications on the Size of the Inhibition Zone

The title of our project is The Effect of Different Acne medications on the size of the inhibition zone. Our project tested how well different acne medications treated bacteria. We did this by spreading e. Coli bacteria on a Petri dish, next we dipped sterile disks in the different acne medications and placed them on top of the bacteria. We then let them grow and the next day we measure how big the inhibition zone was, (the circle around the sterile disks where the bacteria can't grow). And measured how big the inhibition zone in millimeters and the biggest inhibition zone has the most effective acne medication.

Babic, Harlow

*Alexandria City High School*

*Teacher: Lay*

### How Does the Type of Starch Affect the Water Solubility of Bioplastic?

A major problem in today's world is the overuse of petroleum plastics, which contribute to carbon emissions. A common alternative is plastic made of starches; however, they are highly water soluble. During this experiment, I tested how the water solubility of bioplastic is affected by the type of starch used to make it. I tested the water solubility by weighing the plastics before and after submerging them in water for one day and then calculating the percent increase in weight. The data showed that the bioplastic that was the least susceptible to water solubility was the one made of cornstarch and that bioplastic made out of glutinous rice flour is completely unsuitable for any purpose involving water. Understanding how the type of starch used affects the properties of bioplastic allows people to make bioplastic for themselves that is best suited for their needs, which can result in increased usage of homemade bioplastic and decrease the amount of petroleum plastic used in the world.

Bartrum, Olivia

*Wakefield High School*

*Teacher: Harris*

### Analysis of Anti-Inflammatory Compounds in Drug Absorption and Calculated Transdermal Permeability Utilizing the Parallel Artificial Membrane Permeability Assay (PAMPA)

The study's purpose was to analyze the role of drug concentration and type of analgesic in transdermal drug distribution. Drug concentration and type of analgesic were the primary independent variables; wavelength was a secondary independent variable. Concentrations included 1mM, 0.1mM, 0.01mM, and 1 $\mu$ M, and analgesics included capsaicin, menthol, and hydrocortisone. The dependent variable was absorbance (in AUs), which was used to calculate transdermal permeability. It was hypothesized that with higher drug concentrations, greater absorbance would occur. Capsaicin was believed to experience the highest permeability rate, resulting from its smaller particle size. Experimentation was undergone utilizing an in-vitro simulation of passive transdermal absorption, with each solution passing through a membrane replicating the skin. Following a 22 hour incubation period, UV-Vis Spectroscopy was utilized to determine raw absorbance for the solutions. Using Two-Factor ANOVA Testing with replication, it was found that the results were statistically significant (Capsaicin:  $p = 9.49E-26$ , Hydrocortisone:  $p = 3.14E-9$ , Menthol:  $p = 5.61E-3$ ), indicating that regardless of analgesic utilized, there was a statistically significant difference in absorption between drug concentrations. Increases in concentration were also associated with concurrent increases in absorption. Utilizing the absorbance measurements, the permeability rate (cm/s) for Hydrocortisone, Capsaicin, and Menthol were calculated at 1 mM, having permeability rates of  $4.8369E-5$  cm/s,  $6.6078E-6$  cm/s, and  $8.075E-6$  cm/s, respectively. From this, it was found that Hydrocortisone had the highest permeability rate at 1 mM, unlike what was hypothesized; however, capsaicin consistently showed higher levels of absorption at all concentrations.

Cordon, William

*Kenmore Middle School*

*Teacher: Gantenbein*

### The Effect of Different Substances on Mummification

There is a need in the packaging industry to keep moisture levels low. Desiccants are substances that can take moisture out of the surroundings. Desiccants are used to control humidity in the packaging. The goal of this experiment was to find the effect of different desiccants (soda ash, baking soda and salt) on the ability to mummify hot dogs. Three hot dogs were put into three containers and each container was filled with a different desiccant and left in a cold and dark place for three weeks. The hot dogs were checked at the end of each week and the length, circumference, and weight were measured. Soda ash was the best at mummifying the hot dog. After three weeks the hot dog in soda ash had the highest reduction in length, circumference and weight. It lost 2.5 cm in length. Which is 1 cm more than the hot dog in salt and 1.1 cm more than the hot dog in baking soda. It also lost 1.4 cm in circumference. It lost .3 cm more than the hot dog in salt and baking soda. It lost 28 g in weight which is 15 g more than salt and 11 g more than the hot dog in baking soda. This experiment successfully shows that soda ash works best to remove water from a hot dog. It can contribute to the packaging industry because it can help some packaging stay dry and keep moisture low in trucks.



Menta, Rahil

*Williamsburg Middle School*

*Teacher: Willet*

### The Effect of the Type of Sports Beverage on the Electrolyte Concentration

What is the effect of the type of sports beverage on the electrolyte concentration? This question is a common issue for many athletes and players across the globe. The goal of this experiment is to solve this issue and make it easier for athletes to choose the beverage with the most electrolytes to hydrate themselves. The levels of IV for this experiment are water (control), Gatorade, Powerade, and Prime. The results show that the drink with the highest amount of electrolytes is "Prime" (Mean: 8.57 mS), followed by "Powerade" (Mean: 5.68 mS), then "Gatorade" (Mean: 5.16 mS), and lastly "Tap Water" (Mean: 1.03 mS). Considering the low fluctuation between the trials (the highest being 0.45 mS), I am confident that the data is accurate and reliable. The experiment proves that "Prime" is the drink to choose when you want the greatest amount of electrolytes and energy to replenish your body after excessive exercise.

Oberkirsch, Purvi

*Gunston Middle School*

*Teacher: Patel*

### Comparison of Electrolytes in Sports Drinks and Juices

Electrolytes are important for athletes because they help regulate muscle functions and keep cells hydrated. Sports drinks are often advertised based on containing a high number of electrolytes. This project measured the number of electrolytes (dependent variable) contained in different drinks (independent variable) such as freshly squeezed orange juice and grapefruit juice and Sports drinks such as Gatorade, Powerade, and Bai Boost. The goal of the project was to answer which drink has the most electrolytes. To measure the electrolytes, a circuit was created using two copper wires, a 9-volt battery, and a multi-meter to measure current. The other ends of the copper wire were left open (wrapped around a non-conducting plastic tube) so that current would not flow. To close the loop and let current flow, the tube was placed in each drink, and if electrolytes were present, a current would be displayed on the multi-meter. Since electrolytes conduct electricity, the more current meant more electrolytes. The hypothesis was that sports drinks would have the most electrolytes. The experiment proved the hypothesis wrong. The project showed that Grapefruit juice contained the most electrolytes.

Perez Castanaza, Fatima

*Patrick Henry K-8 School*

*Teacher: Geddes*

### Elephant Toothpaste

The purpose of my experiment was to examine something so simple as hydrogen peroxide, water and yeast with such a large reaction.

In order to test this I added common household ingredients and measured the height of the reaction.

Surprisingly my data showed that too much or too little hydrogen peroxide caused a similar reaction. The most successful reaction occurred when a half cup of hydrogen peroxide was added. Too little and too much caused a faster reaction rather than a higher reaction.

Nevertheless, I hope that my experiment will help people to become more aware and safe in their own kitchen.

Butler, Leah; LaGarde, Laurel

*H-B Woodlawn Secondary Program*

*Teacher: Taggart*

### Electrolytes in Sports Drinks

The purpose of this experiment was to find which sports drink is best for replenishing electrolytes. We chose this topic because we both play sports and while we both drink water, we wanted to know if drinking sports drinks is better, and if so which one is best. Our hypothesis was that gatorade would have the most electrolytes, because it's the most widely used and was the first one ever made. Some constituents that we had were the temperature, the amount of drink (100ml), and 200k ohm on the multimeter. We used a multimeter to measure the electrical resistance of each drink. The higher the resistance, the lower the amount of electrolytes and vice versa. We tested Gatorade, Gatorade zero, Powerade, Propel, Body Armor, Vitamin water, and we used deer park water as a control. We did three trials, and took the averages of each trial. Gatorade Zero and Gatorade had the most electrolytes. Water was our control, so it obviously had the least, but the worst sports drinks were body armor and vitamin water. This supported our hypothesis because we guessed that gatorade would have the most and it did. We could improve the experiment by having more drinks or adding in other factors like the amount of sugar and salt in each drink. This experiment could be valuable to society so athletes and others know which sports drink is worth buying and which is best for athletic performance.

Adhi, Romeesa

*Thomas Jefferson Middle School*

*Teacher: Candelora*

### The Effect of Acidic Beverages on the Mass of Eggshells

The purpose of this experiment was to display the detrimental effects of commonly consumed beverages on oral health. People tend to overlook the long-term, damaging effects of certain beverages on our teeth, as they are considered to be healthy alternatives and staples of certain meals. For example, orange-juice is an advertised item for breakfast. This experiment aimed to determine which commonly consumed beverage has the most damage on eggshells over a span of a week as eggshells have similar chemical compositions to human teeth. It was believed that the eggs soaked in Coca-Cola would erode the egg the most. To test the hypothesis, 12 white chicken eggs were soaked inside 4 different beverages (Water (control), Coca-Cola, Orange Juice, and Lemonade) for a week, weighing the eggs every day. After the experiment was performed, the results accepted the hypothesis and concluded that the acidity of Coca-Cola did erode the egg the most. These results signify how deleterious these beverages are and provided further insight into their effects on human teeth.

Barua, Preontee

*Thomas Jefferson Middle School*

*Teacher: Candelora*

### What is the Effect of Solvents on the Surface Tension of Water?

The question that was asked in this experiment was “What is the Effect of Solvents on Surface Tension?” My hypothesis was If sugar is dissolved in water then the surface tension of the water will be greater than the water with salt or no substances because surface tension increases with the amount of molecular bonds and sugar consists of more chemicals to bond with hydrogen molecules. To perform this experiment and test my hypothesis, I dissolved sugar and salt separately in separate cups of water with equal measurements, and left one cup of water without any substances in it. To measure the surface tension rice grains were placed on aluminum foil on the surface of each liquid. My hypothesis was proven wrong as saltwater had the highest surface tension as it held 334.33 rice grains at the surface and was followed by regular water that held 226 rice grains at the surface, leaving sugar water to have the lowest surface tension as it held 206 rice grains. In conclusion, salt dissolved in water increases the surface tension and has a higher surface tension than water with or without sugar.

Ganzorig, Ronald

*Swanson Middle School*

*Teacher: Hu*

### The Effect Of Type of Orange Juice on Amount of Iodine Solution

The study found that Tropicana orange juice had the most amount of vitamin C in average. Used a titration method to measure amount of iodine solution needed to titrate the orange juice. My hypothesis was proven correct.

Hjerstedt, Gabriel

*Williamsburg Middle School*

*Teacher: Woodbury*

### The Effect of the Number of Homemade Batteries Run in Series on the Amount of Energy Generated

Batteries are an ubiquitous aspect of the lives of Americans. In addition, the series configuration is much more common than most may think. Almost all batteries that are more than 1.5 volts are multiple cells that are connected in series. From Alessandro Volta to modern day electrochemistry, sodium batteries have been implemented for their accessibility and economic advantages. In this experiment, a total of fifteen homemade batteries were constructed from copper anodes, galvanized steel cathodes, and saltwater electrolytes. They were then wired in series and their wattage, amperage, and voltage were evaluated. In order to test if the series configuration did in fact increase the amount of wattage a battery produced, the amount of copper and galvanized steel remained the same amongst all battery configurations. The four levels of IV utilized were one battery with eight copper and galvanized steel components, two batteries with four components each, four batteries with two components each, and eight batteries with one copper component and one galvanized steel component. Since batteries are so common, this experiment is important in order to educate others about the items that power their lives. After 5 trials at each level of IV, it was determined that running batteries in series increases the wattage by an average of 45%, contrary to the hypothesis. This is an interesting result because it shows that when multiple batteries are placed in a device, the reasoning for this is that more power is generated than by a single, larger battery.



Jones, Delanie

*Dorothy Hamm Middle School*

*Teacher: Kennedy*

### The Effect of Conditions on Yeast Fermentation

The purpose of this experiment is to compare how much carbon dioxide yeast produces when mixed with different substance and left to ferment for 1 hour. The experimenter's research prior to the experiment showed that yeast was the main catalyst for creating bubbles in bread, and that yeast could make those bubbles by producing carbon dioxide. The experimenter found that yeast fed off of sugars and gave off waste in the forms of ethanol and carbon dioxide; the latter creating the signature bubbles in many breads. By putting an equal amount of yeast and other ingredients into a bottle topped with a balloon and suspending them in water, the experimenter could ensure that the amount of ingredients given to the yeast would not interfere with results. The experimenter let the mixture sit for 1 hour, and would dip the gas-filled balloon into a pot filled with the same amount of water for every trial. The water spilled out of the pot was caught in a pan, and measure to find the amount of water displacement in yeast fermentation. The experimenter found that out of all the ingredients; just water, sugar, sugar and baking soda, sugar and salt, and sugar and vinegar, sugar produced the most recorded water displacement. However, the experimenter found in their initial research that baking soda is known to trap the bubbles better than just sugar.

If the experimenter was to employ their results in a real-life situation, they'd make bread with baking soda included; bigger bubbles.

Keane, Taogh

*H-B Woodlawn Secondary Program*

*Teacher: Boyle*

### The Effect of Reactant on Battery Output

The hypothesis was that if the reactants in the battery are changed the output will change. The goal was to inform others how batteries work. Additionally, the goal was to find what elements would work best in a battery. Three batteries were assembled with online instructions. Then their outputs were tested with a voltmeter. The test was done 3 times for accuracy. The results showed that the zinc carbon battery outperformed all the others. This may be because of the difference in electronegativity, a property which defines how likely an atom is to give up electrons in a reaction. This may be the cause because if one side gives up a lot of electrons, then one side takes a lot. The difference in the amount of electrons on either side increases which increases voltage. The zinc carbon battery had a difference in electronegativity of .9. The worst performing battery, the zinc copper battery, had a difference of .25. The middle battery, aluminum steel, has iron in it which would lower the voltage because it would make a low difference. But there is carbon in steel which boosted the voltage to about 1.3. Overall, the zinc carbon battery performed the best.

Lawler, Catherine

*Williamsburg Middle School*

*Teacher: Woodbury*

### The Effect of the Type of Cleaning Method Used on the Amount of Gluten Cross-Contact

This experiment tested the effect of the type of cleaning method on the amount of cross contact. The purpose of the experiment was to figure out what method of cleaning was most effective at removing cross contact. The results showed that dish soap, kitchen cleaner spray, and hot water each tested positive for cross contact. However, they were slightly better at preventing cross contact than no cleaning. These results can be explained because of the strong adhesive properties of gluten protein, making them difficult to remove from surfaces. The testing kits used were also extremely sensitive, identifying amounts of gluten as little as 10 parts per million, which is less than the FDA's standard of 20 parts per million. To further improve the experiment gloves could be worn, and new utensils could be used for each trial. More experiments could also be performed testing other methods of cleaning to find the most effective. This information could be useful to restaurants or other establishments serving food, so that they can better serve gluten-free customers.

Seaver, Aelwen

*Swanson Middle School*

*Teacher: Hu*

### The Effect of the Type of Battery on the Amount of Voltage

In my experiment I tested the voltages of four different types of batteries, a double A, potato, Coke, and lemon battery to see which one has the highest voltage. My hypothesis was if test the four batteries, my control, the double A battery would have the highest voltage. I thought this because double A batteries are manufactured to store high amounts of voltage, and to be efficient at charging devices. To conduct my experiment, I assembled my lemon, potato, and Coke batteries by using different metals such as nickel and copper, and putting them into the fruit, drink, and vegetable. I then used a voltmeter and tested the voltages of each battery. According to my data, my hypothesis was correct. The double A battery had the highest voltage with 1.6 volts on average. The lemon and potato batteries were close in voltage. The lemon had 0.757 volts on average, and the potato battery had 0.739 volts on average. The Coke battery had the least amount of voltage, with zero. I was not surprised that the coke battery had zero volts on average. Coke is made up of 90% water, carbon dioxide, and sugar. Therefore there are no electrolytes, so when a conductor touches the Coke, no power is made. I did this experiment because I thought it would be interesting to find the voltages of different foods. In the future we could use experiments like this one to find renewable energy sources that are better for the environment.

Sidahmed, Gaia

*Alexandria City High School*

*Teacher: Riley*

### Baking Powder's Effect on Leavening

The purpose of this project was to show how baking powder affects the height of a muffin. In order to do this, a muffin batter was prepared (without baking powder), separated into 4 bowls with varying amounts of baking powder ranging from none, to half, to the normal amount, and to the doubled amount. Then three muffins per mixture were baked, with 80 grams of batter each. After baking, the height of the muffins was measured and recorded in centimeters. The data collected shows that as the amount of baking powder increases, the height of the muffin increases, and vice versa. The conclusion was reached that baking powder directly affects the height of a muffin and the hypothesis was proven correct.

DeMots, Avery

*Washington-Liberty High School*

*Teacher: Fretts*

### The Effect of Combined Catalysts on the Efficiency of Water Splitting Reactions

This purpose of this study was to generate insight into how combinations of catalysts perform in water splitting chemical reactions, and in particular, if compounds native to the moon are effective in increasing the efficiency of water splitting reactions. This study is interested in moon native compounds because of their potential to support renewable energy for space exploration. This study hypothesized that if two high performing catalysts were combined, then the water splitting reaction would increase in efficiency because the two catalysts would aid each other's reactions. This hypothesis was successfully demonstrated in this experiment. This study rejected the null hypothesis, which stated that combined catalysts would not improve reaction efficiency. This study tested Manganese Dioxide, Ferric Chloride, and Cobalt Nitrate Hexahydrate in two separate independent variable levels in order to determine which catalyst was most efficient overall and the level at which its greatest efficiency was recorded. Following that, the two most efficient individual catalysts were then combined in order to observe whether their combination resulted in increased efficiency compared to previous levels. The study found that the combination of individually high-performing catalysts did result in even more improvements to the efficiency of the water splitting reaction. This suggests that combining catalysts could have better, more efficient results in creating renewable energy than use of individual catalysts alone. Specifically, this study found that, of the three catalysts tested, Ferric Chloride seems to have even greater potential than Cobalt Nitrate Hexahydrate in generating reaction efficiency.

Freeman, Anna

*Washington-Liberty High School*

*Teacher: Fretts*

### The Effect of the Amount of Gelling Agent on the Density of Marshmallows

This experiment was conducted to find how the amount of gelling agent affects the density of both vegan and non-vegan marshmallows. The levels of the independent variable in this experiment included double gelatin, half gelatin, and the control (full gelatin). The same levels of the independent variable were tested with carrageenan instead of gelatin, for the vegan marshmallows. Each level of the independent variable was tested twice, to minimize random error. The research hypothesis for this experiment was that if both vegan and non-vegan marshmallows are made with different amounts of gelling agents, then the non-vegan marshmallows with double the amount of gelatin will be the least dense, because if there isn't enough sugar in the gelatin-to-sugar ratio then the marshmallows will be more gooey and less dense, because sugar encourages gelatin to form shorter protein chains. Shorter protein chains make the marshmallows stiffer, and since the sugar stays constant while the gelatin doubles, the gelatin-to-sugar ratio will be off, leading to gooier and less dense marshmallows. This hypothesis was partially accepted, because the gelatin double marshmallows were the least dense, but it was not because of the gelatin-to-sugar ratio. Statistical tests lead to the conclusion that the data was statistically significant. The overall trend of the data suggested that if more gelling agent is added to marshmallows, then the marshmallows will be less dense. The opposite was also true, with marshmallows with less gelling agent being more dense. This was the same for both vegan and non-vegan marshmallows.

