



84th Pittsburgh Regional Science & Engineering Fair

Intermediate Division

**Behavioral and Social
Science (MBS)**

Student Project Abstracts

March 28, 2023

Notes to Judges

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- Purpose of the experiment
- Procedures used
- Data
- Conclusions
- Possible research applications
- Minimal reference to previous work
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Project Numbers are assigned as XYYABC

- X: M – Intermediate Division (7th and 8th grade)
- YY: Category Name
 - BS – Behavioral and Social Science
 - BI – Biology
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Behavioral and Social Science (MBS)

MBS100: Investigating the Reliability of Eyewitness Testimony.

In this day and age, eyewitness testimony is still one of the most vital pieces of evidence in criminal cases. Despite advances in technology and forensic science, the reliability of eyewitness testimony is still a controversial issue. A science project investigating the reliability of eyewitness testimony could explore factors like bias, stress, and environmental factors to determine how these influence the accuracy of eyewitness accounts. Additionally, the project could provide insight into how to best reduce the chance of a false conviction due to inaccurate testimony. The results of such a project have the potential to benefit our justice system and increase the fairness of trials in society today.

MBS101: Musical Emotions

Emotions recorded on written questionnaire by elementary and middle school students after hearing certain musical selections were evaluated. The age of the students were compared to the emotions recorded. In addition, the key of the musical selection was also compared to the emotions recorded by the student volunteers.

MBS102: Sound Psychology

When taking a test it can often be difficult to concentrate. There can be many distractions, especially sounds that can shift the test-taker's attention away from the test. It has long been known that sounds affect our concentration, but exactly how much this alters test scores is not as obvious. Should schools spend money on completely sound-proof classrooms, or are current conditions adequate? Moreover, can certain audio actually increase test scores? To answer these questions, I assembled a group of nine seventh-grade participants and have them take four sets of two tests, two taken per day. Each day would consist of one control test and one test with a sound, the latter changing each day. The tests were fifty randomly generated two-digit multiplication questions, which the participants were more than capable of completing but required some concentration. Sounds included the looped sound of an infant crying, the sound of a crowd, a clip from a movie, and a playset of calming music found on the Internet. The scores of the sound test will be compared to the scores of the control test to minimize variables. Thus far I have observed that, contrary to my hypothesis, the looped baby crying increased the test scores compared to the control. Due to delays and invalid trials, this has been my only successful trial at the time of this writing. Optimistically, the experiment should be completed and analyzed by the seventeenth of February.

MBS103: Why are teenagers so emotional? Contributions of adolescent brain development

Rationale: Being a teenager is an intermediate stage of growth between being a child and one going on to be an adult. This is a difficult stage of growth because teenagers (adolescents) are known to be emotional, meaning that they find it hard to control their emotions. This leads to many problems including experiencing traumatic events that may affect their lives when they become adults such as being aggressive, getting into criminal activities and using drugs. Procedures: Scientists have related emotional problems to differences in developing brain among teenagers. I wanted to use the deidentified data of emotional performance of adolescents and relate them to specific regions in the brain assessed on images obtained using magnetic resonance imaging (MRI) scanner. Some of the regions that I will be examining include amygdala, orbitofrontal cortex (in the base of the brain) and other related regions as I learn more about these structures because these regions are known to regulate emotion. My plan is to correlate the emotional behaviors scored on standard forms with the volume of these regions. I will use Pearson's correlation tests to examine my hypothesis. For differences among different types of emotions, I will use t- tests. I will also attempt to examine the differences between males and females in emotion expressions and volumes of brain regions. Hypothesis: My hypothesis is that the smaller regions (measured as volume of these regions) will be related to being more emotional because smaller regions may reflect slower development of the emotion regulating regions. Bibliography: Richard Gross, Psychology: The science of mind and behavior, Hodder & Stroughton, London 1996
Richard Lane & Lynn Nadel, Cognitive neuroscience of emotion, Oxford University Press, Oxford 2000

MBS104: Social Media's impact on social behavior

Social media's original purpose is to help connect digitally with friends, colleagues, family members, and like-minded individuals they might never have met in person. Twenty years later, is it fulfilling its original purpose? Or is it impacting social behavior, the way people interact? To test if social media is impacting social behavior, I needed to research the topic. After research, I found social behavior is the way people behave with each other, and this can be changed by the situation and their environment. I hypothesized that social media raises connections to others, but the 10-15 may get impacted by social media because of early exposure. For my procedure, I designed a detailed questionnaire which I gave to three age groups, 10-15, 16-40, and 40+ years old. A control group was made of people who do not use three or more social media platforms and limited their online activity. After conducting the survey I found the control groups, 10-15, and 40+ groups had positive results, the 40+ participants had more of a neutral impact. Finally, the participants who were between the ages of 16-40 reported they felt negatively impacted by social media. My hypothesis was correct when I stated social media is fulfilling its purpose of connecting, but I was proved incorrect when the data showed participants in the 16-40 group did not get impacted. Overall, social media can connect people and is not impacting social behavior in the ages 10-15 and 40+ but is showing impact in the ages 16-40.

MBS105: Is the Second Child More of a Visual Learner than the First?

I created a google form to survey adults asking what personality traits they relate to, then asking them to choose whether they prefer to learn visually or not in a series of tasks/skills. I organized this data in a spreadsheet to analyze and to find answers to Does the second child in the family believe they are a better visual learner than the first child? Project research is still ongoing, and results will be shared on the day of the PRSEF competition.

MBS106: Is Creativity Linked with Age?

Student volunteers were asked to view inkblot diagrams and recorded what they saw when viewing the given inkblot. These data compared student age and creativity.

MBS107: Desensitization In Media

Please visit student's exhibit for abstract

MBS108: Grade Levels & Stress

I tested the effect of students' grade levels on grade-related stress. My hypothesis was that kids with higher grades would stress more. I thought this because I thought that they would feel more pressure, which would create stress. However, based on the answers people submitted and the trends I saw this was proven false. I found that kids with lower grades actually stressed more.

MBS109: Polyglot Perfection

This science experiment examined three different Scandinavian languages to determine which is the easiest to learn for native English speakers to learn. Swedish, Finnish, and Danish were chosen because they all use the English alphabet and are all from the same geographic region, making them easy to compare. My hypothesis was, Swedish will be the easiest language to learn for native English speakers. This is because the Swedish language has many similar roots to English as well as vocabulary words that resemble each other. All 70/70 Swedish questions were answered correctly which proves my hypothesis. 63/70 Danish questions were answered correctly and 58/70 Finnish questions were answered correctly. Overall, this experiment depicts how much easier language acquisition can be when a new language has similar root words and vocabulary to a person's native language. Since there are so many benefits to being multilingual, this research can help people choose which language to learn.

MBS110: Do Men and Women Perceive Things Differently?

In my experiment I tested to see if different genders react differently to certain images. All the images I showed were gender motivated. I had them rate the images on a scale of extremely like to extremely dislike. In the study I found that each gender did react differently to certain images, but only in certain categories. I learned that middle schoolers of either gender don't like depictions of violence or being less than. And I learned that boys and girls don't agree when it comes to depictions of women in power. It's fair to say that there is an effect of gender.



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Biology (MBI)

MBI100: What temperature is the most conducive for the growth of an iris purple sensation?

The iris purple sensation is important to society because it is becoming one of the many natural air filters. It helps to produce clean air and therefore reduces the amount of toxins we breathe in.

MBI101: Can Chickens Learn?

The ability of chickens to apply knowledge to new situations was evaluated using mealworm treats.

MBI102: OG It's Algae

Problem: How do phosphates affect algae growth in water? Hypothesis: It is Hypothesized that higher amounts of phosphates in water will cause algae growth to increase. Research: In this experiment they will be testing How phosphates in water affect algae growth. Phosphates is a type of Acid that contains ester. Phosphates can be very dangerous to work with. Materials: Clear plastic containers with lids Labels for containers Lab notebook. Outdoor water source. pond/lake water Plant fertilizer containing phosphates. Procedure: the steps of this experiment he or she will need are listed below. First collect all the lab materials the scientist will need. Collect an adequate amount of pond water. Add pond water to containers with controlled amounts of phosphate. Allow time to pass by for algae growth. Compare and record the results from the samples. Draw conclusions and write reports using data recorded from the experiment. Idea of the project: https://www.sciencebuddies.org/science-fair-projects/project-ideas/EnvSci_p054/environmental-science/effect-of-fertilizers-on-algal-growth Some information websites: <https://phosphatesfacts.org/what-are-phosphates/> <https://www.sciencebuddies.org/> <https://www.epa.gov/national-aquatic-resource-surveys/indicators-phosphorus#:~:text=Too%20much%20phosphorus%20can%20cause,to%20human%20and%20animal%20health.> <https://www.pca.state.mn.us/pollutants-and-contaminants/phosphorus>

MBI103: Effectiveness of Cleaning Products

Problem: In my experiment I wanted to know which of the following five cleaners, Lysol, Clorox, Seventh Generation, Everspring and Better Life, kills the most bacteria on a kitchen counter? Hypothesis: Given 1 ½ mL of the five following cleaning agents, Lysol, Clorox, Seventh Generation, Everspring and Better Life, and a 144.78 cm by 91.44 cm countertop, the researcher hypothesizes that Clorox will kill the most bacteria and Seventh Generation will kill the least amount of bacteria on average based on three trials of the experiments. Perform surface sample with TSA agar plates Incubate TSA plates for 48-72 hours at 30-35C Incubate TSA plates for 5-7 days at 20-25C Count total colony forming units (CFU) for each sample, then average results from each of the three tests per cleaner to determine the most effective cleaning agent Where did I get this idea for the project?: My dad is a pharmacist who works in a clean room and uses disinfectants to keep it clean. This made me interested in which daily cleaning products have the best effect.

MBI104: How Does Ocean Acidification Affect Marine Life?

I am doing this experiment to see and better understand the effects of ocean acidification on marine life. How does ocean acidification effect marine life? I think the mussel shells will be at least partially dissolved after thirty days in the saltwater. At the beginning of this experiment, I will be opening the pH meter and calibrating it with the calibration liquids. I will be removing the flesh from the mussel shells and washing them out throughly. I will then be preparing the solution to put the shells in. I will read the instructions on the side of the bag and follow them until the saltwater solution has the recommended amounnt of salt. I will then be testing the pH of the solution. if the pH is not 8.1 I will either be adding more salt or more water to the solution, using filtered tap water, I will make enough of this solution to fill 6 half liter jars to the rim. I will then start to prepare the control jars. I will take a paper towel and place it on the scale and then measure 1oz of mussel shells. I will then place the mussel shells into a bag and lightly smash them with a hammer until the fragments are about the size of an american quarter. I will then place the shells into a clean glass jar and fill it to the rim with the seawater soluton. I will place a lid on the jar and then take the date on which this process was done, the pH of the solution in the jar, and the weight of the jar. I will the start to make the acidified jars. I will use the same process as I did for the control jar to prepare the shells for the jar. I will then place the shells in the jar and fill it up with the seawater until it is almost full. I will then take an eyedropper and place three drops of vinegar into the jars. I will then take the jar and measure the pH. I will do this for four more jars, but on every jar i will increase the amount of vineger i put in each jar. Once thirty days passes, it will take the jars and empty out the seawater solution until only the shells are left. I will then wash off and dry the shells. After doing this, I will measure the shells andsee how much weight they lost. The weights will be the results of my experiment. I will be taking several precautions during this experiment. This experiment involves vinegar, an acid, which could be harmful if not handled properly . I will handle the vinger with care and wear gloves while doing so. This experiment also involves using a hammer to smash mussel shells into small fragementes. The hammer smashing could possibly result in injury and the mussel shell fragments are sharp and could also result in an injury, both of these items must be handled with care. I will be careful while handling both of these. I am going to conduct three trials of my experiment and average it. I will then place my data intio charts and bar graphs. I am going to look for patterns that suggest whether my hypothesis was supported or not. Ocean Acidification <https://www.noaa.gov> April 1, 2020 Swimming In Acid: Understanding Ocean Acidification <https://www.sciencebuddies.org> November 20, 2020 Ocean Acidification <https://whoi.edu> n.d. Ocean Acidification: What You Need To Know <https://www.nrdc.org> October 13, 2020 Ocean Acidification <https://www.biologicaldiversity.org> n.d.

MBI105: Seeding and Weeding

The purpose of this project is to find out which pea seed is the better buy. What pea seed will grow the fastest to determine which one is the better buy? The researcher hypothesizes if more expensive pea seeds and less expensive pea seeds are grown, then the more expensive seeds will grow stronger, and taller than the cheap pea seeds. 1. Fill dixie cups with soil. 2. Put 2 seeds in each cup 3. Water them every other day for 9 weeks. 4. Measure the growth of the plants every week. 5. See what pea seed grows the strongest. Seed group 2 grew the highest and strongest. Seed group 1 grew the shortest. This determines that seed group 2 which is the burpee snap peas are the best buy. The researcher's hypothesis was supported that the expensive seed grew the highest and strongest.

MBI106: BEEtle Juice

This experiment was to find out which water bugs like best: sweet, salty, sour, or bitter. What water do the bugs like best? The scientist hypothesizes that the sweet water will be the most attractive. If so, more bugs will be around the water. Put water into eight condiment cups. Add lemon water into two condiment cups, salt water into two cups, lemon water into two cups, and apple cider vinegar water ino two cups. The sugar was the most attractive because it was the most consumed and had more bugs around it.

MBI107: Does Your Dad Love His Lawn Too?

The purpose of my experiment was to determine which LED color light--red, blue or white--allowed for the fastest germination rate and tallest plant growth in Zoysia Japonica seeds. The procedure steps for my experiment include gathering all the materials needed for the experiment, setting up the lamps, installing the blue LED light in its lamp, installing the red LED light in its lamp, and installing the white LED light in its lamp. Next, you should place 240 mL of soil in each cup in 15 containers, label 15 containers (A1-A5; B1-B5; C1-C5), plant 20 seeds in each cup, place 5 cups under each lamp, add 15 mL of water to each container, and make sure the plants get 12 hours of light exposure (6:30am to 6:30pm) each for 24 days. Finally, you should observe and record the date of germination (evidence of roots/shoots) at 6:30AM EST over 24 days, observe, measure, and record the height of germinated plants over a 24-day period, and collect and record data for 24 days. Finally, the red LED light growth after 24 days was cup 1 grew to be 1.9cm, and cup 2 grew to be 0.64cm. Cup 1 under the white LED light grew to be 0.32. In conclusion, the red LED light's plants had the fastest germination and grew the tallest. The white LED light had the slowest germination and grew the smallest in height. The blue LED light had the second fastest germination and grew the second tallest in height but died.

