83rd Pittsburgh Regional Science & Engineering Fair

Intermediate Division

Student Project Abstracts

March 22, 2022
Notes to Judges

Students prepare Abstracts limited to 100 words that include the following:

- Purpose of the experiment
- Procedures used
- Data
- Conclusions
- Possible research applications
- Minimal reference to previous work
- For continuation projects, the abstract should focus on work done since the last PRSEF
- Should not include: a) acknowledgments, or b) work or procedures done by the mentor

Many students continue their research after the Abstract is submitted, and therefore the Abstract may not fully represent the Project.

Abstracts are available to the Judges prior to the Science Fair as an aid in pre-screening the Projects. Judging is to be based on the actual Project as presented by the student.

Project Numbers are assigned as XYYABC

- X: M – Intermediate Division (7th and 8th grade)
- YY: Category Name
  - BS – Behavioral and Social Science
  - BI – Biology
  - CH – Chemistry
  - CM – Computer Science and Math
  - CS – Consumer Science
  - EE – Earth and Environment
  - ER – Engineering/Robotics
  - MH – Medicine/Health/Microbiology
  - PA – Physics and Astronomy
- ABC: Project number
  - 1xx or 2xx – Individual student projects
  - 3xx – Team projects (2 or 3 students)
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MBS100: Get your COVID Shot?
Where do people want to get a COVID shot and if it was available would they get it there? After looking at 6 options at https://www.vaccines.gov/ page, only hospitals, pharmacies, and Health Centers were on the list. My hypothesis for this experiment is that I want to know if people are interested in getting the COVID shot and willing to go to other locations as well if there is availability. In order to find the hypothesis there are four steps that need to be taken. Step one is to make a COVID shot survey. Step two is to make a poster to send around the school community. Step three is to create an email to send to teachers, staff, families and the community. Step four you need to collect information for two months then graph the data. When receiving a COVID shot there are risk factors that can occur. Some risks are not being able to get people to complete the form, people concerned if we take personal information, and people may not want the COVID shot due to health concerns. It's important to take in consideration the risks factors due to it being significant. To answer my hypothesis data it is important to include data. Once Data was collected it showed that most people would get the shot at their workplace (job). If people had a preferred choice to get the shot, 93% would get the shot. To conclude, my findings were wrong.

MBS101: Can Video Games Help Students Earn Higher Test Scores?
Students will be asked to either take a short quiz with traditional paper and pencil, or students will take the same quiz using an interactive format. Quiz scores will be compared.

MBS102: Do Women Remember Details Better Than Men?
Photographs will be shown to student volunteers for 10 seconds. After the photograph is removed from view, students will be asked to respond to questions about details in the photograph. Results will be tallied based on gender.

MBS103: Will Classical Music Help with Learning and Memory?
Students will be shown common nouns for 10 seconds. The words will be removed from the view and students will be asked to recall as many words as they can remember. This will be repeated while classical music is played during the testing.

MBS104: STEM vs. STEAM
Art is becoming an important factor in today's society. However, is art so important that we incorporate it with the scientific world? Is art required in STEM education? In order to answer this question, I ran an experiment to see if art is important in the development of a computer interface another field in science. I had 2 experimental groups of which one contained 5 software engineers and the other with 5 software architects. The software architects believe that art is necessary for STEM education while software engineers believe the opposite. I gave all 10 participants a 10 question, innovative test (using google forms) to see how the scores will display the relevance of art in science. After collecting the data, it is shown that the software architects scored higher than the software engineers, approving my hypothesis. In conclusion, the results of this experiment help answer this worldwide debate of STEM vs. STEAM.

MBS105: Introverts, Extroverts, and Dilemmas
Introverts and extroverts is a topic no one really discusses but I find an interest in. My experiment, “Introverts, Extroverts, and Dilemmas”, is a survey regarding adults, introvert or extrovert, and their decision making in hard situations. My research question is: do introverts and extroverts go through a different thought process when making difficult decisions? My hypothesis is that people who identify as introverts are more likely to pick Track A in the first “Trolley Dilemma” and will most likely pick to do nothing in, “The Large Man (The Trolley Dilemma)”. In this experiment, it specifically focuses on two variations of, “The Trolley Dilemma”. I conducted a survey with qualitative and quantitative questions among adults over the age of 18. My survey asked participants to evaluate their own tendencies and then make decisions about an ethical dilemma. Using the answers from the questions, I am able to figure out if being an introvert or extrovert differs their way of decision making, or if there might be a trend that no one has noticed. I am in the process of evaluating the data and results will be available on fair day.
**MBS106: What Really Stinks**

What is the effect of basketball shooting percentage based on the arc of the ball? Does more or less arc improve shooting percentages? Hypothesis: If the researcher shoots 75 shots from the foul line then it is hypothesized that the researcher will make more shots with around 57 degrees arc. Research: An average player who shoots with an optimal arc of 45 degrees (give or take two degrees) is going to make around 11% more free throws than a player with a higher arc of 53 degrees. The same is true going the other way. That same average 45-degree player makes 12% more free throws than a falter arc 35-degree player. Depending on player height, an arc trajectory of between 49 and 52 degrees is your best bet for making the shot each time. assuming you're shooting from near the three point line. If you're closer to the hoop, increase the angle of your shot. This will ensure the ball is moving at its slowest pace possible when it either goes through the net or hits the rim. James Harden is 6' 5", shooting with a 49.6 degree launch angle, which is pretty much perfect for his height to get the slowest moving basketball at the rim. The basketball was released at a height of eight feet, which is a bit high for a player with a height (6'8). Typical release height for a free throw is 1 foot above the top of the shooter's head. The release angle of 54.0 degrees and velocity of 23.3 ft/s is fairly typical for a 6'8 player (53.9 degrees) When shooting a 2-foot shot, you only need a launch speed of approximately 10 miles per hour. For a 3-point shot you need a launch speed of approximately 18 miles per hour. More force (speed) is necessary for longer shots to get the ball to the basket. Materials: Basketball Hoop, Basketball, Tripod, iPhone for video, Shooting Arc Tracker, Microsoft Laptop, Father to help get data Procedure: Be sure to record and get the data for each shot. Start at free throw line. Shoot around 75 shots all on video tape. When finished, go through and look at every shot. Regardless of whether the shot went in or not, mark the arc angle and if it was a make or a miss for each. Lastly, calculate what the best arc is to make the most free throws possible. Questions: 6. The idea was found on a website when looking for sports related science projects.

**MBS107: Correlation between Reading mediums and reading comprehension**

For my science fair project, I looked at different reading mediums to find out which method of reading comprehension works best. My hypothesis is that the subjects that read out loud will be able to comprehend the information that they are given the best. I tested this by having subjects read different articles in four different ways: reading to themselves (hardcopy), reading online, reading out loud (hardcopy), and listening to someone read to them. I found that reading out loud was the best method of reading comprehension.

**MBS108: The Stroop Effect: Does IQ Matter?**

The Stroop Effect measures how fast a person's brain can process information. My experiment shows whether IQ has an impact on it. If it does, then Stroop Test results can give a rough IQ range for the people who cannot take IQ tests. I gave my participants an IQ test and a Stroop Test and documented the results. The data shows that people with lower IQ tend to finish the Stroop Test faster which contradicts my hypothesis that states that people with higher IQ will finish quicker.

**MBS109: Transposed Letter Priming**

The purpose of this experiment was to determine whether words can be read fluently when letters in words are transposed. The idea for this project came from a phenomena known as “typoglycemia” which surfaced on the internet in 2003. Transposed letter priming is when the letters in a word are switched with each other or moved around. For this experiment I had tested the number of incorrect words pronounced and how long each test took. The first test handed out was a practice where no letters in the word were wrong. Second the letters in the middle of the words were scrambled and the third all the letters in the word were scrambled. The hypothesis said, “If the letters in words are rearranged, then the number of words that are accurately read will be decreased proportionate with the number of letters that are scrambled in each word.” My hypothesis in this case was supported by my results. My results showed that it took longer to read the third sample on average than it took the first and second. It also showed that the third sample was the most challenging to comprehend and read to all the readers. With this data I was able to conclude that scrambling all the letters in the word lead to more people getting more words incorrect than they got correct. This also led to a longer time to read. This is because the more scrambled the text, the less people's brains can comprehend.
**MBS110: Effects of Music on Sleep Stages**
Sleep playlists can be found in abundance, but there is no direct proof that they actually help sleep. This experiment finds out whether they're actually effective or not. 6 people were assigned to a matched pair and submitted 5 nights of data of sleep without music, and 5 days with music. The averages of each section of each person was calculated and compared. While statistically, the data proved the hypothesis true, further testing is needed as the percentages are too close to be significant.

**MBS111: Do middle schoolers have differences in what they laugh if they are in a group?**
Do middle schoolers have differences in what they laugh at if they are in a group? Laughter is a necessary social sign of fondness and closeness. People with a strong sense of humor and those who laugh a lot have a longer life than those who don't laugh as often, this even occurs with those who are battling cancer. If middle schoolers are shown a funny video then the test subjects are more likely to laugh at the funny video when they are in a group than not because research has shown that humans are thirty times more likely to laugh when they are in a group. A laughter scale was used to measure the data on a scale of one to ten. After recording this information the average and the calculated laughter scale were found. There was a 0.3% difference in laughter between the group and the individual averages. When shown the video some participants reacted by joking about laughing about the video, some participants reacted more mildly, like smiling through their eyes.

**MBS113: The Relationship of Age and Intuition**
For my science fair, I tested if different age groups were better at using intuition to their advantage. I hypothesized that the older age groups would do better because they have been through more experiences and therefore know more. I tested from ages 7-14. I found that the older age groups were better at using intuition than the younger groups (approximately 29% better).

**MBS114: The Correlation between Dungeons and Dragons and Creativity**
In my science fair project, I tested to see whether or not playing Dungeons and Dragons (D&D) has a correlation with people’s creativity. My hypothesis is that people who played D&D will be more creative than people who do not. To do this, I tested the creativity of 10 people who do play D&D and 10 who do not. From my experiment, it looks like people who do play D&D are just as likely to be creative as those who do not.

**MPA115: How does the material of a guitar string affect how it sounds**
This project will be a study, testing whether the gauge of a guitar string effects the pitch. The purpose of the project will be to observe how the gauge and thickness of the strings affect the pitch. A riff and pitch meter will be utilized to measure the pitch. I hypothesize that if I use thinner strings, then the pitch will be higher. Likewise, using thicker strings will produce a much lower sound. The data will be analyzed and present at the fourth day. This project will be used to determine what type of strings are best for certain desired sounds. In addition, the project results could provide insight to musicians, actors, guitar luthiers, or just your average guitar enthusiast about pitch and sound of guitars.
Biology (MBI)

**MBI100: Determining Regeneration Limits in Planaria**
Regeneration of tissues is important for health. How tissues in the body regenerate remains a mystery. Because planaria regenerate large parts of its body, it offers clues to this mystery. Planarian regeneration happens after stress, defined as an adaptive response to tissue damage after injury. I hypothesized that different levels of stress would affect the extent and rate of planarian regeneration. I cut different amounts of the planarian body as the source of stress. Planaria were left ¼ intact, ½ intact, or ¾ intact. The ¾ grew the fastest, but the ¼ grew the most proportionally to everything else.

**MBI101: How Does Acid Rain Impact Plant Growth?**
Plants will be watered regularly with acidic solutions, ranging in pH values from 3 to 8 S.U. Plant growth will be evaluated over a 3 week time period.

**MBI102: What Type of Fertilizer Will Result in the Greatest Amount of Plant Growth?**
Various concentrations of nitrogen based fertilizer will be added to radish plants. Plant height will be measured over a set time period.

**MBI103: How Do Mealworms Respond to Different Liquids?**
Research indicates that mealworms are capable of breaking down plastic products, specifically polystyrene. This project will focus on finding liquids that could be added to the polystyrene to attract the mealworms.

**MBI104: Testing how motor oil affects the photosynthesis process of an aquatic plant**
How does motor oil affect the photosynthesis process of Elodea densa? If the researcher takes Elodea densa and puts increased amounts of motor oil on top, 5ml 10ml 15ml, the researcher hypothesizes that the bubbles created during photosynthesis will decrease to two bubbles when oil is present. During the photosynthesis process a lot happens to the plant's cell. Specifically, within the plant cell, the water is oxidized, meaning it loses electrons, while the carbon dioxide is reduced, meaning it gains electrons. This transforms the water into oxygen and the carbon dioxide into glucose. The plant then releases the oxygen back into the air, and stores energy within the glucose molecules. Oil hampers the growth of plants to a great extent. It cuts off the air supply and sunlight, thus making it impossible for plants to carry out photosynthesis and make food. In the absence of photosynthesis, plants fail to germinate and the growth stops. Plants are not able to transpire and most of them die. Kelp and very few other aquatic plants are able to grow again once water is made free of oil. To do this experiment these materials are needed; test tubes, 2 liter bottle, funnel, Elodea densa, sodium bicarbonate solution, NaHCO3 solution, motor oil, sunlight, aluminum foil. To carry out this experiment, there are two main experiments. The first is taking a small sprig of Elodea densa and putting it in a test tube with a sodium bicarbonate solution ( a CO2 source for photosynthesis). The bubbles produced by the cut end of the plant will be counted. The same experiment will be done, but with 5ml of motor oil on top. In the second experiment, small pieces of Elodea are placed in a funnel inside a 2 liter bottle filled with NaHCO3 solution. A test tube is inverted on top of the bottle to collect oxygen evolved during photosynthesis. Another 2 setups are made with 10ml, and 15ml l of oil added on to. These setups will be wrapped in aluminum foil to prevent any sunlight from entering through the sides and is left in the sun. The amount of liquid that is displaced in the test tube will be measured to determine how much oxygen was produced during photosynthesis. I chose to do this experiment because boats and cars produce so much motor oil and this oil is leaking into bodies of water, causing the plants to die. I want to see exactly how this process works, how quick it is, and what happens during photosynthesis to these plants, or in my case to Elodea densa.
MBI105: What Effect Does 10 mg, 50 mg, 100 mg, and 150 mg of Caffeine Have on a Contender Bush Bean Plant?
The purpose of this experiment was to determine the effect of different concentrations of caffeine on a contender bush bean plant. I planted 45 bean seeds and watered them on day 1. On day 5, a few curled green shoots appeared and more subsequently sprouted. Each day they were placed under a grow light for 12 hours. On day 9, I carried out the caffeine administration procedure. I divided the plants into 5 groups of 9 plants each. To administer the caffeine to each group of plants, I added the total amount of caffeine that I was going to feed to each group to 9 ounces of water and divided it into 9 individual servings for each plant in the group with 1 ounce per plant in one group in each serving. I watered one group with 150 mg of caffeine per plant, another group with 100 mg, one with 50 mg, one with 10 mg, and a control group that I watered with 1 ounce per plant. I will perform this procedure again one more time and continue to observe the experiment. Experimentation is continuing and final results and conclusions will be available on fair day.