O'Toole, Gabriel

*Yorktown High School*

*Teacher: Hessler*

### The Effect of Preparation Method of Various Foods on Iron Content

According to the CDC, iron deficiency is the most common nutrient deficiency globally, as approximately half of the children living in developing countries suffer from iron deficiency. Dietary iron deficiency over a long period of time leads to a condition known as anemia. Anemia in young children is known to impair both cognitive and motor function, while in adults, anemia commonly causes fatigue and lack of productivity, and can sometimes damage reproductive organs. Studies conducted in refugee camps in Syria, Jordan, West Bank, Gaza Strip, and Thailand show that between 54 and 85 percent of refugee children in these areas are anemic. Implementing iron-dense foods into diet through optimal methods of preparation can help reduce anemia. Experiments like this one investigate the best dietary choices to prevent anemia. In this project, spinach, broccoli, and tuna in their raw and cooked forms were tested for iron concentration using titration and stoichiometry. It was predicted that raw tuna would be most dense in iron due to its animal form of iron known as heme. However, it was found that raw spinach contains the most iron. Prior research and data from this project prove that iron can leach out of foods when they are cooked in water. Limitations in the design of this experiment prevent the experimenter from testing the amount of iron absorbed by the human body after consumption. This experiment strictly measured the amount of iron present in foods, which can differ from the amounts absorbed by the body.



Schiaffino, Elizabeth

*Wakefield High School*

*Teacher: El Gamal*

### Measuring Electrolyte Content of Sports Drinks

As the field of health and fitness continues to advance, your options for improvement and recovery are increasing. So, how do you choose the best drink for exercising? The common thought is to aim for a drink with the most amount of electrolytes. But in order to find out which one does, you must observe the beverage at the chemical level. To do this, you measure the conductivity of the individual drinks and that corresponds to the amounts of electrolytes. Out of the common options you may see, Powerade and Gatorade have larger levels of sodium and conductance. So when in doubt, look for drinks with sodium if you're aiming to increase your electrolyte levels. And if given the opportunity, drink Powerade, as it has the highest amount of electrolytes. A large part of improving your health is supplying your body with the proper nutrients. Drinking correctly is just one way to help yourself; and identifying what to drink can help athletes all over the world with their recovery.

Scharnweber, Lillian; White, Seamus

*Alexandria City High School*

*Teacher: Strimple-Barker*

### The Effect of the Amount of Carbon in Nails on the Amount of Rust Produced

This project aims to answer the question: Does the amount of carbon in steel metal affect the amount of rust it produces? Metal is made into pipes to carry water into facilities and homes around the world and it is imperative that they do not rust. Most famously, in Flint, Michigan, the rusting of pipes led to lead and other harmful chemicals leaking into the city's water supply. However, this is an issue seen in many communities. In order to test this idea, nails made with different carbon contents (0%, 0.3%, 0.5%, and 0.7%) were placed in a solution of saltwater, most like the conditions in Flint, and let sit for fourteen days. To determine the amount of rust they had produced, the five nails in each group were measured every day and their masses were averaged. The more mass lost, the more rust that had produced and fallen off of the nail. It was found that the amount of carbon in metal does not affect its rate of rusting. While the high carbon group gained 0.03g mass on average, the other groups stayed around the same, fluctuating between the starting point of 2g and 1.98g, despite their differences in appearance.

Opshara, Afifa

*Alexandria City High School*

*Teacher: Nemeth*

### Does the Amount of Baking Powder Affect the Height of a Muffin?

Baking powder is used in baking to help dough and batter rise. It's composed of an alkaline and an acid, which react when combined with a liquid to produce carbon dioxide gas. This gas is what causes the dough or batter to expand and rise. The recipe was divided into three batches, each with a different amount of baking powder. The first batch had no baking powder, the second batch had one teaspoon of baking powder, and the third batch had two and a half teaspoons of baking powder. After baking, the muffins were measured for height. The results of the experiment showed that the amount of baking powder used did affect the height of the muffins, but it was also not fully accurate. While the muffins with 2.5 tsp of baking powder rose a lot while baking, they, however, cratered just before taking them out of the oven. The muffins with no baking powder were the shortest, and the muffins with one teaspoon of baking powder were the tallest due to the other batch of muffins collapsing. In conclusion, the amount of baking powder used in a muffin recipe affects the height of the muffin, but it also depends on the amount of the powder. It will crater and the muffin will be crumbly and a bit bitter, while if there's the muffin will have no height. This experiment demonstrates the importance of using the correct amount of baking powder in a recipe to ensure the desired results.

Dementi, Kye

*Francis C. Hammond Middle School*

*Teacher: Kochis*

### Strength in Shapes

I knew that the strongest shape was a triangle, but I wanted to learn more. So I dug up all of the information on the internet and came up with nothing. So I decided to test 5 different shapes and test their strength. One of my passions is engineering, and I wanted this experiment to help me if I ever pursue my passion. Thus, why I decided to choose this.

Leaning, Alexandra

*Gunston Middle School*

*Teacher: Santos*

### The Peltier Tile Watch

I hypothesized that I could power a watch using the wearer's body heat and Peltier tiles. I experimented with two Joule thieves to boost the voltage, but they didn't work. In the end I soldered five tiles together which worked but was impractical.

Nizami, Hennah

*Patrick Henry K-8 School*

*Teacher: Geddes*

### Fun Flying

The purpose of my experiment was to see if the mass of a paper airplane will change the distance it flies. This is important because the weight of commercial airlines affects fuel efficiency and overall cost of flying.

I performed my experiment by changing the weight of the paper to see if it will change how far it flew.

Based on my experiment the construction paper was the most successful airplane because it went farther than the other 2 airplanes with both more and less weight.

Thus, the best weight for a paper airplane was the construction paper. It went to an average of 3.47 yards. Too much weight as well as too little weight causes an unsuccessful flight.

Robasson, Sydney

*Francis C. Hammond Middle School*

*Teacher: Chapman*

### Why You So Dense: The Effect on Density on the Strength of Buildings

In this project, we'll be going over the effects of density on the structure. During this project, readers will be able to learn what density is, what a tornado is, and why it's so dangerous. After this, we will learn how the two things can combine in science. With this experiment, I hope to find a way that density can be used to make buildings stronger in case of natural disasters such as tornadoes. This question is tested by the experiment further below. Finally, this project will be concluded with an analysis of the result of the investigation. Afterward, I will be doing a "Future Directions" on new hypotheses, questions, and things that could come out of this experiment that could be tested.

Ainspan, Isaac

*H-B Woodlawn Secondary Program*

*Teacher: Boyle*

### Mechanical Keyboards: How to Build and Change the Sound of Them

Mechanical Keyboards or just Keyboards in general are one of the 2 main ways people interact with the digital world. Yet most people just use the one that comes with their computer. This is why some people choose to create their own with commercially sold parts to tune it to make it sound how they want. These are known as custom keyboards and will be what this Project is exploring today. The purpose of this Project is to inform the public about the hobby and show its advantages and disadvantages. This was done by creating a new mechanical keyboard that can be taken apart and then presenting it and informing people about some of the specifics. Hopefully trying to get them into the hobby.



Anderson-Sprecher, Isaac

*Kenmore Middle School*

*Teacher: Brown*

### The Effect of Changing the Sweep Frequency on How a Wave Form is Displayed

The research problem for this experiment is how will changing the sweep frequency of a CRT influence how a waveform is displayed. CRT stands for cathode ray tube. A type of display technology that operates by shooting an electron beam at a phosphor-coated screen and is deflected by an X and Y deflection coil. The hypothesis is that the cycles shown will be calculated by the equation  $C=Y/X$ . With C standing for the cycles shown, Y standing for the Y deflection coil frequency, and X standing for the X deflection coil frequency. This experiment is conducted by inputting a constant frequency of adequate amplitude into the X deflection coil (sweep frequency) and incrementing the Y deflection coil frequency in multiples of the X. The data is recorded in cycles shown and cycles shown plus return. After conducting the experiment and analyzing the data there is a clear correlation between the predicted value and the data from the cycles and return. However, the data from the cycles shown does not match the predicted value, seemingly increasing at a proportional rate as the cycles and return. The difference between the predicted value and the cycles shown is most probably caused by the fact that the waveform for the X sweep frequency is a sawtooth wave. Resulting in an unproportional rise and fall time. This causes a larger "sample" period during the linear ramp-up and a lower sample rate during the decrease.

Lyon, Nora

*Swanson Middle School*

*Teacher: Seliskar*

### The Effect of the Length of a Trebuchet's Short Arm on the Distance the Ammunition Travels When I Launch It

I completed my project for the purpose of designing a more efficient way of launching small objects for various uses, and to gain more knowledge for myself. I tested the effect of the length of a short arm of a trebuchet on the distance it launches the ammunition. I first designed a trebuchet model, then built it with the help of my partner and Mr. DeMarino. After the trebuchet was built, I brought it to my partner's yard, where I tested each arm length 10 times and documented the results. My results were inconclusive because while we initially tested the trebuchet, we only documented attempts that went 2 meters or more. However, by the time I got around to testing our final arm, we documented all of my attempts due to time constraints. Because of this, my averages for each IV level may not accurately reflect the actual data. I met my objectives, since I created a machine that can launch small objects, and I also gained lots of technical knowledge along the way. This experiment contributes quite a bit, since this design can be used to launch lots of things, such as tennis balls for a dog.

McComis, Matthew

*Kenmore Middle School*

*Teacher: Brown*

### The Effect of Propeller Shape on Peak Voltage Generated

Hydroelectric power plants use water to spin a turbine that generates electricity, but what propeller shape is best at it? This project looks at which design of propeller will generate the highest amount of voltage when water flows through it. The 4 propellers tested were propeller 1, four flat paddles around an axel, propeller 2, 4 flat paddles that twist around an axel, propeller 3, 4 curved paddles around an axel, and propeller 4, 4 curved paddles twisted around an axel. The propellers were tested in an 8ft tube, rigged with a multimeter that was connected to a DC motor. When the motor was spun by the propeller it would generate a current. The highest voltage recorded on the voltmeter was recorded for the trial. The hypothesis was that Propeller #4 would generate the largest peak voltage of the propellers tested. The experimental results supported the hypothesis by showing that the 4th propeller design had the highest peak voltage. The experiment also showed that the design most similar performed second best, likely because the curved edges added extra surface area to the design.

Miller, Peter

*Swanson Middle School*

*Teacher: Hu*

### Impact of Surface Area on Lift

An airplane can fly because as air passes over the wing the area below is low pressure and the area above is high pressure. The system wants to move from high to low pressure and this creates lift. This is Bernoulli's principle (Bernoulli's Principle, 2023). Air travel is important to our society because of commerce and social benefits. More and more people can fly because air travel has become more affordable. If you can increase the efficiency of a wing, then the airplane uses less fuel is environmentally sound and reduces the cost to travel. These improvements that lower the cost to fly, such as increasing fuel efficiency, will help the airline industry and society (Lisitsin, 2020).

In this experiment, I examine if increasing the surface area on either the upper or lower surface of an airfoil impacts the lift (Johnston, 2020). To do this, I printed 3D models of an airfoil with channel(s) in either the upper or lower portion of the wing.

To keep this experiment simple, I tested the difference in force for each wing (Althaus, 2023). Using a spring scale, I tested the Force (Newtons) produced by each wing configuration (One Monroe Aerospace, 2023) in my homemade wind tunnel (Van Milligan, 2010). I then analyzed my data to determine which wing performed the best (Rodriguez, 2023). My hypothesis was supported because the wing with 2 channels on the lower surface exerted the greatest force as shown by the results.

Tarpley, Michael

*H-B Woodlawn Secondary Program*

*Teacher: Taggart*

### C++ Retro Gaming Console

The purpose of this invention was to find a way to make a more cost efficient gaming console. The main scientific principles behind this invention were coding, electrical engineering and engineering. The product of this invention was a game boy console. The invention was successful because it is able to let the user play a hill runner game. This invention was similar from previous inventions because they both followed the same idea. The invention was different because it has the option to use ir to play the game and it uses an arduino instead of a microchip. This invention could be improved in a number of ways including by improving the code to be more smooth and creating a hammer screen. This invention may be useful to society because it could offer a great source of entertainment and it could offer a stepping stone for a person that is new to engineering how to code and design a project.

Vasisht, Janak

*H-B Woodlawn Secondary Program*

*Teacher: Taggart*

### Python Password Cracker

The python password program is a python script that can be used to decrypt hashed passwords. The project shines light on how simple it is for systems and user accounts to be breached. Taking only a few weeks to design, the program can successfully hash a password, as well as decipher a one way hash, showing the ease of cracking passwords in the modern world. The program will first hash a user input in what is called a hashing algorithm. This is an algorithm that transforms a word into a jumble of random characters to make it almost impossible to figure out the original password. It will then decipher what the original password was using a list of over 15 million passwords. There are certain limitations to the success of the script, one of them being a lack of computer size. This entails that less words can be deciphered because they are not in the word list. After running the program many times for many different people, I found that many people use similar passwords, such as test123456. This helped educate onlookers on how important strong passwords are.

Ward, Ben

*Kenmore Middle School*

*Teacher: Price*

### How Does the Angle of a Solar Panel Affect the Amount of Energy Produced?

Solar panels are powerful things, and they may be the best way to fight climate change. That's why this experiment is important. The planet is changing for the worst and we need to do something about it, and using solar panels which are a reusable resource is important. But if you have a solar panel then you want to get the most out of it. That's why the researcher did this experiment. The goal of this project was to find how the angle of a solar panel affects the amount of energy produced. This experiment was done by putting a solar panel on the ground and using books to change the angle. (The angles were 0, 22.5, 45 and 67.5 degrees.) The light source was a lamp with 5W. The results concluded that the solar panel at 0 degrees gains the most amount of voltage. It collected 1969 V compared to the next highest amount of voltage the 45 degree solar panel at 1781V. The 22.5 degree solar panel collected 45 V less than the 45 degree solar panel. The solar panel with the least amount of energy was the 67.5 degree panel 0.67V. This relates to engineering because solar panels make energy through photovoltaic cells that engineers made and engineered to a real thing. The researcher made its objective because the goal was to find which angle is the best and we clearly found that in the 0 degree panel.

Kwan, Alexander; Kwan, Benjamin

*Dorothy Hamm Middle School*

*Teacher: Kennedy*

### The Effect of Viscosity on Hydroelectric Power

The intent of this experiment was to determine the best possible viscosity for a liquid used in hydroelectric generation. Water is most commonly (if not always) the liquid used, but it has a relatively low viscosity. We increased the viscosity to be able to determine which would generate the most electricity. In order to perform the experiment, a waterwheel was built, to which a DC motor was connected. We used 500 mL of liquid to spin the wheel, which, when read with a multimeter, gave us our results. We also had to calculate viscosity using a falling ball viscometer and Stokes's Law. The model showed that a liquid with a viscosity higher than water ( $>0.89$  mPa-s) was optimal, with water only generating 14.82 volts and the highest viscosity generating 24.82 volts. The results could be applied to theoretically almost double the output of modern hydroelectric generators. This is not without its disadvantages. The more viscous liquid would replace water in generators not designed for it, and in those that use rivers to spin a turbine, changing the liquid could have potential environmental concerns.



Shewchuk, Abigail; Gannon, Ella

*George Washington Middle School*

*Teacher: Gray*

### Which Wing?

In our project we sought to determine the best wing shape for maximum unassisted (no engine) flight distance after launch. To do this we constructed planes out of cardboard, balsa wood, and plastic. After all of the planes were done, we made our launching system out of a stomp rocket and began to test. We launched the planes individually, straight in front of our system. Next, we used a tape measure to measure the flight distances and our computers to record the data. Our data proved our hypothesis to be incorrect, so instead of rounded wings flying farthest, triangular wings flew the furthest in our experiment.

Kambhampaty, Kedar

*Washington-Liberty High School*

*Teacher: Brodowski*

## The Effect of Algorithm Choice on Automated Face-Detection in Images of Occluded Faces

Occlusions of the face in captured images can prove a challenge for facial detection and recognition algorithms, degrading performance and causing both false negative and false positive results. This experiment explored the effect of different facial detection algorithms on detection accuracy against the Specs of Faces (SoF) dataset, which focuses on occluded faces. The algorithms tested were Haar Cascades from OpenCV, the deep neural network (DNN) module from OpenCV with an externally trained model for occluded faces, MTCNN (Multi-Task Cascaded Convolutional Networks), and the face detection model from Google's MediaPipe library. It was hypothesized that MTCNN would perform the best, as it implemented a cascaded technique with deep convolutional neural networks, boosting successful networks with a more efficient and accurate cascading system. Each algorithm was implemented in Python and tested on a collection of 1,833 images selected from the SoF dataset. The total count of images, and the number and percentage of positive face detections were tabulated for each algorithm.

A chi-squared ( $\chi^2$ ) test rejected the null hypothesis that the accuracy of face detection is the same for all four algorithms tested. The externally trained DNN algorithm had the highest rate of positive detections, at 99.7% while MTCNN had a 86.3% rate for positive face detection, rejecting the study hypothesis that MTCNN would be the most accurate of the four algorithms.

Kiesel, Emily

*Washington-Liberty High School*

*Teacher: Sotomayor*

### The Effect of the Distance Between Coils on a Three-Stage Mass Driver

The purpose of this experiment was to understand which sequence of coils will create the greatest amount of power to most effectively launch the payload of a three-stage mass driver. It was hypothesized that if the distance between coils is changed, then the coils that are evenly spaced (the first level) will reach the highest distance, because the payload will have an equal amount of power the entire way through the tube used to launch the payload. The first level had an equal distance between coils, and the second level had two closely placed together coils at the beginning of the tube, and then a final coil at the near the end of the tube. The third level one coil at the beginning of the tube, and final two coils placed closely together near the end of the tube. Finally, the fourth level had all three coils placed evenly together near the center of the tube. Each level was tested ten times, and then the data was compiled onto a Microsoft Excel worksheet. An ANOVA test was then performed and a p-value of  $4.2058E-38$  was recorded, which shows that there is a statistical significance between the groups.

Hettinger, Grace; Espiritu, Arianna

*Alexandria City High School*

*Teacher: Matthews*

### Sun Seeker; Mechanical Sunflower

The purpose of this project was to construct a heliostat by creating our own mechanical sunflower. Our engineering goals consist of using micro servos on a rotating axis to accurately follow light intensity, taking data in luxes with light sensor modules, and engineering two iterations in the programming that will improve the heliostat's performance. To accomplish our goals we designed and constructed a Lego base to which we attached the bread board and servos. Then we wired everything together and programmed it to track the sun. After testing our heliostat for three days, we received 250 seconds of data in luxes per day. It seemed that the heliostat reported more accuracy and consistency as the days went on. Through conducting the experiment we learned that making a cheap and simple heliostat is achievable. It is also something that could have a profound impact on Alexandria's energy consumption if used on a larger scale.

Anderson, Karin

*Washington-Liberty High School*

*Teacher: Fretts*

### The Effect of Metallic Foil and Different Geometric Shapes on Light Reflection

The purpose of this experiment was to determine whether the specific heat capacity of a substance has an effect on the amount of light it reflects or absorbs. It was hypothesized that a metal with a higher heat capacity will reflect less light back to the origin because materials with higher specific heat capacities absorb more light than those with lower specific heat capacities. The independent variable was the type of metallic foil and geometric shape of the foils; the dependent variable was the amount of light reflected back, measured in lumens. The experimental groups consisted of two V-shapes and two W-shapes, one of each made of copper foil and one of aluminum foil. The control was a V-shape and a W-shape made of paper. The experiment was conducted by placing the control or experimental group under a cardboard box that had two holes cut out so that a phone and light source could be shone inside the box. This allowed light to reflect against the shape and be recorded by the lux meter located on the phone. The T-Tests between the Al W and V, Cu V and W, and Al W and Cu W were less than 0.05, whereas the T-Test between the Al V and the Cu V were not. These results conform to the research stating a V shape would reflect less than a W shape, but not the the research pointing towards metals with higher heat capacities absorbing more light.

