85th Pittsburgh Regional Science & Engineering Fair

Intermediate Division

Student Project Abstracts

April 2, 2024

Notes to Judges

Students prepare Abstracts that include the following:

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

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

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

Project Numbers are assigned as XYYABC

- X: M – Intermediate Division (7th and 8th grade)
- YY: Category Name
  - BS – Behavioral and Social Science
  - BI – Biology
  - CH – Chemistry
  - CM – Computer Science and Math
  - CS – Consumer Science
  - ES – Earth/Space/Environment
  - ER – Engineering/Robotics
  - MH – Medicine/Health/Microbiology
  - PH – Physics
- ABC: Project number
  - 1xx or 2xx – Individual student projects
  - 3xx – Team projects (2 or 3 students)

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Behavioral and Social Science (MBS)

MBS100: What is the most effective cat deterrent?

My testable question was: What is the most effective cat deterrent? Three important things about this subject are that a cat's sense of smell can vary because of age and medical conditions. A cat's sense of smell is 14 times better than a humans, and if you ineffectively deter a cat it can harm the cat or even attract more. My original hypothesis was: If vinegar is used to deter cats, then it will deter them best because of its strong, powerful scent and its long lasting abilities. I collected my data by placing treats around the deterrent and then letting the cats in the room. If they avoided the deterrent and didn't eat the treats, they were marked as deterred. If they ate the treats and did not avoid the deterrent then they were marked as undeterred. My data proved that my hypothesis was incorrect. Orange peels were the most effective deterrent, deterring 2 cats, vinegar deterred one cat and store bought deterrent deterrent deterred no cats.

MBS101: Do Caffeine and Sugar affect your memory?

The question I had for the Science Fair was Do Sugar and Caffeine affect your memory? Some main points or facts from my research was that caffeine can help prevent brain diseases like alzheimers and parkinsons disease, the memory aspects of your brain mainly take place in the hippocampus section, as well as other related structures in the temporal lobe, and that the average American eats 3 pounds of sugar a week. My hypothesis is that if you compare sugar and caffeine, (alone and together) then sugar by itself will be worse, because after having sugar, you have a sugar high, and then you will crash, which isn't good for you or your memory, and makes you feel bad. Caffeine will better concentration, and attention span, which in theory should help your memory. Though sugar and caffeine combined will have an okay effect. I gave my participants their soda, and their flashcards, giving them exactly 5 minutes to memorize their 10 words, and finish their drink. After the 5 minutes were over, I called each person back to test them, having them recite as many words as they could remember while I timed them. After conducting my experiment, I concluded that my hypothesis was partially correct, but mostly incorrect. Caffeine did end up being the best in the recollection aspect. Sugar ended up being the best in the time category. Sugar and caffeine combined had the overall worst results compared to sugar and caffeine alone.

MBS102: A Data-driven Predictive Model to Assess the Correlation Between Electronic Media Usage and Sleep Stage Dynamics

A conversation about media usage and proper bedtime routines with my parents made me explore the detrimental effects of media usage on sleep stages. I hypothesized If more time is spent with electronic media, particularly observing times closer to one's bedtime, then the overall sleep quality decreases. I researched the 4 sleep stages, the Circadian Rhythm and machine learning techniques to come up with a model for my own sleep routine and my media usage. My constants were, a scheduled 2.5 hours of monitoring before bedtime, same time to bed, media devices being smartphones and ipads, a constant wake time and device of measurement as a fitbit. I varied my time spent on screen which was my independent variable and measured the dependent value as the percent of time spent in my individual sleep stages. Once I collected the data, I cleaned it and derived a predictive model by coming up with an algorithm and implementing it in python, using machine learning libraries like numpy and sklearn. I displayed the 4 sleep stages as scatter plots and found that my models followed a linear regression best fit with a high correlation as expected in the deep, REM and awake stages which proved my hypothesis. The program calculates the predicted sleep stage percentage given time spent on media using this derived model. This experiment would prove beneficial to predict the ideal media usage for adolescents that would result in good deep and REM sleep which is essential for growth.

MBS103: Image Color v. Emotion

I am testing out which colors produce certain emotions. First, I will create a drawing on my phone and then use the color filter and change the color of the shirt to yellow, and save it and repeat that process for blue and red. Then I will create a Google survey online and insert the 3 images and create directions: First take a look at these 3 images for a few minutes. Then I will create a question, What does this image make you feel? There will be 6 options to answer: a. Happy b. Upset c. Annoyed d. Mesmerized e. Depressed e. None of the above. Once I'm done, I will test the survey myself to be sure nothing is messed up or wrong. After I'm done, I will have 50 people take the survey and record their answers on my phone in my notes. Last, I will record how many people chose each option. If I color the picture yellow then it hopefully make the person feel happy. I want to do this project because it can go with my abilities and it's something I'm interested in rather than something I wouldn't want to do. The results matter to me because I am an art fan and this can help me learn what colors produce certain emotions in people. I preferably would want to produce a happy emotion from my art. Because I draw so often, I mainly want to know some colors that can make people feel certain ways about my art!