MBI106: How Does Temperature of Water Affect the Growth of Chickpeas
Over 2 quadrillion gallons is used for agricultural purposes around the world. So much of this water is unknowingly wasted every year by improperly growing crops. My experiment provides us with a start to a process of consuming less water, while growing the best crops. I wanted to deduce which temperature of water provided chickpeas with the best growth. To do so, I sprouted chickpeas in distinct glass jars with 3 different temperatures of water for 5 days, measuring the height of each chickpea every day. After averaging all of my data, I observed that the chickpeas growing in the cold water had grown the overall best. This result opposed my hypothesis that the chickpeas growing in the room temperature water would have the best growth.

MBI107: Do Your Fingerprints Tell Your Genetics?
The purpose of my project is to identify if the type of thumbprint you have is related to your genetics (hair/ eye color). Thumbprints will be taken using an inkpad; the subject will gently press their thumb onto a notecard. The subject's eye and hair color will be written on the back of the card. Thumbprints will be analyzed for patterns and genetic correlations. Final results will be available at the fair.

MBI108: Does Bird Color Affect Budgie Behavior?
Budgies have feathers that are green, yellow, blue, black, gray, and white. Budgies are social birds that form mating pairs. It has been shown that female mate choice is affected by UV light reflecting off of male feathers. When a budgie sees its reflection in a mirror it thinks it is another bird. My question is if feather color also affects budgie behavior. My hypothesis is that both male and female budgies will interact less with different colored birds. To test my hypothesis I mounted different colored mirrors (red, orange, yellow, green, blue, purple, and a UV filter) next to the perches of a male and female budgie. I recorded one hour long videos of their behavior over a period of six days. After the videos were recorded, I reviewed them to see how long each bird interacted with each mirror. The male bird showed no preference for any colored mirror. The female bird showed a preference for the clear mirror and avoided interaction with the green mirror. These results might be because females are the ones that are choosing the mates. My results also show that male behavior is not affected by the appearance of different colored feathers. These results did not support my hypothesis because I thought that both males and females would be affected by feather color. In conclusion, the results of my experiment show that feather color might affect female mate choice.

MBI109: Food and Fertilizer
The purpose of this experiment is to find out which method for providing nutrients to plants would be better for plant growth and amount of crops, plant food or compost. The question asked in this experiment was to ask if plant food or compost was better for plant development. The hypothesis is that plant food will be better because it was chemically engineered for the plant's growth. The procedure taken in this experiment is to place plants in containers, fill with different soils, water twice daily, and record every two days. The results recorded that plant food was better for the development of crop and size. In conclusion the hypothesis was supported meaning that plant food is clearly the better choice.
**MBI110: Growing to Stop Flowing**

Erosion causes a lot of environmental issues, and it can be prevented by planting vegetation in areas that are susceptible to erosion. This project was completed to determine what Planting Pattern of Grass Prevents Soil Erosion Best. The hypothesis was that grass grown in horizontal rows will prevent soil erosion better than other planting patterns or no grass. To perform this experiment, grass was grown in trays of soil and water was poured over the trays and captured to determine the amount of soil that was eroded. The results concluded that the random pattern of grass prevented erosion the best, which did not support the hypothesis that the horizontal rows would be best at erosion prevention.

**MBI111: Lichen What I’m Seeing**

The purpose of this experiment was to determine whether or not the type of tree a sample of lichen was originally in symbiosis with will affect the growth rate of the lichen. The question that the scientist asked was, “Does the type of tree that acted as a host to a sample of lichen affect the growth rate of the sample?” The hypothesis is that the type of tree will not affect the lichen's growth because the tree and lichen do not have a mutualistic relationship, and the only benefit the lichen gets from the tree is a place to live, as it does not take nutrients from the tree. The procedure involves removing samples of lichen from the host tree, taking initial measurements, watering the samples daily in a mildly sunny area until the end of the experiment, and recording and comparing the final measurements of the samples and the initial measurements. The results of the experiment were inconclusive, with only one sample from each host group growing enough to provide a proper measurement comparison, though the samples from the locust tree had the greatest average growth, with a 2.5 cm² growth rate. The other sample sets had averages of 2.3 cm² (hickory) and 1.1 cm² (oak), which are not different enough from the locust tree samples to disprove the hypothesis. As such, the hypothesis was mostly supported, as the lichen samples did not grow much and the amount that they did grow was not significant enough to support the opposite. Because of this, we can assume that given a more natural environment and host, all of the lichens would have grown at roughly the same rate.

**MBI112: Sometimes You Feel Like a Nut Sometimes You Don’t!**

This experiment was conducted in order to determine what type of nut squirrels like best using 5 different kinds of nuts. The investigator was questioning what kind of nut squirrels like best. The hypothesis was that pecans would be the favorite because they contain the most fat and calories. In order to conduct this experiment, the investigator must put 10 nuts on a plate outside every day for 10 days and the squirrels are observed using a video camera. Pecans were the favorite with a total of 98 that were taken; followed by walnuts with a total of 71; then almonds with 21; hazelnuts with 2; and lastly 0 Brazil nuts were taken. The investigator’s hypothesis was correct since the pecans were the most favorite nut that were taken.

**MBI113: Chloro-fuel: How chlorine in water affects the density of algae growth**

This experiment was aimed at finding whether algae could be grown for the use in biofuels in chlorinated waters, and to find if algae could be grown in unfiltered, natural water, such as river water. I did this by growing algae in different waters and then measuring their percent transmittance, or how much light passes through the sample and isn't absorbed using a spectrophotometer. In this experiment I found that algae grown in chlorinated water had a very low density of algae and a high percent transmittance, which means very little light was absorbed. Algae grown in river water had a much higher density and a lower percent transmittance. The reverse osmosis water had the highest density and even lower percent transmittance, showing that, if algae were being grown by farmers, they could use purified water for the highest density of algae. But they could use unfiltered water as well, but it wouldn't grow algae in as high of a density as purified water, and chlorinated water would be a terrible option to grow algae in. This experiment is important because algae is a material that can be used for biofuel, which is a clean sustainable alternative to fossil fuels such as gasoline. Algae is a good material for this because it is not a food source for humans and has high oil amounts. This experiment can be a positive step towards slowing climate change through the development of sustainable fuels.

**MBI115: Mars. What’s on the Menu?**

The goal of this project is to see if life on Mars could be sustainable. One of the issues with living on Mars is growing food with enough nutrients to sustain life. It is known that the soil on Mars is not nutritious enough for plants to grow. This project is being conducted to see that if you add Vitamin C when watering the plants will retain the added nutrients. Results will be available at the day of the fair.
**MBI116: The Effect of Temperature on Daphnia magna’s Heartbeat**

The purpose of this experiment is to determine if temperature will affect the heart rate of Daphnia magna. It was hypothesized that Daphnia magna’s heart rate will increase in warmer temperatures than in colder temperatures. To perform this experiment, Daphnia magna were placed in a large beaker and cultured for three days. The temperature of the room was recorded. Daphnia magna were placed in a petri dish under a microscope and the number of heart beats were recorded for one minute. Room temperature was used as the control. The Daphnia magna were placed under a heat lamp and the temperature was recorded until it increased by 2 degrees for three minutes. The number of heart beats in one minute were recorded after being in a warmer temperature. These steps were repeated with the Daphnia magna in a colder temperature. Final results available at fair.

**MBI117: Which Soil pH do plants grow the best in?**

The question for my project was what pH of soil do plants grow the best in. Oil pH is a key factor in growing plants. Acidic soil has less nitrogen, phosphorus, potassium, and calcium in it. Alkaline soil has less iron, manganese, copper, and zinc in it. The hypothesis is if 3 different amounts of pH levels are added into soil, then the pH level of 6-7 will grow the plants the best, because the pH range of 6-7 has the ability to absorb vital nutrients from the soil the best. To get the data the plants were grown over 3 weeks. The data collected did support the original hypothesis. Control plants had the biggest impact, with an average height of 9.5 centimeters. The Acidic was 7.4 centimeters, the neutral was 8 centimeters, and the Alkaline was 6.8 centimeters.

**MBI118: Will batteries affect plant growth?**

The purpose of this experiment was to test if batteries planted in the soil of plants affect the plant growth in height. One research point was that 20-30 thousand tons of batteries are thrown away every year. Batteries take a long time to decompose, which causes harmful acids to affect plant growth negatively. Another fact is batteries go through a photochemical reaction causing emissions of greenhouse gasses. The hypothesis this experiment was based on was, if batteries are added to the soil of plants, then the batteries will have a negative effect on the plant’s growth, because battery acid transmitted into soil causes plants to wilt and die. The data was collected using graphs and tables. The data collected did not support the original hypothesis. The data collected ended with both groups of plants at the same height average of 7.6 centimeters.

**MBI119: What Type Of Hand sanitizer Prevents Bacterial Growth the Best?**

What hand sanitizer prevents bacterial growth the best. The need for hand sanitizer has gone up by a tremendous amount. Bacteria are microscopic organisms that live on everything. You cant get rid of them but you can grow them. When growing bacteria there are many different parts that go into the process. The original hypothesis was incorrect because it stated that the purell would work the best, but “The Other Brand” worked the best. This was surprising because getting clean was a generic drug store brand that is not by a popular company. The biggest zone of inhibition was 0.6 cm which is not very big, but the smallest was 0. If this project was to be done over again something that could be expanded upon would be to leave the dishes for longer so there would be more growth. One could also use different types of bacteria. Some things that would affect the data would be accidentally touching the auger and messing with it.

**MBI120: Food Dye or Food Die**

Please visit student's exhibit for abstract
**Chemistry (MCH)**

**MCH100: Which Beverages Have the Greatest Amount of Electrolytes?**

Various liquids were evaluated as to their electrolyte content.

**MCH102: Does and Apple a Day Really Keep the Doctor Away?**

Do the seeds and flesh of apples, cherries, peaches, red plums, and purple plums contain cyanogenic glycoside and, if so, which one contains the most amount? Hypothesis: It is hypothesized that the seeds of apples, cherries, peaches, red plums and purple plums all contain cyanogenic glycoside and that the seeds in peaches have the highest amount of cyanogenic glycoside among these fruits. It is also hypothesized that the flesh (hypanthium/mesocarp) in each of these fruits do not contain cyanogenic glycoside. Materials: Pipettes Microcuvettes ReagentStrips #1 (impregnated with Chloramine T hydrate and Monobasic and Dibasic phosphates) ReagentStrips #2 (impregnated with a solution of Isonicotinic and 1,3 Dimethylbarbituric acid) Color Chart 3 Apples 3 Red Plums 3 Purple Plums 3 Cherries 3 Peaches Cutting board Knife Mallet Hydraulic Press Water Camera Lab Notebook Pen and pencil Paper towels Timer Procedure: Run a control before each fruit sample. Using a knife and/or mallet, find the pit in each fruit (except apples). Extract the seed from the pit (in apples remove all seeds from the fruit directly). 4. Place the seed(s) in the hydraulic press and crush the seed(s). 5. Add 50 ml of water to the crushed seed(s) taken from the hydraulic press and mix well. 6. Using the plastic pipette, extract 2.0 ml of water/seed mixture and dispense it into a microcuvette. 7. Dip 1 ReagentStrip #1 into the microcuvette using an up and down motion continuously for 30 seconds. 8. After 30 seconds, remove and discard this ReagentStrip. 9. Place 1 ReagentStrip #2 into the same microcuvette and dip it continuously in an up and down motion for 30 seconds. 10. After 30 seconds, remove the ReagentStrip #2 and match it to the closest color on the “ReagentStrip Colors” chart. 11. Record results on the data collection sheet and take photographs of the results. 12. Using a timer, let the microcuvette sit for 10 minutes. 13. After 10 minutes, place the microcuvette on the “Microcuvette Color Chart” card #2 and match to the closest color block by looking directly down the center of the microcuvette. 14. Record the results on the data collection sheet and take a photograph of the result. 15. Draw conclusions from the recorded data. 16. Repeat steps 1-15 set forth above with the mesocarp, or hypanthium, of the piece of fruit from which the seed had been removed. 17. Repeat steps 1-16 set forth above with the seeds and the mesocarp/hypanthium from 2 additional pieces of the same type of fruit. 18. Run a control. 19. Repeat steps 1-18 set forth above with the seeds and mesocarp from the remaining fruits. * For results between 0 and 0.5 ppm, the value from the microcuvette color chart should be used as the final determination of cyanide content, and for results between 0.5 and 5.0 ppm, the results obtained from the ReagentStrip color chart should be used. (Industrial Test Systems, 2005).