Hemsh, Emma

*Washington-Liberty High School*

*Teacher: Fretts*

### The Effect of the Catholyte on the Power Produced by a Microbial Fuel Cell

This experiment investigated the effect of the salinity of the catholyte on the power output of a two-chamber microbial fuel cell (MFC). MFCs are a sustainable power source and run on organic waste. Environmentally integrated MFCs may function differently depending on their location. Salinity is increasingly a concern for waterways in the DC region, so streamwater (the control), tap water with 6g and 12g of salt, and tap water with 6g of sodium-containing detergent were tested as catholyte solutions. Conductivity was used as an indirect measurement of salinity, and streamwater was the control. The dependent variable was the power produced by the MFCs, which was calculated as the product of the voltage and current of the cells. It was hypothesized that if the conductivity of the catholyte was higher, then the power produced would be greater, because the solution would be a stronger electrolyte, which would allow for more movement of charged particles and make the voltage of the circuit higher. The group with the highest power output was the detergent group, and the lowest was the 12g salt group. An ANOVA test returned a p-value of 0.18, meaning there was no statistically significant difference between the means of all groups. Since all of the trials had low voltage and current measurements that were difficult for the multimeter to read, the data were not very precise. There are many possible reasons for the overall variance, including inconsistent salt bridges and water-to-mud ratios in the cells.

Hoganson, Taylor

*Alexandria City High School*

*Teacher: Strimple-Barker*

### Warren Truss Bridges: Is Bigger Better?

Humanity is currently facing a desperate crisis, decades in the making. That crisis is global climate change, and it threatens infrastructure on a never-before-seen scale. With sea level rise and increased tropical storms, it's safe to assume that the next couple decades will lead to catastrophic infrastructure failure, which would inevitably lead to a global economic crisis. Updating massive infrastructure can be difficult, especially on the global scale. Because of this, the project was designed to be a sort of contingency plan. This project aimed to produce a model of the ideal warren-truss bridge for replacing lost infrastructure quickly. The structures here are designed to be as martial efficient as possible, and can hold thousands of times their own weight, which is remarkably beneficial for the construction and maintenance of large-scale infrastructure. This project serves as a proof of concept for two ideas. Firstly, it is meant to prove that the Warren-Truss bridge design is one of the most efficient, and simplest, bridge designs available. This project also proves the strength of PLA (Polylactic Acid), which is a 100% renewable, and 100% biodegradable plastic, that can also be used in a 3D printer. All in all, this is a two-part civil engineering project with a single goal: sustain the world's infrastructure.

Khanna, Evan

*Alexandria City High School*

*Teacher: Yale*

### The Black Hole Project

My science fair is important because of the many mysteries of black holes, as there has been little to none in-person experience and witness of black holes. This creates many curious, burning questions about black holes. My science fair project answers the question, what impacts does a black hole have on its surroundings? I have created a simulation that will give others a visual representation of how black holes affect other objects around the black hole. The simulation was made using [slnova.org](http://slnova.org) (StarLogoNova). The code for the simulation was written in block code, which is what StarLogoNova uses as its language. Visuals were made with StarLogoNova's basic shapes, graphics, and colors. The simulation works when the user clicks different buttons to use the simulation, as each button has different . The simulation measures the growth of the black hole in StarLogoNova's units and the number of asteroids absorbed. What seemed to happen when running the simulation, is that there will be slight dips in the number of asteroids absorbed when the growth of the black hole drops. This project contributes to the community because it gives a visual representation that is easy to interpret to those who maybe curious but don't have knowledge of black holes. This also helps those because of the little knowledge and in-person experience of black holes. This simulation/project met all the objectives and did meet the design criteria as the simulation basically, visually represents what happens to objects when absorbed by a black hole.



Shah, Jaya

*Washington-Liberty High School*

*Teacher: Barrett*

### The Effect of Weather Condition on Autonomous Vehicle Sensor Accuracy

Weather conditions can greatly impact the safety of a car. About 1.2 million car accidents occur yearly due to bad weather. Autonomous vehicles have the potential to reduce crashes, as they are better at sensing the surrounding environment and anticipating what is coming ahead. However, a sensor's ability to identify objects ahead can be impaired during inclement weather. The purpose of this project was to evaluate how an electronic infrared distance sensor was able to identify objects at varying distances in different weather conditions (rain, snow, and fog). The car sensor tested out in this project was the electronic distance sensor, which was tested out at a distance of 10, 25, 50, and 80 centimeters. It was predicted that the "normal" weather condition would lead to the most accurate object detection distances. The experiment was performed by connecting the sensor to an Arduino IDE which converted the sensor's returning pulse into a distance in centimeters. The accuracy of each sensor was calculated by subtracting the actual distance of the sensor by the distance the sensor detected, in order to find the margin of error. In the end, the results showed that the "normal" weather condition led to the most accurate results, reaffirming the hypothesis. The greatest margin of error was the "snow" weather condition. The results from the experiment showed that more research and development must be put towards developing more accurate sensors which can maintain accurate readings during poor weather conditions.

Shiffer, Andrei

*Alexandria City High School*

*Teacher: Liercke*

### The Power of Excel: Can Excel Be Used as an Easier, More Friendly Game Engine?

Microsoft Excel is the most used programming language in the world. The software can do a lot, but what happens when we bring Excel to its limits? I wanted to test this by seeing how well it compared to other game builders. Can Excel compete with other game engines, or does its functionality and great power stop at computing numbers? If Excel is a competitor to other game engines, this would mean that game creation would be much more accessible and people with ideas would be able to make those ideas into reality. I wanted to create a game within Excel that could engage people, work by itself (without using external applications), would have the computer make intelligent decisions, and was all connected. I set out to do this by creating multiple popular gambling games that were fairly simple to understand and play. Going into this project, I believed that building games within Excel would be straightforward and would be easier with the help of Excel's interface being easy to understand and use. After creating all of the games and meeting all of my engineering goals, I concluded that Excel wasn't built to create games. The interface breaks and the language that it uses isn't user-friendly with multiple large bugs and a lack of functionality. While it is very possible to be able to build games within Excel, it's tedious, unresponsive, very ineffective, and doesn't hold up with the other competitors.

Volpe, Claudia

*Washington-Liberty High School*

*Teacher: Fretts*

### The Effect of the Type of Heat Source on the Number of Volts It Can Produce Using a Thermoelectric Generator

Thermoelectric generators use heat to produce electricity, which is an advantageous source of electricity because it is highly reliable, low maintenance, environmentally friendly, and does not produce any pollutants. Thermoelectric generators can be easily made and can use a wide range of heat sources, which would make it beneficial to a homeowner during a power outage. The purpose of this study was to determine which type of heat source was able to produce the largest number of volts, using a thermoelectric generator. The heat sources tested were candles, handwarmers, and a stovetop, which are all easily accessible and commonly found in most households. It was hypothesized that the stovetop would produce the largest number of volts, since it reaches the highest temperatures. The experiment was conducted by building a thermoelectric generator and testing each heat source 10 times for 2 minute intervals. The results showed that the stovetop produced the largest number of volts, with a mean of 12.1 volts. The control group of candles had a mean of 5.7, and the handwarmers had a mean of 0, showing that there was a significant different between each heat source. The data collected suggests that thermoelectric generators are an effective way to produce electricity, and can do so using household heat sources, which can be beneficial to homeowners during power outages.

Rami, Rayyan; Curry, Noah

*Alexandria City High School*

*Teacher: Yale*

### Retractable XC Spikes

The point of our project was to find a way to improve cross-country spikes, which are shoes that can improve runners' times in races by 10 to 20 seconds. Though they improve grip on surfaces like grass, it is dangerous to run on asphalt, a common feature in race courses, with the spikes in these shoes. We chose to solve this issue by creating retractable spikes. Our rationale was that if the spikes can retract into the shoe when pushed up against a hard surface like concrete, it'll be smoother for runners to run on and they won't be at risk of injury. In theory, the spikes wouldn't retract when used on soft surfaces like grass, allowing them to still provide a better grip for the runner. We originally wanted to build the retractable contraption inside the rubber of the shoe, but we ended up building a retractable spike contraption and attaching it to the shoe externally. In order to keep the bottom of the shoe uniform, foam was attached to the rest of the bottom. Our model did work, though it broke completely and was unusable after trial 13. This might be attributed to a course change that occurred; the distance was lengthened to 100 meters and the course began on a sharp decline. In conclusion, our idea worked in theory, but, when executed, it didn't hold together. In future tests, we should use stronger adhesives and more flexible materials.

Bell, Daisy

*Dorothy Hamm Middle School*

*Teacher: Krueger*

### The Effect of Radiation on Seed Germination

Many places have been affected by radiation. The purpose of this experiment was to figure out if it was still possible to grow plants, specifically cress seeds there. Some scientists have said radiation can be lethal for plants (Sax,1955). Others have pointed out that it depends on the amount of radiation (Pallavi,2017) and the plant's species.

5 different sets of seeds were microwaved a distinctive amount of time. The first; the control was microwaved 0 seconds. The second 5 seconds, the third 10 seconds, the fourth 20 seconds and the fifth 40 seconds. Each was put in a container filled with soil and then spritzed with water. They were set by the window and every afternoon for a week the amount of seeds germinated was logged.

The first day nothing occurred but on day two 1 seed germinated in the control group and 2 seeds germinated in the 5 second group. From then on the control and 5 second group germinated at the same amount every day until day six when the control group germinated twice and the 5 second group didn't germinate any seeds at all. In conclusion the control group germinated 7 times, the 5 second group germinated 6, and the 10 second group germinated 4 times. The 20 and 40 second groups didn't germinate at all.

In short Reed Miller of Stanford University concluded that radiation can "Reduce seed germination," and such was shown in the experiment.

Bryant, Andrew

*Francis C. Hammond Middle School*

*Teacher: Coussens*

### Water Quality Experiment

Since water pollution is a problem globally I wanted to see if it was a problem in my area. So I came up with a hypothesis that population density is a factor in the quality of water. So I began to take samples of densely populated areas and less populated areas and the results showed that the quality of water in my area stayed consistently good regardless of population density.

Gennarelli, Evelyn

*George Washington Middle School*

*Teacher: Haisfield*

### To Make Water From Energy

There are several ways to make energy from the resources around us. Wind, water, and sun are types of renewable energy that are better for the environment than fossil fuels. This project explores using rainwater from house gutters to make energy.

Five trials were conducted using three PVC pipes of different diameters. Water was poured at a steady pace down the PVC pipe each trial. A propeller at the bottom was connected to an energy-measuring device, a multi-meter. When the water hit the propeller, it spun to create energy, which was measured by the multimeter. After 5 trials, a new pipe with a different diameter was placed in the pipe stand.

The hypothesis for this experiment was that water poured down the smallest diameter pipe would make more energy because the water moves faster in a smaller space than through the larger diameter pipes.

The hypothesis was supported by the data. After all of the trials were conducted, the average amount of energy made for the  $\frac{1}{2}$  inch pipe (smallest) was 1.43 watts was more than the 1-inch and the 1  $\frac{1}{2}$  inch pipes' averages, 1.27 and 1.28 watts. The results indicate that the smallest pipe produces the most energy. The result of this experiment suggest that if we made gutters skinnier and added a propeller, energy could be captured from naturally occurring rain. Using this technique to create energy for our homes will decrease the need for energy from other, more harmful energy sources.

Ghosh, Sid

*Williamsburg Middle School*

*Teacher: Willet*

### The Effect of APS Schools on Stormwater Quality

The purpose of this experiment was to determine which schools in Arlington are best at managing stormwater, and which need their stormwater management practices to be updated. This is important because excessive stormwater can cause flooding, and dirty stormwater can pollute bodies of water, affecting aquatic ecosystems. During the testing, water quality was tested at three different schools: Williamsburg Middle School/Discovery Elementary School (both schools are located in the same place), Dorothy Hamm Middle School, and Taylor Elementary School. Data was taken from three places at each school, including storm drains, storm grates, and pipes. Data was also collected three times from tap water flowing from an indoor sink, so that there could be a control that the water from the schools could be compared to. The data showed that Williamsburg/Discovery has very good stormwater management practices because the stormwater collected from the two schools had the most dissolved oxygen, which is an indicator of healthy stormwater. The hypothesis was that Taylor Elementary would have the worst stormwater because it didn't have as many stormwater management requirements when it was built compared to the other schools. This hypothesis was rejected, because the stormwater from the school had the least amount of phosphates (phosphates are associated with bad stormwater). However, there weren't many storm drains at Taylor, which can cause excessive runoff and potentially, flooding. Lastly, the results showed that Dorothy Hamm needs more stormwater management, because the school had the most phosphates and the least saturation of dissolved oxygen.



Gomez Crummett, Candela

*Williamsburg Middle School*

*Teacher: Zarro*

### The Effect of the Type of Preservative on the Mass of a Cut Flower

The experiment title was "The Effect of the Type of Preservative on the Mass of a Cut Flower". The reason for conducting this experiment is so that people can learn which preservative keeps flowers from wilting, the effects on the flowers, and the water the flowers are submerged in so that their cut flowers will last longer. The levels of independent variable for this experiment were lemon juice, sugar, flower food and a control of water. The dependent variable was the mass of the flowers after seven days. My hypothesis was if the preservative added to the flower is flower food the the mass will increase because, flower food contains acid, sucrose and other minerals which a healthy flower need to thrive and with these chemicals the flower will be able to continue to take in water therefore increasing the mass. After seven days, the data showed that the hypothesis was supported and the flower with flower food had the largest mass. The flower with the least mass was the flower with sugar. This was supported by my research which showed that if only sugar was added, bacteria would grow in the cup causing an unsuitable environment for the flower. This experiment could be expanded in a few ways including testing other preservatives or other factors like the mount of water.

Procida, Eliana

*H-B Woodlawn Secondary Program*

*Teacher: Taggart*

### Turning Food Waste Into Paper

The purpose of this experiment was to study the effect of different kinds of food waste on paper making. Making paper out of trees is really dangerous for the environment and one of the biggest issues for climate change on our planet. Unfortunately, trees are the main materials for a lot of our everyday necessities, including paper. Finding other ways to make paper is a good start to saving our planet. This project tested food waste because “wasted food has far reaching effects both nationally and globally. Reducing wasted food has been cited as a key initiative in achieving a sustainable food future.” (Harvard School Of Public Health - The Nutrition Source). “Americans waste more than \$218 billion each year on food. The average American family of four throws out \$1,600 a year in produce.” (Feeding America). The hypothesis for this experiment was that onion skin would work the best to make paper because it is thin like paper and would make the most easy texture to write on and fold. The information gathered with this study is valuable to society because it is a better way to make paper that is less harmful to the environment. This experiment used four different types of food waste - garlic, green beans, onion, and carrots - to make four different pieces of paper. The results were that each paper had different textures, colors, and some were easier to write on. This procedure succeeded in making paper out of food waste.

Snipe, Amelia

*George Washington Middle School*

*Teacher: Breslin*

### The More Eco-Friendly Plastic

The purpose of the lab is to investigate if the amount of tapioca starch will affect the number of grams the bioplastic can hold. To conduct this experiment the following procedures were used: to start, I'm going to combine all of the ingredients in the pan. Next, I'm going to mix them all together on medium heat. Then, the durability is measured using the tensile strength test. Afterward, I'm going to keep everything else the same but use 2 tablespoons of tapioca starch instead of 1 tablespoon. Lastly, I will repeat the experiment 5 times for each of the independent variable levels: 1 tablespoon + 2 tablespoons. The data supports the hypothesis because the more tapioca starch I added to the recipe the higher the number of grams the bioplastic could hold. For example, the mean of the 2 tablespoons on the graph shows that it's 1644 grams higher than the mean of the 1 tablespoon. Adding an extra tablespoon makes it stronger and more durable, which is helpful because we're trying to eliminate plastic from our day-to-day life, and some uses of plastic require a material that's very tough and durable, so using the bioplastic with 2 tablespoons of tapioca starch is the way to go. Based on the finding it can be concluded that adding an extra tablespoon to the bioplastic makes it able to hold more weight.

Burks, Thomas

*George Washington Middle School*

*Teacher: Matthews*

### Monte Carlo Model of Wind-Assisted Container Ships

In this project, I explored the use of wind-assisted technology on cargo ships. I did two smaller projects to complete this project. First, I built a physical model of a shipping container, and I took out cargo where the wind-assisted technologies would be. This gives an estimation of the cargo lost for each technology. Next, from data I was able to determine five routes that are high-traffic areas for cargo ships. I mapped the wind speed and direction along these five routes, and I used transfer functions for the wind-assisted technologies to determine the output power or velocity as a function of the input wind speed and direction. I built a Monte Carlo simulation with the input wind speed, direction, and price of fuel to run 1,000 simulations for each of the wind-assisted technologies. From the model, two of the three wind-assisted technologies (Flettner and Kite) do not produce enough power to contribute significantly to fuel savings. The Wing/Sail does produce fuel savings (up to \$1,000,000 for some routes), but 10% of the cargo would have to be removed from the cargo ship, and the sails in the way might make loading and unloading more difficult.

Pines, Asher

*Williamsburg Middle School*

*Teacher: Warden*

### The Effect of Filtration Methods on Environmental Water Sources

Encountering survival situations is rare. But when they do occur, such as plane crashes, desert island strandings, or more commonly getting lost while hiking, people can find themselves without access to clean water. The question being answered through this experiment is the best way to filter it in a survival situation. Water is one of the most important things in a survival situation. People can only survive for three days without water. This is even less in situations where water losses are faster (e.g. hot environments or when exercise is needed to survive). It is also important because it is vital to drink the cleanest possible water to reduce the chances of getting sick. If dirty water is consumed, people can become ill from water-borne illness. Examples include cholera, amebiasis, and typhoid. These can cause diarrhea and can further dehydrate someone which can lower the chances of survival. Water can also have other substances in it that can hurt you, like mercury and lead. The point of this experiment is to make recommendations about the best environmental water source and how to make it safe to drink in a survival situation.

Schroeder, Zoe

*Kenmore Middle School*

*Teacher: Brown*

### The Effect of the Type of Method on the Amount of Oil Cleaned Up

Marine life is essential to the environment and counteracting effects of global warming because of a process performed by marine animals called a “biological pump”. Oil spills are preventing this process and creating a negative impact on the environment. This project looks at what method of collecting oil from oil spills is most effective. The methods (kitty litter, dish soap, sponges, and rag) were tested by setting each method in a pan with water and oil to absorb the oil for 15 minutes. The data was collected by measuring the mass of the method and pan before and after each trial (dependent variable). The hypothesis for this experiment is if kitty litter is used then there will be less oil left in the water because kitty litter is an oil absorbent. Based on quantitative and qualitative data this hypothesis was not supported. Although the hypothesis was not supported, the qualitative data shows that the kitty litter was a close second to being the most effective method. The sponge method had an average mass of 326.4 grams but when the sponges were rung out the liquid collected was mostly water. To compare, the kitty litter method had an average mass of 137.8 grams but had more water than oil left in the pan. In conclusion, the dish soap method was found to be a solvent for oil and most effective. This is because it left less oil in the pan while having a greater mass than kitty litter.

Shoffner, Sophia

*Swanson Middle School*

*Teacher: Seliskar*

### The Effect of the Type of Filter on the Phosphorus Levels of Simulated Fertilizer Runoff

The purpose of this experiment is to compare water filters, and effectiveness in phosphorus extraction. The importance of this experiment is to combat the negative effects of algae blooms. This data could be implemented to improve Arlington's streams.

My project tested the effect of the type of filter on the phosphorus levels in simulated fertilizer runoff. My hypothesis was that if the type of filter is changed then the phosphorus levels would decrease the most with natural filter two.

To start, I created fertilizer runoff by combining phosphate granules and tap water. I assembled 4 filters. Natural filters one and two were layers of natural materials. For human made filter one, I layered metal mesh and cloth. For human made filter two, I lined charcoal powder, sediments and cloth. Lastly, I poured phosphate water through each filter, testing before and after.