MBI108: How Does Carbon Dioxide Affect the Growth of Different Plants?

Global temperatures rise as more carbon dioxide is added to the atmosphere, threatening the earth, and affecting plant growth. For my project, I wanted to test how carbon dioxide will affect the growth of plants. I hypothesized that the basil will grow best in the condition where carbon dioxide is added three times per seven days. I set up four conditions: 1) carbon dioxide added three days per week, 2) carbon dioxide added daily, 3) open/natural, and 4) control. I planted 3-4 basil seeds in thirteen pots and placed lids on all, except the open/natural condition. I set up grow lights above the plants, and misted them with 5 mL of water daily. The first signs of seed growth were visible on Day 6, in the carbon dioxide added everyday condition. I extended the experiment to run for two weeks to see more plant growth. At the end of the two weeks, 8 of the plants grew in the open condition with an average height of 0.3 cm. All the plants grew in the control with an average height of 1.6 cm. In the carbon dioxide three days condition, all plants grew with an average height of 1.5 cm. In the carbon dioxide added everyday condition, all the plants grew with the tallest average height of 1.7 cm. My results do not support my hypothesis that the tallest growth would be in the carbon dioxide added three days condition.

MBI109: What are the Most Bacteria Prone Places in a Home?

This science experiment is about which areas in the average home carry the most bacteria. Following the completion of this experiment, the results will show which areas are home to more bacteria. Cleaning the area more regularly will help stop the spread of these bacteria and germs! The areas to be studied were sanitized and then allowed to accumulate bacteria for seven days. Then, the selected areas were tested for bacterial contamination using surface cultures on luria broth media. Based on the results of the first house, the kitchen sink handle and joint by far had the most bacterial growth. Wherever the swab had touched the dish, it was covered in a yellow bacterial mass with small orange growths as well. The light switch had the least amount of bacteria, with no growths. This experiment is ongoing; two more households with similar study areas will be tested prior to the final presentation. In the first house, the sink faucet and joint held the most bacteria, and surprisingly, the light switch had few or no amounts at all. Since this experiment has not yet concluded, a final interpretation of the results will not be made until studies have been completed for all three houses.

MBI110: Effects of sports drinks on daphnia

Please visit student's exhibit for abstract

MBI111: What's the best fertilizer?

Please visit student's exhibit for abstract

MBI112: Which fertilizer makes plants grow the tallest?

Please visit student's exhibit for abstract

MBI113: How do Stem Cells React to Temperature

Please visit student's exhibit for abstract

MBI114: How does fertilizer affect algae growth?

The testable question for the experiment was how does fertilizer affect algae growth? Some important research on this topic is that fertilizer enters nearby lakes or streams through runoff and soil erosion. Algae can be poor for the environment because if there is too much, it can deplete the oxygen in the water harming marine life, but algae can be good because it and other marine plants produce oxygen for use to breathe. The hypothesis was if nitrogen, potassium, and phosphorus nutrients are added into water with algae, then phosphorus would grow the algae the most because it has major plant nutrients and is needed to help plants grow and develop normally. The data was collected by counting the algae cells under a microscope for each water sample. The data collected said potassium nutrients grew algae the most. It grew to be the most on day 12, with an average of 122 algae cells. Nitrogen grew the least with the most on day 3, with an average of 2.33 algae cells.

MBI115: You're Growing on Me

For this project, I wanted to see how much bacteria grows on everyday objects around my house. I ordered a swabbing kit online from Amazon. When the kit arrived, I followed the directions to swab several objects in my house such as game controller, tv remote, cell phone, toilet handle, and door knob. I waited 2 days and measured and recorded the bacteria growth, I measured the groups of bacteria. I then compiled my information into a bar graph and was able to determine which sample petri dish contained the most bacteria. I was then able to determine if my hypothesis was supported or not.

MBI116: How can smell affect taste?

Please visit student's exhibit for abstract

MBI117: Is the mass of a pumpkin proportional to the amount of seeds in the pumpkin

The purpose of the experiment was to see if the mass of the pumpkin affected the number of seeds in a proportional manner. The pumpkins were massed, then each pumpkin was cut open, the seeds were counted, and the amount of seeds were divided by the mass of the pumpkin. The small pumpkins had a standard deviation of seven hundredths. The large pumpkins had a standard deviation of two hundredths. Smaller pumpkins had three tenths of a seed per gram on average. Larger pumpkins had nine hundredths of a seed on average. The seeds in the pumpkin did not stay proportional as the mass of the pumpkin increased. This means pumpkins have different amounts of seeds in them depending on the mass of the pumpkin and size is not indicative of a ratio of seeds

MBI118: Store Bought vs Home Grown Generational Green Bean Seeds

The purpose of this experiment is to see if the homegrown generation seeds work better than store bought seeds. The seeds were planted with all conditions being the same. They were watered weekly and turned to prevent drooping. The seeds were measured daily. The results showed on average that store bought seeds grew more than both large and small homegrown generational seeds. Store bought seeds average - 28.87 cm Big homegrown generational seeds - 19.08 cm Small homegrown generational seeds - 0 cm The standard deviation for the store bought green bean seeds was 9.59 cm The big homegrown generational seeds standard deviation was 11.69 cm. The small homegrown generation seeds standard deviation was 0 cm. This shows that the store bought seeds average the tallest, the big homegrown seeds a close second, and the small homegrown generational seeds last. The store bought seeds on average were at least 9 cm taller than both homegrown generational seeds. The standard deviation shows none of the seeds that grew were consistent at all, but the store bought seeds were still the most consistent. Store bought seeds are better than homegrown generation seeds. Someone would want to know that information so they would know if buying new seeds every year is worth the cost, and so they dont waste their time saving the seeds every year.

MBI119: Why is the saddle fit important to the projected health of a horse?

This experiment will benefit both equines and equestrians. It will help to better fit horses with proper English saddles and will in turn improve many horses' quality of life and comfort. It can also help improve or even fix behavioral issues because many behavioral issues come from saddle fit.

Intermediate – Biology (MBI), 7th & 8th Grade

MBI300: The Queens of Clean

We are conducting this experiment in order to find which disinfectant kills the most bacteria and is best for daily use. To perform this experiment, we will follow these steps: First, we will divide a cutting board into four sections and rub a piece of lunch meat all over it.. Next, we will use sterile cups with samples of each chemical, and cotton swabs to distribute each chemical onto its respective section of the cutting board. Then, we will use different cotton swabs to collect samples and transfer them onto agar plates. After a few days, we will take a look at the bacteria grown and determine the ranking of the disinfectants. Whichever sample has the least growth is the best disinfectant. Once the data is collected, and we have reached a conclusion, the experiment will conclude. As the experiment is continuing, we will provide results on the day of the fair.

Intermediate – Biology (MBI), 7th & 8th Grade



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Chemistry (MCH)

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Chemistry (MCH)

MCH100: Flexible Aluminium-Air Batteries

Wearable and flexible electronics have a wide range of applications. Making a flexible power source for them is important. Aluminum-air batteries are attractive for powering portable lightweight devices due to their inexpensive, light, and powerful source of energy. In this project, the self-made Al-air battery will be made using graphite based and aluminum foil electrodes and chloride-based electrolytes with ionic liquid additives. The characteristics of batteries will be measured. To optimize performance, Design of Experiments (DOE) will be used to align process variables and arrange them to ensure optimal performance.

MCH101: Morning Cup O' Nitrogen

Research and Introduction Caffeine is well-known to be used in gardening and plant growth, however, it is said to have harmful effects on young humans, one of which is stunted growth. That said, how will it affect the growth of plants? About 80% of the U.S. consume caffeine in some form. Anyone who has a garden in their backyard has used excess coffee grounds in their garden or compost. The explanation is that by volume, coffee grounds contain about 2% nitrogen. As the coffee grounds break down, nitrogen is released. Nitrogen can help the plant grow by providing it with essential macronutrients. We are also all told not to drink caffeine as a child, because it will stunt our growth. However, many studies have disproved this conspiracy. I hypothesize that caffeine will negatively affect the growth and development of plants, by stunting their growth. This hypothesis can and has been proven through many scientific studies. I have conducted a controlled variable experiment, testing how different caffeinated products and water can affect a growing basil plant. In this experiment, water will of course be the controlled variable, whereas caffeine will be the manipulated variable- or independent variable. To start the procedure, take 3 cuttings from one basil plant and root them in 16 oz Dixie Cups of Miracle Grow soil. Hydrate one plant with water, one with coffee, and the other with 5-Energy, each measuring 7 ml. Continue to repeat this process every other day. Make sure to label each cup with the corresponding liquid it is being watered with. As time goes on and the process continues, log the results of each day. Based on my hypothesis, the plant that was given water should grow efficiently. In contrast, the plant watered with caffeinated products grounds should barely grow. My reason for starting this experiment was that I was always told that coffee and caffeine will stunt my growth and that I should not drink those beverages as a growing child. I have also noticed that he uses coffee grounds in fertilizer when he starts growing plants. These two things seemed to contradict each other, so I decided to find out the answer myself. The results so far have been much more surprising than I first thought. What does nitrogen have to do with this? you may be asking, so here's a summary. Nitrogen is an essential integrant of amino acids that help mold plant proteins and enzymes. Nitrogen is also essential to the makeup of chlorophyll molecules, giving the plant the ability to take sunlight energy through the process of photosynthesis. The sunlight energy captured through photosynthesis can instigate the growth of plants. With this information, caffeinated products should improve the growth of plants compared to water, however, sugar and other factors should be considered. As far as the project has been going, which is a week and a half, the plant watered with water is growing slightly better than the plant hydrated with coffee. The plant hydrated with 5 Hour Energy began to wilt almost immediately. The plants watered with water and coffee are a much brighter green, however, the plant watered with 5 Hour Energy was duller and darker.

MCH102: Nail Polish Endurance

Problem- Which nail polish brand lasts the longest? Hypothesis- I hypothesize that out of the nail polish brands Olive & June, Essie, Sally Hanson, and OPI, OPI will last the longest because it uses many ingredients that help nail polish to be long lasting, such as Triphenyl Phosphate and Ethyl Tosylamide. Materials needed- 4 brands of nail polish (Olive&June (A), OPI(B), Essie(C), Sally Hanson (D)) Procedure- Group A: Week one- Paint brand A on all fingernails and record observations. Week two- Paint brand B on all fingernails and record observations. Week three- Paint brand C on all fingernails and record observations. Week four- Paint brand D on all fingernails and record observations. I will be using an OPI base coat and an Olive & June topcoat. Group B: Repeat the above a 2nd time My project originated from study.com and that's where I get my idea from. Ingredients (Red= every brand has this, Bold, ingredients that help with long lasting) Brand A (Olive & June) - Butyl Acetate, Ethyl Acetate, Nitrocellulose, Adipic Acid/Neopentyl Glycol/Trimellitic Anhydride Copolymer, Acetyl Tributyl Citrate, Isopropyl Alcohol, Styrene/Acrylates Copolymer, Stearalkonium Bentonite, Acrylates Copolymer, Silica Dimethyl Silylate, Sucrose Acetate Isobutyrate, Dipropylene Glycol Dibenzoate, Octocrylene, Polyvinyl Butyral, Di-HEMA Trimethylhexyl Dicarbamate, Citric Acid, Stearalkonium Hectorite, Dimethicone, N-Butyl Alcohol, Trimethylsiloxysilicate, Aluminum Hydroxide, Methicone, May contain (+/-): Titanium Dioxide (CI 77891), Black Oxide of Iron (CI 77499), Yellow 5 Lake (CI 19140), Titanium Dioxide nano (CI 77891), Red 7 Lake (CI 15850:1), Red 6 Lake (CI 15850), Ferric Ammonium Ferrocyanide (CI 77510), Red Oxide of Iron (CI 77491) Brand B (OPI) - Ethyl Acetate, Butyl Acetate, Nitrocellulose, Propyl Acetate, Tosylamide Formaldehyde Resin, Isopropyl Alcohol, Trimethyl Pentanyl Diisobutyrate, Triphenyl Phosphate, Ethyl Tosylamide, Camphor, Stearalkonium Bentonite, Diacetone Alcohol, Stearalkonium Hectorite, Benzophenone-1, Citric Acid, Dimethicone Brand C (Essie) - butul acetate, ethyl acetate, nitrocellulose, adipic acid / neopentyl glycol/trimellitic anhydride copolymer, acetyl tributyl citrate, isopropyl alcohol, stearalkonium bentonite, styrene/acrylates copolymer, acrylates copolymer, silica, diacetone alcohol, octocrylene, n-butyl alcohol, hexanal, synthetic fluorphlogopite, lithothamnium calcarum extract/lithothamnion calcareum extract, calcium sodium borosilicate, phosphoric acid, dimethicone, mannitol, colophonium/rosin/colophane, trimethylsiloxysilicate, diatomaceous earth, barium sulfate, tin oxide, zinc sulfate. may contain cl 77891/titanium dioxide, cl 77491, cl 77492/iron oxides, mica, cl 77266/black 2, cl 77742/manganese violet, cl 19140/yellow 5 lake, cl 15850/red 6 lake, cl 15880/red 34 lake, cl 77510/ferric ammonium, ferrocyanide, cl 12085/red 36, cl 73360/red 30, cl 15850/red 7 lake Brand (Sally Hanson) - Ethyl Acetate, Butyl Acetate, Nitrocellulose, Propyl Acetate, Tosylamide/Formaldehyde Resin, Alcohol Denat, Polyethylene Terephthalate, Isopropyl Alcohol, Adipic Acid/Neopentyl Glycol/Trimellitic Anhydride Copolymer, Trimethyl Pentanyl Diisobutyrate, Triphenyl Phosphate, Silica, Acrylates Copolymer, Ethyl Tosylamide, Camphor, Stearalkonium Bentonite, Stearalkonium Hectorite, Citric Acid, Dimethicone, Benzophenone-1, Diacetone Alcohol, Synthetic Fluorphlogopite, Calcium Sodium Borosilicate, Calcium Aluminum Borosilicate, Calcium Sodium Phosphosilicate, Tin Oxide. [May Contain: Mica, Titanium Dioxide (CI 77891), Bismuth Oxychloride (CI 77163), D&C Red No. 6 Barium Lake (CI 15850), D&C Red No. 7 Calcium Lake (CI 15850), D&C Red No. 34 Calcium Lake (CI 15880), Iron Oxides (CI 77491, CI 77492, CI 77499), FD&C Blue No. 1 Aluminum Lake (CI 42090), FD&C Yellow No. 5 Aluminum Lake (CI 19140), Ferric Ammonium Ferrocyanide (CI 77510), Chromium Oxide Greens (CI 77288), Ultramarines (CI 77007), D&C Yellow No. 11 (CI 47000), D&C Violet No. 2 (CI 60725), Aluminum Powder (CI 77000), Guanine (CI 75170).