**MCH103: Magnetic Electric Paper for Protein Separation**

The purpose of this experiment is to create iron gradient paper that can be used for electrophoresis and other separations in labs. I hypothesize that varying the strength of the magnetic field the paper is exposed to will change the gradient of iron particles on the paper. Before beginning the experiment I layed out all of the materials needed, and cleaned the area of space needed for testing. Since this project involves substances that, when consumed in large quantities, are toxic, I made sure that no younger children, between the ages of 9-0, were near the testing area. The first step is that I dissolved 325 mg of Iron II Sulfate in 20mg of distilled water, and then applied this mixture onto cardstock paper. Immediately after that I used a magnet to create a gradient on the paper. I am repeating the procedure three times at three magnets strengths. Once the papers are complete, I will measure the electrical resistance across the gradient of iron in ohms at set distances from the magnet. I have not completed testing, and will update results when I do.
**MCH104: Measuring the pH of Fermented Kimchi**
Kimchi is a traditional, spicy, Korean fermented dish that has several health benefits. The optimal pH level for kimchi is 4.2, but if the kimchi is refrigerated for too long it will become more acidic. My experiment shows how the acidity of kimchi changes over time. My hypothesis was that the pH level would decrease (become more acidic) over time. To complete this experiment, I began by making Napa cabbage kimchi with my Korean grandmother. I then separated the kimchi into three jars labeled “Trial 1,” “Trial 2,” and “Trial 3.” Next, the kimchi sat at room temperature for 36 hours. At the end of 36 hours, I put each trial into the fridge and measured the pH of the kimchi every 24 hours for seven days. I found that before I put the kimchi in the fridge, the pH level was at 5.2. After the first 24 hours in the fridge, the kimchi measured at approximately a 5.3 pH level. I found that for the next six days, the pH fluctuated, ranging from 5.2 to 5.5. In conclusion, my hypothesis was partially correct: the pH level went down some of the time and up sometimes too. This shows that it will take more than one full seven-day week to reach the optimal pH level for kimchi, which is 4.2, and that the kimchi will not go bad after one week in the fridge.

**MCH105: To filter or not to filter**
Water pollution is a real thing and our oceans, rivers, lakes, and streams are often polluted. Rivers and streams are often drinkable water sources for us humans. If water is polluted then we cannot drink it. My project will find out what filers will filter contaminated water. I contaminated the water by adding salt, sand, and dirt and filtered them with a Brita filter/coffee filter/paper towels/rice in a strainer. Ultimately the coffee filter worked the best.

**MCH106: A Better Blend of Biofuels**
As humans use up more and more fossil fuels to get from place to place, we are not only depleting our non-renewables but adding harmful pollution to the atmosphere, speeding up global warming. Instead, we can look at our natural alternatives to regular gasoline: biofuels, specifically, biodiesels made from the oils of commonly grown plants. I concluded that soybean oil would be a good starter candidate since it is easy to grow, cheap, and mass-producible. However, some of its qualities negatively impact it. To improve upon it, I added small amounts of sesame and olive oil, with a hypothesis that it would improve qualities of the oil like its pour point and oxidation stability, both attributes in which soybean oil was not very good. I then proceeded to conduct multiple tests, with a control group of 100% soybean oil, and 4 test groups. Each had a majority percentage of soybean oil, with either a 10% or 20% olive or sesame oil percentage added. After the tests, in which the biofuel yield, cloud point, pour point, and oxidation stability was completed, it was determined that the 20% olive and 80% soybean mixture was the best candidate, doing the best in cold temperatures, and winning the pour point, cloud point, and oxidation stability tests (20% sesame oil won in the biofuel yield test). So, my hypothesis that adding these oils to soybean would result in a better blend of biofuels was confirmed.

**MCH107: Diaper Wars**
My topic is, “Which diaper is the most effective at absorbing liquid?” I chose this topic because I have baby brother and cousin and I wanted to determine which diaper would be the most absorbent. My hypothesis is, “If four brands of diapers are tested for absorbency, then Pampers brand will absorb the most because it contains the most sodium polyacrylate.” Water was poured on to squares of each diaper until water was observed leaking on top or leaking out of the diaper. The volume of water absorbed was recorded. Huggies had the most mass of all the brands of diapers and held the most water. Although the amount of sodium polyacrylate could not be confirmed, it is believed that Huggies brand may have had the most of this super absorbent material.

**MCH108: In the Zone of Acetone**
My science experiment is called In The Zone of Acetone. It is all about seeing how much damage the acetone does to the mass of my items that I put in the cups for 2 weeks. The purpose of this project is to find out which solid can withstand the longest by staying close to its original mass. Acetone has been proven to destroy weak items such as plastics according to Millers plastics. Also, whenever you put certain items in acetone there is a harsh smell. (Thrillest) not only that did you know your body produces a small amount of acetone when we metabolize? (verywellhealth). I wanted to do this project to determine the effect of acetone on different materials. Based on the research, acetone will have the greatest effect on the mass of the rubber because the chemical structure will be altered the most. My hypothesis was supported by the data, the rubber ball disintegrated during every trial. The glass marble and the seashell lost almost no mass.
MCH109: Seeing Red- Natural Dyes
The purpose of this experiment is to find out if people could use fruits and vegetables that are around their house and dye their clothes instead of going out to the store and buying expensive ink and dyes. Which red fruit or vegetable gives out the reddest color for tie-dye on cotton? The investigator thinks pomegranates will dye the cotton the reddest color. In order to determine this, the experimenter will place pieces of cotton cloth into bowls of liquefied fruits and vegetables to attempt to dye the cloth. Each of the fruits and vegetables had turned the cloth a different color. The experiment's conclusion is that the pomegranate turned the cloth purple and that the strawberries turned the cloth the reddest in color, so the hypothesis was wrong.

MCH110: Milk Into Plastic is Fantastic
My project is to determine if you can make an eco-friendly plastic using milk and other household items. The question the investigator is trying to solve is whether or not you can make plastic out of milk, vinegar, pineapple juice, and diet Pepsi. The investigators hypothesis is that vinegar is the best followed by pineapple juice then Diet pepsi. To make this you simply add hot milk to your acidic liquid, wait for it to curdle then drain the liquid and let it dry. The investigator knows that Diet Pepsi is the worst option, costing the most and being the least effective. Pineapple Juice is the second best option, costing 20cents per batch but makes a solid plastic. The first and best option is vinegar being the most cost efficient and producing a solid, usable plastic. The investigators hypothesis was supported by the fact that the higher the acidity the faster the curdling reaction would take place.

MCH111: From Which Factory Comes the Best Battery?
The purpose of this experiment is to find out which brand of battery (Up and Up, Duracell, Energizer) has the longest lasting power between AA and D batteries. The scientific question of this experiment is, “Which brand of battery between Up and Up, Duracell, and Energizer will have the longest-lasting power when used in flashlights for a certain amount of time?” The hypothesis is that Duracell will have the longest lasting-power. The three different brands of batteries (in AA and D) are placed in flashlights and turned on for 3 hours at a time, and the voltage of them is recorded after the 3 hours. These experiments are performed all the way up to 45 hours. After the experiments have been completed, the voltage results are averaged and then added up: Up and Up came out as 19.925 V, Duracell came out as 19.96 V, and Energizer came out as 19.92 V. The hypothesis was supported because Duracell had the most voltage left which makes it the longest-lasting.

MCH112: Chromatic Colors
The purpose of performing this project, and what the experimenter hopes to find out, is what type of shirt absorbs the most natural dye and creates the most color vibrancy. Which Type of Shirt Will Absorb the Most Natural Dye Creating the Most Color Vibrancy? The experimenter believes that the 100% cotton fabric will have the most color vibrancy, that the 50/50 blend fabric will have the second most color vibrancy, and that the 100% polyester fabric will have the least amount of color vibrancy. The experimenter cut the squares of three different fabrics, made a natural dye mixture, put the three different fabric squares in the pot, left them to soak in the dye, hung them to dry, and looked at the color vibrancy difference. The 100% cotton fabric had the most color vibrancy. The experimenter's hypothesis was supported because the 100% cotton fabric had the most color vibrancy.

MCH113: This Salt is Shocking
The purpose of this experiment is to determine if salt water can become a new renewable energy source. The scientific question was if salt helps water conduct electricity better. The hypothesis was that the more salt the scientist adds in water, the more electricity it can produce. The scientists' procedure was to add 5.6 grams of salt to 237 mL of water, and see how much electricity the voltmeter could record, and the scientist tested each amount of salt three times each for accuracy of the readings. The results were that for every 5.6 grams of salt added, the electricity went up. The scientists hypothesis was supported because, for the most part, the energy that the voltmeter could pick up increased.
**MCH114: Testing the Filtration Capacity of Activated Carbon**
My science fair project tested different types of activated carbon during filtration to see which type could filter colored water the best. My hypothesis was that if I used different types of activated carbon to filter colored water then powdered activated carbon would filter the water the best because it has the biggest surface area. I tested by mixing the types of activated carbon with the colored water and filtering the mixture through a coffee filter. I tested the types of activated carbon with three concentrations of colored water. My results concluded that powdered activated carbon filters water the best.

**MCH115: Solving for Q Shall Show What flavor is good for you?**
Multitudinous individuals prioritize the efficiency of a diet and do their utmost to maximize their said diet's ability to produce a substantial effect. By making beneficial usage of the field of science tilted calorimetry, one possesses the capability of allowing their diet to become significantly more efficacious. One bears the ability of executing this experiment with a rather prodigious variety of food, although I performed it with chips. I attempted to discover the correlation between a chip's flavor and the quantity of thermal energy housed within it. I meticulously completed this experiment by elevating a glass beaker of water with a scientific thermometer submerged within it over an open flame. This act is succeeded by the introduction of a Pringle over this previously mentioned heat source. I then plugged all of this previously amassed information into the Calorimetry formula of \( Q = M \times C \times \Delta T \). Ultimately, I formed a mathematical scatter plot with the previously collected information concerning the project. The flavor of chip is documented as the X-axis in increasing fat content and Q is documented as the Y-axis. With the points I detected and identified a correlation when a line of fit had been successfully drawn. The slope of this line informs me of the increase of calories that is required to increase the amount of cholesterol and fat. This additionally provides an answer to whether or not flavor matters to any extent. Experimentation still pending.

**MCH116: Light the Way**
Many light bulbs use the filament tungsten. However, tungsten is a very expensive filament. I'm trying to find a cheaper filament but still as long lasting and as bright as tungsten. To find a better filament I will test three different widths of the filament lead and see if any are long lasting enough to be a possible alternative to tungsten. Experimentation is still going on, so results will be available fair day.

**MCH117: Paint's Protection Against Acid Rain**
Acid rain is causing many monuments and statues to slowly disintegrate. This experiment was designed to see if a coating of paint could protect the rocks from the acid rain. Four pieces of marble were painted with interior semi-gloss paint, four more pieces were painted with exterior satin paint, four more were painted with exterior semi-gloss paint, and the last four were left unpainted. All sixteen rocks were placed in jars of a citric acid solution. Every day for the next two weeks, the rocks' mass was measured. At the end of the experimentation period, the marble without paint lost an average of 5.5 grams, the marble with the interior semi-gloss paint coating lost an average of zero point five grams, the marble with the exterior satin paint coating lost an average of one gram, and the marble with the coating of exterior semi-gloss paint lost an average of one point three grams. The marble coated with the interior semi-gloss lost the least mass, which disproved my hypothesis that the exterior semi-gloss would give the most protection.
**MCH118: Don’t Sweat it!**

Motivation: The main reason I did this project was because many of my peers and I are going through puberty, and we are producing more body odor. Body odor in teenage life is a big problem, so finding an effective unscented antiperspirant deodorant that has a reasonable price will help solve that problem. Problem Statement: The purpose of this project is to determine what unscented antiperspirant deodorant is the most effective at eliminating bacteria on the human skin and is the most cost effective. Methodology: After I gathered all my materials and purchased the deodorants I would be using, I was ready to create sterile paper disks. I used a hole punch to create paper disks which were placed in foil and baked for an hour at 177 degrees Celsius to create sterile paper disks. A sharpie marker was used to divide an agar plate into four quadrants. Each quadrant was labeled for identification. A scalpel was used to scrape 2 grams of the antiperspirant deodorant being tested into a weighing dish. Next, the deodorant was melted on a hot plate at 95 degrees Celsius for 45 seconds. A sterile plastic pipette was used to transfer 2 drops or 0.1 mL of antiperspirant deodorant onto 30 sterile disks. The sterile disks containing the melted deodorant were left to air dry for five minutes. A nichrome wire loop was placed in a flame for 1 minute before being removed and allowed to cool for 1 minute before being placed into a tube containing non-pathogenic staphylococcus epidermidis. The bacteria were applied to the plate using a back and forth and side to side motion to ensure ample coverage. Sterile forceps were used to place the sterile paper disks containing the melted deodorant into the center of each quadrant. The plate was then taped shut, inverted, and placed in an incubator set at 37 degrees Celsius, which is normal body temperature for 48 hours. After 48 hours the plates were removed, and the zone of inhibition was read. Three random readings were measured from the edge of the paper disk to the edge of the bacteria using a millimeter ruler. This procedure was repeated 3 more times for each of the paper disks in that plate. The entire procedure was repeated 8 more times for a total of 30 samples for Tom’s, Gillette, Arm and Hammer, Secret, Dove and the control, a sterile paper disk without any antiperspirant deodorant, for a total of 180 samples. Results: Gillette, Arm & Hammer, Tom’s, Secret, and Dove were tested to determine which was the most effective and cost efficient unscented antiperspirant deodorant for teen consumers. Gillette, containing 19% of aluminum zirconium tetrachlorohydrex created the greatest zone of inhibition and costs 7 cents per gram. Implications: This project is important because it is shown that all antiperspirant deodorants are not created equally, and that cost does not guarantee that the product is more effective than a product that is less costly. Some of that increased cost is simply passed on to the consumer to help pay for advertising.