According to the bar graph, natural filter two had the highest average change in phosphorus at 86 ppm. Then, the dot plot showed that natural filter two had the tightest data cluster at a range of 25 ppm. Therefore, natural filter two was most effective.

In summary, my hypothesis was supported by both graphs. One outlier was that originally, I'd planned to use stream water but the phosphorus was too diluted to measure, so I mixed phosphate granules with water instead. Also, the water didn't percolate through human made filter two. Further research can be done on the different phosphorus tests' effectiveness, and how climate impacted the experiment.

Tulgaa, Anu-Ujin

*Gunston Middle School*

*Teacher: Pentland*

## Earthquake

The purpose of this experiment is to understand how different types of soil are big factors of earthquakes and has a great influence on the damage that countries take when natural disasters happen. In a built environment, liquefaction can be extremely damaging. Roads can become impassable, pipelines and ducts can float upward and surface, and as the liquefied soil shifts, it can break buried utility lines. It can even cause entire buildings that do not have a proper foundation to suddenly sink, tilt, or even topple over. So it is important to let people know that sometimes after an earthquake phenomenon like liquefaction can be quite harmful. The goal of this project was to find the effect of type of soil on the damage caused by liquefaction. The scientist experimented on three types of different soils sand, clay, and loam. The experiment was to add water to each soils and make it go through numbers of trials of back and forth movements that stimulates liquefaction. The mean of the loam soil was 6.6 cm when sand was 7.8 cm. The mean of the clay was 12.2 cm so the loam soil was the most resistant one. The data indicates that loam soils are more stable during liquefaction. This project contributes to the environmental science area. Yes it met the objectives.



Waterhouse, Reese

*George Washington Middle School*

*Teacher: Mellis*

### An Analysis of Water Quality in Alexandria

In this experiment, I will be testing four different water sources in the City of Alexandria. I will test Four Mile Run, Holmes Run, Taylor Run, and Backlick Run. They are four different creeks that go through Alexandria. The purpose behind my tests is to see if these creeks are potable. Potable means I will be testing the alkalinity, hardness, pH level, chlorine, copper, nitrate, nitrite, and iron of the four water bodies. My goal is to discover more potable water sources to create drinking water in Alexandria beside the Potomac River and Occoquan Reservoir. I am conducting this experiment because I did a mini water quality lab in my science class which intrigued me. I had known that water quality was one of the biggest issues the world faces.

Wunderlich, Caleb

*Kenmore Middle School*

*Teacher: Price*

### The Effect of Drought on Soil's Ability to Retain Water

The experiment tested the effect of aridity on soil's ability to retain water by simulating rainfall on three soil samples with differing levels of aridity. The experiment's hypothesis stated that an increase in aridity decreases soil's ability to retain water. To test this hypothesis, a container was prepared with a water-proofed foam square resting on a slope. A hole was drilled in the trough where the water could escape. Soil with differing levels of aridity was then placed on top of the foam square. This experiment tested three conditions of soil: unbaked (control), baked for 30 minutes, and baked for 60 minutes. Five bottles were taped together to ensure equal water distribution on the soil. During each experiment, 1422 mL of water was poured into each soil sample. Then, the soil's water output was measured in milliliters and each experiment was recorded with a video device to capture output rate and amount. All three trials established clear trends in data, as the control held water the best, the soil baked for 30 minutes having marginally retained water, and the soil baked for 60 minutes barely retaining water while resulting in rapid flooding. The results validate the hypothesis that an increase in aridity decreases soil's ability to retain water. The experiment also demonstrates growing hazards facing drought-affected communities and the role of soil aridity conservation in mitigating future natural disasters.

Bu, Matthew; Decker, Carson

*Dorothy Hamm Middle School*

*Teacher: Leeb*

### The Relationship Between Water Filtration Method and Contaminants Removed

Both activated carbon and Moringa seeds are known to be able to purify water by removing certain contaminants. The effects of adding activated carbon and grounded Moringa seeds to water obtained from a natural source (4-Mile Run) were examined in this project. The results showed that Moringa seeds performed the same as activated carbon in removing most tested contaminants and surpassed activated carbon in removing copper by around 100%. However, activated carbon cut the concentration of zinc by nearly a half, whereas Moringa seeds failed to remove any. In addition, activated carbon removed around 60% more hydrogen sulfide than Moringa seeds. On the other hand, Moringa was able to disinfect the samples, while the activated carbon facilitated the growth of waterborne bacteria. Thus, Moringa seeds may be a viable alternative to activated carbon in areas where the Moringa plant is more common and waterborne bacteria pose a significant threat.

Kammerman, Noa; Jacob, Erin

*Dorothy Hamm Middle School*

*Teacher: Leeb*

### The Relationship Between the Age of a Tree and Its Soil Quality

With Urbanization skyrocketing you can see Arlington is changing rapidly. Due to the constant construction and urbanization, old growth trees are being cut down just to be replaced with new growth trees. Many people think that new growth trees are just as, if not better then old growth trees but we wanted to see if this was true. As part of the background research I learned about a study showing that old-growth forests have a lower soil organic carbon turnover rate than do younger forests, due at least in part to decreased pH and higher nitrogen concentration which together slow microbial growth and reduce soil respiration. Also some keywords that I found were Nutrients levels, Soil, Tree age, Old growth, New growth, Trees, Dendrochronology.

After testing each tree three times we calculated the median of the results from day to day soil testing over three days. Our results proved our hypothesis to be true showing that old growth trees do in fact lead to better soil quality. New growth trees also had thriving test levels but you see a decrease in our data when the tree is a median age. This may be due to when new growth trees are planted they are planted in nutrient dense soil but the soil may begin to become less nutrient dense when the tree is not able to produce everything that a factory could. The increase could be due to large growth rates in trees when they reach an old growth age.

Umerov-Todoroki, Maya; Louis, Raika

*Williamsburg Middle School*

*Teacher: Warden*

### The Effect of Nitrogen or Phosphate on Dissolved Oxygen Levels

This experiment demonstrates the critical environmental issue, eutrophication, which is typically caused by intensive farming methods and poor sewage and waste management. Nitrogen and phosphates are nutrients and essential for plant and animal growth, but the overabundance of these nutrients in water can cause several adverse health and ecological effects. After this process, the body of water becomes a dead zone, where no life is able to be sustained. The question that is being answered through the experiment is how does the amount of nitrogen or phosphate affect the level of dissolved oxygen. The hypothesis of this experiment is that if there is more fertilizer or detergent, then the dissolved oxygen levels will decrease because fertilizer and detergent both contain nitrogen and phosphate, which will feed algae blooms. The algae will use up the dissolved oxygen of the water. To conduct this experiment, we put different amount of fertilizer or detergent in to 7 jars, and tested the dissolved oxygen level after the first week and the second week. Following 4 weeks of trials, it was found that the more phosphate and nitrogen the water contained, the lower the dissolved oxygen level was. Fertilizer which contains both nitrogen and phosphate decreased the dissolved oxygen levels the most. This contrasts with the control jar, creating high quality water suitable for abundant fish populations. The result of this experiment can be explained by the fact that the larger amount of phosphate and nitrogen feeds into more algae blooms which steal more oxygen.

Dorotheo, Sloane

*Yorktown High School*

*Teacher: McKowen*

### The Effect of Carbon Dioxide on Temperature

The effect of carbon dioxide within the atmosphere is established to raise temperatures. This is due to the way that carbon dioxide absorbs infrared heat waves and insulates the Earth. When CO<sub>2</sub> is at a surplus, this effect can lead to global warming, where average temperatures are higher than necessary. To attempt recreation of this effect on a smaller scale, I built a large (8 foot tall) prism chamber placed vertically over two heated slabs. The heat from the slabs introduced infrared waves into the apparatus. I drilled holes to install thermocouples throughout, to take temperature readings at different areas within the apparatus. I also installed a CO<sub>2</sub> sensor and a pressure sensor. Placing the equipment outside, I attached tubing attached to a carbon dioxide along with a flow-meter and a valve. Thermocouples and sensors were attached to a MEGA Arduino board that was connected to my computer, so readings from all of these devices were taken every 8 seconds for over 90 minutes during testing. This way, I could view the levels of CO<sub>2</sub> while simultaneously introducing CO<sub>2</sub> at different levels into the chamber. Due to the fact that CO<sub>2</sub> lowers pressure and is a coolant, I allowed time for the environment to adjust to temperature. Despite the errors in the project, such as the cooling CO<sub>2</sub>, the apparatus not being fully sealed, and the thermal conductivity of some of the materials, we were able to discern an average 3 degree F increase at the 13% CO<sub>2</sub> level.

McCommons, Margaret

*Alexandria City High School*

*Teacher: Matthews*

### Rainfall Impact on Stream Health

I investigated the impact of precipitation on water quality in our local streams. I hypothesized that after rainfall, the stream would be less healthy. I used the LaMotte water quality testing kit used to measure stream health. I collected data in the areas of temperature, pH, phosphates, nitrates, dissolved oxygen, and turbidity. I tested the stream a total of four times.

Based on the data collected I could not confirm my hypothesis. The changes in values for the dissolved oxygen and phosphates test were not enough to draw a strong conclusion. In the future I plan to cleanse my hands more thoroughly in between each test and to test the stream more frequently.

Mukhtar, Ayah

*Wakefield High School*

*Teacher: Fuamenya*

### Powering the Future: Comparing Renewable and Non-renewable Fuels in Heat Production

This experiment was designed to test the efficiency of renewable and nonrenewable fuels, and compare the amount of heat energy they can produce. Knowing the importance of this topic, I asked the question: Can a renewable biofuel (vegetable oil) release the same amount of energy as a nonrenewable fuel (motor oil)? I hypothesized that motor oil will produce more heat energy compared to vegetable oil because for a renewable fuel to produce the same amount of energy as a non-renewable fuel it would require more maintenance, quantity, and land. To put my hypothesis to the test, I put 100 ml of water in a soda can and put a piece of cotton cordage on a paperclip and soaked the cotton cordage in either vegetable oil or motor oil. I lit the cotton cordage on fire and placed it directly under the can for it to heat up the water. Each fuel was tested 3 times for the most accurate results. At the end of my experiment, I found that my data did support my hypothesis. Motor oil produced more heat energy with an average percent change in temperature of 52.5%, while vegetable oil's average change in temperature was only 33.8%. Even though my hypothesis was proven correct, this does not mean that it is impossible for the world to rely on renewable energy. For the sake of our planet, with more effort and commitment, the world can continue to shift towards renewable fuels.



Batenhorst, Maya; Hardwick, Katie

*Yorktown High School*

*Teacher: McKowen*

### The Effect of the Location of the Sediment Near the Potomac River on The Level of Ph and the Textural Classification

The objective of the experiment is to test to see the ph level and textural classification of sediment near the Potomac River. This research is important scientifically because it shows how the environment of the area around the river affects the water flow, plants, and organisms that are located there as well. Our hypothesis was if the location of the sediment is closer to the town of Georgetown, then the sediment ph level will be higher due to more industrial activity and will most likely be classified as loamy soil due to its inorganic origins. The data collected only partially supported our hypothesis. The pH of the soil was higher/more alkaline closer to Georgetown, however the textural classification varied dramatically from location to location, and was not classified as loamy soil. Our null hypothesis, which was that the location of the sediment doesn't affect the results, was rejected. An ANOVA Test was done to test the significance of the experiments. The results of the test showed that the pH and textural classification data were both statistically significant. Knowing the state of sediment will help in preventing erosion, flooding, and how the sediment moves in and out of unwanted areas.

Bright, Eleanor; Verhoeven, Gaetanina

*Alexandria City High School*

*Teacher: Matthews*

### Bigger Storms Ahead: How Does the Increasing Temperature in the Oceans Affect the New Hurricanes?

The purpose of our project was to find the correlation between the temperature of the ocean in which the hurricanes form, and the strength of the hurricane. Our hypothesis was, how does the increase in temperature in the Atlantic Ocean affect the intensity of new hurricanes? To find our data we used brief overviews of each hurricane from the past ten years, from the website NOAA. We used Pearson's  $r$  to calculate the correlation between temperature and intensity. Our results showed that our data represented a medium positive correlation. In conclusion, our project showed that because of the increasing ocean temperatures in the Atlantic, hurricanes are reaching higher categories and causing more destruction.

Adhi, Roayba

*Washington-Liberty High School*

*Teacher: Fretts*

### The Effect of Food-Grade Flocculants on the Aggregation of Simulated Microplastics in Polystyrene-Contaminated Water

Microplastics are miniscule particles of plastic that have seeped into the world's supply of drinking water, all while carrying contaminants that are potentially dangerous for humans. Using the process of coagulation-flocculation for microplastic filtration, wastewater treatment plants (WWTPs) utilize environmentally-damaging synthetic flocculants that biodegrade slowly and generate toxic byproducts. Thus, the purpose of this investigation was to determine which food-grade flocculant is the most effective natural alternative to the flocculants used today. The flocculants experimented on were okra, aloe vera, and prickly pear cactus, while the control was no flocculants. It was hypothesized that okra would be the most effective in aggregating the simulated microplastics in polystyrene-contaminated water due to its polysaccharide-rich mucilage that works as a binding agent to hold particles together. This experiment was conducted by adding food-grade flocculants to water containing simulated polystyrene-microplastics and calculating the average microplastic aggregation after 24 hours for each of the flocculants. The results indicated that okra allowed for the greatest microplastic aggregation, as the mean mass of simulated microplastics remaining post-filtration was 3.4 grams. In contrast, the control allowed for the least microplastic aggregation, as the mean mass of microplastics remaining post-filtration was 4.7 grams. As such, the data gathered suggest that the food-grade flocculants used are potential natural alternatives for effective wastewater treatment and prompt the need for testing combinations of such flocculants for optimal aggregation results.

Akay, Peter

*Yorktown High School*

*Teacher: Lovrencic*

### The Effect of Material Used to Filter Water on Amount of Filtration

The water crisis throughout the world is only becoming more detrimental of a problem as the population grows. Many cheap methods of filtering water have been created, yet many underdeveloped nations don't have access to clean drinking water. This experiment tests the effect of the material used to filter dirty river water on how clean the resulting water is. In this experiment, three natural filters were used as independent variables: sand, coniferous tree branches, and tree leaves. It was hypothesized that using a tree branch filter would result in the cleanest water due to the xylem in branches. The thin, mesh strainer-like material that makes out xylem naturally filters out bubbles from water, the only filter with natural filtering ability. The results of the experiment were plugged into a data table and made into dot graphs. The results were measured using a conductivity and acidity meter. Filtration using xylem had the best pH for drinking water out of all the dependent variables (average 7.438 pH), and an average ppm (parts per million) of 80. Sand had an average pH level of 7.706 and an average ppm of 342.8. Leaves had an average pH level of 8.47 and an average ppm of 781.4. Overall, sand would filter out a large amount of contaminants, yet xylem is the most reliable method of filtering contaminants out of water, beneficial knowledge for people who don't have access to a safe water source and an easy method of water filtration.

Beaumont, Nicola

*H-B Woodlawn Secondary Program*

*Teacher: Owen*

### The Effects of Salinity on the Growth of Chlorella

Algae can be used to produce biofuel, which is more environmentally friendly than fossil fuels, but has higher costs as it needs resources to grow. To reduce these costs, algae can be grown in wastewater, which already contains the needed nutrients. However, some types of wastewater contain higher amounts of salt than freshwater. Thus, the purpose of this experiment was to explore the effects of salinity on the growth of algae. To determine the salinity levels freshwater algae could grow in, Chlorella was grown for two weeks in solutions with varying salt concentrations, those being the control (0%), 0.6%, 1.3%, 1.9%, and 2.5%. Four trials were run for each salt concentration. Chlorella's growth was proxied by how much light the Chlorella absorbed when tested by a colorimeter set to 635 nm. Daily observations and measurements were taken to test the hypothesis that high salinity would negatively impact Chlorella's growth. At the end of the experiment, growth decreased as the salinity increased, supporting the hypothesis. The control with 0% salinity concentration had the strongest growth, while growth in salinity concentrations of 0.6% and 1.3% was only 65% and 37% of the control's growth respectively. In concentrations of 1.9% and 2.5%, both Chlorella populations ultimately decreased by the end. Salt concentrations of 0.6% and 1.3% also had increased clumping of Chlorella, which is useful for harvesting Chlorella for biofuel. These results are significant because they show the range of salinity that wastewater should have when growing Chlorella for biofuel.

Cozette, Olivia

*Washington-Liberty High School*

*Teacher: Fretts*

### The Effect of Different Locations of the Susquehanna River Relative to the Conowingo Dam on the Concentrations of Different Chemicals

The Susquehanna River contributes around 40% of the nitrogen loads and 25% of the phosphorus concentrations to the Chesapeake Bay. Despite the fact that a dam, known as the Conowingo dam, was built to contain this pollution, recent studies have shown that it has reached 96% of its capacity and is no longer operating as it should. The purpose of this study was to examine the water quality along the Susquehanna River to see how well the Conowingo Dam functions and where the most pollution has accumulated. The various test sites were 200 meters prior to the dam, immediately prior to the dam, immediately following the dam, and 200 meters following the dam. Phosphorus, nitrate, nitrite, and dissolved oxygen were the substances that were tested. It was hypothesized that the water tested right before the Conowingo dam would contain the most nitrate, nitrite, and phosphorus concentration and least dissolved oxygen, because the Conowingo dam has reached 96% capacity and has proven it can no longer capture pollution flowing downstream. The experiment was conducted by collecting and testing 10 samples of water at the 4 different locations and testing the concentrations of phosphorus, nitrates, nitrites, and dissolved oxygen. The results showed that for the pollutants (phosphorus, nitrite, and nitrate), the concentrations were at their highest just before the dam and at their lowest right after the dam. For dissolved oxygen, there was the most right after the dam with 0.88 PPM.

Docena, Nic

*Washington-Liberty High School*

*Teacher: Barrett*

### The Effect of the Material Used as an Oil/Water Separation Membrane on Separation Efficiency

Oil spills pose a significant risk to marine life. Oil spill cleanup methods exist, but each has significant drawbacks. However, scientists have recently studied low-cost materials used as separation membranes for oil and water. These materials have underwater superoleophobicity (repels oil) and superhydrophilicity (absorbs water). These properties allow the material to serve as an oil/water separator. This experiment intends to further research on these low-cost materials.

The low-cost materials tested in this experiment were paper towels, cotton, and cellulose sponges. It was hypothesized that if paper towels were the material used as a separation membrane for oil and water, the separation efficiency would be the greatest because it has the smallest pore size. To test the separation efficiency of each membrane, a separation structure was created. An oil and water emulsion was fed into the structure, and the membrane inside the structure kept the oil suspended, while the water passed through.

The material with the greatest separation efficiency was paper towels with a mean separation efficiency of 89.9%. Next were the cotton membranes, with a mean separation efficiency of 85.9%. The cellulose sponge membranes had a much lower mean separation efficiency of 50.0%. Finally, the control group with no separation membrane had the lowest separation of 0.0%. The results were statistically significant, which was determined by an ANOVA test. The high separation efficiency of the paper towel and cotton membranes was likely due to their water absorption capabilities.

Eichers, Julian

*Arlington Tech and Career Center*

*Teacher: Brasfield*

### The Effect of Harmful Algal Events on the Population of North Atlantic Right Whales from 1990-2021

There may be an effect of Harmful Algal Blooms on the population of North Atlantic Right Whales. There were several sources of data, including the North Atlantic Right Whale Consortium, and the Harmful Algal Event Database. Both of these provided a vast array of data sets, much of which was in a severe state of disorganization, and required much compilation. Much of the research performed to come to such a conclusion was based on data sets that were small, based upon estimation, or observational. With the contrasting results of Model 1 and Model 2, multiple conclusions can be reached. A portion of the data suggests that there is a correlation between the number of North Atlantic Right Whale deaths with indeterminate mortality cause. However, there is a portion of the data that supports a direct correlation of a rate of Harmful Algal Blooms, rather than an inverse correlation, with the population of North Atlantic Right Whales. The quantity, and quality of research into this specific topic is lacking. Further research is vital, as the population of North Atlantic Right Whales is at a critical point. Any information we may have upon the causes of mortalities of North Atlantic Right Whales, and means to prevent such issues, or bring awareness to their existence is something that we must strive for now. There is not very much time left, and without constant and serious action, we cannot solve the problem of the current Unusual Mortality Event, nor prevent future problems.