MCH103: What Factor Most Affects the Conductivity of a Liquid

In the experiment, I will be putting different liquids with different factors changed (ex. more ions) in different plastic containers. I will then drop an electrode into opposite sides of the containers. Afterward, I will check the readings with an electrometer to determine the factor(s) that most affect the conductivity of a liquid. This will be done outside due to the electric components. To remain safe, we will wear protective gloves. So far, we have ordered the necessary components and are planning out the experiment, which will be done by the first week of February. We have yet to put different liquids in containers with different variables changed in each container (ex. warmer, more ions, denser, etc.) after which we will place two electrodes on either side of the container and pass electricity through the electrodes using a battery. After this, we will check the readings with an electrometer. We will put these readings into a chart based on the variable we changed, the liquid, and the readings. Using this chart, we will determine which factors most affect the conductivity of a liquid.

MCH104: The effects of soda on metal

Several different materials were soaked in Coca-Cola for times up to 46 days. They were weighed to determine if they were dissolving. The experiment started off well and the items ended changed a bit initially, but mostly the changes were cosmetic. The egg grew black crystals and darkened, the coins became shiny, and the rusty washer got a little less rusty before the rust eventually returned. The Coca-Cola was not effective in dissolving the materials.

MCH105: The Impact of pH on Fabric Dyes

In Phase 1 of this project, the pH of dye solutions and the resulting intensity of the dyed fabric was evaluated. In Phase 2, the type of fabric and the resulting intensity of the dyed fabric was evaluated.

MCH106: Acid Rain, Such a Pain!

The purpose of this experiment is to figure out which building material is affected by acid rain the most and if antacid counteracts the results. What is the effect of acid rain on buildings and does antacid counteract the effect? The investigator hypothesizes that if different building materials are submerged in vinegar and antacid is placed in half of the beakers, then limestone will erode the most and the antacid will help the erosion of the materials. Take different types of building materials and submerge them in vinegar for twenty-four hours. Also, put antacid tablets in half of them to see if they will counteract the effect. The marble trials without antacid eroded the most and its weight went down 100% by the seventh day. The investigator's hypothesis was not supported since the limestone's weight only went down by 83% in ten days.

MCH107: Bleaching Beautiful

The researcher's purpose is how long and hard it is to get to a blonde color from your natural hair color. Will the black hair bleach? What will happen to the colors in one hour? What color will the red hair come out? The researcher believes that the black hair color will be the least blonde and the red hair will be the most. Also the straight hair will take less time. The researcher dyed three different colors and textures of hair and let it sit for one hour. Red hair came out the best for the color and worst for texture. Brunette hair came out best for texture, and black hair came out worst for color. The conclusion is that the researchers' hypothesis was surprisingly supported.

MCH108: On the Flip Side

Background: Baking powder contains sodium bicarbonate, monocalcium phosphate, and one of two other acids, either sodium acid pyrophosphate or sodium aluminum sulfate. Whenever the dry ingredients of a recipe are mixed with the wet ingredients, the monocalcium phosphate reacts with the sodium bicarbonate and makes carbon dioxide bubbles. This is the first reaction that assists with the rising of the pancake. The second reaction occurs when the batter is heated. Then, either the sodium acid pyrophosphate or sodium aluminum sulfate will react with the sodium bicarbonate once they are wet AND hot. This causes the rising process to be spread throughout the mixing and cooking process, creating more bubbles. What also helps in the rising process is the gluten that is in the flour.

Glutens are long strands of protein molecules. As they develop, they become flexible, and the carbon dioxide fills it like a balloon. However, in gluten free flour, it is lacking gluten, hence the name. The flour I used substitutes the wheat, which contains the gluten, for white rice and brown rice instead. This actually makes the gluten free flour lighter and less dense than flour containing gluten. There is also a substantial amount of additives, including tapioca and potato starch, cellulose, and xanthan gum, so it acts even more similarly to regular all-purpose flour so you can do a 1 for 1 swap, that is, swapping one cup of regular flour with gluten for one cup of gluten free flour. Problem:

The purpose of this project is to determine if there is a difference in the fluffiness of gluten free pancakes and regular pancakes with flour. I also will be testing to see whether baking powder has any effect on gluten free pancakes.

Methods: After ordering my equipment and ingredients, it was time to make my pancakes! First, I combined the dry ingredients: 354.88 mL of gluten free flour, 14.79 mL of sugar, 4.93 mL of salt, and 9.86 mL of double acting baking powder in a bowl. In a separate bowl, I combined the wet ingredients: 295.74 mL of whole milk, 1 purchased large white egg, and 44.36 mL of unsalted melted butter and I whisked for 15 seconds. Then I combined both bowls of ingredients together and stirred with a whisk 30 times. Then the mixture was allowed to rest for 5 minutes. While the batter was resting, I heated the pan to medium heat, which is about 95 degrees Celsius. When the 5 minutes ended, I poured 59.15 mL of batter into the pan. After letting it cook for 3 minutes, I flipped it, and cooked on the other side for 3 minutes. Once the pancake had completed the cooking process, I removed it from the pan and allowed it to rest on a paper towel for 5 minutes. After 5 minutes, a digital scale was used to measure the mass. To measure the fluffiness of the pancake, I used a pre-made template. This template was created by tracing the inside of the pan. To determine the exact middle of the template, the circle was folded in half and then folded again to create 4 quadrants. The corner of the quadrant was clipped to create a small hole precisely in the center of the pancake. The template was then positioned directly on top of the pancake and a clear plastic straw was inserted through the center of the pancake. A sharpie marker marked the height of the pancake in the straw. This allowed the fluffiness of the pancake to be calculated. I repeated this procedure 29 more times for a total of 30 samples. Then the entire procedure was repeated, only this time the amount of baking powder used was 14.79 mL for a second trial consisting of 30 samples. For trial number three, the same procedure was repeated, and 19.72 mL of baking powder were used, and 30 samples were collected. For the fourth trial, 24.64 mL of baking powder were used, and 30 more samples were collected. For the fifth trial, 4.93 mL of baking powder were used, and 30 more samples were collected. For the sixth and final trial, no baking powder was used, and 30 samples were collected. This would serve as the control. Results:

The gluten free pancakes were much fluffier than I expected, even fluffier than some pancakes with gluten! I also have discovered that baking powder does indeed make a difference to the height of gluten free pancakes. This is probably because the additives in the gluten free flour were meant to replicate the structure of gluten as closely as possible. Conclusion: In summary, 30 tests of gluten free pancakes, each with 9.86, 14.79, 19.72, 24.64, 4.93, and 0 mL of baking powder, were conducted. Each pancake was cooked on each side for 3 minutes on medium heat and then allowed to rest for 5 minutes. After that, the pancake was massed, and its height was measured and recorded. It seems the more baking powder that is used in a pancake recipe creates a pancake that is tall, light, and fluffy and the less baking powder that is used results in a flat, dense pancake. It also seems that the brand of gluten free flour that I used, King Arthur's Gluten Free Measure for Measure Flour, makes pancakes that are generally lighter and fluffier than pancakes containing gluten. This information is important because we all want our pancakes to be nice and fluffy, and it seems that King Arthur's Gluten Free Measure for Measure Flour does the job. However, you can actually become ill from the consumption of too much baking powder. If you do find the need to change the recipe whatsoever, a small amount will do.

MCH109: pH and digestion

This will inform everybody on what drinks are safest for their bodies and how they might damage them. If somebody has a stomach issue or disease, they will know what drinks to stay away from.

MCH110: Does the Temperature of a Liquid Affect Its Viscosity?

Different liquids, water, honey and motor oil, were evaluated for viscosity by recording the time it takes for a marble to fall through a set volume of the liquid. A second phase of the experiment investigated the differences in motor oil viscosity at three different temperatures.

MCH111: The Power of Flour - Effects of different types of baking flour on chocolate chip cookies

This experiment will reveal how flour affects the rise, the spread, and the strength of a chocolate chip cookie. Four kinds of flour will be used in the same recipe and baked. The types of flour used in this experiment include: white flour, bread flour, cake flour, and almond flour. Each has a different protein and carbohydrate content that can affect the properties of the cookies. To test the strength of the cookies, a weight test will be utilized. Measuring the diameter and the rise of the cookies before and after the bake will determine their rise and spread. Conclusions will be made from the final results after completion of this experiment. This experiment will determine how different kinds of flour affect chocolate chip cookies.

MCH112: Electrolytes in Drinks!

My project was testing the amount of electrolytes. I set up a circuit that allowed me to see how high the current was (how many electrolytes) in each drink. Each item I used had part in my project and without one of the pieces it wouldn't be possible. I really enjoyed testing all the drinks and hopefully you enjoy it as well.

MCH113: Sticky Liquids

I will test different common liquids on goalie gloves and see how much they increase or decrease how adhesive the goalie gloves are. I will test Orange Juice, Water, Olive Oil, and Milk because they are common liquids in a household. I will use a different glove for each test to insure that there is no cross stickiness. The ball will also be watched after each test. This is the basis of the experiment with a few added steps.

MCH114: Scientifically Baking

This experiment is very important to me because I am attempting to become an entrepreneur in baking, and some people have different preferences for how they would like their cake. With this experiment, I can figure out which sugar will make the cake's density perfect for everyone so there will be no complaints or concerns about anything I bake, whether it's desserts or pastries. I will be using the same cake mix and ingredients (except for the sugars), and measurements. I will also be putting all 3 cakes in the oven at the same time. I will be using vanilla cake mix, brown sugar, granulated sugar, and substitute sugar.

MCH115: What is the best material for filtering water?

Water becomes polluted when dangerous materials, most likely chemicals or microorganisms, contaminate a body of water. Water needs to be at a certain level of cleanliness to be drinkable. Filtration is a process that is used to clean water and different types of filtering materials can separate different types of contaminants. If sand, charcoal, or gravel are used to filter water, then sand will filter water best, because sand is the smallest material which can filter out smaller particles. In conclusion, the original hypothesis was supported because the sand had the best results for pH with an average of 8, and bacteria with an average of 0 meaning absence of bacteria. The data can help answer the testable question because each filter had positive and negative results, but on average the sand filter had the best bacteria and pH results which is an essential requirement in drinking water.

MCH300: Shake It Up

We wanted to prove that the higher amount of sugar there is in a soda, the higher amount it spewed upon shaking it. Our hypothesis was that if we shook up different sodas with the same starting amount of liquid in it, the drink with the highest amount of sugar would spew out the most. We experimented with Canada Dry Ginger Ale, Fanta, Coca Cola, and Sprite. As the ginger ale had the highest amount of sugar, it ended up spewing the most. Since Sprite had the least amount of sugar, it spewed the least. These results prove our hypothesis.



**84th Pittsburgh Regional
Science & Engineering Fair**

Intermediate Division

**Computer Science / Math
(MCM)**

Student Project Abstracts

March 28, 2023

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.

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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
 - ES – Earth/Space/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)

Computer Science / Math (MCM)

MCM100: Concierge

My project is called Concierge, which is a French word, meaning caretaker. My project is a website that allows the user to find the perfect vacation destination with an address. The purpose of this project is to allow the user to spend more time on more useful tasks than just scrolling for destinations, as well as save money. Secondly, the purpose is to develop my skills in coding and help improve the computer science community. The procedure for making this project possible starts by creating an HTML file for the website. The user will be able to enter their query in an input box. I send the query to the python file. In the python file, I use the Google Places API to result in an array of about 20 different locations, and I use the rating and machine learning to analyze how close the summaries of the places match with the query to result in a final answer of a destination. The query is returned to the HTML file where it is displayed. The data for the 20 places is collected by using the Places API. The text analysis dataset is already established within the SciKitLearn model. The conclusions I have reached are that it is possible to create a project like this. I also have found that using the Places API will result in a more positive answer than using a dataset of many countries and results.

MCM101: A More Efficient Verification of Digital Currency

Digital currency is a concept thought of ever since the internet arose. It was created as a decentralized alternative to fiat currencies so governments do not control the supply of it. But even digital currencies have some flaws that may turn them toward centralized control such as ownership of currency by only a few people and only a few nodes operating in the peer-to-peer network. Another big problem with digital currencies is that it requires enormous energy and computing power to mint and secure, most of which are harmful to the environment. The purpose of my experiment is to create a digital currency that can withstand attacks like 51% attack, transaction editing, and central ownership and auditing while making the currency private and user-friendly. I will first test out digital currency protocols such as Proof-of-Work and Proof-of-Stake to see which one consumes less energy (in watts) per unit minted and record the data on paper. Next, I will test those protocols to see how resistant to centralized control they are and how private they keep users' information by checking transaction data in the blockchain on how many leaks each one has. At the end, I will create a digital currency based on the best performing models. I am still completing the project and the final results will be presented at the science fair.

MCM102: Base 10 Time

Please visit student's exhibit for abstract

MCM103: Novel way to detect certain medical issues using facial recognition techniques and AI machine learning

The purpose of this experiment is to detect certain types of medical issues from the face of a person using facial recognition techniques and AI machine learning software. First, various types & characteristics of medical issues that exhibit symptoms on the face were collected and analyzed thoroughly. A software product was developed using industry-leading facial recognition/face mesh software library modules. A sample human face was mapped using facial recognition/face mesh techniques, and the coordinates of all key parts of the face were collected and stored in the system for reference. The pre-defined medical issues were mapped to various facial coordinates and programmed to be detected. After doing the initial set-ups, pictures of people could be taken and fed to the system. The software product would then scan those pictures using facial recognition & face mesh techniques, look for medical issues at specific facial coordinates, and would also look for color matching to detect if a person had any specific medical issue(s). If a match was found, the system would highlight the issue area(s) in the picture along with a warning message specific to the potential medical issue(s). An AI machine learning algorithm was added to the software system. The AI algorithm was set up in such a way that it could analyze all combinations of key parameters that are specific to those medical issues and compare those parameters against what is displayed on the scanned pictures to make better predictions.