**MCH119: Earth’s Ethanol**

Motivation: Fossil fuels are creating environmental problems, such as soil infertility. The main concern, however, is global warming or the increase in the overall temperature of Earth due to a greenhouse effect which traps pollutants in our atmosphere. Problem Statement: The purpose of this project is to determine whether corn, sawdust, or cardboard will produce the most ethanol. Methodology: 1 gram of three different biomasses was treated using a 3-step conversion process where they were first broken down and hydrolyzed. These steps weakened the cell wall. Then the biomasses were fermented by yeast which caused them to produce ethanol. Results: Cardboard produced the most ethanol and sawdust produced the least. Implication: This information is especially useful since online shopping is becoming more and more popular, and much cardboard that is being wasted could be converted to a biofuel.

**MCH120: Flat as a Pancake**

Motivation: Since I like pancakes, I wanted to see if more baking powder would make them lighter and fluffier. Problem: To determine if increasing the amount of baking powder creates a fluffier pancake. Methodology: 30 tests were conducted using 9.86, 14.79, 19.72, 24.64, 4.93, and 0 mL of baking powder. This was added to the standard pancake recipe. The pancake was cooked on each side for 3 minutes at 95 degrees Celsius. Upon completion each pancake was massed, and the height measured. Results: The more baking powder that was used, the fluffier the pancakes, while the less baking powder that was used, the flatter the pancakes. Implications: This is important in the real world because if you consume too much baking powder, it can make you ill, so be careful when altering the recipe.

**MCH121: Crystal Chemistry**

Please visit student's exhibit for abstract
**MCH122: The Light Catcher**
Light plays a huge part in our lives, without the sun we wouldn't survive but it can also cause harm to us, causing cancers and damaging the skin. My experiment hopes to show which color absorbs the most light so that we can wear the safest color during the hot summer months. I will be using a homemade spectrophotometer to measure the absorbance and the transmittance of light. I will be using an LED light, battery, water, light diffraction grating, etc. I will be shining light through colored water to test the absorbance of that color. I will do multitudinous tests to gather the best results. I have installed a software for measuring the wavelength and absorbance of the color.

**MCH123: Optimizing Powder Size Range for Additive Manufacturing**
As 3D Printing, or Additive Manufacturing, continues to mature, the need to optimize the metal powder size becomes more and more important. The purpose of this project is to investigate various powder sizes to determine if an optimum size for printing can be found. Typical parameters used to quantify the printability of powder include Hall flow rate and packing density. These parameters, as well as particle size distribution will be measured and I’ll attempt to correlate the powder size to the measured data to determine what size range may be the most efficient for printing. The collected data will be presented to my sponsor and may result in a printing project for next year’s science fair.

**MCH124: Does the pH of a liquid affect the rate of evaporation?**
This experiment's question was, “Does the level of pH in a liquid affect the rate of evaporation?”. pH is an important quantity that reflects the chemical conditions of a solution, like the level of acidity. Evaporation is the process of a liquid turning into vapor/air. If vinegar, black coffee, water, and milk of magnesia are set out to evaporate, then the vinegar will evaporate the quickest because it has the lowest pH and highest level of acidity. The data was collected by pouring 3ml of each liquid individually on a pan with high heat and using a stopwatch to time how long it takes for them to each individually completely evaporate. Based on the data collected, the level of pH in a liquid does affect evaporation because the liquid with the lowest pH (vinegar) evaporated the fastest with an average time of 1.73 minutes.

**MCH125: How Acidity Affects Corrosion**
For my science fair I tested whether acidity affects corrosion. I had three containers of solution, 100% vinegar, 50% and none. I soaked a strip of steel wool and took the temperature, once every minute for 10 minutes then one more time 5 minutes later. My hypothesis was that the more vinegar in the solution the quicker the temperature would rise. In conclusion my hypothesis was correct. The 100% vinegar solution caused the steel wool to rust the quickest. This is because the acidity of the vinegar, the pH is below 7 causing the corrosion rate to increase.
**Computer Science / Math (MCM)**

**MCM100: The Trigonometry in Hockey**
My project is trigonometry in hockey. I chose this topic because I myself am a hockey player and I wanted to find out where the best spots are to shoot from on the ice and why. I put a grid over a hockey rink. Selected common places for hockey players to shoot a puck. I created triangles, each with a vertex at the two posts of the hockey net and the location of the puck. Used the distance formula and law of cosines to find the angle whose vertex is the puck. That represents the angle of a scoring shot. Compared to all of the calculated angles - the one with the biggest angle is the easiest shot to make. To compare all of my data, I arranged it from greatest to least. The angles I calculated were $94.8^\circ$, $73.7^\circ$, $63.4^\circ$, $56.2^\circ$, $22.6^\circ$, $19.4^\circ$, $17.1^\circ$, $13.8^\circ$, and $5.8^\circ$. I found the greatest shot angle by comparing all the shots. The greatest one was in front of the net and up close. So this supports my hypothesis. The $94.8^\circ$ shot was the best. Though, we have to consider that there is no goalie and that we are not adding in height which will also impact the chances of scoring a goal.

**MCM101: Analyzing Roller Coaster G-Force**
As roller coasters have become more popular, they have also gained height, speed, and many daredevil elements. Among these is the original vertical loop. This mathematical analysis will examine the G-force associated with loops of different designs, and among them, the century-old question: Why don’t circular loops work? Despite being featured in countless physics textbooks, this simple design has some seriously fatal flaws. Using only Newton's laws of physics (and a few others along the way), graphs of experienced G-force will be built and analyzed. The data shows unexpected correlations between loop height and G-force, as you will see in the presentation. This study will reveal the true nature of real roller coaster loops, including the influence of seating position on experienced G-force. Did you know that sitting in different places drastically changes how you feel after the ride?

**MCM102: Can Video Analysis of Hand Tremors Aid in Telehealth?**
Hand tremor disorders are frequently misdiagnosed due to lack of accurate and reliable measurements outside of hospital lab settings. In addition, access to qualified neurologists is a big challenge for rural populations. A reliable telehealth solution would be greatly helpful. To address these challenges, I wanted to evaluate the accuracy of computer vision measurements of hand movement from video. My project objective is to compare the computer vision measurement of hand tremor frequency from a laptop / smartphone video with an accelerometer measurement. In order to do this, I recorded 25 videos of simulated hand tremors from 4 family members. The participants also had a smartphone strapped to their wrist and I simultaneously recorded the hand tremor frequency using the smartphone accelerometer. I created a Python code utilizing OpenCV and MediaPipe libraries to analyze the videos. OpenCV allowed me to create and store the videos, MediaPipe helped me to frame the hand models from the videos and provided access to machine learning algorithms to track finger movement. Once the hand coordinates were defined by the MediaPipe, my Python program was able to calculate the frequency from the time series recording of the hand motion. I found the frequency data from the video analysis to be within 10% of the smartphone accelerometer data. Based on my study, I concluded that video analysis of hand tremors can provide accurate and reliable measures of hand tremors and has the potential to reduce tremor misdiagnosis as well as aid in telehealth.

**MCM103: Bias in Algorithms**
I developed a machine learning (ML) program that analyzes articles to determine if they are politically biased. The goal of this project is to improve the information people receive, by providing them with additional context about any bias present in the article. It separates fact from bias, which helps people acquire information and learn. ML programs require data for its training. The sample data I used consists of randomly ordered websites that are unbiased or biased to left or right. The data is split 80/20 between training and evaluation sets. This entails that 80% of the data is given for the computer to learn, while the remaining 20% is used to evaluate the model. The accuracy of the model is between 89.8% and 91.2%. The program, written in Python and implemented as a Chrome extension, utilizes the SciKitLearn model. The Chrome extension uses JSON and Javascript framework, and it accesses the URL link of the article and sends it over to the ML model. Then the ML model retrieves the article's content and determines if the article is biased. The results are then sent back to the Javascript file, which alerts the user if the article is biased. The program is 90 percent accurate. It can be further improved by using the PyTorch model. The program currently tested for English articles will be extended to other languages by acquiring data sets in those languages. To make the program more accessible, I plan on developing a mobile application.
Consumer Science (MCS)

MCS100: Which Moisturizer Will Retain the Most Moisture?
Various brands of moisturizer will be tested to determine which will help to retain the greatest amount of moisture. Gelatin will be prepared in Petri dishes, and a set amount of the moisturizer will be applied to the surface of the gelatin. Mass of the gelatin plate will be taken at the beginning and at the end of the experiment to determine amount of moisture retained/lost.

MCS101: Which Nail Polish Last Longest?
The purpose of this experiment was to understand which nail polish, of these three: Essie, Sally Hansen, and L.A.Colors, lasts the longest. This is important because it can help consumers choose the rite polish. My hypothesis was: the most expensive nail polish, Essie, would last the longest, Sally Hansen, the second most expensive would be next, and L.A Colors last. To test my hypothesis, I painted 5 fake nails for each brand. I then performed the following procedures on each nail: first, I exposed the nail to UV radiation for 2 hours, then soaked it in water for 10 minutes, abraded it with sandpaper 5 times, and lastly, bent it 5 times. Then, I photographed each set of nails, and quantified how they compare to each other. I measured how much chipping occurred by assigning a score by rating each nail 1-5, and then averaging the scores, and recorded the amount in a data table. After comparing scores, the most expensive brand, Essie, lasted the longest with a final score of 5 out of 5. In 2nd place was Sally Hansen, and 3rd was L.A. Colors. Therefore, my hypothesis was correct. These results, while not comprehensive, suggest a proportional relationship between nail polish price and quality.

MCS102: The 3 “Mask”ateers
The purpose of this experiment is to find out which mask, KN95, Old Navy mask, and surgical mask could not blow out a candle. Which mask is most effective out of KN95, Old Navy mask, and surgical mask. Are they all equally effective. The hypothesis of this experiment was that the investigator of the experiment thought that the KN95 mask would be most effective and not blow out the candle. Gather your 3 masks, a stopwatch, a candle, and a lighter. Next, place the candle on a flat surface and ask a parent to light it for you. Then, you want to use your stopwatch to time how long it takes to blow out the candle, how many seconds it takes to blow out the candle, and if it was blown out yes or no. If it doesn't blow it out the investigator would just put 30 seconds. The results the investigator had for this experiment was that all of the masks did not blow out the candle and they were all effective. The investigators hypothesized that only the KN95 mask would blow out the candle. The investigators hypothesis was wrong and that all of the masks did not blow out the candle.

MCS103: I Scream, You Scream, We All Scream for Sunscreen
To help people understand why it’s so important to wear sunscreen and how not wearing it can affect us in many harmful ways. Which sunscreen is the most protective? If the Person doing this experiment adds the right amount of sunscreen and the right amount of Spf it can prevent any further harm from the sun. Get beads and sunscreen ready, put sunscreen on all the beads, measure Uv light rays, leave beads in the sun for 1 hour or until beads look done, check and put data into an organized chart. The hypothesis was supported that the higher Spf of sunscreen used made the uv reactive beads take longer to change color.

MCS104: Be Kind to Your Hair
The purpose of this experiment is to determine which shampoo and conditioning brands work the best on hair, meaning leaving the scalp and hair strands moisturized and healthy. The question is “which hair care brands leave hair the most moisturized”. The hypothesis is if a certain brand of shampoo and conditioner works better than the other brands tested, then that means that that brand has more fatty oils and humectants in it than the others, causing the hair to be more shiny and smooth. The procedure will be to set up a safe, clean environment then to apply the water, and products, then observe and record the data. The results showed that Pantene was the most effective conditioner. It left the hair the most moisturized and it weighed the most. The hypothesis was supported because there was a brand that stood out more than the others and that is exactly what the hypothesis was suggesting.
**MCS105: The Toxicity of Eco-Friendly vs Conventional Laundry Detergent on Earth Worms**

For my science fair project, I tested the toxicity of detergents on earthworms to see if eco-friendly detergents were better than conventional detergents. I hypothesized that conventional detergents would have a more harmful effect on the worms than eco-friendly detergents. I tested this by placing worms in 5 different containers containing a solution of four different detergents. One container was control with only water and soil. I tested two different concentrations. I found that conventional detergents killed all the worms, that one eco-friendly detergent killed just as many, and that only one detergent was less deadly on the worms.

**MCS106: Water Filtration**

Please visit student's exhibit for abstract

**MCS300: Door Stopper**

The question we answered is, “How can we make the classroom doors at Provident Charter School safer using a wooden door latch in case there is an intruder or break in?”. Our hypothesis is that the wooden door latch system we made will be able to close the classroom door from the inside and for the doors to be locked within five seconds. The steps we took to complete this project were that we made and sent a survey asking teachers if their current door latch system works on their doors. Then, we made a wooden Door Latch System using measurements on the classroom school doors. Next, we tested the wooden lock system on one door and remade the latch if needed to fit the door. Finally, we put the lock system on the door and completed five trials with five different teachers to see if the door locks within five seconds from five different places in the classroom. When the door is locked, we tried to open the door to see if the door locks work from the outside. We found that the lock test did stay closed and all the teachers were able to stay under 5 seconds.