Encinas Mendoza, Melanie

*Wakefield High School*

*Teacher: El Gamal*

### The Effect of Different Types of Rocks on Saltwater Absorption

This study consists of evaluating various rocks and how much each rock can absorb salt water, also known as seawater. The graphs and data show how well the rocks Granite, Sandstone, and Limestone absorb salt water. Following the conclusion of this experiment, granite was the rock with the most porosity, or the rock that absorbed the most salt-water. This experiment was conducted in a non-changing temperature environment, demonstrating that the results are as accurate as they can be. 100 mL was placed in the beakers, and the porosity and absorption of the following rocks were tested: Granite, Limestone, and Sandstone. After careful experimentation, reviewing the results, data, and all separate and conjoined tables/graphs, the Granite rock would have the highest porosity and absorption ability. According to the results of the granite stone, within the timeline of this experiment, granite had absorbed about 13 milliliters of salt-water, which is a significant decrease from what was previously started at 100 mL of salt-water in total. Meanwhile, the Sandstone trial results were mildly impressive. Sandstone could absorb about 12 milliliters. Finally, the Limestone evaluation result was able to achieve 11 milliliters. When compared to the other results, Granite rock was satisfactory in being able to absorb the most saline solution. Every year about 80% of people around the world are affected by global warming. It's quite beneficial to comprehend the form your house is built of and how it functions. These results can guarantee the safety and resilience of our future generations.

Pickard, Elle

*Washington-Liberty High School*

*Teacher: Fretts*

### Determination of Per- and Polyfluoroalkyl Substances, Nitrates, and Phosphates in Different Locations on the Potomac River

The Potomac River has long stood as an important waterway for our nation. However, it is notorious for its historical anthropogenic pollution and dangerous conditions for humans as well as wildlife. Cleanup efforts have made progress since the 1950s, but the river still needs rehabilitation today. An emerging contaminant class of concern is a group of chemicals widely known as “forever chemicals”. Forever chemicals, or per- and polyfluoroalkyl substances (PFAS), are manufactured compounds that can cause serious health effects in humans as well as wildlife. This experiment was conducted in order to analyze the state of the Potomac River’s PFAS pollution and to determine the levels of these chemicals at different points downstream. Water from three locations on the river (Great Falls, National Harbor, and Mason Neck) was collected and tested for PFAS with a solid phase extraction (SPE) technique and a liquid chromatography-mass spectrometry (LC-MS) machine. The PFAS results showed that the lowest concentration was at Great Falls, which was furthest upstream, followed in succession by National Harbor, located in the middle, and then Mason Neck, the furthest downstream sampling site. In addition, nitrate and phosphate results were similar, with concentrations increasing as the sample sites progressed downstream. Alarmingly, each location exceeded safe concentrations of chemicals for river water. This correlation suggests that, as water flows further downstream, one would expect pollutants, including PFAS, nitrates, and phosphates, to become more and more concentrated.

Sagatov, Alina

*Washington-Liberty High School*

*Teacher: Bohn*

### What Time Period Creates the Most Amount of Biofuel in the Least Amount of Time?

Biofuel is a fuel that is derived directly from living matter, algae is a very common source of biofuel. The purpose of this study was to determine the most effective growing time for algae to be produced. The growing times for algae were 3 days, 6 days, 9 days, and 12 days. After the algae was harvested it was then produced into biofuel. It was hypothesized, If algae were grown in different amounts of time, then those grown within days 6-9 will grow the most because algae thrives in an environment that has enough nutrients and space for it to grow while not being too crowded. The results showed that the most amount of biofuel was created on day 12 as expected, the However, the algae had diminishing returns from days 6-12. The data suggests that algae grown in 6 days was the most effective at producing the most amount of biofuel. The data collectively suggests that all days produced biofuel that can help change the world, the project provides further insight into the best strategies for various purposes.

Shapiro, Frances

*Washington-Liberty High School*

*Teacher: Fretts*

### The Effect of Type of Cover Crop on Water Runoff and Soil Erosion

Water runoff and soil erosion in watersheds has caused increased pollution and led to the degradation of bodies of water. The purpose of this study was to determine what type of cover crops would best reduce water runoff and soil erosion. The cover crops tested were tall fescue, annual ryegrass, and white clover, while bare soil was the control. It was hypothesized that the white clover would be the most effective in reducing water runoff and soil erosion due to its dense ground coverage and strong root system. The experiment was conducted by constructing an apparatus to simulate slanted ground over which runoff might occur. 250 mL of water were poured over each group and the average amount of runoff in mL was found after 6 hours. The results showed that the control group allowed for the least amount of water runoff, with 181.0 mL. Conversely, all three types of cover crops reduced soil erosion the most by allowing only 1.0 mL, while the control group produced 11.5 mL of erosion. The data collected suggests that all three cover crops are successful in reducing soil erosion and provides useful information for future ways to protect our watersheds from becoming polluted.

Sjetnan-Day, Erika

*Washington-Liberty High School*

*Teacher: Barrett*

### The Effect of Chloroplast Pigmentation in Marine Algae on the Amount of Dissolved Oxygen Produced

Algae are powerful photosynthetic organisms that could be used to increase levels of dissolved oxygen (DO) in marine ecosystems. This experiment was designed to test if this is possible. The most important factor in determining the amount of oxygen produced by an organism is its chloroplast pigmentation. Other factors included the size of the algae cells, proximity and access to light, and light intensity. In this experiment, three types of marine algae were tested (Nannochloropsis algae, Tetraselmis algae, and Porphyridium Cruentum algae) for the amount of DO each algae could produce. Each of these three algae contain a different chloroplast pigmentation and size, which affects the amount of DO each species produces.

Nannochloropsis algae contains chlorophylls pigmentation, and has a size of 2–5  $\mu\text{m}$ .

Tetraselmis algae contains carotenoid pigmentation, and has a size of 10-14  $\mu\text{m}$ . Porphyridium Cruentum algae contains phycobilins pigmentation, and has a size of 6-10  $\mu\text{m}$ . It was

hypothesized that if 3 different pigmentations of marine algae are added to 50 mL of water and tested for the amounts of DO, the beaker with Nannochloropsis algae will produce the most amounts of DO due to the presence of Chlorophylls pigmentation. After the experiment was complete, it was found that Nannochloropsis algae produced the most amount of DO with 10.6 mg/L, therefore the hypothesis was accepted.

Tomanio, Braelynn

*Alexandria City High School*

*Teacher: Yale*

### The Effect of Artificial Turf on Our Waterways

Over the past years, artificial turf has become more popular along with the infill of crumb rubber. This experiment is building off of data from last year's project. Last year I measured the total amount of artificial turf displaced from a soccer field if a team practices three days a week. I used the results as the variables for this year's project and measured the total zinc artificial turf released in rain. Zinc is a heavy metal toxin that is released from crumb rubber infill. After conducting this year's experiment, I found that the test group with 22 grams of artificial turf infill had the greatest amount of zinc leached while the control group with 0 grams of artificial turf infill had the least amount of zinc leached. In addition, on days 4 and 5, the most amount of zinc was leached from trial groups.

Witmer, Skye

*Alexandria City High School*

*Teacher: Lay*

### Where Are We Most Vulnerable to Electromagnetic Radiation Within Our Community?

The goal of my science fair project is to identify the health implications of different levels of electromagnetic radiation, and why they prevail in some areas of our community more than others. My research taught me about the typical levels of electromagnetic radiation in our environment, and how they impact our health. My hypothesis was that there would be stronger electromagnetic fields in west Alexandria due to the great presence of older power lines. To collect the data, I went to a school, stood about three meters from the front door, spun 360 degrees for 10 seconds to get data from every direction, and then did the same at every school I went to. I also measured the spikes in electromagnetic radiation that I would encounter when driving between testing sites. The results yielded that my hypothesis was not supported. It did not show that there was consistently higher electromagnetic radiation in the west. Frankly, the electromagnetic radiation levels appeared to be all over the map, but all within the mid to low-frequency electromagnetic field range. This means that this radiation poses no unsafe threat to the people in Alexandria. Additionally, the spikes in electromagnetic radiation most commonly occurred along busy roads. All in all, I do regret to say that my experiment was inconclusive. The inconsistent values that my electromagnetic sensor calibrated lowered the accuracy of my experiment drastically. Since the readings of electromagnetic radiation increased the longer I used the measurer, the purpose of my experiment was diminished.

Ariunbayasgalan, Maral; Abdelbagi, Hanan

*Washington-Liberty High School*

*Teacher: Fretts*

### The Effect of Different Levels of Moisture in Grass on the Absorption Rate

Droughts can be defined as prolonged periods that consist of moisture deficit and dryness that can happen anywhere in the world for various amounts of time. While droughts are natural disasters, global warming and human activities can worsen the influence and impact of the drought. The purpose of this experiment was to test the effects of varied moisture levels of watered grass on the absorption rate of the soil. The independent variable is the different levels of moisture in the grass. The dependent variable is the absorption rate, measured in liters and milliliters. The experimental variables were grass that is not watered, frequently watered grass, normally watered grass, and over-watered grass. It was hypothesized that if the moisture levels in grass are different, then the normally watered grass would absorb the most water from the flash flood due to the soil being moist enough to soak up more water. The experiment was conducted by constructing a structure that pours one liter of water onto the grown plants individually, imitating a flash flood. Out of all four experimental groups, the results revealed that the normally watered grass was the most successful at absorbing one liter of water. The over-watered grass being was second best. The frequently and not watered grass absorbed the least amount of water, making them the experimental group that absorbed the least amount of water.



Baron, Bridget

*Alexandria City High School*

*Teacher: Kazanciyan*

### Measuring Ventilation via Carbon Dioxide

People are always talking about how ventilation is a necessary step to slow the spread of COVID-19, but how good is the ventilation in Alexandria City High School, and is it doing enough? This project examines ventilation via measuring the concentration of carbon dioxide (CO<sub>2</sub>) in the air (dependent variable) in various classrooms (independent variable) throughout the active school day. Measurements were also recorded at night when classrooms were empty (control). My hypothesis was that if CO<sub>2</sub> monitors are left in classrooms, recording all day, there will be a steady increase in carbon dioxide concentrations in rooms with poor ventilation. My hypothesis was supported by the data, and further supported by what a teacher was told by the maintenance crew that inspected his ventilation system after the first test results in his room came back. That is not the part of the experimental results that shocked me. In most of the random sample of classrooms that I tested, the data suggests that the rooms are not being properly ventilated. Furthermore, the data suggests that if mechanical ventilation is present within the building, it is not impacting all of the classrooms or otherwise is malfunctioning.

Beasley, Marion

*Yorktown High School*

*Teacher: Amarasinghe*

### The Effect of Different Numbers of Oysters on River Water Quality

Oysters are widely regarded as one of nature's best natural water filtering systems - known for their abilities as filter feeders. Many people all over the world don't have access to clean bodies of water and polluted drinking water can lead to extreme health problems and even death. Creating a quick, effective, and inexpensive way to clean natural water sources, as in quality in house plumbing becomes more regularly available, is vital to the already suffering health of my tribe and our larger Native American community. My research question investigated how efficiently different numbers of oysters (0, 5, 10, and 15) filtered water from the Potomac River. My hypothesis was that if 0, 5, 10, and 15 oysters were added to four different tanks with the same amount of Potomac River water, then the tank containing 15 oysters will have the greatest change in water quality at the end of a three week period. The data was consistent with my hypothesis because the results showed that the water with 15 oysters had the lowest hardness, sulfate concentration, sodium chloride concentration, and total alkalinity. Oysters had a positive effect on the purity of the river water indicating that oysters and other filter feeders can be a cheap, natural, and long lasting way to keep natural water sources clean.

Silva, Leila

*Yorktown High School*

*Teacher: Mower*

### The Effect of Green Roofing on Solar-Cell Performance

As the threat of global warming increases, the development of clean energy becomes more of a necessity. Solar panels are becoming increasingly accessible, but their effectiveness is limited by their efficiency loss. While sunlight is necessary for solar cells to function, excess heat reduces their power output. One possible solution to this is green roofing, a type of roofing with a layer of vegetation. Through the process of evapotranspiration, the plants use heat in the air to turn water into vapor, reducing surface and surrounding temperatures. It was hypothesized that installing a solar panel on a green roof would increase the panel's power output. The effects of green roofing were compared with two traditional roofing materials, EPDM rubber and asphalt, as well as a control group of no roof. After testing with a model roof and a 11.6x11.6 cm solar panel, green roofing was found to have had the highest average power output at 0.0858 W. The control group had the next highest at 0.0841 W, and asphalt and EPDM had the lowest outputs at 0.0838 W and 0.0839 W respectively. A one-way ANOVA test was conducted and the data was found to be statistically significant, suggesting that the relationship tested is worth further consideration. However, more testing on a larger scale is needed to determine the exact extent to which green roofing increases solar-cell performance.

Ermovick, Ryan

*Yorktown High School*

*Teacher: Lovrencic*

### The Effect of Cement Type on Concrete Strength

The purpose of this experiment was to determine the effect of cement type on the compressive strength of concrete cylinders, specifically the strength of concrete made with Type IL cement. The hypothesis for the experiment was "If the cement variety is Type IL, then the concrete cylinder will be stronger because of its higher quantity of limestone." Though widely unknown, cement (a component of concrete) is a major contributor to Carbon Dioxide emission, which can lead to global warming. Type IL cement is more environmentally friendly due to its higher limestone content. For this experiment, three different types of cement, as well as sand, gravel, and water, were used to make concrete cylinders. These cylinders were tested using a Concrete Compressive Strength Tester to determine the Pounds per Square Inch (PSI) of pressure they could withstand before breaking, thereby measuring their strength. The hypothesis was accepted as the concrete with the strongest average strength was Type IL. A one-way Analysis of Variance (ANOVA) test was run on the data to determine if the data had a statistically significant difference. The p-value was less than 0.01, indicating that the data was statistically significant. The null hypothesis, which was that there is no correlation between cement type and concrete strength, was rejected. The conclusions of this experiment can be used to increase the implementation of Type IL cement to help reduce Carbon Dioxide emissions.

Jemaneh, Zechariah

*Alexandria City High School*

*Teacher: Strimple-Barker*

### How Accurate Can a Novel Advanced NBA Statistic Be When Compared to the Player Efficiency Rating?

Such a project was formed on the behalf of an inquiry into a statistical basis to a greatest player, with respect to the "greatest" aspects of the game. Such a project is relevant to its field because while many NBA and sports statistics are by definition advanced, they continually exhibit a lack of variables, or sub-statistics which include some objective deal of greatness within them, not exactly a measure of a player's skill, in terms of points, but rather their off-court winningness and their ability to shine as a player. The problem was that statistics don't fully encompass a player's ability by usually ignoring the aforementioned categories. In order to test such an idea, the hypothesis that if such variables were adjusted, both too fit the game in its current state and to add factors that recognize the same "winning" ability mentioned earlier, then when checked for errors to a ranked list already considered accurate by both statisticians and fans, it would be more accurate than its predecessor, the Player Efficiency Rating. (PER) This was done by finding a data pool of ranked players, being the ESPN ranking of the NBA 75th Anniversary Team, inputting player statistics in over 20 metrics, deriving a new formula in linear weights form and calculating an adjusted new statistic, Player Greatness Scale (PGS) by balancing with league pace. In conclusion the hypothesis was accurate as PGS yielded, in terms of # of misplaced ranks, 128 errors as compared to 150 for a PER ranking.

Song, Sicheng

*Episcopal High School*

*Teacher: Olsen*

### A Deep Learning-Oriented AI Solution to Fire Detection and Recognition for Wildfires

Wildfires, being a continuous problem to climate change, air pollution, and human safety, is increasing year by year; therefore, the purpose of this study was to develop a deep learning algorithm that could quickly and efficiently identify fires. Different manually labeled versions of 900 images from the FIRE-SMOKE-DATASET were used to train YOLOv7, deep learning systems for identification and localization of the fire, DeepLabV3, and LR-ASPP, which are the deep learning algorithms used for the segmentation of the fire. Being some of the current-day state-of-the-art object detectors, five models of YOLOv5 and four models of YOLOv7 were tested against each other to identify the best deep-learning object detectors. LR-ASPP and DeepLabV3, two state-of-the-art semantic segmentation models, were also tested against each other. All of the systems that were applied used either atrous convolution, spatial pooling pyramid (SPP), or both, which are some of the main factors for them to be much more efficient than other deep learning systems. The YOLOv7 system is used to “emphasize” and localize the fire in the image, and the processed image would be sent to the semantic segmentation systems. Because of YOLOv7’s function in the whole system, its loss and accuracy are not as important as its identification. During testing, the semantic segmentation systems achieved a mean IoU of 81.2%, which would only increase with the additional boxing of the YOLOv7 system.

Key Words: deep learning, atrous convolution, spatial pooling pyramid, mean IoU.

Hardies, Alexander; Andersen, Elias

*Alexandria City High School*

*Teacher: Briestansky*

### Comparing Efficiency Between ATX and 12-volt Computer Power Systems

This experiment aimed to analyse efficiency between an ATX and a 12 volt power system computer. This testing was performed by sourcing a motherboard and PSU for both a 12v and an ATX system while keeping as many specs the same for each. A system was built using one power standard then a set of tests was run on said system and power draw was logged to a separate computer using an SDM-3045x DMM. After testing on one power standard had been completed, the system would be disassembled, all parts; barring the motherboard and PSU; were reused in assembling the system with the other power standard. The exact same set of software tests was performed on the other power standard and logged the same way. The results from testing demonstrated that the 12 volt system was almost universally more efficient than the ATX system, with the notable and unexpected exception of sleep mode. The results of this testing were largely expected and backed up existing data, except for sleep mode which was highly unexpected. The test did utilise older hardware that may not fully reflect modern versions of the power standards; this could explain, among other things, the odd behaviour with sleep mode.

Sayre, Julia; Winn, Mia

*Alexandria City High School*

*Teacher: Yale*

### Simulating the Effects of Poison on the Human Body

This project was chosen with the purpose of creating an educational tool with readily available information on the effects of seven different poisons on the human body. This would be an easier, more accessible alternative to having to scour various online and book sources for the same information. The project takes the form of a simulation designed on StarLogo Nova. In order to create the simulation, trial and error was used to find the best approach to programming a usable visual that would provide the necessary information. In the end, the project was successful both in its usability and its ability to have the required information.



Butler, Katherine

*H-B Woodlawn Secondary Program*

*Teacher: Taggart*

### What is the Effect of Antacids on the pH Levels of Stomach Acid?

The purpose of this experiment is to test to see what the best brand of antacids are. It is important because it will help people know which brand to buy. The hypothesis for this experiment was that Alka seltzer antacids will result in the highest pH because they have all together 2916 mg of all of its active ingredients suggested for heartburn and indigestion whereas TUMS and Rolaid's have less of their active ingredients. To start the experiment put antacids into lemon juice to simulate stomach acid then stir each for 20 seconds afterwards test the pH levels and put them into a graph. The results of this experiment showed that Alka - Seltzer is the best antacid followed by TUMS, then Rolaid's. In conclusion when purchasing and taking antacid Alka - Seltzer antacids are the best.