MCM104: Prediction of Coronary Heart Disease Using Machine Learning

Background: Coronary Heart Disease (CHD) is the reduction of blood flow to the heart muscle due to blockage in the coronary arteries and is a leading cause of death in the USA. As such, successful CHD predictions will save lives. Machine Learning has been successfully used to predict weather, the stock market, etc. Hypothesis: Machine Learning approaches can be used to predict 10-year CHD risks in patients. Methods: Using Linear Discriminant Analysis in Python coding, I trained a Machine Learning model with a Framingham heart study dataset of more than 3,658 patients. Next, I predicted 10-year CHD risk in 37 patients. Results: The accuracy of the model turned out to be near 89%. In the test population, the model successfully predicted the 10-year CHD risk in the patients. Conclusion: Successful predictions of CHD using the Machine Learning approach will prevent the disease in patients with a high cardiovascular risk.



**84th Pittsburgh Regional
Science & Engineering Fair**

**Intermediate Division
Consumer Science (MCS)
Student Project Abstracts
March 28, 2023**

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Consumer Science (MCS)

MCS100: Does the color of the sunglass lens impact the percentage of UV protection?

This project can benefit society by informing people about the best types of sunglasses to protect your eyes. Many people buy sunglasses for their looks and not for their actual value of them. With this experiment, people can learn what sunglasses they can buy that look good and help keep their eyes safe.

MCS102: What SPF Level Blocks UV Rays the Most?

Using UV sensitive beads, four different Sun Protection Factors (SPF) levels of Banana Boat spray sunscreen were evaluated. Once the sunscreen was applied to the beads, the beads were exposed to sunlight for a set period of time. The resulting bead color change was compared to a color scale with assigned values. The resulting data show that the SPF 70 sunscreen provided the greatest amount of protection from UV rays. Cream sunscreens were then evaluated in a similar manner.

MCS103: How do Brita water filters compare to generic filters

I tested two GAC (Granulated Activated Carbon) filters (Brita and Kirkland) against different types of water to determine if the cost of the filter affects its efficiency. My hypothesis for this is If the levels of the chemicals in the water are related to where the water was retrieved and the filter brand, then both filters will perform the same because according to freshwater systems GAC filters are mostly made of burnt coconut shells and with the same material in both they will filter the same contaminants out. To begin the experiment, I used a water filter container to funnel water through the filters. I tested the water before and after with water test strips. I found that with the Brita filter, it did almost exactly the same as the Kirkland with removing overall 30 MG/L of fluoride and 10 MG/L of lead from the waters. They both also removed 5.25 MG/L of total chlorine which proves that my hypothesis was correct. Iron, Copper, pH and Free Chlorine were found to be removed at the same rate from all water samples after filtering. There was an error in my procedure with using distilled water in the filter before and after, the water was affected with little to no minerals in the water and there was a trend of low pH's in the water. Since distilled water has no minerals and has a pH of 5.7, it contaminated the results severely. If I could fix my mistake, I would research how to clean the filters without contaminating the results.

MCS104: The Effects of Candle Burning on Indoor Air Quality

Candle burning in one's home has increased in popularity over the past decade because people are interested in home fragrance for enjoyment and aromatherapy. However, when candles are burned they emit trace amounts of harmful organic chemicals into the home. Considering the amount of time people spend inside their homes, having good Indoor Air Quality is important to one's health. Using commercial grade, mass produced candles in various scents and locally produced candles in beeswax and soy, I determined if air quality is effected by a candle burning. An air quality monitor was used to take controlled readings of various measurements, including air quality levels, fine particulate readings, and volatile organic compounds. I determined that a beeswax candle and the scent mint produce that safest readings when my measurements were analyzed.

MCS105: Think Before YOU Drink

When hiking, and during everyday life, it is necessary to have safe water to drink from a natural source. What is an effective and easy method for making water from a natural source clean and safe to drink? The researcher hypothesizes that if water from a natural source is boiled, purified using chlorine tablets, or purified using the Nature Nova water filter, the water that was boiled will be most efficiently cleaned of bacteria and safe to drink. The experiment tests the natural water source for bacteria, applies one of the purification methods, and then retests the purified water for bacteria. All of the purification methods used cleansed the water of bacteria. In conclusion, the most efficient way to purify water is the Nature Nova because it purified the water instantly; the other methods worked, but took more time and resources to purify the water. The hypothesis was not fully supported because while the method worked it was not the most efficient and easy purification method.

MCS106: Fast and Furious Stickhandling

The purpose of this experiment is to determine if composite hockey sticks are better than wood sticks for hockey. The scientific question is will a composite or a wood hockey stick move the puck faster and make handling the puck easier. The researcher believes that composite sticks are better in both elements as it is the most used type of hockey stick in the NHL. Procedures will include speed testing by radar and stickhandling around cones (obstacles). The researcher took the four sticks, shoot the puck/ball, and stick handles around cones. Wood was the best for slapshots, Composite and wood were good for wrist shots, and Comp was the best for stickhandling. The researcher's hypothesis was supported in all the ways.

MCS107: Determining the effects of waste reduction methods on household waste output

Households in the United States produce too much Municipal Solid Waste (MSW). The nation throws away approximately 293 million tons per year. This is a problem, because most of this garbage will end up in oceans, landfills, and most of us do not recycle at all. Even just the production of these materials requires waste and hazardous bi-products. The purpose of this project is to test the effectiveness of a Family Waste Reduction Plan in reducing MSW as well as the magnitude of that effect. To test this, I will perform a two-week house-hold waste audit to estimate the amount of MSW we produce and to identify areas of excess waste. I will develop a Family Waste Reduction Plan (FWRP) that intends to reduce our MSW. Examples of strategies in FWRP include composting, changing from paper towels to cloth towels, and purchasing milk in glass bottles rather than plastic jugs. I will test the impact of the FWRP using a difference and differences design. In the pre-period, I will weigh my family's and my neighbors' total MSW for two weeks. I will then implement our FWRP for four weeks. Finally we will compare the pre-post difference in MSW between treatment and control. After our initial waste audit, we discovered that we throw out 24.6 pounds per week for a total of 1,280 pounds per year. Of that waste, 35% was food packaging, 25% was solid food waste, 21% was paper products and 19% was other.

MCS108: Keeping Your Body Warm: An Insulation Investigation

When we use rainwear, we need to know that the waterproof fabric will hold in our body heat and keep water out. Wet fabric can lower our body temperature enough to have potentially deadly consequences, so we strive to create better fabrics that keep us warm and dry. Unfortunately, many waterproof fabrics require non-biodegradable waterproof coatings and cause unhealthy carbon emissions, and material waste, when produced. This harms our ecosystem, organisms, and ultimately, humanity. Luckily, scientists have begun to create several eco-friendly fabrics for rainproof apparel, including recycled polyester, Gore-Tex, and cork. In this experiment, I wrapped different fabrics around mason jars, filled with body temperature water, then sprayed them with water to simulate rain. Next, I measured the water inside the jar's temperature at fifteen- and thirty-minute intervals. After calculating the average temperatures from the three trials I conducted, wool came in first, closely followed by pineapple, an eco-friendly fabric. This is because they are both thick enough to retain heat, with pores small enough to let water vapor escape. Loosely woven fabrics have air pockets to hold warm air, and both wool and pineapple are woven that way. After them came cork, then Gore-Tex, recycled polyester, fleece, nylon, flannel, canvas treated with Otterwax, my control jar, and finally cotton. This is because cotton has large air holes to breathe, which lets water in, then gets wet. This proves that while some traditional fabrics work well, eco-friendly fabrics have the potential to revolutionize the fashion and environmental worlds.

MCS109: STOP ROT

Please visit student's exhibit for abstract

MCS111: What Brand of Paper Towel Absorbs the Most Water?

In my project, I compared 3 different brands of paper towels, Viva paper towels (3\$), Soft and Strong paper towels (1\$), and Bounty paper towels (4\$), to contrast each different absorbances. Due to the recent inflation of everyday items, being a part of a big family, I wanted to conduct this experiment to not only save money, but to also get the most reliable paper towels for our everyday messes. I hypothesized that Bounty paper towels, would absorb the most water. The tiny pores on a sheet of paper towel (air pockets) are what make a paper towel absorbent. So, I believe the more expensive brand will have the most air pockets, making it the most absorbent. After I completed my experiment, my hypothesis was supported. Bounty Paper Towels absorbed the most water with 24mg absorbed. Viva paper towels coming in a close second place with 21mg absorbed, and soft and strong paper towels coming in last place with 16mg absorbed. In conclusion, my data shows that the more expensive paper towels, will result in absorbing the most water.

MCS112: Stain Remover Challenge

People use stain removers to remove their stains, but do they really stop to think what kind of stain remover works the best? The purpose of my project is to see what stain remover works better. I put five of the same stains on five different t-shirts. I tested lemon juice, hydrogen peroxide, distilled vinegar and Oxi-Clean on four of the shirts. The fifth t-shirt didn't have any stain remover and will act as my control group. Before my experiment, I thought lemon juice would work best but the results showed that peroxide worked best overall.

MCS113: Why do apples turn brown, and what prevents that the best?

The experiment's purpose was to determine which commonly used preserving agent kept apples fresh the longest. Apples were cut at the same size and dipped into solutions of lemon juice, fruit fresh, and lemon-lime soda, then set onto plates for five hours, taking pictures every thirty minutes. Then Affinity photo was used to measure the average brownness of the apples on a scale of 1-10. The data showed that lemon juice performed the best over extended periods of time. This is because it has a lot of acids to deactivate the polyphenol oxidases that react with the oxygen to make a brown color. In conclusion, when trying to keep apples fresh, lemon juice should be used to keep them fresh.

MCS300: Shake and Explode

The purpose of our experiment is to determine which soda will explode the farthest and why it explodes when it's shaken. To some it may seem like a waste of time, but to us it seems like a progression in our knowledge of explosions. We will do this by using a variety of sodas and measuring the distance from where the can started to where the explosion was the furthest. The final results/data will be presented on fair day. We will also show if our hypothesis of (the soda can that will explode the farthest will be Pepsi) is correct on the fair day.



**84th Pittsburgh Regional
Science & Engineering Fair**

**Intermediate Division
Engineering / Robotics
(MER)**

**Student Project Abstracts
March 28, 2023**

Notes to Judges

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Engineering / Robotics (MER)

MER100: Building and Evaluating Limb Movement Tracking System

In recent years, Virtual Reality (VR) has been growing with vast strides, seeming to be the technology of the future. Social VR applications have the maximum adoption, immersive nature of using avatars in vast expansive worlds. One key prerequisite to these applications is the effective use of Full Body Tracking (FBT) to reflect the movement of the user into the virtual world. Market solutions for FBT can range from \$500 to \$1200. For this reason, I am attempting to make a low cost alternative Limb Movement Tracking System (LMTS) comparable to the already existing FBT solutions in use. My LMTS solutions use an ESP 32 microprocessor, 1 Inertial Measurement Unit (IMU), 8 potentiometers, and a series of 3D printed parts used to mechanically track my legs. This experiment will consist of conducting a series of tests to compare my system against other systems in the market, and will attempt to prove that LMTS technology can be developed using a fraction of the cost.

MER101: Sustainable Soundproof Materials

The purpose of my experiment is to determine if soundproof materials are sustainable. If different materials are used for soundproofing, then the acoustic egg foam will have the most sound reduction for all four frequencies and be the most sustainable. The materials(n=15) are acoustic egg foam, aluminum foil, bubble wrap 1 cm and 2.5 cm, carpet, cork, cotton insulation, fiberglass insulation, foam board, foam sheet, foam board insulation, shredded paper, styrofoam, suede with foam backing, and terry cotton towel. My study materials are the Tone Generator® app, the decibel meter app DecibelX®, and a cardboard box. First, cover a sound-producing device with the specified materials. Second, play a sound at four different frequencies(500, 1000, 2000, 4000 Hz). Third, record the sound with a decibel meter with and without the box covering the sound from 0.6096 meters away. Repeat these steps thrice, one for each trial. Lastly, record the data. The data was analyzed by calculating the percentage decrease of the average of all three trials and the control inside the box. The sustainability of the materials was calculated by using a scoring method based on the following parameters: it does not deplete nonrenewable resources, it does not harm the environment, the making is not harmful, it can be recycled, and it does not harm people. Score 1 if it did, and a 0 if it did not. The results indicate that there was no sustainable soundproof material because the superior soundproof materials were not very sustainable.

MER102: Which materials prevent flood water from damaging a building?

This project has a positive impact to society because the US is spending 80 million dollars annually on rebuilding houses from hurricanes or floods. This data benefits people on the coast or living by large bodies of water because they may choose to retrofit their homes to prevent them from water damage.

MER103: Sustainable Buildings

This project portrays how we can help to sustain our Earth's health and cleanliness with renewable energy. With different technologies such as solar products, wind turbines, and geothermal energy pumps integrated into the architectural design of buildings, we can make the world cleaner and greener. We can also incorporate plants into buildings for healthier workspaces and insulation. Even small steps like these can slowly turn the tide of our ever-dirtier world.

MER104: Getting a Kick out of Science

In this science fair project, I designed a device that I will use when performing tests in order to determine the ideal PSI level of a soccer ball for it to travel the furthest distance. I made a kicking device that ensures the same force is applied when hitting the ball in each test which I built out of durable materials that will stay stable and trustworthy during testing. After I collect all of the data needed, I will create charts and graphs to represent the data that I analyzed.

MER105: Fall Sensor Detection

The purpose of my experiment is to detect the fall of a person using an accelerometer, allowing the person to get medical attention quickly. My inspiration for this project is when my grandma fell several times and broke many bones, which has affected her life. I realized that when she fell, sometimes people were not home which led to more injuries, and if someone was alerted she would have gotten medical attention quicker. Another instance where I saw this happening is at the nursing home where my mother works. When I went there I saw the problem of the elderly patients falling when a nurse wasn't around, and this ultimately led to more injuries. Seeing the impact of this problem, I decided to test an MPU6050 and ADXL345 accelerometer with the Arduino Uno, to see if it can identify a fall. I created an algorithm, which detects a rapid change in acceleration, using the accelerometer. My experiment was dropping the accelerometer from 3 different heights and observing the results at each height. The results were that the accelerometer could consistently detect there was a fall from the first height, but as it got higher it got harder for the accelerometer to detect a fall because of more variables and factors as the drop was higher. A way to improve the accuracy is to adjust the algorithm, so it can accommodate for the increased factors and give more precise readings.