**MCS301: Curls Run the World**

The question I answered is, “Do store bought or homemade leave-in conditioners work better for curly hair when leaving braids in for a week?” The goal of this project is to find a product that would keep the braids from being frizzy, provide a shine, and be able to brush through when braiding and getting the braids out. The hypothesis I made was that the homemade leave-in conditioner with avocado, olive oil, and water will prevent the braids from becoming frizzy, provide shine, and be able to brush through when braiding and getting the braids out. The steps I took were I wetted the mannequin head first, then applied shampoo and rinsed the head with water. Then applied conditioner, let it sit for 5 minutes and used a brush to detangle the hair while washing it out. I used a dryer/air dryer while brushing through hair and when I put store leave-in conditioner on one half of the head and put homemade leave-on conditioner on the other half of the hair on the mannequin head. Finally, I braided the hair. The leave hair in braids and bring the mannequin head around to classes for a week and take pictures of hair and take notes. I repeated these steps for the second leave in the conditioner test. I found my hypothesis was correct and the homemade leave-in conditioner with avocado, olive oil, and water did work as well as the store bought conditioner.
Intermediate – Engineering / Robotics (MER), 7th & 8th Grade

Engineering / Robotics (MER)

**MER100: Effects of Liquid Viscosity on Hydraulic Lift**
Hydraulics are a source of mechanical force and control. Hydraulics are commonly used in hydraulic lifts. Liquids are used in hydraulic lifts to send force from the initial pump to the main hydraulic. The purpose of this experiment is to measure effectiveness of Hydraulic lift while using liquids with different viscosity. The experiment setup contains a pump, reservoir, and a large piston which symbolizes the hydraulic. Liquids of different viscosities were used in the tests and the effectiveness of the hydraulic lift measured. A weight of 907 grams was applied to the primary piston/pump that then pushed the weight placed on the secondary piston/hydraulic. The effectiveness of the hydraulic lift was measured in terms of time and weight. These tests conclude that liquids with higher viscosities are more effective than liquids with lower viscosities when used in hydraulic lifts.

**MER101: Which Bridge Design Will Hold the Most Weight?**
Three different bridge designs will be constructed using popsicle sticks. The amount of weight held by each bridge type will then be evaluated.

**MER102: Smart Screening System**
The COVID-19 pandemic has been spreading across the world for two years, causing many facilities to require screening before entering the building. This means that someone must stand at the door and ask screening questions, and must wear expensive protective equipment that may be in shortage. For my project, I made the screening process automatic using a Raspberry Pi. After a temperature check and voice-automated survey, the door will unlock if the user seems healthy. This will reduce the need for special equipment, and will also reduce contact between people, lowering the risk of getting COVID-19.

**MER103: Fly Swatting Robot**
Please visit student's exhibit for abstract

**MER104: Increasing the Strength of 3D Printed Prosthetic Legs**
Nearly 2.1 million people in the US alone are affected by prosthetics in one way or another. 70% of which are affected by BK (below the knee) prosthesis. The price of these prosthetics can be anything from $1,000 to $20,000! Manufacturing of these prosthetics is a tedious and laborious process. Applying principles of 3D printing to this field can yield numerous benefits including a decrease in price, decrease in time and effort to manufacture, more options for customization, and ease of repairs. The goal of this experiment is to increase the strength of 3D printed BK prosthetics via optimization of mass distribution. By determining the best way to use the material, it makes the development in this field with untapped potential much more straightforward. To conduct the experiment, I designed a simple prosthetic model that would be printed using different infill patterns and shell thicknesses but a constant mass (+/-2g) and material. After determining testing groups of infill density and shell thickness that kept the overall estimated mass of the model within +/−2g of 26g, I printed out 6 models for each testing group on an Anycubic Mega X 3D FDM Printer. Then, using a Forney compressional pressure tester, I crushed each of the models recording the pressure at which the model broke. The pressures ranged from 2310psi to 4340psi. Models with high infill percentages and low shell thicknesses broke using less pressure than the models with low infill percentages and high shell thicknesses, rejecting my hypothesis. The models with 2.8mm shells and 20% infill were able to withstand 146psi per gram used in the model compared to the 96psi/g in the model with a 0.4mm shell and 80% infill density. With these results, I concluded that when 3D printing BK prosthetics, it is best to distribute the material towards the outer shell of the part rather than the inner infill of the part.
**MER105: Fall Injury Reduction**
The purpose of my experiment is to find which material can reduce the impact of a fall the best. The inspiration of my experiment is when my grandma fell several times and broke bones, which greatly affected her life. Another inspiration is when I went to the nursing home my mother works for, and collected data for the reason why the patients fall, how many people fall, and how serious were the falls. I conducted my experiment using a load cell sensor, which would calculate the impact force of the fall. The weight is dropped onto the load cell to measure the impact force. For the materials, I kept it at the same thickness and dropped the weight from the same height. For each material, I dropped the weight 10 times. The material that gave the best results and had the smallest impact force, was the foam pad. The foam pad worked the best, because it had the best compression, which lead to the impact distance being maximized. The impact distance is the compression of an object after hitting the ground. Therefore, the higher the impact distance, the lower the impact force will be. The material's compression allows it to absorb the energy when hitting the ground. The foam pad is effective because it can dampen the force of impact.

**MER106: Improving Solar Tracking**
Normally, solar tracking is expensive and high maintenance. I made something simpler while accomplishing the same goal. The device uses a motor that angles a solar panel every hour based on the sun. I was going to test by putting the modified and control panels outside for three days while measuring the wattage of both every hour. However, after much troubleshooting, I wasn't able to test because the days weren't sunny enough, but based on prior knowledge, my device would decrease the amount of maintenance required compared to normal solar tracking, and generate more wattage than an unmodified panel.

**MER107: Does Number of Blades Change Windmill Energy Production**
Have you ever seen a windmill? If you have, then you've probably seen their blades. They almost always have three blades. But have you ever thought why? Why don't windmills have 2 blades? There would be less weight and more energy, right? Well, in my experiment, I intended to find out if 3 blades is the most optimum for energy or is the industry standard not using its full potential. To do so, I experimented with 3 different numbers of blades on the same windmill to find out which generates the most energy (joules) by comparing the average of 3 tests for each number of blades. After running the tests and comparing the averages, I found out that 4 Blades produced more energy than 3 Blades which produced more energy than 2 Blades. These conclusions did not support my hypothesis of 2 Blades producing the most energy.

**MER108: Rockets with Glare**
The reason I am conducting this experiment is to determine whether the change in the amount of liquid added to a rocket bottle will change the height that the rocket will fly. My hypothesis is that if I add more liquid to the bottle, then the rocket will fly higher. The rocket is a very simple device. The top of the bottle has a cone to reduce the amount of air resistance that is acted upon the rocket to make it go higher. The fins of the rocket will control the balance of the rocket. Once the rocket is completely created, then I will make a base for the rocket to use as a stand. This base is meant to keep the rocket still and in place while I place pressure into the rocket. The purpose of the pressure is to force water out of the rocket. Using Bernoulli’s principle, we can see that whenever we shorten the diameter, there will be a pressure buildup. Once I open the cork, the water will push out of the bottle with great force. This will be Newton’s third law. It will push the rocket up into the air. I will record the height of the rocket by observing where the string is marked at the highest point. Lastly, I will record the height of my rocket for data collection. Experimentation is continuing and results will be available on fair day.

**MER109: Remote Rescue Robots - Inexpensive Robotic Hand Platform Controlled by Human Motion**
It is obviously the case that search and rescue missions, emergency response, and remote exploration expeditions are inherently dangerous. Robots have been used for these situations, but their use is not widespread due to the limitations of robots and their control, and the cost of attaining the machines for these purposes. There should be no trade-off between efficiency, accuracy, or cost in using robots to carry out dangerous tasks previously done by people. To fix this problem, I designed a 3D-printed robotic hand and sensing glove to reduce costs and increase intuitive control. The hand will be connected to the glove, which will read the position of a human hand's fingers. The robot then will match the position of the glove. This project will create a robotic hand controlled entirely by the motion of a human hand that is both easy to use and inexpensive to produce. This will allow the user to keep the focus on the task at hand, not the control of the robot, thereby improving outcomes in these situations.
**MER110: How Does the Paddle Design Affect a Waterwheel?**
Please visit student's exhibit for abstract

**MER111: Cardboard Boat Design Using ANSYS**
Please visit student's exhibit for abstract

**MER112: Bicycle Generator**
Mounting a reasonably sized DC (direct current) motor to a pedal bicycle can effectively generate electricity to charge batteries. The electricity is generated when the motor is spun backward due to electromagnetic induction. Electromagnetic induction is the use of magnetic fields to generate voltage. The bicyclist pedals which spins the wheel causing the motor to spin, which generates electricity that travels through a circuit to the batteries. Installing diodes allow the electricity to flow only through one side to charge the battery and to prevent the electricity from powering the motor. This makes them the most important part of the circuit. This modification is very handy for the avid camper and for long biking trips.

**MER113: Plastic Printing**
The purpose of the project is to determine what direction of a 3D model's layers makes the model the strongest. What angle of the layers is the strongest? The hypothesis is that the 0° (laying down) model will be the strongest because there are the least amount of layers and the most surface area for the layers to adhere to each other. The models were printed at different angles then the testing apparatus was built and then the models were tested and the maximum force held were recorded. The 0° (laying down) model was the strongest and the 90° (standing up) was the weakest. The hypothesis was supported that 0° (laying down) was the strongest.

**MER114: The Pluses of Trusses**
This experiment attempts to determine what types of bridge columns are strongest. Does adding additional structure to vertical columns increase their strength? Adding connections that create more triangles should increase the strength of vertical columns independent of the thickness of the individual vertical columns. A variety of column structures were created, then sequentially placed under a common bridge deck structure, and tested with increasing weight until the bridge pillars collapsed. Experimentation showed that the number of triangles created by the pillar structure did not independently affect bridge load limit on its own. Other variables (such as the number of points of contact created by the pillar structure, and especially increasing the number of planes of support) more strongly predicted the load limit compared with simply the number of triangular components in the structure.

**MER115: How Does Temperature Affect the Performance of a Soccer Ball?**
The purpose of this project was to determine if temperature had an effect on the performance of a soccer ball. It was hypothesized that the ball would travel the furthest in the warmest temperature. To perform this experiment, a testing apparatus was constructed that kicks a soccer ball with the same force on every kick. The soccer ball was placed in the testing apparatus, struck by the kicking arm, and the distance that the ball traveled was then measured. The test was performed in temperatures at 22.2 degrees, 5.6 degrees and -13.3 degrees Celsius. Final results available at fair.

**MER116: Which foundation can survive an earthquake the best?**
My question is which foundation can survive an earthquake the best? Slab foundation is one of the most popular foundations in the world for its wide open budget options. Crawl space foundation is known for its open space for plumbing, electrical wiring, and heating and cooling. Monolithic slab foundation is known for its low price and its fast time to build the foundation. My hypothesis is that a concrete slab foundation will withstand the shaking on a shaking table the longest without coming apart because out of all the foundations that will be tested it has more bottom layers that allow movement of the foundation without collapsing. Materials to build all three foundations were collected and each plastic bin was filled with the individual foundation materials. They were then placed on a shake table to recreate a mini earthquake. The data tells me that the Slab Foundation survived the longest with exactly 37.03 seconds. My hypothesis was found to be correct.
**MER117: Self refilling litter box**
The problem is that it’s very annoying to fill up your cat’s litter to the perfect level consistently. The tub was marked daily to track the amount of litter used after cleaning each day and checked that the litter was still flowing through the tube. On average the cat used about 0.89 cm of litter from the tub each day and it could continue to work for an additional week. The design could have been made even better if a larger funnel was used so that it would be easier for more litter to flow. The results did support the hypothesis and address the engineering question, which means that it made it much more convenient and worked well having litter flow through the tube to the litter box.

**MER118: Do Not Kill the Mouse**
The question trying to answer is, “How to trap a mouse in a humane way, in a time and cost efficient manner.” To try and solve this problem, a trap was constructed that can successfully trap mice, without killing or injuring them. A trap was placed in an area prone to mice and was checked frequently until a mouse was discovered. Once a mouse was found, the mouse was able to be released into its natural habitat. Two mice were caught over two different experimental trials. The mice were unharmed and were reintroduced to their original environment without problem. The trap met the criteria, as it was inexpensive to make and successfully caught two mice in under two days. Therefore, the trap is extremely effective as two different mice were caught in a short period of time and the trap was not costly.

**MER119: Cooling Made Cooler**
In this experiment, the goal was to create a leg-cooling device for a laptop. It can be uncomfortable when a laptop gets too hot to rest on your legs. This issue was the main reason why the experimenter thought to come up with this device. Is there something that could cool off your legs when your laptop is too hot? There were plenty of materials that went into making a solution to this problem. A simple, but effective device will be created that will have fans blow directly on the laptop user's legs. Laptop heat is caused by either the laptop's optical drive, the battery, or the ventilation fan. This device will prevent heat transmission, which can be harmful if it gets too intense.