DeFilippi, Georgia

*Thomas Jefferson Middle School*

*Teacher: Holland Shuford*

### The Effect of Distance on the Circumference of Splatter

The researcher decided to choose the question, "what is the effect of distance on the circumference of a splatter?" The researcher looked into forensic ballistics, and learned a lot of information, like that with VS technology you can virtually find the exact weapon that the bullet is matched to, and even more facts like that. This helps and is globally relevant because with increasing gun violence around the world, forensic ballistics is an important tool for law enforcement. That type of information led to the hypothesis of, "If the balloon is punctured from a higher height, then the splatter will be bigger because of the effect of height on impact." The researcher did the experiment, and learned that the researcher's hypothesis was correct, and that when the balloon was popped from a higher height, there were more splatter dots on the paper, and the splatter was bigger. The researcher measured and analyzed each splatter, and saw very interesting results. The first splatter, from 61 cm was mainly a straight line, the second, from 122 cm, was generally in one area but had more little splatters, and the third, from 183 cm, had tiny splatters everywhere, went all over the walls, and was by far the biggest splatter. The researcher learned a lot in this experiment, and was very interested in the experiment and the result.

Cunningham, Josephine

*Francis C. Hammond Middle School*

*Teacher: Pellito*

### What is the Best Drink to Get Electrolytes?

For my science fair project I tested different drinks to find the best drink to find electrolytes. Electrolytes are minerals that help your body function and stay in shape. For example, electrolytes help you sleep at night. I created a circuit using an ammeter, alligator clips, 9V battery, and copper wire. I tested around 12 different drinks and found the best drink to get electrolytes overall, the best sports drink to get electrolytes, and the worst drink to get electrolytes. My hypothesis was that Gatorade had the most amount of electrolytes, and tap water had the least. I found that Pedialyte (a medicinal drink for a person who is sick) had the most amount of electrolytes. Kinderlyte (same drink but made for toddlers) was a close second. The best sports drink to get electrolytes was BodyArmorLyte. The drink with the least amount of electrolytes was tap water.

Anwar, Ayesha

*Alexandria City High School*

*Teacher: Swartwout*

### BLASTing Flu Viruses

Many people get infected with the Flu every year. To prevent this, people get flu shots or flu vaccines beforehand. How do those vaccines work and ensure safety against the virus? What are they made of? And why is there a new vaccine every year? This heavily intrigued me and I decided to do my Science Fair based on this. The research question I chose was "How similar is an influenza virus to the Influenza Vaccine?" To find out the answer to this question, I selected five influenza seasons and the most common virus strains found in those years. Then, I found their vaccines. After that, I tried to find their Hemagglutinin or Neuraminidase protein sequences. Finally, I used the BLAST Program to find the percentage of similarity between the vaccine and the virus. I noted my observations and findings for each season in the results. The Conclusion I came to was that Vaccines do indeed need to be similar to their virus to be effective. Another finding was that there are recurring patterns and viruses between the seasons however, the virus can mutate as well.

Dieguez, Kenshu

*Yorktown High School*

*Teacher: McKowen*

### The Effect of the Type of Pre-Trained CNN Model on the Accuracy of Classifying Covid-19 from Lung X-rays

At the start of the COVID-19 pandemic, healthcare systems were put under significant stress. This experiment demonstrates that machine learning can speed up diagnosing COVID to relieve that stress. A Convolutional Neural Network (CNN) was created that can classify lung X-rays as COVID-19, viral pneumonia, or no disease. Additionally, pre-trained learning was added to increase accuracy. Six pre-trained models were tested and their accuracy was measured: InceptionV3, MobileNet, ResNet50, VGG16, EfficientNetB0, and DenseNet169. The experiment demonstrated MobileNet performed the best with an average accuracy of 84.5% despite having the lightest architecture. Other studies collaborate with my results reporting >99% accuracy when applying MobileNet, which performs incredibly well because it uses depth-wise separable convolutional layers. These are special convolutional layers that apply filters to each color channel individually and add up the output, which results in fewer parameters. Regular convolutional layers apply a filter to every color channel simultaneously. Depth-wise separable convolutional layers have less overfitting and increased speed due to fewer parameters, while also achieving equal or higher accuracy. Additionally, the images in this experiment are similarly sized to those MobileNet was trained on, which leads to better compatibility. Though 84.5% may seem impressive, it is nowhere near the required accuracy to be put into real-world practice. Future experiments would attempt to increase the accuracy by adding more depth to the CNN or by adding data augmentation.

South, Caroline

*Washington-Liberty High School*

*Teacher: Brodowski*

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

Often medicine is coated to allow the individual to swallow the medicine easier. The coating needs to release the medicine before it can go into the bloodstream, and relieve the patient's pain. The experiment's purpose was to test what type of Advil (Ibuprofen) coating releases the medicine fastest. The coatings tested were tablets, caplets, liqui-gels, and liqui-gel minis; there was no control. It was hypothesized that if different kinds of over-the-counter medicine coatings are put in a low pH environment, then the caplets will release at a faster rate, because the caplet has a film coating, which has been proven to release the medicine faster than the other coatings.

The independent variable was the type of coating, and the dependent variable was the percent decrease from the original pill weight. The pH of a 1M solution of hydrochloric acid was tested and measured to an acidity level of 1.5, and heated to 37 degrees Celsius. Each Advil was weighed before being dropped into 20 ml of the solution. The pills remained in the solution for seven minutes before being weighed again. The null hypothesis was if different kinds of over-the-counter medicine coatings are put in a low pH environment, then there will be no difference in the weight of the over-the-counter medicine coatings between the tested groups. An ANOVA test was conducted to determine the significance of this project's data. The calculated p-value was less than the critical value of 0.05, meaning the null hypothesis can be rejected.

Martah, Sara

*Washington-Liberty High School*

*Teacher: Fretts*

### The Effect of Cook Time on the Amount of Vitamin C Present in Broccoli

The purpose of this study was to determine the most effective cooking method for preserving vitamin C. The research question was to determine what effect cook time had on the value of vitamin C (mg/g) of broccoli. The independent variable was the cook times of 5, 10, and 15 minutes. The control was left raw. The dependent variable was the vitamin C levels at each cook time. It was hypothesized that if cook time is tested on the amount of vitamin C in broccoli, then the broccoli group cooked for 15 minutes will have the least amount of vitamin C because it will have the longest time for the chemical composition of the broccoli to change. The null hypothesis is, if cook time is tested on the amount of vitamin C found in broccoli, then there will be no difference in vitamin C between the experimental groups. To determine data significance, An ANOVA test was done. The calculated p value was  $1.89 \times 10^{-37}$  meaning there was a difference in the data between the groups, and rejecting the null hypothesis. Because vitamin C is a water soluble vitamin, this may result in loss of the total value of vitamin C, but it may also make the nutrient more accessible for testing, and also may be gained back from the water as the broccoli is boiled longer. This may explain the surprising overall trend of the increase of vitamin C levels in the data as cook time increased.

Mohanty, Anna

*Washington-Liberty High School*

*Teacher: Aksoy*

### The Effect of Axon Diameter on Heart Rate Variability

Patients with autism spectrum disorders (ASD) have statistically higher likelihood of developing heart disease independent of congenital predisposition. These occurrences have not been linked to the same widespread obesity as most others, as they typically manifest in the ventricular areas. As such, there is precedent to believe it can be caused by functional neurological conditions. Fundamentally it is due to the overtime deterioration of heart rate control signaling caused by abnormal signals resulting from certain conductive properties (voltage, current, resistance) of neuronal axons of people with ASD, leading to detrimentally lowered heart rate variability or the length of time between heart beats (HRV). It was hypothesized that the genetic difference in axonal size (therefore increasing neuronal resistance along with current and voltage), which declines with increasing severity of an ASD, would lower heart rate variability. To test this, a circuit model of the cardiac vagus nerve (CVN) was built using an adapted semiconductor diode model connected to an electrocardiogram. This allowed an estimation of what patient data for an EKG would look like in the future after there is time for the signaling to be gradually damaged. The results supported the hypothesis, showing a statistically significant decrease in the artificial heart rate variability between the affected and control groups, analyzed with an ANOVA and subsequent t-tests. This can be applied to create patient-specific early intervention plans for a range of both functional neurological disorders and arrhythmias, as well as predicting conditions such as myocardium neuromuscular cell death.



Yang, Lihao

*Episcopal High School*

*Teacher: Olsen*

### Transcriptomic and Epigenomic Analysis of Regenerating and Non-Regenerating Axonal Injury Models Reveals STAT2 as a Potential Drug Target

The purpose of this study is first to uncover and rationalize the molecular mechanism underlying why axonal injury results in regenerative success in PNS but regenerative failure in CNS, and then to discover novel drug targets that can be utilized to treat injury-induced or neurodegenerative disease-induced axon loss.

We performed comparative transcriptomics analysis on RNA-seq data generated from dorsal root ganglion after sciatic nerve or dorsal column axotomy and revealed a set of candidate regeneration-associated genes (RAGs). Subsequent screening to validate the expression of these genes in neurons showed a subset of genes, among which were the transcription factor STAT2 and its downstream target apoptosis regulator MCL1. In light of this discovery, we performed TOBIAS transcription factor footprint analysis using ATAC-seq data generated from both CNS and PNS lesions to explore the post-injury regulatory pattern of STAT2. At last, we predicted the downstream targets of STAT2 using iRegulon.

In this study, we novelly identified STAT2 as a regeneration-associated transcription factor that regulates some previously known RAGs and members of the BCL2 family antiapoptotic proteins. However, the post-injury binding dynamics of STAT2 suggest that it probably does not play a decisive role in determining regenerative success or failure; rather, it acts in junction with downstream modulators. These findings suggest overexpression of STAT2 in regeneration-incompetent neuronal cell types may be able to salvage post-injury cell death or even partially restore their regeneration ability, the understanding of which can provide new insights into the therapeutics of CNS axon loss.

St. Clair, Lauriston

*George Washington Middle School*

*Teacher: Breslin*

### Genetic Probability

The purpose of the experiment is to investigate the expression of the Dominant and Recessive genes of two parents on their children. To conduct this experiment the following procedures were used: Two containers were labeled, one "Male," one "Female." Each contained 20 Blue M&Ms ('A') and 20 orange M&Ms ('a'). For each of the 20 trials, two M&Ms were picked at random (with replacement) from each container to establish two "genes" for each parent (e.g., Male ('Aa') and Female ('aa')). Using Punnett Squares, we can establish all possible combinations of the two parents for each trial. The presence of even one Dominant gene in the child's genetic pair will cause the child to express the Dominant trait. The percentage of the possible combinations with a Dominant gene is the probability that the child will express the Dominant trait. For example, if both of the parents have 'Aa' genes (one Dominant and one Recessive), the possible results for their children are (AA, Aa, aA, aa). Three results, (AA, Aa, aA), will result in the "A" trait being expressed. Therefore, the child has a 75% chance of expressing the 'A' trait. This demonstrates how the Dominant gene overpowers the Recessive gene. The data from the original 20 trials averaged 75% Dominant and 25% Recessive. Experiments with larger trial sizes of 100, 500, and 1000 trials yielded similar patterns of approximately 75% Dominant and 25% Recessive. These results are consistent with the hypothesis.

Kamens, Harper; Keeton, Annalena

*George Washington Middle School*

*Teacher: Haisfield*

### How is Our Pollution Affecting Diatoms?

This experiment was to see how humans impact the smallest units of life with pollution. People generate a large amount of pollution every day. This pollution affects even the smallest organisms on the planet. Because of their importance in the food chain, their loss could spiral and affect almost everything. This project was made to see what specific pollutants were affecting Diatoms the most. This experiment included four types of pollutants that were left in water and viewed 4 different times. The pollutants were a cut up plastic water bottle, dishsoap, fertilizer, and olive oil, as well as a control group that was watched without pollutants. After the final test a week after starting, the petri dishes were cleaned and pollutants disposed of responsibly. The hypothesis was that the plastic and fertilizer samples would affect the diatoms the most. The results showed that the control and olive oil had the steepest decline from around 10,000 diatoms to around 150. The plastic, dish soap, and fertilizer decreased steadily and showed that the pollutants with the most harm were oil and separation from the source. This shows that all pollutants will affect diatom organisms in local water sources, but some will move quicker than others.

Goody, Claire

*Washington-Liberty High School*

*Teacher: Brodowski*

### The Effect of the Type of Mouthwash on the Inhibition of *Escherichia coli* (*E. coli*)

Mouthwash is an oral product that can help reduce the number of bacteria in the mouth. The rapid transmission of Covid-19 across the globe led to measures taken to control the spread of the virus, one of which included using mouthwash since its ingredients help kill off viruses (including Covid-19) found in saliva. The purpose of this study was to determine the effectiveness of different types of mouthwash at inhibiting the growth of *Escherichia coli*. The types of mouthwash used in the experiment were Listerine® (alcoholic), Crest® (non-alcoholic), and Tom's (all natural), while distilled water was the control. It was hypothesized that Listerine® would be the most effective at inhibiting the growth of *Escherichia coli*. The experiment was conducted over 4 days, which included preparing the agar plates, inoculating the plates with the *Escherichia coli* bacteria, and treating them with each type of mouthwash (and the control). The mean zone of inhibition was calculated after 68 hours for all groups. The results showed that Crest® was the most effective at inhibiting the growth of *Escherichia coli*, with a mean zone of inhibition of 1.45 centimeters. Listerine® and the control had mean zones of inhibitions of 1.25 and 1.18 centimeters, respectively. On the other hand, Tom's was the least effective at inhibiting the growth of *Escherichia coli*, with a mean zone of inhibition of 0.58 centimeters. The original hypothesis was rejected, although the null hypothesis was partially accepted since there was no statistical significance between some of the groups.

Lach-Hab, Nadia

*Washington-Liberty High School*

*Teacher: Leonard*

### Effect of Treatment Type of *Escherichia coli* on *E. coli* Zone of Inhibition (mm)

The purpose of this experiment was to determine which treatment type of *E. coli* was most effective at limiting the growth of *E. coli*. There were three different treatment types: vitamin C, ampicillin, and a combination of the two. Results were measured using the zone of inhibition of the *E. coli* bacteria. It was hypothesized that the trials containing a combination of vitamin C and ampicillin would be most effective at limiting the growth of *E. coli*, therefore increasing the zone of inhibition. This was hypothesized because previous studies have proved both ampicillin, an antibiotic that derived from penicillin, and vitamin C, a nutrient, were effective at limiting the growth of *E. coli*. This hypothesis was supported, however, the trials that contained only ampicillin were equally as effective, both were 100% effective: there was no growth of bacteria. Vitamin C was 35% effective on average at limiting growth, and the average zone of inhibition was 7.38 mm. Adding on to the previous statement, all three treatment types were more effective at limiting the growth of *E. coli* than the control. This data was statistically significant, as all of the treatment types had an effect on the zone of inhibition of the *E. coli*. This data suggests that using ampicillin or a smaller dose of ampicillin and a smaller dose of vitamin C is 100% effective against the growth of *E. coli* bacteria. The data and conclusions reached were mostly alike to similar studies done in the past.

Muldoon, Aidan

*Alexandria City High School*

*Teacher: Matthews*

### How Well Do Mainstream Cleaning Products Acutally Work on Bacteria?

Disease is commonplace in today's society, and COVID-19 has dramatically impacted the world. How can we be sure that the tools we use to safeguard ourselves, such as disinfectants and cleaners, work? This experiment was to see if cleaners did their job and which performed the best at it. Nine samples of *E.Coli* contained on agar plates were tested in 3 different substances. The zone of inhibition was measured in millimeters to test how well each cleaning product worked. We expect Clorox Bleach to perform the best. The findings in my experiment suggested that lethal solutions work best at stopping a bacterium's vital processes. The most effective solution was Clorox bleach, which achieved a maximum zone of inhibition of 15mm and a minimum of 11mm; in comparison, the least effective solution was Lysol disinfectant spray, which exhibited a maximum zone of inhibition of 12.5 and a minimum of 7mm. The results from this experiment suggest that disinfectants that include bleach in their ingredients will be effective at cleaning and decontaminating but not as effective as pure bleach.

Goldener, Sylvia

*Washington-Liberty High School*

*Teacher: Aksoy*

### What is the Effect of Common Metals on Bacterial Growth?

Copper is recognized as a highly effective antimicrobial metal, and the use of copper as a surface material in bacteria-critical locations such as hospitals has been considered. The purpose of this study was to determine the viability of copper as an antimicrobial agent. *E. coli* bacteria was introduced to atomized copper, stainless steel and brass. It was hypothesized that *E. coli* in contact with copper would have a significantly larger zone of inhibition compared to stainless steel or brass due to its antimicrobial properties. This experiment was conducted by placing paper disks coated in atomized metal into agar dishes swabbed with *E. coli* samples and recording the zone of inhibition after three days. Copper had an average 1.29 cm zone of inhibition, while stainless steel and brass produced no observable zone of inhibition across 16 trials. This suggests that copper is the only metal tested with antimicrobial properties.

Hubbard, Leia

*Alexandria City High School*

*Teacher: Lay*

### Can Yogurt Inhibit the Growth of K-12 *Escherichia coli* (*E. coli*)?

This project was testing whether Yogurt acting as a probiotic and Yogurt + prebiotic (Fructo-Oligosaccharide) would inhibit the growth of K-12 *E. coli*. The goals of this experiment were to use this information to see if Yogurt can help prevent disease from spreading around someone's body, and if Yogurt + Prebiotic would be able to do this to a greater extent. By having this information people could just eat yogurt while they are sick and it can stop the spread of disease and fight it off, so the person will get better quicker. The outcome was that the yogurt was able to inhibit the growth of K-12 *E. coli*, the mean of this inhibition zone was 0.86mm. While yogurt + prebiotic was able to inhibit the growth of K-12 *E. coli* to a greater extent than just the yogurt, because the mean of this inhibition zone was 1.44mm. This does give supporting evidence to the hypothesis that Yogurt and Yogurt + Prebiotic can inhibit the growth of bacteria meaning people can take these as medicine to stop the spread or the worsening of a disease.



Smaragdis, John

*Washington-Liberty High School*

*Teacher: Fretts*

### The Effect of Different Concentrations of Isopropyl Alcohol in Homemade Hand Sanitizer on Reducing the Growth of Bacteria Commonly Present on Hands

Public health officials consider proper hand hygiene to be a first line of defense against the transmission of microbes and infections. The Centers for Disease Control recommends that if alcohol-based hand sanitizer is used, it should have an alcohol concentration of at least 60% in order to be effective. During the early stages of the COVID-19 pandemic, commercial hand sanitizer was often unavailable in the United States and individuals reportedly began to make homemade hand sanitizer using isopropyl alcohol and aloe vera according to instructions widely disseminated on the internet. The purpose of this study was to determine the effectiveness of homemade hand sanitizer made from isopropyl alcohol and aloe vera gel mixed at alcohol concentrations of 45.5%, 60.6%, and 68.25% against *Staphylococcus epidermidis*, a bacteria commonly found on hands. It was hypothesized that the homemade hand sanitizer made with 68.25% isopropyl alcohol would show the greatest inhibition of *Staphylococcus epidermidis* growth because a concentration of 60% to 90% isopropyl alcohol has been shown to be most effective in studies of commercially prepared hand sanitizer. Data collected in this study showed no significant difference in inhibition of bacterial growth among the groups, and the null hypothesis that there would be no difference among the tested hand sanitizers in inhibiting the growth of *Staphylococcus epidermidis* could not be rejected. The data collected suggests that hand sanitizer made in a home environment may not be as reliably effective in inhibiting bacterial growth as commercially prepared hand sanitizers.