MER106: The Effect of Infill Density of a 3D Printed Object on Strength of That Object

Please visit student's exhibit for abstract

MER107: Break Legos with Ease

The question we will be answering is, Can spraying legos with water, water/soap, or hand sanitizer before building help legos come apart faster? I have played with legos many times and sometimes it is really hard to get them apart. I believe if you spray the legos with water, water/soap, or hand sanitizer before building the legos will come apart faster. I think the water/soap will help the legos come apart faster after you build something. This project can help kids and lego builders clean up faster and not be mad or get hurt over stuck lego pieces. To complete this project I used three bags of twenty legos. I had three students spray their twenty legos with water first, build identical towers, and then timed them taking the legos apart. Second I had three students spray their twenty legos with soap and water, build identical towers, and then timed them taking the legos apart. Third I had three students spray their twenty legos with hand sanitizer, build identical towers, and then timed them taking the legos apart. I found the soap and water mix was the only spray that allowed all the students to take the legos apart without problems and in 16 seconds.

MER108: Why We Should Have Vertical Wind Turbines for Pittsburgh's Roads

The purpose of this project is to show people how vertical wind turbines can prove useful for Pittsburgh's economy. It is hypothesized that wind energy will be a cleaner and alternative energy source for people to use. The wind measured for this project was measured by a wind anemometer that tells the wind speed of the coming cars. The average wind speed (AWS) will be measured on the PA turnpike and another will be measured on one of Pittsburgh's bridges. I will also collect measurements & wind speeds of a train to compare them to a car's AWS. These tests will determine how much wind energy can be provided Pittsburgh's multiple roads.

MER109: Hammer time! Work Hardening of Metals

The world is full of different metals. They are among the most important materials in society. Metals are found in things from airplanes, cars, baseball bats, to even cereal. Sometimes metals are not as hard as they need to be to make an effective product. To fix this, the metals are work hardened. Work hardening is when dislocations are created in a metal by hammering, rolling, or other processes. These dislocations strengthen the metal. Work hardening is very important for the development of new alloys. The purpose of this experiment is to find what metals work harden the easiest and most proficiently. It is hypothesized that aluminum will work harden the best because of its light yet sturdy nature. It is also hypothesized that the more dense metals will be more difficult to work harden, such as stainless steel. The hypothesized order from best to worst is aluminum, titanium, nickel, copper, and stainless steel. Five strips of different metals will be measured for their thickness using a micrometer, and hardness using a hardness tester as a baseline. The strips will be hammered to work harden the metals. Thickness and hardness will be measured again and compared to the initial measurements. This process will be repeated multiple times. All data will be entered into a spreadsheet. Results including Statistical analysis (ANOVA, T-Test, Exc.) and graphs will be presented at the fair.

MER110: Removing Metal Contacts from Solar Cells to Improve Efficiency

This project revolves around the removal of fingers and busbars from the top layer of solar cells. While metal contacts are a vital part of solar cells, there are some drawbacks to them, some of which include a loss of usable space and more money spent on making and applying the contacts. As a solution to this problem, I designed a new structure for the contactless solar cell with the research I conducted with Oriden LLC. By inverting the PN junction from a vertical to horizontal configuration, and using rear contacts as the charge carrier collectors, the hypothetical science shows that there would be an increase in efficiency. However, I am not able to manufacture the custom solar cell at this moment in time, but I am working with Bally Design to produce and test a prototype in the future.

MER111: Mega Magnetism

Please visit student's exhibit for abstract

MER112: What is the most effective insulation for a home?

Please visit student's exhibit for abstract

MER113: Ultimate Fisherman

The purpose of this project is to be able to hold all of the necessary equipment for fishing in one little cart for easy transport. When creating this project there were some engineering problems. One of those being how it was going to hold all of the supplies together. The procedures used to make the fishing cart were 1. Attach the rod holders (PVC Pipes) 2. Add the milk create along with the bait bucket and tackle box 3. Apply JB Weld to the metal bracket and add the battery inside the ammo crate 4. Hook up the wiring for the battery and add the tool holders and aerator. The fishing cart worked because it was able to hold all of the fishing supplies easily in only one trip. This means that the experimenter was able to take this cart down to a fishing spot with no trouble and all at the same time. So in conclusion the Ultimate Fisherman project was a success. It is able to hold all of the fishing stuff to get to the fishing spot easily and quickly.

MER114: Bucket - Lift N' Dump

The experimenter created the project because it would be beneficial for time management, when lifting buckets over a gate. When doing farm chores, the experimenter has to lift a bucket of milk over a gate, while calves try to knock the feeder off the fence. It is difficult for the experimenter to dump the bucket into the feeder. By having a Lift %u2018N Dump pulley system, the experimenter will be able to lift the bucket quicker than usual. If the lift can hoist the bucket quicker than the experimenter could, it would make the job take less time and energy. - The project is used to lift a 5 gallon milk bucket over a fence and dump it into a feeder. The pulley system is held together by metal piping. The research consists of how pulleys operate and why they work efficiently. To operate this invention, the experimenter simply cranks the winch in order to activate the pulley, once the pulley is activated, the bucket is hoisted up and over the gate. The winch, pulley, and bucket mechanisms all work like they are supposed to. The winch is able to activate the pulley and the pulley cables are able to support the weight of the 5 gallon bucket. The conclusion of my pulley system was that the original prototype had to be slightly modified to make the goal of the pulley system accurate.

MER115: Shower Flow Rate Display Device

The purpose was to reduce the amount of water consumed during a shower by providing someone the ability to see how much water or money is spent while showering and set a custom threshold for a visual warning. The procedure used to test the device was to set the threshold and pour a measured amount of water (2.0 L) into the top reservoir and let the water flow through the device, expecting the LEDs to light in sequence during, the LCD to display the accurate flow and cost. After the water flowed through the meter check the LCD display board, and record the water the device thought went through. The first test the LEDs were lighting successfully but the LCD showed an average of .68 Liters. The second test, after modifications including recalibration, had an average of 1.97 Liters registered. The interpretation from the first test data showed that the flow meter was not reading the water volume properly and probably the flow rate, flow meter, or something in the code was wrong. The tests after the modifications showed that the modifications were successful and the project is accurate. The conclusion is, the project can properly read water flowing out of the demonstrative device and can be adjusted for any flow velocity within the range the device can handle. This device can be used in research to record the amount of water and how long any shower took. This information could be interpreted and used for other devices.

MER300: Sound energy

A conversation about the lack of clean energy sources available led us to notice the untapped possibility of converting the kinetic energy in sound waves into electricity. We hypothesized that if we used technology similar to that found in a dynamic microphone, then we could produce electricity from sound waves. To test our theory, we disassembled a dynamic microphone to see if we could use its sensitive, premade assembly to produce a significant electrical charge. We then modified the assembly with 3D-printed housings intended to improve the efficiency and longevity of the device. Continuing with our testing, we measured electrical outputs in correlation to the decibel level and frequency of the sounds inputted. We theorized that a change in decibel level and frequency would affect the electrical output. Provided the results show an appreciable production of electricity, we hope to implement this technology in locations with desirable noise levels and adjacent sites that would benefit from the surplus of green electricity.

MER301: Wonder about Yondr

Wonder about Yondr The question we answered was, Do Yondr pouches prevent students from using phones in school?. We believe our school's goal by having students use Yondr pouches is to prevent students from using phones so we are safe, education is first, and we are not cheating. We believe yondr pouches are not working to prevent students from using phones because students know how to open them. The Yondr pouch website explains the school will be a phone free area with their product. The steps we took to complete this project was to make a survey on google forms asking students if they have a phone, do they use the yondr pouch, have they used a Yondr pouch, and if they do not use the Yondr pouch how. We collected data by sending out the Yondr survey to all the teachers so they could post the survey to students in their google classrooms. Finally, we tested the Yondr pouches to see if phones stay in them. When looking at our data we do not think the Yondr pouches prevent students from using phones in school. We think many factors help students not use phones but if they really want to use their phones in school they can.

MER302: DIY Dynamo

My experiment provides bikers with a light powered on a dynamo. We wanted to find out if using a dynamo to power a light is more efficient and eco friendly than using a battery. To do this I took a brushless 3v dc motor, a circuit board (which consists of a 2v led light, a button, and a connected rechargeable battery), and a wheel glued to the shaft of the motor. How it works is that when the motor spins at a certain speed it causes the motor to generate up to 3 volts of electricity to the circuit board, both powering the light and providing charge to the battery. The battery being charged is beneficial due to the fact that the dynamo system doesn't need to constantly run to power the light, instead being powered from the battery. The user can turn on and off the light at any given time, but does not stop the battery from being powered. After several tests, and research we have concluded that the motor needs to be spinning at a minimum constant speed of 2400 RPM (rounds per minute) to power the minimum voltage to power the light and give charge to the battery, this speed can be achieved by even riding pretty slowly for a few minutes. More designs, and improved materials will be used to increase the efficiency and power of the dynamo.



84th Pittsburgh Regional Science & Engineering Fair

Intermediate Division

**Earth / Space /
Environment (MES)**

Student Project Abstracts

March 28, 2023

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Earth / Space / Environment (MES)

MEE100: How quickly does a heat lamp increase the temperature on different surfaces?

These materials are used mostly everywhere, on buildings, clothing, the world itself, roads, and more. All these can be affected by heat, with looking at the temperature of each of the materials from a 250 watt lamp. You can see the temperature closely compared with the sun, you can look at the temperature and change materials to help with anything like building homes, buildings, schools, etc.

MEE101: Controlling Duckweed Populations

Duckweed has many benefits to the ecosystem and reproduces rather rapidly. However, large quantities of Duckweed can be harmful for the environment. For my experiment, I have several different ways to control the growth of Duckweed such as using daily products, competition of resources, and different pH levels. I will then compare the results of my experiment and deem the factor that controlled the growth the best as the most efficient way. The population of the Duckweed should neither be rapidly dwindling nor thriving in reproduction in order for a factor to have successfully controlled the population growth.

MEE102: How Do Environmental Factors Affect Solar Panels?

The cleanliness of solar panels on energy production was evaluated. A solar powered solar toy car was tested with a clean solar panel, a solar panel covered with dirt and dust and a solar panel covered with artificial bird droppings. The resulting run times were measured.

MEE103: How different liquids keep flowers alive

Hypothesis: if i find a liquid that has water base Research:<https://www.livescience.com/38901-keep-cut-flowers-fresh.html> I need my project. I need vodka, aspirin with tap water ,water, 7up and 4 chrysanthemums. I am also going to need 4 reuse soda/water bottles. First pour the material into the bottles then we have to wait and see which flowers stay alive longer. once the flower stays alive for at least two weeks. I found it online on a website called 7thgradescience projects.com the website showed me how to do my project and what materials to use and how to use it. Did you know that there is more than one liquid to keep your flowers alive? I have found out that 7up, vodka and aspirin and water a liable to keep your plants alive i am going to see which liquid is going to last longer in the span of two weeks. I am going to be using my research to see if some of won't do anything or if it keeps it alive. My first research website is where I used this website to find the ingredients to my project <https://www.livescience.com/38901-keep-cut-flowers-fresh.html> i used this website to find my ingredients ingredients and how to use them. This link has what each material will do for the flower. <https://www.ftd.com/blog/create/mythbusters-keep-flowers-fresh-longer> My second website showed me what the flowers looked like each day. It also showed me what worked best when they did the experiment. The website also provided how they flowers set up and how the liquids are going to affect the flower My third link <https://www.rd.com/list/how-to-make-flowers-last-longer/> this website gave me tips on different types of liquids that I didn't use but it gave me some on some that did. First it told me what each material would do to the flower it also showed how it would affect the flower. My fourth link is <https://www.epicgardening.com/aspirin-for-plants/#:~:text=Many%20gardeners%20swear%20by%20dissolving,help%20the%20plants%20last%20longer>. I used is google.com To answer my question for each one I also used it told me that some of the materials i am using might need to be Refrigerated and they need to be in the sun My fifth link is <https://www.proflowers.com/%u203Ablog/%u203Ahow-to-make-flowe...> I used this link to write my introduction paragraph and it gave me tips and tricks to help me do my project. this link also showed me the best way for my flowers to be when doing my project. the link showed me how to set it up too.

MEE104: How does atmospheric temperature affect the energy output of solar panels?

Carbon dioxide pollution causes climate change and global warming. 40% of all carbon dioxide pollution comes from power plants burning fossil fuels for energy. The Department of Energy's (DOE) goal of net-zero carbon emissions by 2050 can be achieved by making renewable energy, mainly solar energy, more abundant, affordable, and accessible to everyone. The purpose of this experiment is to better understand how atmospheric temperature affects the energy output of solar panels. I used three solar panels connected in series to measure voltage (Volts) and current (Amperes) using a digital multimeter on different days with different weather conditions. The atmosphere was measured using quantitative and qualitative data. Quantitative data included the outdoor temperature measured with a thermometer (in degrees Fahrenheit), date, and time. Qualitative data included the weather conditions such as cloud coverage and sun location. I calculated the Power (Watts) by multiplying the Volts and Amps. The collected data was analyzed by making a table, and 3 line graphs, each for Volts, Amps, and Watts versus temperature. This was an effective method to display smaller changes in a trend over a temperature range. My hypothesis states that at cooler temperatures, the panels will produce more energy because of the effects of the temperature coefficient. The data collected thus far shows there is an optimal temperature range where the power produced is greater. Experimentation is continuing to collect and analyze more data. This study can be used to determine in which cities solar energy would be a more feasible option.

MEE105: Runoff Ruse

The purpose of this project is to determine if farms pollute nearby streams. Does runoff from farms affect nearby streams? The researcher hypothesizes that if there is a farm near a stream then there is potential for the fertilizer and animal waste runoff from the farm will impact the stream. To test the hypothesis, the researcher tested stream water at different locations near farms and away from farms, to measure concentrations of nitrate, nitrite, phosphorus, sulfate, and ammonia, which are common contaminants from farms. The results of the stream sampling streams indicated that streams near farms had higher detections than the control stream. Based on the results, the hypothesis was supported because it was predicted that there would be more pollution in the streams near farms than in streams not near farms.

MEE106: It's All About the Soil: Bacterial Inoculant vs Fertilizer

Due to soil erosion, pesticide use, and modern farming techniques, the average person's soil has been depleted of many nutrients needed to grow plants. To relieve this problem, people have been adding nutrients in various forms to the soil. However, they are unsure of which nutrients to use and some people may even think chemicals are useful to the soil itself. Recent science has uncovered the importance of bacteria and fungi in the soil makeup. One bacterium that is necessary to convert the nitrogen in the soil to a usable form for plants is rhizobia. In my project, I would like to compare growing bush beans in soil with rhizobia inoculant vs a nitrogen fertilizer.