**MER120: The Hypothermia Hiker**
While hiking hikers can be exposed to very cold temperatures that can cause hypothermia. The purpose of this experiment was to create a heated boot meant for these hikers in these conditions. A test to measure the performance of the boot was done. It was hypothesized that the higher the heat setting the hotter it would be inside the boot compared to no heat. To test this hypothesis an apple was placed in the boot at the 4 different heat settings. After the test began the apple’s temperature was recorded every 5 minutes for 20 minutes. After testing and comparing the results, the data showed that when the setting in the heating element was increased the boot temperature increased. The apples temperature was greater with it on then with no heat at all and the temperature was greatly increased. The experimenter can conclude that the heating element did a good job inside the boot at producing heat and making the boot warmer than it would otherwise be. Therefore the experiment can be deemed a success.
Earth and Environment (MEE)

**MEE100: How pH Affects Grass Growth**
Driving by different neighborhoods everyday, I'm sure you've noticed the differences in lawns, whether it's the color of the grass, or the height of the grass. My experiment provides a look at how the pH of soil affects the grass, and what pH level would provide the best base for grass to grow. First, I gathered soil and measured their pH. Then, I separated the soil into three parts, and used vinegar and chelated calcium to mix in the soil. I ended up with one acidic, which had a pH of 3, one alkaline, which had a pH of 10, and one neutral, which had a pH of 7. I put the soils into 18 small plastic cups, with 6 of each kind of pH level. I waited 3 weeks, watered the grass every 3-4 days, and measured the grass height, in centimeters, every week. After 3 weeks, I saw that the neutral grass had grown the tallest, and the most seeds sprouted. I made a data table, with the average heights of each soil type, which were 22 for acidic, 25 for neutral, and 21 for alkaline. I was able to clearly see my results, and the differences in the grass types. My experiment had supported my hypothesis, that out of the pH levels of 3, 7, and 10, the best pH level for grass to grow is 7.

**MEE101: The Effect of Insecticides on Plants**
It is estimated that over 1 billion pounds of various pesticides are used in the United States yearly, and more than 5 times that much worldwide. Anywhere between 2% and 25% is lost during application. The purpose of my experiment was to see how insecticides affect non target plants. To do that I planted radish seeds in 20 soil filled pots. After I let them grow for a week I applied the insecticides, 5 pots for each Sevin, Organocide, Malothion, and control, which was not treated. I measured the height of each plant twice during my experiment, once two weeks after planting and once four weeks after planting. At the end of my experiment the plants treated with Sevin had the greatest growth average and the least plants had died. This did not support my hypothesis that Organocide would effect the plants the least.

**MEE102: Aquatic Plants: Not Just a Decoration**
When people first started using the atrazine pesticide, they thought it just got rid of the weeds and left the rest of the environment alone, so it helped everyone. However, that is not true. Scientists have found out that the pesticide can runoff into water polluting it. Then, animals and humans use and drink that water, making themselves sick. To conclude, I would like to experiment whether two aquatic plants, the Common Cattail and Feathery Mare's Tail, help remove the atrazine in the water.

**MEE103: Harnessing the power of wind turbines-continuation**
My continuation project on wind turbines will show how different sized blades effect energy production. I will take multiple turbine blades to put on my turbine to measure which one produces more energy off of the side of the highway with a voltmeter.

**MEE104: Cheers!**
The purpose of my experiment is to raise attention towards the amount of chemicals in regular water sources. I became interested in the topic when I began to think about how much safer bottled water must be compared to other sources. I tested five different water sources for PH, Iron Bacteria, Nitrates, Nitrites, Total Chlorine, and Hardness using H20Ok water testing kit. Additionally, I made a homemade water filter using activated carbon in order to compare against the store bought one. Based on my data, I came to a conclusion that the filtered tap water was the most pure of the 5 sources.

**MEE105: Cost Effective Carbon Capture System**
For my science project I will be creating a carbon capture system that can remove carbon and moisture from the surrounding environment quickly and efficiently, as a tree does for our planet. I have always wondered what I can do to help the growing environmental crisis as a kid without much budget and time. This led me to look into environmental science, and eventually the up-and-coming field of Carbon-Capture, Utilization, and Storage, (CCUS) a way to remove the harmful byproducts of everyday life. Without all this unnecessary waste in our biosphere, humanity and earth would thrive in ways we could never imagine. My process of testing will include creating a prototype, testing the prototype, and giving it a score based on multiple criteria including but not limited to: Carbon removal, Moisture removal, Safety, temperature displacement, and speed. I will then make slight modifications to the prototype, and score the changes accordingly. Once I have a substantial pool of data I will apply all of the changes that improved the score into a more powerful, final version of the system.
**MEE106: Keeping Cool with Insulation**
Because of global warming, keeping things cool will become progressively more difficult. Insulation is a great way to keep small and large items cool without using power for a refrigerator or something similar. My experiment tests what the best insulator is to keep the temperature constant in a small glass container. In order to properly test this, I needed to first place a glass container covered with a material that could serve as a decent insulator on a hot plate, and then place an ice cube in it. I would then turn on the hot plate and time how long it would take for the ice cube to fully melt. Experimentation is continuing and results will be ready and presented on fair day.

**MEE107: Rain, Rain, Go Away**
Motivation: I've always been interested in geology and the effects of pollution on the environment, so I often read articles on pollution. After reading a recent article on acid rain and how it has eroded away the writing on the headstones at a local cemetery, I decided to design a test to determine if this information was hype on the part of the media or as serious as represented. Problem: To determine if acid rain affects limestone and if it does how much. Methodology: 210 limestone chips were massed prior to being separated into groups of 30 and placed in labeled cups containing 100 mL of acid rain with a pH ranging from 1 through 7 for 7 days before being removed and allowed to air dry for 24 hours before being returned to a new solution of acid rainwater. This occurred every week for 4 weeks. Results: The results were then averaged, and the percent reduction was calculated. To calculate the percent reduction, I took the average mass after experimentation and subtracted it from the average mass prior to experimentation. This difference was then divided by the average mass before experimentation. This quotient was then multiplied by 100 to determine the percent reduction. As the pH level decreased the amount of mass in the limestone chip also decreased. For example, the pH of 1 lost more mass than the pH of 7. So, the results of my test explain that the more acidic the rain is the more damage it does. Implications: One of the main reasons that this project is important is educating the population about the harmful effect of pollution on the environment. It is important to make changes concerning our use of fossil fuels so that we don't lose priceless statues and architecture, such as the Great Pyramids of Giza because of weathering.

**MEE108: The Effects of pH on the Hatching Rate of Brine Shrimp**
Motivation: After reading an article about how pH can affect the toxicity and heavy metals in the water, I wondered how this would affect how brine shrimp hatch and survive. Problem: To determine what pH brine shrimp hatch the best in Methodology: I counted brine shrimp eggs and added them to 210 sterile petri dishes. 10 mL of water with a pH of 4, 5, 6, 7, 8, 9, 10 were added to 30 individual plates. The petri dishes were placed below grow lights for 48 hours before being counted and recorded. Results: It appears that brine shrimp were able to hatch in the various pH ranges used in this project. However, brine shrimp prefer a solution with a pH of 8. This was an alkaline solution. There as an average of 13 out of 15 shrimp that hatched. Implications: Knowing what pH brine shrimp hatch best at is important because they play an important role in providing nutrients for birds as they prepare nests and prepare to migrate. If they didn't have this source of nutrients, birds would have to find a new source of food that might not be constantly available to them.

**MEE109: Lettuce Grow**
Motivation- Tradition in soil farming is creating problems in the environment such as the use of excess water. The main concern, however, is toxic runoff from fertilizers into lakes and streams. Problem Statement- The purpose of this project is to determine whether hydroponics will work better than soil to grow lettuce. Methodology- Lettuce was planted into both growing mediums and grown for a four-week period of time. Then they were measured, and later bio massed to find the results. Results- Hydroponics made the lettuce grow better height wise, and soil made them have more mass. Implications- This information is useful because it shows that hydroponics does have advantages over in soil farming. This is important because using hydroponics could help the world's food problem.
MEE110: How pH Affects Clam Shells?
Motivation- I became interested in this topic because of my fascination with seashells as well as the environment. I wanted to determine if acidity as well as alkalinity affected clam shells, and so I decided to design a test. Clams are an important part of our ecosystem. They rotate nutrients, filter feed: which purifies water, and trap carbon from the atmosphere. Clam shells are made of calcium carbonate, the clam makes a shell through its mantle, or the tissue that bonds to the inside of the clam's shell. The mantle uses minerals and proteins to create the shell. pH levels can have a great effect on clam shells. As ocean waters steadily become more acidic the shells can become slimmer or smaller in size making the clams more vulnerable. Problem Statement- The purpose of this project is to determine the effect of various pH levels on clam shells. Methodology- The clams were massed before tests were done and separated into groups of 30 for each of the 7 pH ranges. The clams were then allowed to sit in the solutions for 7 days and taken out, allowed to air dry for 24 hours before being massed. This procedure was repeated for 6 weeks. Results- Results were averaged and then the percent change was calculated. The average mass of the clam shells increased as the pH levels increased, beginning with a pH of 6 and culminating with a pH of 9. While those in the pH of 4 and 5 declined. Surprisingly, the shells in a pH of 5 lost almost twice as much mass as those in the lower pH of 4. A T-test was run to determine the confidence level of my results being able to be replicated. A confidence level less than 95% would be classified as non-significant. This means that the outcome of the test was by chance and cannot be replicated. This is shown in the results for a pH of 5. A confidence level of 99.9%, means that the results of my test can be replicated. This applied to the pH of 4, 7, 8 and 9, while a pH of 6 shows a confidence level of 99.9% which also means that these results can be replicated. Implications- Knowing how pH levels affect the clams can make us more aware of how the pH of the ocean water is changing due to ocean acidification and allow us the opportunity to do something to prevent the loss of this precious resource.

MEE111: GREENHOUSE EFFECT
Purpose: In recent years the climate crisis has become one of the most important challenges facing Earth and all of Earth's inhabitants. Understanding how the greenhouse effect works is a fundamental lesson we need to be teaching everyone. But through education and changing our practices and lifestyles, there are things we can all do to make a difference and protect our planet. Greenhouse effect is the trapping of the sun's warmth in a planet's lower atmosphere, due to the greater transparency of the atmosphere to visible radiation from the sun than to infrared radiation emitted from the planet's surface. Data and Conclusion: Will be shared on Fair Day.

MEE112: Which renewable energy source wastes the least amount of energy?
The question was: What renewable energy source wastes the least amount of energy. The research has found that all three renewable energy resources (Wind Turbine, Water Turbine, and Solar Panel) have drawbacks that might contribute to climate change. Water Turbines produce currents and might destabilize the ecosystem, Wind Turbines create noise pollution and create a lot of turbulence, and the Solar Panels create heat and also give off heavy metals if broken. The hypothesis is if I measure the amount of electric voltage versus temperature in Celsius produced from a Solar Panel, a Wind Turbine, and a Water Turbine, then a Solar Panel would be the most efficient, because there are barely any moving parts, so it would create little heat. In conclusion, the hypothesis was incorrect as the Solar Panel is the least efficient as it produces 1.44 volts per 32.99 degrees Celsius. The Wind Turbine was in the middle at 1.44 volts per 22.67 degrees Celsius, and the Water Turbine was the most efficient with 6.85 volts per 12.31 degrees Celsius.

MEE300: How Land Use Affects Water Quality
How Land Use Affects Water Quality: Lakes and creeks are becoming more polluted by the environments surrounding them. Our experiment provides us with information about differing pollutants caused by a multitude of environments. To do this, we collected water samples from different bodies of water. We tested for the pH value of the water and the amount of nitrates in the water. Then, we took note of the surrounding environment, and used this information to analyze the results. Creeks and lakes around more rural areas were less acidic, proving our hypothesis that urban areas would have more acidic water.
MMH100: Factors Influencing Retinal Fatigue in Adolescents
In a modern world full of flashing lights and bright colors, eye fatigue is becoming more and more common in our society. Digital eyestrain, a condition caused by looking at a screen emitting blue light, is commonly in the news since the COVID-19 pandemic sent many everyday activities online. Another specific type of eye fatigue is called retinal fatigue. Retinal fatigue is created when you stare at one specific color long enough that you see an afterimage of the complementary color in the air. The afterimage occurs because the cones in your retina become tired from staring at one color for an extended period of time. In my experiment, I investigated what factors affect retinal fatigue in preteens and young adolescents. I randomly assigned participants to one of the following three groups: rest their eyes, read an article on a computer to create digital eyestrain, or read an article on a computer with blue light glasses. Each of these activities was performed for two minutes. Then, I had them complete a retinal fatigue test and timed how long they saw the afterimage. My results showed that that digital eyestrain significantly increased retinal fatigue relative to the control condition where they rested their eyes. My results also suggest that using blue light glasses partially reduces the effect of digital eyestrain, but more research is needed.

MMH101: Protecting Against UV: Which material is best?
For my science fair project, I tested a variety of different materials to compare how they protect UV reactive beads against UV radiation. My hypothesis is if I use sunglasses, different pieces of clothing, and sunscreen to test the effect of UV radiation. Then the sunscreen will work the best because it is proven that it lowers the risk of skin cancer and other health issues. I tested that by making an assortment of bracelets with the UV reactive beads and placing them outside in the sun for periods of time. I would check methodically how well the beads were protected with the materials. I found that UPF clothing and a tight Black T shirt protect the best.

MMH102: Bye Bye Bacteria!
Bathrooms are generally filled with bacteria and can produce various sicknesses. I will be testing which cleaning product, of a selected 5, is the most effective in killing bacteria in bathrooms. The 5 products are water and soap, an antibacterial wipe, an antibacterial spray, and vinegar. I will be swabbing one area of a commonly and frequently used restroom after one of the 5 products has been used on the surface. I will swipe the cotton tipped wood applicator over the surface ten times, then I will take the applicator and swipe it in the agar-lined petri dish 10 times. Results are still being calculated.