Levin, Nate; Khani, Cambyses

*Yorktown High School*

*Teacher: Lovrencic*

### The Effect of Reproductive Method and Rate of Food Generation on the Population Size and Genetic Evolution of Computer-Simulated Choanoflagellate-like Unicellular Organisms

Our project's aim was to simulate evolutionary change in Choanoflagellates, a well-studied unicellular organism. We looked at how specific genes were affected by a change in food generation rate and a change in reproductive methods. To perform the experiment, we created a custom cell simulator that takes into account many aspects of real-world cell lifecycles and behavior. After performing 6 tests, which ran a total of 60 million individual simulation steps, we analyzed the data with graphs and other statistical techniques. From the data, we were able to find many statistically significant relationships between the cells' environment and their genetics. These results occurred entirely from the genetic rules of the simulation, not because of any specific programming, but because of environmental pressures naturally causing "survival of the fittest." We also reproduced the theorized cause of the large size of the dinosaurs. Our simulation showed that both asexually and sexually reproducing cells were able to evolve to best fit their environment, with both taking advantage of changes in food availability and adapting uniquely to fit their environment. The results of our experiment also support that computer simulations can be used to understand large-scale evolutionary processes. In the future, similar evolution simulations could help us understand the effects of invasive species and climate change.

Westwater Brodsky, Julia

*H-B Woodlawn Secondary Program*

*Teacher: Young*

### Characterization of Novel *Acinetobacter baumannii* phages EAb3 and EAb7

*Acinetobacter baumannii* is a pathogenic bacterium associated with multi-drug resistant nosocomial infection that has been classified as an urgent threat by the CDC. Phage therapy is promising for resistant *A. baumannii* infections. Bacteriophages EAb3 and EAb7 were previously isolated on *A. baumannii* MRSN 3692; genomic and host-range analyses determined them to be similar but distinct novel phages in the *Myoviridae* family. This study aimed to illuminate the characteristics of the phages through analysis of bacterial lysis, single-step growth curves, comparative genomics, and plaque morphology. The lytic properties of EAb3 and EAb7 were compared with an in vitro host growth dynamics assay. EAb3 and EAb7 multiplicities of infection (MOI) greater than 1 were found to cause near-immediate cell lysis, and even at MOI as low as .0001 were found to significantly decrease bacterial load. EAb7 decreased *A. baumannii* concentrations more quickly than EAb3, while EAb3 developed larger plaques than EAb7. Single-step growth analysis revealed phages EAb3 and EAb7 to have slow adsorption, a short latent period, and a relatively large burst size. 46 EAb3 genes and 49 EAb7 genes were assigned putative functions; the remaining 280 ORFs found were classified as hypothetical proteins. No potential lysogenic or toxin-encoding genes were found. EAb3 and EAb7 are promising candidates for further study; more work is needed to understand the relationships between plaque morphology, lysis dynamics, and lytic cycles for these phages. The microplate method for in vitro growth dynamics assays developed in this experiment should be considered for future use.

Ayalew, Maedot

*Kenmore Middle School*

*Teacher: Anderson*

### The Effect of Distance on Light Intensity

Humans have always had an interest in space. For centuries, people have looked up to the stars. They may seem like tiny specks of light, but in reality they are actually big balls of gas. It's not possible to take a ruler and measure the distance between the Earth and a star. Therefore, scientists have come up with different methods to measure the distance between the Earth and stars. One of these methods involves light intensity. This project investigates the relationship between distance (independent variable) and light intensity (dependent variable). A light sensor app was used to measure the light intensity of a LED light bulb (point light source) at 5 cm intervals starting from 30 cm and decreasing. The hypothesis for this experiment was; If the distance increases, then the light intensity will decrease. The results supported the experiment because the lux (unit of measurement for light) decreased as the distance increased in cm. The highest average lux being at 5 cm (33,510.98 lx) and the lowest average lux being at 30 cm (2,004.24 lx). The results also showed that the relationship between distance and light intensity follows the inverse square law. Scientists use their knowledge of the inverse relationship between distance and light intensity to figure out the distance to stars from Earth. By knowing the light intensity, scientists can figure out the distance and vice versa. Knowing our place in the universe is crucial to understanding our place on Earth.

Carpenter, Kylie

*Williamsburg Middle School*

*Teacher: Willet*

### The Effect of Playground Surface on Max Fall Height of Egg Without Breaking

The independent variable in my project is playground surfaces and of the surfaces are grass, sand, turf, wood chips, and concrete. The dependant variable is the maximum height an egg can fall without cracking. The hypothesis for the experiment was that if the playground surface is sand, then it will increase the maximum drop height because sand is made of tons of particles ranging in size from 0.02032 cm to 0.2032 cm, so it will be able to shift to cushion the egg (Britannica, 2022). The major findings of this experiment are that grass is by far the most protective surface for playgrounds coming in at an average height of 863.6 cm. The worst surface is clearly concrete coming in at an average height of 6.7 cm. Turf came in second with a height of 313 cm which is similar to sand's height of 272.6 and woodchip's height of 265 cm.

Hopkins, Vivienne

*George Washington Middle School*

*Teacher: Haisfield*

### Measuring Skyglow

Skyglow is human-caused light pollution in the night sky. Skyglow is making observing stars and constellations much harder. Skyglow not only affects humans but animals as well. Most key wildlife areas are affected by skyglow. Governments have been trying to help to stop skyglow by putting up laws about using shielded outdoor light fixtures to stop the light from reaching the sky. Also, LED lights affect the skyglow. LED lights produce blue lights which is a big contributor to skyglow. An approach to measure Skyglow is to take pictures of the night sky with a digital camera. ImageJ (software that can analyze images) can analyze the photos to measure the average pixel value. The pictures are compared to calibrated photos to find when the skyglow or pixel value was the highest. I Took pictures at 7:30, 8:00, 8:30, and 9:00. Then uploaded the pictures onto the ImageJ software and analyzed them. After that compare the images to calibrated images and find the EET (Equivalent exposure time) of each image. Whichever image has the greatest EET is the image with the highest skyglow. I hypothesized that the skyglow will be highest at 9:00 PM because humans are still active and with all the lights on at night the skyglow will be its highest value. The results of the experiment demonstrated that skyglow was the highest at 7:30 P.M. which means that my hypothesis was not supported by the data.

Beckner, Colin

*Swanson Middle School*

*Teacher: Seliskar*

### Airplane Wingtips

For my project, I tested the effect of the style of wingtip on the percent change in weight when it was run through a wind tunnel. My hypothesis was that the Split Scimitar winglet would perform the best. To accomplish my project, I first designed and 3D printed a wing five times and 3D printed the four different winglets. I also built a wind tunnel out of cardboard and Plexiglass. I then ran each wing in the wind tunnel ten times. After this I calculated the percent change between the mass and weight of the wing when it was ran through the tunnel. Based on the averages, the Split Scimitar winglet was the best and the Blended winglet was the worst. I found this interesting because they are the most similar. However, I concluded that my Hypothesis was inconclusive because there was a lot of overlap between all of the five different different winglets on the scatter plot.

La, Myriam

*Williamsburg Middle School*

*Teacher: Woodbury*

### What is the Relationship Between Plarn Width and the Amount of Weight a Crocheted Swatch Can Bear While Stretching 2cm?

The question being answered in this project was: What is the relationship between plarn width and the amount of weight it can bear while stretching 2 cm? The hypothesis was that the thicker the width of plarn, the more weight a crocheted plarn swatch will be able to bear when stretching. This topic is important because this project's research seeks to better understand the properties of plarn, specifically, the relationship between plarn width and the amount of weight a crocheted plarn swatch can bear while stretching. The aspirational societal impact of my project is to build a better and more sustainable world by increasing the understanding and use of plarn for various daily-use items, thereby decreasing the amount of plastic shopping bags that end up in landfills.



Moran-Uriona, Tomas

*Swanson Middle School*

*Teacher: Robles*

### The Effect of Temperature on the Magnetism of Neodymium Magnets

This experiment was conducted to find how much of a difference temperature makes on the strength of rare earth neodymium magnets. I hypothesized that the higher the temperature, the weaker the magnetic force of the magnet would become. This is the case because magnetism is caused by the alignment of all of the atoms in a crystalline or metallic substance. The higher the temperature, the more the atoms will vibrate and become less aligned. This will then cause the magnetic field to become weaker. The experiment was conducted by placing a ball bearing next to a ruler at the one millimeter mark and slowly moving a magnet of various temperatures closer to it. The experiment showed an inverse correlation between temperature and magnetism, thus supporting my hypothesis. In conclusion, I learned that the higher the temperature that a magnet is, the more the magnetism decreases.

Yoo, Andrew

*H-B Woodlawn Secondary Program*

*Teacher: Taggart*

### The Effect of Magnesium Carbonate Chalk on Friction

Rock climbing is a rapidly growing sport, and started becoming more mainstream in 2021, at the pandemic-delayed Tokyo Summer Olympics. Athletes rely on friction when climbing in order to cling onto handholds in order to fight gravity. Nowadays, nearly all climbers use chalk, which is composed of magnesium carbonate ( $\text{MgCO}_3$ ), believing that the white powder enhances their grip. The purpose of this study was to determine whether magnesium carbonate chalk has a positive or negative effect on friction. Twelve elite climbers (8 male, 4 female) participated in this study. The climbers mean age =  $18.75 \pm 10.411$ . Climbers' mean hardest redpoint during previous 6 months =  $23.917 \pm 0.669$  IRCRA scale. Participants hung, in a dead hang position (i.e., without engaging the scapular muscles), from the 35 degree 'sloper' holds on the Beastmaker 2000 hangboard, first without chalk, and second with chalk after resting for 10-15 minutes. Friction Labs brand chalk was used because it is indisputably the most popular climbing chalk brand. The chalk was ground down to produce an even texture. The ratio of chalk to no chalk hang time was calculated for each participant. The mean ratio was  $3.31 \pm 3.53$ . The result of the study supports the hypothesis that chalk would improve friction, and therefore hang time. Further statistical analysis (regression analysis) is necessary to determine the effect of other variables, such as temperature and humidity, on the chalk effect.

Hutchison, Ronan; Burducea, Stephan

*H-B Woodlawn Secondary Program*

*Teacher: Boyle*

### The Best Material for Soundproofing

The experiment was to test which material worked best. The hypothesis was that the more air the material trapped, the better the sound proofing. A box was placed on the floor with a mic on one side with the sound proofing, and a speaker on the other. A sound from the speaker was recorded and compared to the trial without soundproofing. The towel worked the best. It blocked about 16.3 decibels. The next one only blocked about 5.2 decibels. The hypothesis was incorrect, since the professional sound proofing trapped the most air. The experiment could be improved by getting a more accurate microphone.

Hogans, Catherine

*Washington-Liberty High School*

*Teacher: Brodowski*

### What Material of Metal Wire Will Create the Strongest Electromagnet?

The purpose of this experiment was to find out which metal conducts the most electricity within electromagnets. The research question tested was: what metal material of wire creates the strongest electromagnet?

The independent variable was the type of metal wire used and the dependent variable was how many mini paper clips were picked by the electromagnet. My experimental groups were silver, copper, aluminum, and steel. There was no control group. The hypothesis was if you change the material of wire in an electromagnet, then the silver wire will create the strongest magnetic field and pick up the most paper clips because it has the most movable valence electrons. As there was no control group, there was no null hypothesis.

The p-value from a T-Test, was  $6.59E-11$  which is less than the initial value of 0.05. A null hypothesis could not be rejected because there was no null hypothesis.

In my data collection, silver picked up the most mini paper clips, meaning it created the strongest electromagnet, hence it conducted the most electricity. The theory that correlated with my hypothesis, the Band Theory, states that materials conduct electricity if there are free valence electrons in the electron cloud and will not if there are no free electrons in the electron cloud. They agree because silver has only one valence electron, making it very movable, meaning it will conduct electricity well. The research conducted beforehand also supported these findings because it predicted that silver would be the most conductive metal.

Leighton, Declan

*Yorktown High School*

*Teacher: Dorman*

### The Effect of Electrode Spacing on the Force Generated by Magnetohydrodynamic Drive

Magnetohydrodynamic drive (MHD drive) is an effect that uses Lorentz force to accelerate a fluid. MHD drive performs this without any moving parts as it only uses only a magnetic field running perpendicular to a current. This experiment serves to understand what is the ideal spacing of a set of electrodes to generate the most force possible with a given voltage. This experiment had two independent variables (IV). The first IV was the electrode spacing at six distances: 15 mm, 13 mm, 11 mm, 9 mm, 7 mm, and 5 mm. There were 500 repeated trials per test run. Five test runs were performed resulting in 2,500 total repeated trials for this IV. The second IV was the device configuration. One device configuration was open and the second was closed, which reduced the overall flow of water. In conclusion, both hypotheses were disproved because the trial results had the inverse relationship of what was expected. This occurred because the salt water used in the trials was significantly more conductive than expected and the electrical equipment used limited the amperage to 5.1 amps. These factors coupled with the decreasing electrode spacings resulted in decreased force. This occurred because as the electrodes moved closer together, they restricted flow and did not increase amperage, which is the dependent factor in the Lorentz force equation.

Miller, Andrew

*Yorktown High School*

*Teacher: Paz-Soldan*

### The Effect of 3D Print's Extrusion Temperature on Its Compression Strength

The purpose of this project was to determine the optimal extrusion temperature for 3d printing with polylactide (PLA) plastics with specific additives. Due to PLA's advantageous properties and high availability, it has become the material of choice for prototyping. However, a dilemma emerges when using an additive process such as 3d printing; the material ceases to adhere to itself. As a result, crumbling. If consumers had information on how temperature affected compression strength, they could utilize PLA's properties even further, stretching the limits of their designs and saving resources. Before experimentation, further exploration of PLA's properties was conducted using the specific heat equation. Leading to the following hypothesis, If the 3d print's print temperature is within 101.667-104.444 C, then the print will adhere while not losing structure. Procedures included slicing 50x20x20 mm blocks in Cura, with each set of three blocks printed at their respective temperatures. Then, 15-degree increments were marked on a vice. After testing the compression force applied from each 15-degree turn, each 3d print was individually placed into the vice and tested until deformation. After experimentation, the collected data was converted into kgs of compression force. Observations from the data were apparent, the higher the extrusion temperature, the higher the compression force the block withstood. However, this strayed from the previously constructed hypothesis. Which overcompensated the effect of additives on PLA's adhesion and melting temperature. Prior research indicated compression strength to eventually plateau, a cause for questioning and further research.

Monroy, Sebastian

*Washington-Liberty High School*

*Teacher: Brodowski*

### The Effect of Flap Deflection Angle on an Airplane's Takeoff Time and Speed

The purpose of this experiment was to find the optimal angle of flaps on an airplane to allow it to takeoff in the shortest amount of time possible. It was hypothesized that if the flaps on an airplane are set to around 20 degrees, then the airplane would use the least distance to takeoff because this angle would provide the maximum lift without producing excessive drag that comes from high flap deflection. The null hypothesis was that if the flaps are set at any degree, there will be no difference in the takeoff time or speed.

This experiment was carried out using MSFS2020. The independent variables in this experiment were the 9 planes tested and the different angles being tested. The angles varied per plane due to differences in flap settings between models and manufacturers, so not all of the planes were tested at all angles. The dependent variable was the amount of time in seconds and the speed in knots it took for the plane to achieve a positive climb rate.

After the experiment was conducted, most of the planes showed a large decrease in takeoff time from the control to the first flap setting. Takeoff times also decreased as the flap angle increased, but at a lower rate. Takeoff speed also decreased due to the increased lift. The hypothesis was not supported by the results, but the null hypothesis can not be accepted either, because there was a difference in the takeoff time based on the flap deflection.

Pericak, Ryan

*Yorktown High School*

*Teacher: McKowen*

### The Effect of the Voltage of the Battery on the Strength of an Electromagnet

The purpose of this experiment was to determine the effect of the Voltage of the battery on the strength of an electromagnet. The device of an electromagnet is created by electrically charging a metal core with a power source, and is particularly useful when the magnetic strength needs to be manipulated, differing from a permanent magnet. It was hypothesized that a greater Voltage would result in a stronger electromagnet. An electromagnet was created using a copper wire, an iron nail, and batteries of the Voltages three, six, and nine to test the hypothesis. A ruler was used to measure the farthest distance a paperclip was successfully attracted by the electromagnet. Ten trials were conducted for each battery, indicating that a greater Voltage consistently attracted a paperclip from farther away, resulting in a stronger electromagnet, and supporting the hypothesis.



Ilie, Victor; Meydenbauer, Luke

*Washington-Liberty High School*

*Teacher: McCoart*

### The Effect of Different Materials on the Dampening of Sound

The question that arises is: “What is the best material that can be used for soundproofing?” This experiment’s purpose is to answer that question and discover what material is most optimal for keeping homes quieter. The materials that were used for this experiment were mass loaded vinyl (MLV), acoustic foam, soundproofing paint, and a cardboard box. They were tested by recording the amount of sound (dB) that passed through them. The difference between each group was changing the material inside the box, while the control was just the box with no soundproofing. The sound was recorded by a microphone that was placed outside the box. This experiment’s hypothesis stated that if different materials are tested for soundproofing, then the acoustic foam will dampen the sound the most, because porous materials perform better at sound absorption. The null hypothesis stated that if different materials are tested for soundproofing, then there will be no difference in the mitigation of sound between the materials.

After the experiment was conducted, it was shown that acoustic foam dampened the sound most effectively, and the MLV dampened sound the least effectively. These results are statistically significant, as the p-value of the results were less than 0.05, meaning that the null hypothesis was rejected, as the materials did have an effect on sound. The theory for this experiment suggested that a stiffer material would perform better in sound proofing than a softer material. This experiment shows that softer materials are better soundproofers than stiffer materials.

lov, Sebastian; Keene, Massey

*Alexandria City High School*

*Teacher: Matthew*

### UV Radiation: What Can Stop Ultraviolet?

The purpose of this study is to analyze the UV-blocking properties of objects and find which materials work best in blocking UV radiation. The hypothesis was that the materials that have a greater density and/or have chemical properties resistant to UV radiation, then less UV radiation will be detected. This was tested by blasting a UV  $\lambda$  365 nm flashlight at several objects. Behind each object was a UV sensor card that tracked the irradiation or intensity of the UV light. Recording the irradiation levels under each material, the data gathered supported the hypothesis. Materials like a black cotton shirt, black baseball bat, and gelatin slathered with SPF 50 sunscreen were able to fully block UV radiation. Using this data, it can be concluded that there are several options to protect from UV radiation. With these several options to block UV radiation, applying a combination of these materials is recommended.

Wiley, Claire

*Wakefield High School*

*Teacher: El Gamal*

### The Effect of Temperature on the Bounce of a Tennis Ball

This experiment measured the effect of different temperatures on the bounce height of tennis balls. This was done to determine the consistency of tennis ball bounce, and what temperature they should ultimately be kept at for tournament officials to note and keep match play fair. The experiment was completed by keeping 3 tennis balls at 3 different temperatures (hot, room temperature, and cold), and measuring how high each ball bounced in inches. The results showed that the tennis balls kept in a cold environment bounced significantly lower than those of hot and room temperature. This suggests that the optimal temperature to keep tournament-ready tennis balls is 68°F.

Zee, Rebecca

*Kenmore Middle School*

*Teacher: Anderson*

### The Effect of Different Light Sources on the Height of Bean Plants

Many people wonder how it'll be possible to eat fresh produce when we go to the moon and Mars. Fresh produce is essential to keep a human body healthy. Since we will be forced to grow food in something other than the ground, space is limited. That means we will need a compact farm. Only so much space will be available to grow, so we need height in a plant rather than to have the plant spread out. This project looks at the effect of the light source on the height of a bean plant after three weeks. 15 soon to be bean plants were separated into three groups depending on what source of light (full-spectrum growth light, string of LED lights, and the sun) (independent variable) they would be provided with. After the three weeks, the bean plant's height was measured in millimeters (dependent variable). Each plant received one tablespoon of water every day. The hypothesis was that the artificial light would surpass the natural light as a light source when the goal is height. The results supported the hypothesis because on average, the plants with the LED lights (artificial light) light source grew the tallest (390.2 mm) in comparison to the plants that received light from the full-spectrum growth light (135.8 mm), and the sun (125.2 mm). The research for this project shows that the best artificial light source to use when your goal is height in a plant is an LED light.