MEE107: Model to optimize energy consumption in a household to charge Electric Vehicle

Model to optimize energy consumption in a household to charge Electric Vehicle **Rationale** In order to decrease the carbon footprint, electric vehicles are the future of the world. Use of the electrical vehicles will add to the energy consumption for each household and increase the load on electric grids. The national data from the American Council for an Energy Efficient Economy (ACEEE) report in 2017 finds that high energy burdens remain a persistent national challenge. On an average, energy consumption per household is 893 kWh per month. In addition to this, electrical vehicles for example Tesla Model 3 will add extra consumption of 180 kWh per month. So I wonder: To what extent the increased electrical consumption due to charging of electric vehicles can be offset by making the average household more energy efficient? This research is important because finding different ways to make your house energy efficient will not only keep your utilization and cost under control but eventually reduce the burden on the country and reduce the carbon footprint. **Research question:** To what extent the increased electrical consumption due to charging of electric vehicles, can be offset by making the average household more energy efficient? **Hypothesis:** My hypothesis is that using energy efficient measures like LED bulbs and lights, Energy efficient appliances in the house and proper insulation will reduce the consumption of the electricity enough to offset the increased cost of charging an electric vehicle. **Method (Procedure)** I intend to create a statistical model to calculate the consumption of electricity in an average suburban home (3-4 bedroom, approx 2500 sqft) without an Electric vehicle and then recommend changes in the installed lights, appliances and insulation to make them energy efficient. For this, 1. I will first record the current electric consumption in the house. Following data from 10-15 typical homes will be collected- a. Type and energy consumption of light bulbs in each room b. Type and energy consumption by each major appliance c. Whether smart thermostat is being used d. Whether old windows (older than 25 yrs) have been replaced 2. Identify the opportunities in the house to make it energy efficient Use of the LED lights to replace regular bulbs a. Use of smart thermostat b. Use of energy efficient appliances 3. Compute the reduction in the energy consumption a. Estimate reduction in each change in Step 2 b. Compute total reduction 4. Compute offset a. Compute increase in energy consumption by the electric vehicle based on the average usage b. Compute the offset in cost. **Data Analysis** I will input the above data in an excel sheet, then calculate the change in energy consumption before and after taking the energy efficient measures. I will also do the cost benefit analysis for making the changes in the house. This model will provide actionable recommendations for achieving energy efficiency in order to power the electrical vehicle.

MEE108: Does Magnetism Affect Hatchability?

Background: I became interested in magnetism after discovering that cell towers, electrical lines, and radio transmissions all produce magnetic fields. A magnetic field is the area where a magnetic force is exerted. Magnetic fields make it possible for magnets to interact without touching. Magnetism is simply an attractive force between objects. Magnetic field lines are invisible lines that map out the magnetic field around a magnet. The lines form complete loops from pole to pole and never cross. The distance between magnetic field lines indicates the strength of the magnetic field. The closer together the lines are, the stronger the magnetic field. According to the U.S. Department of the Interior, magnetism does not directly affect human health, however, as stated in the European Journal of Biology, brine shrimp eggs that are exposed to magnetic fields are noticeably affected by the magnetic field. The magnetic field had a negative effect on the brine shrimp. The higher the magnetic strength the lower the hatching rate. Since magnetic fields are quite common, I wondered if they affected the hatching rate of brine shrimp. So, I decided to design a test to find out. Brine shrimp are crustaceans found in the Great Salt Lake of Utah. There are approximately 35 cell towers around the Great Salt Lake and in the surrounding areas. This got me thinking, if these towers are so close to the Great Salt Lake, then, what kind of effect does the presence of the magnetic field have on the hatching rate of the brine shrimp. Magnetic strength, also referred to as magnetic field intensity, is simply how intense a magnet is. The strength of a magnetic field depends on how high the magnetic strength is. Magnetic strength decreases as you get further from the source of the magnetic field. Brine shrimp, (*Artemia*) are tiny aquatic crustaceans that live in very salty waters. They serve as a food source for the 200 species of birds that migrate over the Great Salt Lake, smaller crustaceans, and other fish. According to the Utah Department of Natural Resources, eared grebes feed mostly on brine shrimp during their preparation for migration. If an animal does not have enough food to sustain their diet, it can affect the entire food chain, and affect us. Methods: To begin, it was necessary to purchase brine shrimp eggs, petri dishes, sea salt, spring water, 33mm (about 1.3 in) magnets, grow lights, a Vernier LabQuest 2, and a Vernier magnetic field sensor. (Next Slide) 30 brine shrimp eggs were placed in each of the 90 petri dishes. Then, 30 dishes were randomly selected for each level of magnetism and then labeled 1-30 for identification. So, there are 3 sets of petri dishes containing 30 brine shrimp eggs. Grow lights were placed 21.5 cm above the testing area and an area of 30 cm was marked so that each dish received the same amount of light. (Next Slide) Next, 93 g of sea salt was added to 1000 ml of spring water. The sea salt was dissolved into the water with a magnetic stirrer for 15 minutes. As you can see, I designed a template in order to keep the placement of the magnets consistent. The magnets of the first level (the inner ring) contacted the petri dish which is the large circle in the center of the template and were 42 mm away from the center of the petri dish to the center of the magnet. They were placed 31 mm apart from center to center of each magnet. Vernier software was used to measure the strength of the inner ring. The average strength of this ring was 3 mT (Milliteslas). A millitesla is a unit of measurement used to describe a magnet's strength. A millitesla is 1000 times smaller than the standard unit used to describe magnetic strength, the Tesla. The magnets for the second level (the outer ring) were placed 92 mm away from the center of the petri dish and 74 mm from center to center. These magnets had to be glued down so they would stay in place because opposites attracted one another while likes repelled. Once again, the Vernier software was used to measure the strength of the magnets. The average magnetic strength of this set of magnets was 0.06 mT (Milliteslas). Next, 6 petri dishes were filled with 6 ml of mixed salt water. The lids were then placed on the petri dishes and the grow lights were turned on. The petri dishes containing 30 brine shrimp eggs were then placed on the template and left under the lights for 48 hours. After 48 hours, the live brine shrimp were counted and recorded. This process was repeated 5 more times for 30 petri dishes for the control. Then magnets were placed on the templates for level 1. Once again 6 petri dishes were filled with 6 ml of mixed salt water. The same process used for the control was also used for level 1, except there was a magnetic field surrounding the petri dishes. This process was repeated 5 more times for 30 petri dishes for level 1. Next, magnets from level 1 were removed and replaced with magnets on the templates for level 2. Like level 1, 6 petri dishes were filled with 6 ml of mixed salt water. The same processes used for the control and level 1 were used for level 2, except there was a lower magnetic field surrounding the petri dishes. This process was repeated 5 more times for 30 petri dishes for level 2, giving me 90 points of data. Results: Conclusion: This project can prove many things in the real world. If a power plant, cell towers or radio towers needed to be built near the great Salt Lake it wouldn't disrupt the ecosystem. You must be careful when introducing new forces and elements to an ecosystem, because it could disrupt the whole food chain. Overall, this project shows that there is no statistical effect of magnetism on brine shrimp.

MEE109: Which energy works better for cars: Wind or Solar?

Climate change is a concerning situation for the present and future of humanity. It will reach catastrophic levels by 2050 if we do not reduce CO₂ production. Traditional cars play a crucial role in Climate change. They emit greenhouse gases (such as CO₂) when they burn fossil fuels. But gasoline is not the only energy we can use; Aeolian and Solar energies are renewable and sustainable options. Studies have shown that both are very efficient, but scientists are still researching which is more efficient and for what. My project aims to evaluate if Solar or Aeolian energy is better for the future of cars not powered by fossil fuels. I am testing three prototype cars, one powered by Aeolian energy, another by Solar energy, and one with batteries. The car with the batteries represents fossil fuels. First, I will test how far and fast the car prototypes powered by solar and wind energy advance. Then I will compare their results with the speed and distance the battery-powered car achieves. With those results, I will be able to determine which renewable energy could be the best replacement for fossil fuels. I am using cardboard, DC motors, straws, cups (wheels), skewer sticks for the axles, solar panels for the solar car, and a fan for the Aeolian car. I am using these materials to create the cars. Experimentation is continuing, and the data will be available on the day of the fair.

MEE110: Wireless Energy Transfer

Wireless transmission is useful to power electrical devices and eliminate wasteful material. Whenever a coil obtains energy, it creates a magnetic field around itself. For the basic structure, one of the coils is connected to a transmitter which is an electronic circuit that transforms electric power from a battery. When I added a resistor to reduce current flow. The second coil with the same resonant frequency as the coil. Then, it resonates anywhere within that region converting the oscillating magnetic field into a magnetic current within the second coil. This is called highly compelling magnetic resonance. The coil is connected to a led which turns on to show the energy transfer. Based on this basic structure above I established other experiments. When using inductive coupling, the efficiency degrades sharply as coils separate. The strong resonant coupling can achieve longer distances of separation between coils with a relatively good efficiency. When the receiving coil is displaced, the energy produced by the generating coil spreads at 90 degrees in front of the generating coil and at 90 degrees behind the same coil. It can also be seen that the highest radiation level is located at 345 degrees and at 165 degrees. When both coils are together, all the energy is sent to the front by the generating coil which is taken by the receiving coil. This is noticed when the voltage gain is 50%. Beyond the 8 cm distance, the system voltage gain falls below the -30dB range.

MEE111: Development of Scaled-Down Hydroelectricity.

Electricity is a necessary component in our daily lives in the modern world, but unfortunately, it is not always accessible to everyone and everywhere. The aim of this project is to investigate the potential of hydroelectric dams in providing electricity to underdeveloped countries and as a profitable product marketed towards campers. To gather data, we constructed a PVC pipe dam and attached a miniature hydroelectric generator. We then measured the voltage output under different head pressures and found that there is a direct proportional relationship between the head pressure and the voltage output. Our data shows that the head pressure is directly proportional to the voltage output. In conclusion, our findings suggest that this generator is portable and can be scaled to meet different needs and locations.

MEE112: Remediation of Acid Mine Drainage

Four different natural materials (compost, mulch, limestone chips and pine needles) were evaluated to determine if any one of them might be able to increase the pH of acid mine drainage (AMD). A simulated AMD solution was prepared, and each of the natural materials was soaked in the simulated AMD solution for a set time period. The pH values from before and after treatment were evaluated.

MEE113: Leaf My Yard Alone

Please visit student's exhibit for abstract

MEE114: ZEOLITE FILTERING: Effect of Zeolite on Water

The decreasing amount of drinkable water is a problem that can threaten lives. In order to help solve this problem, I analyzed how zeolite affects water by making a homemade zeolite filter and running water through it. I thought the water would be clearer because zeolite captures particles. When the data showed the percentage of light reflected increased by an average of 7 %u2153% which is approximately a 41% improvement. It proved my hypothesis was true. After using zeolites in the case of a standard filter, the unfiltered water is now clearer.

MEE115: The Right Size

I aim to increase the survival of people who are in a situation where they don't have clean water source with a quick and easy invention: the solar cooker. Its not new. The solar cooker has been around for a while. My plan is not to make a new one but make the one that is already here better by testing if the size of the inside jar matters so in case someone is travelling they will bring the right size. I plan on building my solar cooker with a large ½ gallon jar, a medium inside jar, a small inside jar, tin foil, a cardboard box, water, black paint, and a thermometer. I will first paint both inside jars black and wrap my trifold board in foil. I'll use the smaller inside jar first and put the water inside. I place the big jar in the sunlight, put the smaller jar inside the big jar and put the trifold board behind the jar and wait around ten minutes or if the water starts boiling to check the temperature. I will do the same thing with the medium inside jar. My hypothesis is that if I use a small inside jar for a solar cooker, then the water will heat faster than if I used a medium inside jar because the smaller jar will have less water molecules than the medium sized jar. Less atoms means that the energy can spread through faster since there are fewer water molecules. Some risks do include burning myself or breaking the glass, but I will make sure to check the heat before I touch the glass and I will make sure I wear oven mitts to protect my hands. I will also make sure an adult is in the room to help me. I will make sure that the glass jars are at a level to where I can reach so that I won't drop it on the floor, but if they do, I will get an adult immediately to help clean it up. I will not be drinking the water but only checking the temperature of it. I plan on using a notebook to record my data. I will use the same large jar and will try to have equally sunny conditions for each trial.

MEE116: Staying Grounded

I live in a valley, so it is more common to hear about landslides near me. Landslides can occur near buildings, and they can and will destroy houses and businesses. I want to figure out how to prevent them so I can share the information with my community. If I can find out how to prevent landslides, then I might be able to save my community the money and time it can take to fix the damage. Also, if others live in valleys, they can also use the information in my project to help their communities as well. The reason landslides are more common is because valleys have a steep slant on both sides so when erosion comes into play it makes it extremely easy for dirt to fall from the hillside. If I can help myself and other communities stay and feel safer, then I am willing to do whatever I can to help. I will create a fair and careful procedure where I will test different grass seeds and pour water over them to see which grass prevents erosion the most.

MEE117: Does the type of water affect how tall a plant will grow?

My hypothesis was that if I used tap, spring, and distilled types of water when growing chives, tap water would help the chives grow the tallest. Tap water is the water that humans mostly drink on average. Spring water has fewer chemical elements, but it isn't usually used when watering plants, unlike tap water. Distilled has quite a few chemical elements, making it a lot less natural. The manipulated variable was the type of water used. The responding variable was how tall the chive seeds would grow. After watering each pot of chives with either tap, spring, or distilled water every other day, I measured and averaged all of the heights of the sprouted seeds. The chives' water with tap averaged to 1.233 centimeters, and the chives watered with spring water averaged out to 1.7 centimeters, but only two out of three sprouted, unlike the seeds watered with tap water. The chives watered with distilled only had one seed sprout, so that was the whole average, at 4.3 centimeters. I believe that the type of water affected the soil more than the seeds because it seems like the tap water fully soaked into the soil, so all the seeds sprouted, the spring water only soaked through some, so only two seeds sprouted, and the distilled water barely soaked into the soil, having only one seed sprout.

MEE300: Digital Data Conversion Magic: A JavaScript Binary/Decimal/Hexadecimal Converter

As 7th grade computer science students, we are always looking for ways to deepen our understanding of how computers represent and manipulate data. That is why we are excited to work on this project, which involves writing a JavaScript program to convert numbers between binary, decimal, and hexadecimal notation. Through this project, we will not only improve our programming skills, but also gain a greater appreciation of the various number bases and how they are used in computing. We will learn about the trade-offs and limitations of different number bases, and how these factors have impacted the evolution of computer systems over time. We are also looking forward to the opportunity to engage in further exploration and research in computer science. Completing this project may inspire us to delve deeper into topics such as computer architecture, algorithms, and data structures, or to pursue careers in fields such as networking, cryptography, or data storage, where a solid understanding of number bases is essential. Overall, this project presents a valuable opportunity for us to learn about the fundamental principles of number representation in digital devices and to develop our programming and problem-solving skills. We are confident that it will be a valuable addition to our education and a stepping stone to further success in computer science.