MMH103: Mask Effectiveness: Seal or No Seal
COVID-19 has impacted many lives. This highly infectious virus has been known to transmit through aerosol particles found in the air. Gradually, masks have been considered as an essential protection against COVID-19. Some masks may leave spaces between a mask and the face due to improper fitting. How do these gaps when wearing a mask affect a subject's exposure to COVID-19? I hypothesize that the gaps between the mask and face will increase COVID-19 exposure. To investigate this, I designed an experiment using an aerosol generator I used when I was a kid, paper towels, and food dye. By folding the paper towels into a pocket, and controlling the size of the pocket opening, I was able to model a person wearing a mask. I directed the aerosols made of blue dye onto a mask with a 0 mm gap, 2 mm gap, and 4 mm gap. I used an iPad to record the experimental process and end results. Each scenario was tested twice. I found that as the gap size increased, so did the intensity and area of the food dye stain on the inside of the paper towel model. This meant more leaked aerosols (representing virus particles) found their way inside the pocket/mask. In conclusion, gaps between a subject and their mask will indeed increase their risk of COVID-19 exposure.
**MMH104: The Role of Gut Bacterial Metabolome in Colorectal Tumourigenesis**

Colorectal cancer (CRC) is one of the most common cancers, affecting more than five million people worldwide. Accumulating evidence suggests that gut bacteria are closely associated with CRC and bacterial metabolites play key roles in human health and disease. I hypothesize that gut bacterial metabolites are important for CRC generation and changes to levels of certain bacterial metabolites may have an effect on CRC tumorigenesis. To test this hypothesis, I prepared bacterial supernatants from four bacterial strains (Staphylococcus Epidermidis (SE), Fusobacterium Nucleatum (FB), Escherichia Coli (EC) and Staphylococcus Aureus (SA)) and examined the effects of these bacterial supernatants on viability of COLO205 cells (a CRC cell line). I also performed liquid chromatography-mass spectrometry-based metabolomics experiments to determine the levels of different metabolites in these supernatants. Bacterial supernatants prepared from EC and FB were found to inhibit COLO205 cell growth significantly. In addition, we found that the level of ciliatine, a prototype phosphonate, was significantly increased in both supernatants prepared from EC and FB, suggesting a key role of ciliatine in inhibiting COLO205 cell growth as well as CRC tumorigenesis. In future research, we will test 12 more bacterial strains which were reported to associated with CRC. We will also investigate the role of ciliatine as well as other phosphonates in colorectal cell growth and colorectal tumorigenesis using cultured COLO205 cells and CRC mouse models.

**MMH105: The use of surface electromyography to monitor Tourette motor tics**

Tourette Syndrome (TS) is a neurological disorder that causes people to have involuntary vocal and motor tics. Tics naturally increase and decrease over days, weeks, and months, so it is difficult to measure the overall severity of symptoms in people with TS. Because of this, it is hard for doctors to learn whether treatments are effective in controlling tics. To solve this problem, I used a Myoware Electromyogram (EMG) and an Arduino microcontroller to develop a device that measures the electrical activity that occurs in a muscle during a motor tic. The device converts the readings into numerical data and graphs, allowing tics to be counted over time. Since I have TS, I was able to test the device on myself and found that it successfully measured the electrical activity during a motor tic and plotted the activity on a graph. This device could assist doctors in treating Tourette Syndrome, as well as help progress research involving motor tics.

**MMH106: Exploring the effects of face masks on oxygen levels**

Exploring the effects of face masks on oxygen levels: The Covid-19 pandemic has forced many people to wear masks. My experiment aims to determine whether face coverings reduce oxygen intake, and if there was a difference in the effect face coverings had on children versus adults. I used a pulse oximeter to measure the oxygen level of study subjects at rest for five minutes while wearing either no mask, a FLTR mask, or a cloth mask. After testing nine subjects so far, no significant drop in oxygen levels while wearing masks has been observed. Additional subjects will be tested.

**MMH107: The Impact of Alcohol Concentration in Hand Sanitizer**

For my science fair, I tested different alcohol percentages in hand sanitizer to see which was most effective when killing bacteria. My hypothesis is that I predict that the hand sanitizer with the highest alcohol percentage will kill the greatest amount of the germ. I tested this by having three different percentages where I swabbed my hands before using the sanitizer and after. I then grew the bacteria and observed it over a week to see which one was the most effective when killing the bacteria. I concluded that the hand sanitizer with the highest alcohol percentage did, in fact, kill the most bacteria.
**MMH108: Preventative Preservatives?**

Motivation This project was important because it helped to determine what type of preservative (sodium benzoate and potassium sorbate) is better at inhibiting what type of bacteria (Bacillus cereus and Escherichia coli).

Problem Statement I believe that sodium benzoate will be able to inhibit Bacillus cereus but fail to inhibit Escherichia coli due to Escherichia coli being a gram-negative bacterium. For the same reason, I believe potassium sorbate will be able to inhibit Escherichia coli, but since Bacillus cereus is a gram-positive bacterium, potassium sorbate will have trouble inhibiting it. Methodology I used a hole punch to create paper disks. The paper disks were then placed in foil that was placed in a toaster oven set at 177 degrees for an hour. A magnetic stirrer set at 500 rotations per minute was used to mix sodium benzoate with Selene for 20 minutes until it was well dissolved. A sharpie marker was used to divide a sterile petri plate containing nutrient agar into 4 quadrants. Each quadrant was labeled for identification using the day of the week, what type of preservative was being used, what type of bacteria was being used, and whether it was a control. I then took a nichrome wire loop and sterilized it for a minute in a flame. I removed it from the flame and allowed it to cool for 30 seconds. Then I inserted it into the tube of Bacillus cereus and streaked it across the agar plate in a back-and-forth and side-to-side motion to ensure that there was ample coverage. Using sterile forceps, a sterile paper disk was placed in a sterile beaker containing 10mL of sodium benzoate for 1 minute before removing it and allowing it to drip for 30 seconds. After it was done dripping, I put the disk onto one of the quadrants that contained Bacillus cereus and repeated this for the other three quadrants. I then taped the petri dish shut, inverted it to prevent condensation and put it into the incubator set at 37 degrees Celsius for 48 hours. I repeated these actions 7 more times until I had 32 total samples of sodium benzoate against Bacillus cereus. This procedure was repeated for sodium benzoate against Escherichia coli, potassium sorbate against Bacillus cereus, potassium sorbate against Escherichia coli, and all the controls in my project which was an absence of preservative. For a total of 256 samples.

Results - Sodium benzoate was able to inhibit both types of bacteria, but there was certainly a difference in how much it inhibited the growth of Bacillus cereus compared to Escherichia coli. Just like sodium benzoate, potassium sorbate was able to inhibit both types of bacteria, but there was a major difference in how much it inhibited the growth of Escherichia coli against Bacillus cereus. Implications - This is an important issue because I wanted to find out if preservatives actually inhibit bacteria or are we just putting our health at risk since some preservatives may cause hypersensitivity, allergy, asthma, hyperactivity, neurological damage or cancer.

**MMH109: Correlating the Effects of Nighttime Noise Pollution on Memory and Sleep**

Noise pollution is increasingly common. Irregular noise can harm sleep, but white/rhythmic noise can stabilize it. Sleep duration and consistency can affect memory. My hypothesis was that higher nighttime noise pollution causes worse sleep and memory. In my study, I wanted to figure out how nighttime noise pollution correlates with sleep duration and the short-term memory of individuals. I pulled data from a publicly available and anonymized data set called UK Biobank, a set that surveyed people in the United Kingdom. I compared adults (of the same gender and age) experiencing lower noise pollution had more varied sleep duration, in comparison to the high noise pollution group, which had more consistent sleep times. However, they had the same mean. For the memory test, people with low noise pollution received a wider range of scores versus high noise pollution, which had a narrower range but a higher mean. This proves that my original hypothesis was wrong because high noise pollution was associated with better memory and consistent but not more sleep. This suggests that the noise pollution may have been more like white noise, which stabilizes sleep and memory.

**MMH110: Is it possible to slow down the spread of diseases?**

Can you slow viruses down? Virus-caused pandemics such as COVID-19 are serious global health challenges. The current solution of vaccination (by injecting a dead or weakened part of the original virus, so the body can create antibodies) is useful, but takes a while. However, a research team developed a new strategy to slow down virus infection by introducing fake viruses that compete with real viruses for replication. In this project, I used a computer to generate a lot of dice to simulate the competition process. Let R represent a real virus and F represent a fake virus (which is harmless). When the R virus enters, they attack a cell to create a duplicating factory. They have RNA to tell the factory what to do. However, with the introduction of the F virus, the factory has the possibility to take the F virus's RNA, thereby duplicating the F virus. The F viruses then continue to do this to all the infected cells, slowly removing the R viruses. I created the number of duplicates each virus can produce in a cycle, and then calculated the number of duplicated viruses for each type (through dice). I learned, through the data, that the more the F virus can duplicate than the R virus, the fewer average of the R virus present in the body, supporting my hypothesis.
Intermediate – Physics and Astronomy (MPA), 7th & 8th Grade

Physics and Astronomy (MPA)

MPA100: How Does Color Affect Heating by Absorption of Light?

Problem: Which construction paper color out of red, orange, yellow, green, blue, purple, white, and black will absorb the most light produced by a 250 watt heat lamp for 30 minutes, and what will be the difference between the starting temperature and ending temperature be? Hypothesis: If the 250 watt heat lamp shines on each glass 0.9 cubic decimeter jar for 30 minutes at a distance of 15 centimeters each, then out of all the colors (red, orange, yellow, green, blue, purple, white, and black), the color black will absorb the most heat and the difference in starting temperature and ending temperature will be more than -12 degrees Celsius. The researcher also hypothesizes that the color purple will absorb the second-most amount of light, followed by blue, then green, then yellow, then orange, then red, and finally white. Materials: 8 identical glass jars, 0.9 cubic decimeter (Must have at least 1 lid to drill a hole into) 8 sheets of colored construction paper, 1 for each color (I'm using red, orange, yellow, green, blue, violet, white, and black Crayola construction paper) Scissors Tape A partial immersion thermometer (I used a Thermapen MK4) Modeling clay (I used Cra-Z-Art) Heat Lamp (250 watts) Timer A small drill Water

Procedure: Drill a hole slightly larger than the diameter of your thermometer in the lid of one jar. (In this project you'll be testing the jars one at a time, so you can use the same lid with each jar.) Make sure to use gloves and other safety equipment to avoid injury. Tightly wrap each jar with a different color of construction paper and secure the paper with tape. Carefully fill each jar with water. Keep the construction paper dry. You need to have the same starting temperature for each jar. The easiest way to do this is to have all of the jars at room temperature. Fill them with water that is about the same temperature the day before you want to start your experiment. Cover the jars and leave them to equilibrate to room temperature overnight. Cover the jar to be tested with the lid with the drilled hole. Put the thermometer in through the hole so that its bulb is completely immersed in the water. Use the clay to seal the hole and hold the thermometer in place. The rest of the thermometer will be out of the jar, and you should still be able to take readings with it. Keep the thermometer at the same height with respect to the jar lid for all of the tests. Note the starting temperature for each jar. Next, set up your heat lamp in a convenient location, so that it can shine directly at the side of a jar placed 15 cm away. Set the jar to be tested at the correct distance, centered in front of the heat lamp/infrared lamp. Leave the jar in front of the lamp for 30 minutes, and check the temperature of the jar when that time has elapsed. Be sure to use the same time interval for each jar. Repeat until all of the jars have been tested. You should do at least three separate trials for each color, with each trial starting with water at room temperature. (It may take more than one day to do your measurements, so plan ahead!) Analyze your results. What was the average increase in temperature for each color? Make a bar graph to show your results, ordering the colors from lowest to highest temperature increase. How does the arrangement of the colors in your bar graph compare to the spectrum of incandescent light?

MPA101: What is the best gear for the highest ratio of speed on a bike

Hypothesis: If the researcher bikes a half mile circuit with different gears, the researcher hypothesizes that the 3rd lowest gear will be the gear that sets the highest ratio of speed. Directions: Go to local track with trek multigear road bike. Start stopwatch then record results. Materials: Multi Gear Trek Road bike, helmet, stopwatch, notebook, friend or parent to start/stop stopwatch, bike speedometer
**MPA102: Basketball Shot Arc**

Problem Statement: What is the effect of basketball shooting percentage based on the arc of the ball? Does more or less arc improve shooting percentages? Hypothesis: If the researcher shoots 75 shots from the foul line then it is hypothesized that the researcher will make more shots with around 57 degrees arc. An average player who shoots with an optimal arc of 45 degrees (give or take two degrees) is going to make around 11% more free throws than a player with a higher arc of 53 degrees. The same is true going the other way. That same average 45-degree player makes 12% more free throws than a falter arc 35-degree player. Depending on player height, an arc trajectory of between 49 and 52 degrees is your best bet for making the shot each time. Assuming you're shooting from near the three point line. If you're closer to the hoop, increase the angle of your shot. This will ensure the ball is moving at its slowest pace possible when it either goes through the net or hits the rim. James Harden is 6'5'', shooting with a 49.6 degree launch angle, which is pretty much perfect for his height to get the slowest moving basketball at the rim. The basketball was released at a height of eight feet, which is a bit high for a player with a height (6'8). Typical release height for a free throw is 1 foot above the top of the shooter's head. The release angle of 54.0 degrees and velocity of 23.3 ft/s is fairly typical for a 6'8 player (53.9 degrees) When shooting a 2-foot shot, you only need a launch speed of approximately 10 miles per hour. For a 3-point shot you need a launch speed of approximately 18 miles per hour. More force (speed) is necessary for longer shots to get the ball to the basket. Materials: Basketball Hoop, Basketball, Tripod, iPhone for video, Shooting Arc Tracker, Microsoft Laptop, Father to help get data Procedure: Be sure to record and get the data for each shot. Start at free throw line. Shoot around 75 shots all on video tape. When finished, go through and look at every shot. Regardless of whether the shot went in or not, mark the arc angle and if it was a make or a miss for each. Lastly, calculate what the best arc is to make the most free throws possible.