Foerster, Nolan

*Thomas Jefferson Middle School*

*Teacher: Holland-Shuford*

### The Effects of Pollution on Algae

In this experiment I will test the effect of pollutants on the oxygen levels of algae. I was interested in testing this because I want to help the world and by showing people this data we can help stop global warming and keep an important oxygen provider alive and well. My hypothesis was if you add chemicals to the water then the oxygen levels will decrease because the chemicals will harm the algae. I will test my hypothesis by adding pollutants to algae and comparing the oxygen production to a control. I used bromothymol blue to test the oxygen levels and waited 3 days for the algae to show photosynthesis. After that I checked to see if the algae was blue meaning there was oxygen or yellow meaning there was no oxygen. The results for this experiment were the control being the darkest, the motor oil being the second darkest, the isopropyl alcohol being the second lightest and the bleach being the lightest. So my hypothesis was proven to be correct because the chemicals did work and this data will show which pollutants are the most toxic.

Oakey, Graham

*George Washington Middle School*

*Teacher: Thomas*

### The Effect of Local Waters on the Growth of Bean Plants

If a plant grew using the water from your washer then you could use less water from your tap. The plants you grow can produce food so you can save money from the grocery store. I worked on this problem of growing plants with different local waters including gray water, tap water, rainwater, and runoff water. I wanted to grow plants for my experiment and I decided to use different local waters, I did not want to grow the plants outside because of the variability of the weather so used a grow light instead. My results showed that plants grown with tap water grew the tallest. Gray water came in second, Runoff in third, and Rain in last. I predicted that Rainwater would come in first but I was completely wrong. I met all of the requirements I needed and the project showed that plants can be grown effectively with grey water.

Vogel, Page

*George Washington Middle School*

*Teacher: Ms Owens*

### The Effect of Invasive Species on Native Northern Virginia Plants

Invasive species have been a problem since the beginning of time, taking over yards and forests. Once an invasive species gets going, it's hard to stop. I'm trying to find out if invasive species not only takes over places, but kills plants as well, so I tested with the native plant, coneflower, and 4 invasive species. My hypothesis is: "If eight native species are put in pots with eight invasive species (two of each kind), then the invasive plant will probably choke the native plant because 3 out of 4 of my invasive species are weeds that are long and can wrap around plants and choke them." My procedure was to go this way: plant the plants, one invasive with one coneflower each, with 5 control coneflowers. Give them equal amounts of sunlight and water each day, and measure and take notes every 3-4 days. I am able to say that some invasive plants affect coneflowers, and some don't. So, from my research, I am able to conclude that some invasive plants can affect coneflowers, a native plant, negatively. My project contributes to scientists research because if I was a scientist studying invasives, I'd want to know what they are capable of and if they can hurt other plants. My results would contribute to science in the research of what invasive plants really do.

Carestio, Blake

*Kenmore Middle School*

*Teacher: Brown*

### The Effect of Soil pH Level on Radish Seed Germination

It's no secret that the food in our supermarkets isn't as nutritious as it used to be. A 2004 US study found that important nutrients such as calcium, iron, and phosphorus levels in some garden crops have decreased by 38 percent since the middle of the 20th Century. A solution to this problem, and the purpose of this experiment was to test the effect soil pH levels have on plant growth. This was done by using aluminum sulfate and ground agricultural limestone to alter the soil's pH levels, making the soil either acidic, neutral, or alkaline, and then comparing the data from radish seeds grown in each pH level. The hypothesis for this experiment was that if radish seeds are grown in soil with a pH between six and five tenths (6.5) and seven and five tenths (7.5), neutral pH, then they will have the greatest amount of growth. The data supported this hypothesis because the neutral group had an average of one and three tenths (1.3) cm greater growth than the next leading contender (the alkaline group). The data also showed that the wrong soil pH can have a great negative affect on a plant's growth because the neutral group's shoots were 206 percent taller than the acidic and the roots were 56 percent longer. The results of this experiment prove that soil pH levels have a great effect on a plant's growth, thus supporting the idea that this method could be beneficial in large crop productions.



Grajales, Olivia

*George Washington Middle School*

*Teacher: Mellis*

### What Conditions Best Preserve Your Fruit?

The reason why I decided to do this project was because it's very important to keep your food lasting as long as possible. Wasting food is okay in small amounts however if many fruits or any kind of food is left out for too long at the wrong places they can grow mold so you cannot eat it or even hurt you if you don't realize it has mold on it. To keep myself safe from the mold I did not taste any of the fruit that I was using, I made sure to check it every day so that as soon as I found mold I would throw it away and I had everything kept in a plastic bag. I collected the data using Google sites. The red shows no change in that day, the green shows there was mold found on one of the fruits, and the pink shows that there were two fruits found with mold on them in the day. From this data collected you can clearly see that the orange did mold the fastest on the table. A close second, oranges on the window. We can also see that in the fridge everything stayed safe other than an apple. In conclusion, the best place to keep your fruits is in the fridge If you don't mind cold fruit.

Quinones, Mia

*George Washington Middle School*

*Teacher: Mellis*

### Artificial vs. Natural: Which Will Win?

When I started this experiment, I had one question: Artificial Vs. Natural: which will win? My hypothesis was that if I use natural sunlight versus artificial light on the plants then the plants will grow taller. I ended up using dwarf sunflower seeds since they grow quickly and they did grow quickly. I let them grow for a month and gave them water every two days. I used UV growing lights and occasionally had to put them higher above the plants using books because Plant C was growing so tall that it was being burned by the strong UV lights. I ended up having to use two books on each side and the leaves would still burn sometimes. When I measured the plants on the last week, I learned that the plants growing with UV light ended up being the tallest. The tallest plant out of all of them ended up being Plant C which was eight and a half inches tall. The only plant that came close to that was only about six inches tall and that was Plant B. My hypothesis ended up being wrong and the plants that grew the tallest were the ones with UV light.

Sherman, Lila

*Dorothy Hamm Middle School*

*Teacher: Marszalek*

### The Effect of Sunscreen on Aquatic Plant Growth

The purpose of this experiment was to see which sunscreens cause the most harm to the health of aquatic plants and ecosystems. The experiment compared the impact of three different types of sunscreen (Oxybenzone, Oxybenzone-free, and mineral) on the growth of a freshwater aquatic plant. It is hypothesized that the oxybenzone sunscreen will cause the highest decrease in the plant growth, followed by oxybenzone-free sunscreen, and mineral sunscreen. The results supported the hypothesis. The control plants grow an average of 1.47 cm in 21 days. The plants growing in water containing Oxybenzone sunscreen had zero growth. The plants growing in water containing non-Oxybenzone sunscreen grew an average of 0.97 cm in 21 days. The plants growing in water containing mineral sunscreen grew an average of 1.0 cm in 21 days. In conclusion, the data shows that all types of sunscreen have a harmful effect of decreasing plant growth. However, the oxybenzone sunscreen causes the most harm, followed by non-oxybenzone sunscreen and then the mineral sunscreen.

Fallon, Alexandra; Swartz, Lydia

*Dorothy Hamm Middle School*

*Teacher: Leeb*

### The Effect of the Color of Light on how Tall a Plant Grows

The purpose of our experiment was to figure out if one color of light was advantageous in the growth of plants. We hypothesized that red light would be best for plant growth because red light will be absorbed by green plants instead of reflected like green light. We planted the seeds inside colored cubes that would filter the color of light that would enter. We then watered the seeds on the first and third days of our five day experiment. In the end, the plant in the red cube was the tallest, and the plant in the yellow cube was the shortest. What we didn't expect though, is that the plant in the green cube was the second tallest. Further research should be done into if this was just a fluke or if there is a reason behind the green cube's surprising performance. In conclusion, our results support our hypothesis because the red plant grew the tallest.

Dalley, Lilah

*Yorktown High School*

*Teacher: McKowen*

### The Effect of Different Growing Techniques on the Growth of a Basil Plant Over Time

This project is important because in the future we may face a global food crisis and we need to know the most efficient way to grow our plants. This study tested the effect of different growing techniques on the growth of a basil plant over time. The plants were grown in soil, hydroponically, and hydroponically with a bubbler. The goal of the project was to see the growing condition in which basil plants would grow the tallest and have the most leaves. It was originally thought that if the basil plant was grown hydroponically with a bubbler it would grow the most because plants grown hydroponically grow much faster than plants grown in soil and the bubbler will help it grow even more. The results partly supported the hypothesis, concluding that basil plants grow best when grown hydroponically rather than in soil. There was also no significant difference in growth between the hydroponic without a bubbler and the hydroponic with a bubbler. The p-values conducted in the ANOVA tests for both dependent variables were lower than 0.05, meaning that the null hypothesis was rejected, and there was statistically a significant between at least one of the variables. If I were to do this experiment again I would include more trials so the data wouldn't be as controlled by outliers. To extend this project in the future I would test which growing conditions other plants (mint, cilantro, lettuce, etc.) grow best under.

Mendoza, Alessandra

*Washington-Liberty High School*

*Teacher: Sotomayor*

### The Effect of Different Wavelengths on the Growth of Radishes

nt was conducted in order to determine the effect of wavelengths of light on plants. The hypothesis was that radish plants grown under wavelengths of 740-590 nm will be the tallest because red light is best for photosynthesis and does not negatively affect shade avoidance responses. The null hypothesis was that growing radishes under different wavelengths of light would have no effect on the height of the plants. The wavelengths tested were wavelengths of 740-380 nm (white light & control), 740-590 nm (red light), 590-520 nm (green light) and 565-435 nm (blue light). Each experimental group contained 20 trials with cellophane being used to manipulate the color of light. The experiment lasted four weeks. The 1st week, radishes were grown under a full spectrum of light (white light) to ensure growth of all radishes and the last three weeks the radishes were grown under their corresponding cellophane. Every three days of the three weeks under cellophane, the height of each radish in all experimental groups was recorded along with qualitative data consisting of the amount of leaves. The radishes in each experimental group all grew to be about the same height. The quantitative data was analyzed with an ANOVA test. The p-value was .90 meaning the data was not statistically significant. This also meant that the null hypothesis was accepted. This conclusion, however, does not fully support the theory. In theory, white light would do best followed by blue instead of red.

Snyder, Elliana

*Washington-Liberty High School*

*Teacher: Sotomayor*

### Plant Paper Chromatography

The analysis of different plant pigments during the process of chromatography provides a unique way to create a better understanding of what really makes up a plant. Plants are an essential unit of life. They are autotrophs, providers for themselves, and then providers for the heterotrophs that come along next in the food chain. It is important to understand what makes up these vital units of life, to better understand the world around us. This experiment tested different flowers and leaves during the process of paper chromatography, to find out what pigments truly make up these different plants. Additionally, comparing leaves and petals, and whether they had a comparable difference in the amount of pigments each had. Due to the differing plants, they each had different pigments. Once experimentation was over, the results were obtained using the eyes to carefully observe how many pigments appeared afterwards. For example, since chlorophyll is in every plant cell, red roses, showed 2 pigments, chlorophyll, and anthocyanin which gives red roses its red color. After doing an ANOVA test, the results were found to be statistically significant due to having a P-value of  $1.6128 \times 10^{-10}$ , which is less than 0.05. Since the hypothesis stated that red roses would only have one pigment, it was rejected, due to experimental data showing it had two.

Uddin, Maqsuda; Lopez, Emely

*Wakefield High School*

*Teacher: Fuamenya*

### The Effect of Different Solutions to Determine Which Rose Survives the Longest

This project is important because it will assist roses and possibly other flowers and plants live for extended periods of time. Those who appreciate fresh roses will be able to enjoy them a little longer and spend less money if roses can last for extended periods of time. As fewer flowers would need to be picked, it would also benefit the environment. There are going to be 4 solutions; water and vinegar, water and sugar, water and sprite, and one with just water. Which liquid solution will help the roses last the longest given that In this project, 13 oz of water with different substances are used. The hypothesis of this experiment is if a rose is put in Sprite solution then it will last longer than the one with just plain water and all of them. 13 oz of water were placed in each of the 4 bottles, with 1 1/2 tablespoons of sugar, vinegar, and Sprite in the bottles, respectively. The last bottle was filled with plain water. Each bottle was stirred and included a trimmed rose stem that would last for a week or more. The hypothesis was rejected, the solution of one tablespoon of sugar and 13oz of water was the one that lasted for the longest amount of time. The one with the sprite lasted the second longest amount of time of time after the one with just water (the constant) and the vinegar and water solution was the first one to die.



Collard, Megan

*Alexandria City High School*

*Teacher: Briestansky*

### The Effects of Different Liquids on Plant Growth

For some time scientists have tried to find another liquid to use and I wanted to test the theory myself to really see if another liquid can be used to water a plant. Well, my science fair project is about the Effects of Different Liquids on Plant Growth. The five liquids I used were vegetable broth, vinegar, almond milk, Diet Coke, and water as my control. Over the course of 3 weeks, every morning I would measure the height of the sprout in centimeters and then record the measurements in my notebook. After I had all the measurements, I averaged the numbers out. My hypothesis was if plants were watered with different liquids, then the milk will grow the highest because milk has proteins and vitamins, My results rejected my hypothesis because the plants watered with water had grown the highest although the vegetable broth and Diet Coke each had grown one sprout at the end of 3 weeks. What I learned from this experiment was that there might be different liquids but water will always be and has always been the liquid to use when watering plants.

Edsall, Alba

*Washington-Liberty High School*

*Teacher: Aksoy*

### The Effect of the Percentage of Polystyrene Microplastics in Soil on the Root Length of *Raphanus sativus* Over a Four-Week Period

The purpose of this experiment was to determine the effect of the percentage of polystyrene microplastics in soil on the root length of *Raphanus sativus* plants. The independent variable levels were 1%, 3%, and 5% microplastics while 0% microplastics was the control. The hypothesis stated that if *Raphanus sativus* plants are treated with different percentages of polystyrene microplastics in the soil, then those treated with no microplastics will have the greatest root length because microplastics reduce the ability of root crops to transport nutrients needed for growth. The hypothesis was not supported by the data because the plants treated with 1% polystyrene microplastics had the greatest root length growth over the 4-week period. Additionally, 3 t-tests determined that there was no statistical significance between the 0%, 3%, and 5% microplastic groups. However, an ANOVA test was performed and the p-value was 0.005. The p-value indicated that the data was statistically significant, and the null hypothesis was rejected. The null hypothesis stated that if *Raphanus sativus* plants are treated with different percentages of polystyrene microplastics, then there will be no difference in the root length between groups. Overall, the 1% microplastic group had the greatest root growth while the 0%, 3%, and 5% microplastic groups had no statistical effect on the growth. The results of this study indicate that further research is needed to understand the effects of microplastics on plant growth. Future studies could involve a longer experimental period, different types of microplastics, and smaller sizes of microplastics.

FitzHarris, Olie

*Washington-Liberty High School*

*Teacher: Fretts*

### The Effect of Water pH on Mung Bean Length and Mass

Mung beans or *Vigna radiata L.* are small sprouts that are grown on more than 6 million hectares worldwide. They were used for this study for their massive presence in the world as well as being consumed when germinating, not when fully grown. The purpose of this study was to figure out how acid rain (water pH) affects the growth of these beans, as well as others like it. The experiment was conducted by placing 50 mung beans in separate jars and washing them with water of varying pH levels. The pH levels that were tested ranged from 4-8, with an interval of 1 between levels and 6 being the control. The control level of 6, was also hypothesized to grow the most due to it being closest to the pH of natural rainwater. The beans had their mass weighed twice a day for 5 days as well as having their sprout measured on the final day. The results showed that the control group, with a pH of 6, grew the most. They had the longest average sprout length as well as the largest final mass, measuring 1.73 cm and 490.40 grams respectively. Contrasting this was the 2 extreme pH levels, pH 8 and pH 4, which barely grew past their starting weight. These results show that acidic rain and alkaline water have negative impacts on the growth of mung beans and that the closer to natural water levels the beans grew more.

Wearmouth, Isla

*Washington-Liberty High School*

*Teacher: Fretts*

### The Effect of Aquaponic Farming, in Comparison to Nitrate-Fertilized Soil, on the Growth of Lettuce Plants

The widespread use of chemical fertilization in agriculture is becoming an increasingly prominent issue, and aquaponics may potentially provide a solution. Aquaponics is a type of agriculture that combines aquaculture and hydroponic farming methods. Plants and fish are grown for consumption in a symbiotic cycle where nitrogen-rich ammonia water is produced through fish waste which plants are then able to filter out of the water and use for growth. This experiment was conducted to determine if lettuce plants grown in aquaponic systems can grow to the same size or larger than lettuce plants grown in nitrate-fertilized soil. The hypothesis was: If the aquaponics system is used, then it will produce lettuce plants the same size or larger than plants grown using nitrate-fertilized soil because of the nitrates produced from ammonia in the aquarium water. Three agricultural groups included aquaponics, nitrate-fertilized soil, and organic soil (control). Lettuce seeds were germinated in petri dishes one week prior to placing them in their experimental groupings. The plants were then separated into the three agricultural groups and growth was observed for one month. Aquaponics had the highest mean growth of 6.90cm and the largest total dry weight biomass of 0.03g. The hypothesis was supported because there was a significant difference between the mean heights of the aquaponic group and the nitrate-fertilized group. Nevertheless, it is important to recognize the scope of this experiment in relation to real world application, as future experiments of greater scale may produce more significant results.

Fitzgerald, Lia; Enow, Madison

*Alexandria City High School*

*Teacher: Strimple-Barker*

### Bleach Leach

The purpose of this experiment was to simulate the effects of hazardous water run-off and improper waste disposal on a basic level using wheatgrass and bleach (a common household chemical). As part of the procedure, 15 planters were filled with 6 seeds, 3 planters per experimental group. Each experimental water solution had an increased bleach concentration of 25% from 0% bleach to 100% bleach. The plants were watered equally for 4 weeks and given consistent sunlight using a UV lamp. After the experimental period, the results showed that the plants with bleach-water solutions grew significantly less. During the experiment, gradual signs of distress could be seen in the plants such as yellowing and shrinking of the grass. An observation seen during the project was the brown-orange water that would leak from the plants when watered with bleach. In conclusion, the hypothesis proved correct that the experimental plants over a 50% bleach solution would be stunted half the height of the control plants. This project successfully showed how dangerous even a small amount of chemicals could be to the livelihood of plants, especially in agriculture. Hopefully, this experiment can show the detrimental effects of chemical leaching on the growth of plants. If this experiment were to be expanded, it should include the effects of different chemicals on different plants such as ammonia and corn. In addition to harmful, household chemicals, "safe" chemicals could be tested as well- like those found in pesticides, synthetic fertilizers, and other artificial additives used in agriculture.

Rizzo, Amelia; Helms, Helena

*Wakefield High School*

*Teacher: Harris*

### The Effect of Water Temperature on Algae Growth

The purpose of this experiment is to discover how variations in water temperature affect the rate and quantity of algae growth. Many marine organisms rely on algae as a primary food source. However, climate change has caused a rise in global ocean temperatures, which may affect natural algae growth. It was hypothesized that if water temperature increases, algae grows more quickly and in larger quantities. This experiment was conducted by filling 9 clear medicine cups each with water, algae culture nutrients, algae culture salt, and *Nannochloropsis oculata* algae spores. These cups were then split evenly into 3 trial groups. One cup from each trial group was placed under a heat lamp, one in the refrigerator, and one in a “room-temperature” room. The temperature of each cup was measured daily for 6 days, and the data was input into a table, a line graph, and a bar graph. Visual observations on the algae growth were also noted in the table. Analysis of the data led to the conclusion that an increase in water temperature does increase the rate and quantity of algae growth. This conclusion was based on the visual observations that the cups in the refrigerator only started to produce algae at the very end of the 6-day data collection period while the cups in the room temperature and hotter environments produced algae steadily after the 25 hour mark. However the heated medicine cups produced algae much more rapidly and in larger quantities than those in the room temperature environment.