84th Pittsburgh Regional Science & Engineering Fair

Intermediate Division

**Medicine / Health /
Microbiology (MMH)**

Student Project Abstracts

March 28, 2023

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Medicine / Health / Microbiology (MMH)

MMH100: Emotion vs. heart rate?

Learning how different emotions impact your heart rate is a benefit for society because it tells people with heart conditions what kinds of scenarios to try to stay away from in order for them to stay healthy.

MMH101: If You Can't Beat Them, Should You Join Them?

Background: *Daphnia Magna* are arthropods found along the Atlantic coastline and rocky fresh pools in Maine. They prefer waters with a temperature between 18 and 22°C. They have a kidney bean-like shape to their bodies. The males are usually 2 millimeters while the females are larger, tending to be 3 to 5 millimeters in length. Both species of *Daphnia magna* have an enclosed shell-like structure around their body called carapace and five thoracic appendages. The thoracic appendages are used to create a current of water that carries food and oxygen to the mouth and gills. *Daphnia* also have two long claws that are used to clean the carapace and, a compound eye that looks like a dot. *Daphnia magna* has a myogenic heart, which exhibits responses comparable to the human heart. This simply means that the signal for cardiac compression arises in the heart tissue itself, rather than from brain signals. Caffeine is a stimulant commonly found in tea, coffee, energy drinks and chocolate. It keeps people awake and aids in weight loss. Caffeine increases heart rate and blood pressure. A healthy adult should consume no more than 400 milligrams of caffeine per day. If more than that is consumed the adult can experience sleep deprivation and heart burn. After the caffeine is metabolized in the liver the caffeine is absorbed by the small intestine 45 minutes later. Problem: The purpose of this project is to determine how caffeine effects the heart rate of *daphnia magna*. Methods: In order to begin *daphnia magna* were ordered from Carolina Biological and caffeine powder was purchased from my local pharmacy. I decided to order pure caffeine rather than use an energy drink because energy drinks contain a variety of additional ingredients, and I wanted to prevent these ingredients from affecting my data. Once my materials arrived, I was ready to begin. 12 grams of caffeine powder were gradually added to 500 mL of spring water. The solution was stirred using an electric stirrer set at 600 rotations per minute for 40 minutes. In order to create a 25% solution, one drop of the caffeine solution was added to 3 drops of spring water. This procedure was repeated until 28 drops of the 25% solution was in a well slide. To create my 50% dilution, 2 drops of the caffeine solution were added to 2 drops spring water. This procedure was repeated until 28 drops of the 50% dilution added to the well slide, and the 75% dilution was created by adding 3 drops of caffeine solution to 1 drop of spring water until 28 drops were added. For my 100% dilution 28 drops of caffeine were added to the well slide. This entire procedure was repeated until 30 tests were done for each sample. A *daphnia* was randomly selected from the stock culture placed in a well slide under a microscope. 28 drops of spring water were added to the slide. The arthropod was allowed to rest in the solution for 5 minutes before the number of heart beats were counted for 10 seconds and then multiplied by 6 to determine the number of beats per minute. This would be the heart rate prior to experimentation. The *daphnia* was then transferred to a second well slide containing 28 drops of caffeine dilution 25, 50, 75 and 100% and the same procedure was repeated to determine the number of heart beats after experimentation. The *daphnia* was then placed in a beaker to prevent the organism from being returned to the stock culture. This procedure was repeated 29 more times for a total of 30 samples. Results: As you can see in this graph entitled Average Percent Increase in the heart rate of *daphnia* when exposed to various levels of caffeine for five minutes. The y axis shows the average heart rate, and the x axis shows the various caffeine dilutions. As you can see, as the amount of caffeine increased so did the average number of heart beats. However, once I got to the 100% dilution you can see that there was no percent increase because the organisms died after five minutes of exposure. The error bars show a range or spread of data. On this graph it represents the percent increase of the greatest number of heart beats to the lowest number of beats. Now, I would like to explain the stars located within the bars. These stars show the results of my T-test, a T-test shows the percentage of likelihood that results are random, The lower the results of my T-test the more likely the results can be replicated. The results of the T-test all had a p value of

MMH102: How caffeine affects heart rate

In this experiment, daphnia magna were given caffeine to find out how caffeine affects heart rate. It was thought that with an increased amount of caffeine the heart rate would increase. To perform this procedure, dilutions were made to allow for there to be specific amounts of caffeine given to each daphnia magna. The daphnia magna would then be put on a depression slide with a few drops of a specific dilution and would stay there for a few minutes to allow the caffeine to perform its effects. After a few minutes, the depression slide was put under a microscope and a timer was set for ten seconds so that the number of times it beat in those ten seconds would be multiplied by six to find the average beats per minute. The data showed a difference in the most caffeine (100 mg/L) which averaged 264 beats per minute and the control (0 mg/L) which averaged 174 beats per minute. This confirmed that the hypothesis for heart rate increasing with increased caffeine was correct. Of course, there was a strong possibility of error due to the heart rate being counted manually, which may have led to random outliers. Additionally, all the daphnia magna were kept in the same container so it was possible that a daphnia magna was used for multiple trials, which may have led to outliers because it started out with the most amounts of caffeine. For example, in the 10 mg/L, one of the trials got the result of 288 beats per minute while the rest stayed under 252. In addition, in the 100 mg/L, all the trials were over 270, except for one trial that was 246 beats per minute.

MMH103: Can clove oil improve oral hygiene?

I chose this project to explore a variety of different, possibly more efficient ways of improving oral hygiene. Clove oil is known to have anti-inflammatory and pain relieving properties, but what about antimicrobial properties? By finding a better way for people to maintain a good standard of oral health, money can be saved while also working to protect the environment with sustainable products. The additions of peppermint oil and Crest mouthwash gave a good comparison for clove oil. In my experiment, I swabbed my own mouth for bacterial samples and transferred them to agar plates to grow for four days. After four days, I added 0.25 mL of test agent to each quarter of the agar plates (except for the control). My data showed that, while clove oil had a decent effect on the size of the bacteria, peppermint oil actually had the most shrinkage in the size of the colonies. In conclusion, clove oil did prevent the growth of oral bacteria, even though peppermint oil showed better results.

MMH104: The Effect of the Type of Disinfectant on Effectiveness of Killing Bacteria

Please visit student's exhibit for abstract

MMH105: The Amount of Bacteria in Different Types of Water

This project was testing how much bacteria exists in different water sources to see what water would theoretically be the safest to drink if you excluded contaminants. My hypothesis was that water that touches the ground or mixes with sewage will be dirtier than filtered water. Preferably, a method to identify the types of bacteria would be used, but an accessible method was not available. The experiment consisted of collecting water from rivers, a lake and in and outside of a house. Next, the water was applied to agar dip slides. Then, I waited for the bacteria to grow and observed it at 3 and 6 days. The two measurements of bacteria were the approximate count of colonies and the approximate colony-forming units per milliliter. The results showed that any water that has gone through some sort of treatment and is potable is cleaner than water that is found in the outdoors. The outliers to these findings was potable water that had come into contact with an organism. Organisms carry bacteria; those bacteria are usually not harmful, but still contribute to the total amount of bacteria in the water.

MMH106: Do Different Types of Dance Affect Your Heartrate?

Different types of dance can affect your heartrate. My experiment provides us with information on which type of dance raises your heartrate the most. I wanted to test and see if tap, ballet, or jazz affects your heartrate the most. To do so, I got four qualified dancers to test. Each of them wore a watch to track their heartrate, then took each 45-minute class. Before and after each class I recorded their heartrate. The average tap heartrate was 152.25 bpm, the average ballet heartrate was 139.5 bpm, and the average jazz heartrate was 139.75 bpm. I hypothesized that tap dancing would raise the dancers heartrate the most, and this experiment supported my hypothesis.

MMH107: Is the 5 Second Rule True?

Everyone wants to know when you drop food on the ground, is it safe to eat after 5 seconds? My experiment helps people by proving if your food is safe to eat after on the floor for more than 5 seconds. If people finally know the answer to my question, Is the 5 second rule true?, then they can keep themselves safe by not letting bad germs get into their bodies, or that they don't have to worry about it and that it is ok to eat the food 5 seconds or after on the ground. The results of my experiment will be posted on fair day.

MMH108: A Novel Approach to Predicting Flu Seasons

Influenza is a highly contagious virus which majorly affects America in winter months. This time is referred to as the flu season. The purpose of this project was to look for a correlation between vaccination rates, population, and the length of flu seasons in order to ultimately be able to predict their length. I hypothesized that states with lower vaccination rates and higher populations would have longer flu seasons. To test this, I collected data from a variety of states on their populations, vaccination rates, and flu season lengths. I organized this data into various charts, maps, and graphs. After observing the correlation, I saw that high vaccination rates did decrease flu season lengths, while the connection to population was less clear, as flu transmission is more dependent on population density than simply population. Through research, I found that hot climates also decrease the spread of flu, so I decided that hot states and states with very low population density were outliers in the correlation between flu vaccinations and season lengths, and therefore should not be used in the data. I then made a linear regression graph using the percentage of vaccinated individuals in a state as x and the state's average flu season length as y. This graph gave me an equation which I used to predict future flu season lengths in Pennsylvania and can also be used for other states with similar conditions, such as weather, in order to better prepare for the flu season and prevent many cases and deaths.

MMH109: The Effect of pH on Algae and its Cell Structure

For my experiment, I empirically evaluated which pH level is the best for the sustainability of Spirogyra cultures. The pH levels I tested ranged from 5-9. I divided the Spirogyra cultures into 6 cups and added sulfuric acid for acidity or limestone for alkalinity to reach the desired pH. I observed the changes the cultures underwent through a microscope every day for 12 days. I learned that the optimal pH for Spirogyra is 7.5.

MMH110: UV Defense System

I tested the best ways to defend against Ultra-Violet (UV) rays. My hypothesis is that if I use the defense system of sunscreen and clothes covering the skin, they will equally defend the sun rays. Also, the more time the skin is under sunlight, the more it will get damaged by the UV rays. The results show that the exposed skin got more damage from the UV rays. My hypothesis was untrue because the exposed skin with sunscreen got damaged more by the sun compared to the skin being covered by clothing.

MMH111: Which flour in a sourdough starter creates the lowest pH?

Please visit student's exhibit for abstract

MMH300: Efficiency of the 3 Stages of the Grey Water Management Cycle

Climate change and rapid urbanization has led to huge amounts of wastewater discharge. The wastewater reuse has a great potential for reclamation to conserve the valuable fresh water sources. This project demonstrates opportunities in expanding reclaimed greywater reuse, specifically for irrigating lawns in urban areas with simple changes in plumbing system design so greywater could be separated from blackwater and run into a separate treatment system for reuse. Water samples from kitchen sink, bathroom shower and laundry were collected for the project experiment. No toilet water was used in this experiment. We started by replicating what traditional wastewater treatment (WWT) plants use to treat the wastewater. A screening device with filter fabric was used to remove larger solids (preliminary treatment). A multimedia filter (secondary treatment) consisting of fine, coarse sand, pea gravel, coal and coffee filter was used to remove fine settled solids. This water is then treated with chlorine (tertiary treatment) for bacterial removal and prevention of microorganism growth. Both the pre-treated and treated wastewater samples were sent to a laboratory to measure and compare PH, Chlorine, Water Hardness (Ca, Mg), Phosphorus and suspended solids. The lab results indicate that tertiary treatment is not necessary when taking into account the cost and quality aspects of greywater treatment for irrigation reuse. The lab results and research suggest that domestic treated greywater is safe for lawn irrigation and mitigates about 10% of overall irrigation water demand for ensuring long-term economic and environmental sustainability.

MMH301: 5 Second Rule

5 Second Rule: Our goal is to test and find out whether the 5 second rule is reliable or not. Our group wonders if the supposed theory of the 5-second rule is actually a valid excuse for consuming dropped, delicious, and possibly dirty food off of the floor, and we also believe that food picked up after 5 seconds will collect fewer colonies of bacteria than food picked up after 50 seconds. We can apply the data collected in this experiment to validating or voiding the 5 second rule. This experiment can help us find out the truth about the 5 second rule and solve our moral dilemmas. After performing this experiment, we will be able to apply what we learned to the real world, and answer the question; Should I eat this baloney? The basic steps we most likely will take to achieve this goal are (but are not limited to) sanitizing all materials needed for experiment, creating an incubator using a foam cooler, lightbulb, and digital thermometer, creating agar for experiment and putting it into petri dishes, dropping various baloney pieces and using a cotton swab to take bacteria and put onto petri dishes, and incubating petri dishes while checking every day and recording results. The only risks for this project are spillage of substances and electrical fire/shock. The final conclusion and result to this experiment will be provided on fair day.



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Intermediate Division

Physics (MPH)

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March 28, 2023

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Physics and Astronomy (MPA)

MPA100: What is the Perfect Shooting Arc?

Rationale: I decided to do this because shooting arc has always fascinated me. If you can get the perfect arc, you will instantly become a better shooter. Question: What is the perfect shooting arc? Hypothesis: It is hypothesized that the perfect shooting arc (when using a 29.5 inch basketball shooting from the top of the key) is 41 degrees.

Procedure: Take 10 shots using the following arcs: 41, 42, 43, 44, and 45. Whichever arc you make the most shots with is determined to be the most efficient shooting arc. Data Analysis: I will be doing 3 trials, averaging them, I will be looking for patterns in the data that either support or don't support my hypothesis, then I will go back and make bar graphs of my data, I will then go back to my research to conclude why I got what I got, and then I will conclude whether my hypothesis was supported or not. Risk Factors: I could twist my ankle while landing wrong or I could get hit in the head with a ball if it bounces wrong. Bibliography: 1. sciencing.com, Science experiments involving a basketball 2. noahbasketball.com, The Science of Shooting: Arc 3. psusites.com, The Science behind shooting a basketball 4. coachad.com, Building the perfect arc in your shot 5. coachdavelove.com, How to get perfect ARC on the basketball and make more shots

MPA101: Does Viscosity of Fluids have an Effect on the Efficiency of a Hydraulic Lift?