Questions: 6. The idea was found on a website when looking for sports related science projects.

**MPA103: The Strength of Electromagnets**

Problem Statement: What is the best construction for an electromagnet? Hypothesis: If the researcher puts more coils, then the electromagnet will get stronger in strength. If the core of the electromagnet is metal it will get stronger in strength, than an electromagnet with a wooden core. Electromagnets simply coils wrapped around a piece of metal which can attract metal. Materials: 6 volt battery with jumper cables, metal wire, 5 screws, and paper clips.

Procedure: 1. Take the 5 screws and put different amounts of coils in each screw. 2. Then take the 6 volt battery and connect the jumper cables to the battery, red to positive, black to negative. 3. Finally leave a little piece of coil out to connect the jumper cables. 4. Now get a bowl of paper clips and see how many paper clips each electromagnet can pick up. The weight of the paper clips will determine the strength of the electromagnetic field. Why did I pick this project? This project was chosen because I am interested in electromagnetism. I would like to know how much stronger an electromagnet will become with each additional coil. What Factors affect the strength of an electromagnet

**MPA104: Put It in the Basket**

Does Crossed Hand/Eye Dominance Affect Basketball Shooting Accuracy? Hypothesis: If subjects between fifth through eighth grade shoot three free throws each, then the subjects with crossed hand/eye dominance will make more shots than subjects without cross dominance or subjects with mixed dominance. Materials: Subjects, permission slips, 28.5 basketballs, 29.5 basketballs, a small cone, a 10 foot basketball hoop, and our school's basketball court. 5. Directions: Step 1: I will pass out the permission slips to students in grades fifth through eighth. Anyone who hands them back to me signed by a parent or guardian will be a participant in my experiment. Step 2: Getting groups of five subjects at a time, take them to the school gym and first test which eye is their dominant eye. Once that is finished I will have each participant shoot three free throws. Repeat this process until all subjects are tested three times. Step 3: I will then collect and analyze the data and compare the results to the hypothesis. 6. I got this experiment idea from www.sciencebuddies.org because I wanted to do an interesting experiment about something that I loved and that I would enjoy doing. That something is basketball. I also thought that this experiment would be interesting and exciting for my participants.

**MPA105: The Effect of Turbulence on the Trajectory of a Knuckleball Kick**

The purpose of my project is to determine if differences in the exterior stitching patterns of soccer balls have an effect on the way they fly. Specifically, I want to determine if less stitches create more trajectorial deviation. I will do this by testing soccer knuckleball kicks and recording the maximum deviations. My hypothesis is that less stitches/grooves will create more deviation in the flight path. My procedure is to have 4 athletes kick 5 different soccer balls in knuckleball shots 3 times each and record the maximum deviations. Results are still being calculated.
MPA106: Drill Bit Friction
This experiment will determine what material of drill bit stays the coolest after being drilled into a piece of wood. First get a titanium drill bit, Colbalt drill bit and a black oxide drill bit. Second, charge a drill to its maximum amount of charge. Third place one drill bit into the drill. Fourth take the temperature of the drill bit and record it on a piece of paper. Fifth drill the bit fully into the wood and take it out. Sixth take the after temperature of the bit. Seventh record the after temperature of the bit on a piece of paper. Lastly repeat all the steps for all drill bits. In conclusion the cobalt bit conducted the least amount of heat with an average of 7°F but is also had the steadiest increase of heat. Titanium or high-speed steel (HSS) conducted the second most amount of heat with an average of 10°F because it holds heat. Black oxide has a high conductivity because of this it rises the highest temperature with an average of 13°F. This average was 3°F higher than titanium's average and 7°F higher than Colbalt's average

MPA107: The Aerodynamics of Shapes
The purpose of this project was to determine which shape would be more aerodynamic. Lift is a force that pulls and pushes things up like a wing on a plane, the shape of the wing allows the air to pull the plane in the air. Weight is the gravitational pull of something that has mass and density. Drag is something that has friction on the ground or even in the air, like a plane wing or cars. This experiment will teach and show others how the different shapes effect the drag of the object. The hypothesis is If two shapes of wood are exposed to fog in a chamber, then the triangle shape will be more aerodynamic. The two shapes were put into a chamber. A fog machine was attached to the chamber with tubing. Fog entered the chamber and was timed to see how fast the fog traveled around the shapes. The triangle was more aerodynamic than the block of wood because the triangle had less surface area in the front of the shape while wood had more surface area.

MPA108: Radiation Generation
The purpose for this project is to see what household appliances emit electromagnetic frequencies, and what ways EMF can be blocked or prevented from touching the human body. The question is: What are the best ways/materials to use to block household EMF emissions? The hypothesis is that common materials like wood block EMF very well. The procedure goes as follows: Measure every device without any blocking, then every device with every material. Measure every device without any blocking, then get further away while still measuring. The result of this project was that EMF can be blocked by some common materials but not very many, and that distance works well for Magnetic EMF but not as well for RF. The hypothesis was not supported by the data.

MPA109: Need for Speed
Abstract The purpose of this project is to see how far and fast a baseball rolls on different fields. The scientist conducted his research by rolling a baseball with a ramp that the scientist and the scientist's grandfather built, on three different fields, dirt, wet dirt and turf baseball fields. The scientist learned that a baseball rolls the fastest and farthest on a dirt baseball field. The scientist also learned how important it is to rake a baseball field before play.

MPA110: Feel the Need, the Need for Electro-Magnetic Speed
The purpose of this experiment is to test the voltage of an electromagnetic motor. The question the experimenter answered is, how does changing the voltage affect the speed of an electric-magnetic motor? The experimenter's hypothesis beginning this experiment was, the higher the voltage is, the faster the motor will spin. A current will flow through a coil of wire, causing a magnetic field to form around it. By putting a magnet under the coil, the magnet should manipulate the field and cause the coil to spin. With numerous attempts, the coil slowed down when the resistors were added to the circuit. My hypothesis proved to be correct, because when a resistor was not in the circuit, the coil spun the fastest.
**MPA111: Parachute Properties**
The objective of this experiment is to determine which material will make the best parachute and will have the most wind resistance. The scientist is testing to determine which material will take the most time to fall from a landing to reach the ground. Whichever material is the lightest will have the most resistance resulting in the greatest amount of time. The first step is to cut out the material, weigh it, and record the weight of each fabric in the data table. Next, punch holes in each of the four corners of each piece of fabric and attach string to the corners. Then drop the toy figure from the dropping point, record in the data table, and then attach the string to the action figure. Perform three trials and drop the parachute from the designated height. Fleece had the least amount of wind resistance with the fastest time. Silk was next, and nylon had the most amount of wind resistance with the slowest time. That makes it the best material for parachuting. The scientist's hypothesis was correct because nylon is the best material for manufacturing parachutes and is also the lightest. Nylon had the least amount of gravity to counteract the upward force of the air.

**MPA112: Speed Racers: Mastering the Pinewood Derby**
The purpose of this project is to find out the best way to build the fastest pinewood derby car and win the race. What is the optimum pinewood derby car design? The hypothesis for these experiments consists of the added weight on the optimum design being just above the rear wheels, the rear tilted outwards, one of the front wheels lifted off the ground, the other front wheel being a rail rider, keeping the car from bouncing around on the track, and all of the axles graphited. After assembling the cars, they will be raced down the track five times each to collect the average data. The results of these tests showed that in order to make a fast car, the wheels must be graphited, one front wheel must be lifted off the ground, and the weight must be balanced between the middle of the car and the back axle. For the most part, the data collected did not support the hypothesis for this project.

**MPA113: Efficiency of Hydraulic Braking Fluids**
For my science fair project, I tested the best fluid to use with hydraulic. The fluids included brake fluid, water, canola oil, and motor oil. I hypothesize that the brake fluid will work the best because it is what is most commonly used to power hydraulic systems. I tested by connecting two syringes with plastic tubing. This was my "brake". I connected one of the syringes to a disk that had a pressure sensor on it. I found that motor oil works best with hydraulics.

**MPA114: Shocking H2O!**
Hydroelectric power has existed for centuries. It is a clean renewable source of energy with many benefits. This experiment provides a potential way of harnessing the power of water being used for one purpose to be used for another purpose at the same time. It also shows how hydroelectric power, which is usually used to make power using very large dams and water sources, can be used within our homes. I tested 1 generator and then added another until 4 generators in total were connected to the light bulb. I used 4 micro-hydroelectric generators to illustrate that together, they can be attached to a shower head and can provide sufficient light to take a shower without using electricity from the house's electrical grid. My hypothesis that if I increase the number of hydroelectric generators connected to the lightbulb, there will be more light generated by the light bulb that will be sufficient to illuminate the shower was proven true.

**MPA115: Baseball Spin Rate**
Please visit student's exhibit for abstract

**MPA116: Electron Movement Comparison**
Motivation- I became interested in the topic of electricity after watching my dad work on his electrical engineering homework. Problem Statement- I believe that the stranded wires will conduct more current than the solid wire since the stranded wire has more resistance than the solid wire. Methodology- I connected one of the wires to the multimeter with allegator clips. Then I connected the multimeter to the computer and tested each wire for one minute. Results- The solid wires have more conductance than the solid wires. Implications- To get the most out of your electrical products it is important to know which type of wire has the greatest conductance because each wire has different uses for many things and in a variety of environments.
**MPA117: What Type of Wall Protects a Community the Best During a Tsunami?**

Tsunamis cause catastrophic destruction and fatalities. What type of wall provides safety to coastline communities but does not take away the view? This project looked at alternative types of seawalls to find one that best prevents a wave surge from breaching a wall. A model of a tsunami wave tank was built using gutters as a wave tank and seawalls made of mortar. Four types of walls were created: a short, straight wall; a tall straight wall; a short recurved wall; and two recurved walls with a space in between. The amount of water that went over the wall was measured with each wave surge. My hypothesis was that a recurved wall would prevent water from going over the wall better than a straight wall because a recurved wall reflects water back into the incoming wave. Also, that the two recurved walls would prevent water from reaching the other side of the walls the best since water would collect between the two walls. The experimental results did not support my hypothesis that the single recurved wall would prevent more water from breaching the wall than either of the straight walls. However, my hypothesis that the double recurved walls would best prevent water from breaching the walls was correct because the combination of the two walls dramatically reduced the amount of water that went over the second wall. This could have important implications because a park could be built between the two recurved walls and thus protect the community and provide a recreational space.

**MPA118: Throwing into thought**

Please visit student's exhibit for abstract

**MPA119: Which Bat Produces the Most Exit Velocity**

Please visit student's exhibit for abstract

**MPA121: Efficient Water Electrolysis**

Water electrolysis is an effective way to mass produce 2 of the most important elements. But the power requirement is immense for the gases produced. The purpose of this experiment is to try making water electrolysis efficient. The battery will be connected to the electrodes placed in the box. Safety precautions will be worn, and the tap water used will be filtered. 5 liters of tap water will be poured into the box, along with sodium hydroxide flakes. Tubes will be placed on the anode and cathode, and balloons will be placed on the tubes. The battery will be turned on for 1 hour, and then turned off. The water that was split will be checked, and the data will be recorded. The experiment will be repeated multiple times to check for consistency. The data are the gases produced. I can conclude that it will work because the equations of the half-reactions are correct. My project is continuing, and I will present the final result at the fair.

**MPA122: Visualizing Sound Vibrations**

For my science fair project, I constructed a device to see sound. Cymatics is the visualization of vibrations. By observing cymatics, I could confirm that vibrations affect all matter. I hypothesize that if cymatics visualizes frequencies and frequencies that affect living organisms, then cymatics can help us learn more about how frequencies affect living organisms. My experiment consisted of making a machine that would visualize the vibrations of different frequencies using salt. I found that cymatics makes frequencies visible and frequencies can affect living organisms, therefore cymatics can teach us about how frequencies affect living organisms.

**MPA123: Coolest Cube**

The purpose of the project is to find out what shape ice cube will create the lowest average temperature in the cup after they all melt. Build all 4 molds in the shapes of a cube, window, z, and hollow cylinder, then freeze water. Set up thermocouples and water cups to put ice in and record temperature until ice is gone in every cup. The hypothesis was supported because the shape with the most surface area, which was the window, had the lowest average temperature. And the shape with the lowest surface area, the cube, had the highest overall temperature in every trial.
**MPA124: How much do household items absorb sound compared to studio foam?**
The purpose of this experiment was to test how much do average household item absorb sound compared to studio foam. Sound in this experiment is being recorded in decibels. This was tested by taking a cardboard box and put two devices at either end (one for sounds receiving and for playing sound) and put the thing being tested in between. When the sound is play the sound in decibels for each will be averaged and compared to each other to see which one absorbed the greatest amount of sound. Each item will be tested 5 times and the lower the number of decibels the quieter the amount of sound. The hypothesis was supported because the pillow had a final sound in decibels recorded as 33.988 which was the lowest showing that the pillow had the greatest amount of sound absorbed.

**MPA300: Swimming Is A Drag**
We decided to explore hydrodynamics and speed in the sport of swimming. When swimming, a swimmer wants to create the least amount of drag as possible. One way they do this is by wearing swim caps. We wanted to know how one's hair affects their speed while swimming and if one type of cap is most effective. We will test the drag of different swim caps on a bowling ball by dropping them from the same height in a pool. We're using three different hair lengths and caps. We predict that silicon caps will be the most drag efficient.