Hydraulics is the branch of science that deals with the movement of fluids through channels and systems used in common mechanics. I first learned about them at a summer camp at Carnegie Mellon University where I made a wooden hydraulic claw with water as hydraulic fluid. Based on my research, I found that commercial hydraulic systems use hydraulic oil but its viscosity varies. I wanted to see if different fluids with different viscosities would affect the efficiency of the hydraulic claw. My hypothesis was that a liquid with a lower viscosity would increase its efficiency. I conducted my experiment by using ten milliliters of different household fluids with water as my control. I used a 200-grams weight and calculated the work done with each fluid and then compared it to water and computed relative efficiency. My results showed the greater the viscosity of the fluid, the lower the efficiency proving my hypothesis to be correct. I believe that this can help us in the real world by making more efficient hydraulic fluids with lesser viscosity which would increase the efficiency of hydraulic pumps.

MPA102: What is stroke rate achieves the best performance in rowing?

The purpose of this study is to investigate the relationship between stroke rate and performance over time for youth rowers. In rowing, it is understood that there is a tradeoff between stroke rate and power. Too high of a stroke rate leads to suboptimal hip opening and reduces the ability of the cardiovascular system to bring in oxygenated blood and remove wastes from the muscles. Too low of a stroke rate leads to fluctuations as the rower goes through the stroke cycle and may result in not taking advantage of opportunities to apply force. This experiment had youth rowers row in intervals of 500 meters and 1000 meters at a range of stroke rates on an ergometer. The distance, time, stroke rate, and pace were recorded from the ergometer monitor. The data for each rower was analyzed using quadratic regression. For both 500 and 1000 meters, most rowers did not have significant linear or quadratic terms, so we can not say that there was a relationship between stroke rate and speed. Potential reasons that there was not a relationship between stroke rate and speed for youth rowers when there was for adults include a youth rower's less developed technique and less consistency than collegiate and adult rowers that were in the literature.

MPA103: Sound amplification and varying parabolic sizes

I am an avid bird watcher and love to watch and hear the different birds that frequent our garden. Last year I studied extensively about air pressure through my science fair project and when I learned that sound travels through air pressure variation I was interested in researching more. I got interested in sound amplification. I have observed parabolas and amplifications in one of the museums I went to. Parabolic aided microphones are best suited for directional amplification from long-distance sources while reducing surrounding noise. It is effective for wildlife recording, game recording etc. I formed my research question at this juncture. How does sound amplification vary with different parabolic sizes? Looking at my mom's plant plots gave me an idea to make a DIY parabola. My research will help in determining effective parabolic sizes given a distance which can be held comfortably for longer times. I hypothesized that If the parabola's size/diameter is bigger than the sound amplification increases. I got 3 different sizes of wide plastic plant pots, found the focal point for each one and placed the microphones there. I downloaded and played a sound of the Yellow Bellied Sapsucker from a speaker kept at a constant distance of 9 ft from the microphone and recorded the sound using audacity, keeping the volume of sound constant. I monitored frequency and amplitude and found that amplitude increased as I increased the sizes, and frequency stayed the same proving my hypothesis. This project taught me the science behind sound waves, Parabolas, Frequency, Amplitude, frequency spectrums and how to analyze them. I learnt to use audacity to edit, view waves and do spectrum analysis.

MPA104: An Experiment on Exoplanet Atmospheres

Purpose: The purpose was to replicate experiments done by the National Aeronautics and Space Administration (NASA) to determine the possibility of life on exoplanets on a micro-scale. Hypothesis: We hypothesized that we could identify gases based on their absorption of different colors of light. Procedures: The set-up consisted of an off-the-shelf airtight plastic box with a tube attached and the spectrometer placed inside the box. The experiment began by turning off all room lights except a lamp. We took a picture of the spectrum with an iPhone® camera before we put the gas in to compare it with pictures later. Next, we attached the tube to our gas of choice (nitrogen, helium, or oxygen.) and released the gas into the box while taking pictures of the spectrum. We opened the box between the gases to prevent contamination. Data Collected: After comparing the pictures, we found that the gases nitrogen, helium and oxygen had emitted the colors we expected. Nitrogen emitted mostly red, followed by green and purple. However, after comparing the pictures we found that nitrogen had no change, so we considered the test inconclusive. Helium emitted blue yellow and red; and oxygen emitted green blue and red colors. Conclusions: Our hypothesis was correct as our gases reacted the way they should have to the light. If we know the spectrum of light emitted by all gases, we can detect the gases that are the building blocks of life on exoplanets.

MPA105: What fin arrangement on a rocket works the best?

Hypothesis: If the rocket fins are evenly spaced out and are in an aerodynamic shape, then the rocket will perform the best in flight. Procedures: Using nasa.gov, I went to various sites for information. After finding various sites, I jotted down what I found on the most reliable websites. I then condensed the information into the terms that all the reliable websites say. Data: The fins of a rocket are designed to decrease drag and provide stability and control. The four forces that act on a rocket are thrust, weight, lift, and drag. Stability in a rocket increases when the center of pressure is farther away than the center of mass. The way fins work is by moving the center of pressure closer toward the tail. The more distance between the two points creates more stability. The greater drag on the fins keeps the bottom of the rocket at the back and in the right position rather than it being unstable. This helps the tip of the nose cone go through the wind and into the directed path. Conclusions: These are the conclusions I reached after the research. For the rocket to be in the directed path and have the most stability, we need the center of pressure as far away from the center of mass. To do this, we need to give the rocket the right amount of fins and the right amount of angle so the center of pressure does keep the maximum distance from the rocket.

MPA106: The Effect of Agar Percentage of Gel on the Migration Distance in Gel Electrophoresis

For my experiment, I tested the effect of the agar percentage in gel on the migration distance in gel electrophoresis. I made the hypothesis if the agar percentage in gel affects the migration distance in gel electrophoresis, then the higher the agar percentage is the less the migration distance will be because of the different viscosities of the different gels. To test my hypothesis, I connected 9-volt batteries together and mixed different amounts of agar into a buffer solution. I poured the agar solution into a soap box and let it sit for 30 minutes to solidify. Food dye was added to wells that were created in the gel using a comb made of cardboard. The machine was then run for 25 minutes. Then, the distance the food dye traveled was measured. The averages of the trials, in order of decreasing agar percentages, are 3.15, 2.9, 2.65, 1.2, and 0.88 centimeters. The migration distance decreased as the agar percentage increased. This data proves my hypothesis to be correct. The data, however, is not perfectly consistent due to some errors and inconsistencies. The wires did not stay perfectly still in the gel. The wires would shift either closer to the food dye or farther away from the food dye. This may have caused the dye to move faster or slower. Also, due to human error, type of food dye, or the syringe, the exact amount of dye could not be put into the wells. It was approximate, not exact. One of the biggest limitations was the temperature not being the exact same. That could have caused the gel to solidify too much or not enough. All in all, my experiment helped me learn about electrophoresis and why different agar percentages are used in different situations.

MPA107: What knots are the strongest?

I tested the breaking weight of four different fishing knots. The knots were: the Albright knot, the slim beauty knot, the blood knot, and finally the nail knot. The albright knot had the most twist while the nail knot had the least. If the direction of twists in a knot is related to how strong the knot is, then out of the knots I am testing, the blood knot will be stronger because an even number of twists in opposite directions causes more tension that holds the knot together. I took a broomstick and put it between 2 chairs as a support. Then I took a bucket and tied it to the broomstick with the knot. Then, I put coins in the bucket until it broke, saw which side of the rope broke, then recorded the weight and side that it broke on. The slim beauty knot was the strongest, with a mean break weight(MBW) of 2,294 g, next was the blood knot, with MBW of 2,252 g, next was the Albright knot, with MBW of 2,181 g, and finally, the control of the nail knot, with MBW of 2,025 g. Notably, the break weights of the slim beauty knot were skewed upward, suggesting that if we had collected more data, the slim beauty knot might have been a clearer winner. In conclusion, the hypothesis is rejected, the slim beauty knot was stronger. Possible errors could be: not having consistent strength throughout the thread, having weights in the bucket at the start, providing constant pressure instead of gradual pressure.

MPA108: Is London Bridge Falling Down?

The purpose of this experiment is to find which bridge structure is the strongest. The goal is to reduce the amount of bridges collapsing or breaking. What bridge structure is the strongest? The researcher hypothesizes that if the beam bridge, truss bridge, and the arch bridge are tested, then the truss bridge will be the most structurally sound bridge. First, gather all materials, Glue the sides together to form platforms next, make posts out of the scrap wood, make the arch and the designs on the bridges with leftover popsicle sticks, measure the strength of the bridges. The beam bridge was the strongest followed by the truss bridge, then the arch bridge. The researchers hypothesis was incorrect.

MPA109: Sideways Sunshine

The purpose of this project is to determine what effect the angle a solar panel position has on its electrical output. Which position out of West 47°, East 47°, vertical, and moving with the sun would produce the most electrical energy. The hypothesis was that the moving solar panel would produce the most electricity out of the four because it is in direct sunlight the most. The 3D printed stands held the solar panels at the correct angles during the testing. The result supported the hypothesis that the moving solar panel would create more electrical energy than its opponents.

MPA110: Cheerio Mate!

The purpose of this experiment is to find out what cereal is healthier for you to digest and burn calories. What cereal has the best calories to burn off quickly? The researcher believes that Cheerios would be the fastest burning in calories. The researcher will take different cereal brands and burn them to see which is the fastest burning in calories. Cheerios was the fastest burning while Frosted Flakes was the slowest burning in calories. After this experiment, the researchers hypothesis was stated as correct.

MPA111: Electromagnetic Propulsion: Fantasy? Or Reality?

My science fair project was on magnetic propulsion, specifically, the relationship between the power in a solenoid and the force exerted on a nearby magnet. In order to test this, I made a solenoid from copper wire and ran a current through it. I performed 160 trials in my experiment varying the fixed magnet's direction and starting position, the length of the solenoid, and the current in the solenoid. The north pole of the fixed magnet was repelled from the north pole of the solenoid and attracted to its south pole. There was more power in the solenoid when I made the solenoid longer, as well as when I increased the current. With more power in the solenoid, the magnet traveled farther, either into or away from the solenoid.

MPA112: Measuring Skyglow in Pittsburgh

For this project, I am testing where light pollution is especially high. To do this, I will be taking photos of in different locations in Pittsburgh, such as urban and rural areas, to test for the amount of light pollution in that area. I will determine the amount of light pollution by the number of stars visible and the brightness of the stars.

MPA113: Do Naturally Occurring Rocks Have Photovoltaic Properties?

Do naturally occurring rocks have photovoltaic properties: Climate change and a limited supply of fossil fuels have stimulated interest in renewable energy. Solar energy panels are made of layers of silicon containing different mineral impurities. I have noticed that the crystals in geodes also form in layers containing different minerals. My experiment aims to determine whether slices of naturally occurring rocks or crystals can generate an electric current when exposed to sunlight. I will place copper conducting tape on agate slices and other rocks and then use a voltmeter to measure if a current is generated in sunlight.

MPA114: Mastering the Pedal Board

Please visit student's exhibit for abstract

MPA115: How High Can a Basketball Bounce On Different Surfaces

My project is about Basketball's bouncing on different surfaces and this is important to me because it is really hard to play basketball on a bad surface. This project helped me understand basketball better and what actually happens every time you play basketball. And most surfaces proved my hypothesis right but it was interesting to see what happened every different time.

MPA116: Testing Which Model of Plane Is The Most Stealthy

For my science fair project, I tested which of four model planes would be the stealthiest between a Biplane, Boeing 747, F117 Nighthawk, and SR71 Blackbird. I figured this out by using a lux meter to determine the amount of light reflected by each plane. My hypothesis was that the F117 Nighthawk would reflect the least amount of light. I thought this because the edges of the Nighthawk were sharp and flat. I tested this theory by putting the model planes in a cardboard box that I painted black. I put the lux meter across from the plane, and then I made a hole right under the meter to put the flashlight through. Each time I turned on the flashlight, the lux meter would give me a number based on how much light was being reflected back. If the number was higher, it meant that the plane was less stealthy. In the end of my experiment, I figured out that my hypothesis was correct. The F117 Nighthawk did in fact reflect the lowest amount of light.

MPA117: Magnetic Motors, Do They Work?

I tested whether magnet motors work or not. My hypothesis was that the magnet motor would not run forever due to magnet decay, which is where the magnetic field decays over time and stops functioning after a while. While magnet decay may be a small factor, a different variable affected the experiment. The magnets attracted in the wrong places, forcing the magnet motor to stop spinning early. The only way to fix this was a material that completely stops a magnetic field from passing through it. Because of this, my original hypothesis was proven incorrect. While perpetual motion via magnet motors is theoretically possible with the right materials, it will be long before the motors actually start to work.

MPA118: Guitar Strings and Temperature

The experiment was about testing guitar strings in different temperatures. The question asked was Does the temperature affect the tuning of a guitar? A solid body electric guitar, a phone, a thermometer, and a guitar stand. The guitar was tuned on the first day. The experimenter then measured the surface temperature, the ambient temperature, and the humidity. Then on the second day the experimenter measured the temperatures and the humidity. Then, the experimenter measured the guitar tune to see if it changed in temperature. This was repeated for 5 more days. The experiment then moved it to a warmer room. Then I waited and took the temperatures and the humidity. The measurements for the guitar strings were taken. This was repeated for 6 more days in the new room. The guitar was then moved to a different room and the temperatures and the humidity was noted. The measurements for the guitar were then taken. This was repeated for 6 more days. It was found that the humidity didn't affect the tune of the electric guitar but the temperature affected it. The data shows that the colder temperature made the strings tighter and the warmer temperature made the strings go looser. This caused the strings to play off the key.

MPA119: The Difference of Flight of a Ringwraith with Paper

The purpose of my experiment was to see the effect of paperweight on a ringwraith's flight distance. To perform the experiment, two ringwraiths were made of two different types of paper and were launched with a modified bean bag launcher. The heavier paper flew farther than the lighter one. This was the outcome because air resistance had a larger effect on the lighter paper than the heavier one. The experiment showed that heavier weight paper flies farther than lighter weight because the lighter one is held back by air resistance more than the other.

MPA120: Which type of paper airplane design will fly the longest in distance?

The purpose of this experiment was to see what type of paper airplane will travel the farthest in distance. Folded 3 different ways and then launched. The plane with the larger wingspan went the farthest. This happened because the wings were larger, having more air resistance and not having gravity pulling the plane down. This experiment shows how having more surface area can increase the flying distance of a plane