MBS104: Soccer Kick Technique v. Accuracy

I am doing this experiment to find out how soccer kicking techniques affect the accuracy of the ball. This helps others find how to kick the ball accurately, and for people who are starting to play soccer, this may be useful. I will start by collecting my goal and ball and then placing the ball and goal 30 meters away from each other. I make sure that the ball is directly centered toward the goal. After every kick, I will make sure I am placing the ball in the same spot as the first time I have placed the ball. I will have my notebook right next to me so that I can record data when I have completed the kick. I will start with the curl kick and repeat the kick 10 times making sure I record the data each time after I kick. After I have completed the curl then I'll go on to the instep kick and repeat the same steps I did for the curl kick. Once I have completed the instep kick I'll move on to the knuckle ball and repeat. Lastly, after I have all the data that I need I am finished. I hypothesize that the instep kick will be the most accurate because the instep has no extra spin on the ball except top spin because of where you are having contact with the ball. Also the knuckleball has no spin at all so it might be good as well, but I believe that the instep kick will be the most accurate. I play soccer myself so the results matter to me so that I can be able to use it in the game. Soccer is the most popular sport so I bet a bunch of people can use this information in some way. There are a bunch of kicking techniques and these are just some of the basic ones, but it is a fun project all in all.

MBS105: Testing Speed Reading Techniques

My experiment will find which speed-reading technique is the fastest and how speed reading affects comprehension. I will time myself reading passages of the same length and difficulty with different techniques recommended by colleges; after reading each passage I will answer 10 questions reacting to the passage to test comprehension. I hypothesize that if the technique relies on reading less of the text, then I believe comprehension will be diminished at the expense of reading faster because you are reading less of the text. I am doing this project because I love to read as well as knowing how critical it is to read and understand quickly in an academic setting.

MBS106: Phone Brightness vs Eyesight

For this project I will be testing how screen brightness has an immediate impact on a person's eyesight. I wanted to do this because my sister wears glasses and my mom doesn't like it when she is playing with her iPad with the brightness turned all the way up. Sometimes it's hard for her to see without her glasses after she has been using her iPad, which has me wondering what the exact impact is on immediate, short-term eyesight. To gather data, I will have participants complete an initial eye test before watching a 2-minute bright video. Following this, participants will complete a second eye test to gather data on the immediate impacts of phone brightness on eyesight. I believe that if a person watches a screen on high brightness, then their eyesight will be worse because the brighter lights will negatively impact their ability to see.

MBS108: How does a person's heritage influence their career path?

I've always been curious of the background in people, where they're from, and what they do. For my procedures, I'm going to survey people on their heritage and occupation, indicating careers, people's backgrounds, and how they relate. A Microsoft form will be emailed to participants and conduct interviews. There will be two groups of twenty people, a younger group and an older group. The demographic of participants will be 2 White, 4 Mexican, 4 African, 4 Indian, 4 Latino, and 2 Asian. Surveying an interviewing is ongoing at this time.

MBS109: The Room Makes the Grade

The Room Makes The Grade is a project that will determine how the physical environment will affect one's physical performance, which will support the statement said by phycologist, John Bargh that People are highly sensitive to their immediate environment, automatically picking up cues about what content and what way of thinking is relevant in the moment. In this way, contexts influence what is on people's minds. People pay attention to what is on their minds in forming judgments of how frequent, likely, or typical events are. Supporting this stance will require a bit of a procedure. I will conduct this experiment by gathering information first. Then, I will set up two different spelling tests, recommended for seventh grade students. Next, I will create two different rooms. One that will have a positive environment (calming music, dimmed lights, plants, positive posters.) And another room that will create a negative environment (bad smell, loud, distracting music, not a lot of decorations, room is messy.) Then, I will gather two different groups of seventh grade students to take these tests. Finally, I will analyze the data and calculate the average, mean, median, mode, interquartile range, abstract value etc of the scores from each test for the different rooms. Doing this will prove how a better or worse room environment will affect one's performance on a task.

MBS110: Effect of Appearance on Outcome

Please visit student's exhibit for abstract

MBS111: Superstition, Age & Anxiety

Please visit student's exhibit for abstract

MBS112: Ben Mezare

Please visit student's exhibit for abstract

Biology (MBI)

MBI100: Can you water plants with different liquids, and still have the plant grow?

My testable question is What type of liquid makes plants grow the fastest. One of the main points of my research is that sugar helps with plants growth because it gives a boost to the glucose levels in a plant which is part of the photosynthesis process. If I water my plants with sugar water, then the plant will grow in a shorter amount of time, because the sugar in the water will provide additional nutrients and boost the plant's growth, but should not shock the plant and stunt its growth. The way I collected my data after the 18 days of my experiment using a ruler to measure the plants growth in inches, starting with the top of soil to the tip of the plant. My data shows that my testable question was valid because it shows that the project wasn't just a waste of time, it had actual results. Even though it only had a few results over all, it can still help people who need help knowing what's good for their plats and not.

MBI101: Does mold grow more on fruit that's left out or in a fridge?

The question my project is based on is will mold grow more on fruit in the refrigerator or left out? The main idea of my project is that strawberries are an easy fruit to grow mold, but how long can they be preserved? Another key feature of my project is the types of mold that can grow on my strawberries, those would be botrytis fruit rot and gray mold. The final point of my research is how long it takes for a strawberry to grow mold, but that is all based on temperatures. From the research I gathered my hypothesis is If strawberries are in the refrigerator vs left out then the strawberries that were left out will accumulate more mold because of temperature. I collected my data by taking photos and notes of the strawberries every three days. I did this until they all had mold. To sum it up, the colder the temperature the longer your fruit lasts. So in conclusion the refrigerated strawberries took the longest to grow mold. It took them two to three days.

MBI102: How does the type of light affect Wisconsin fast plant growth?

The purpose of my project is to determine how different types of light impact the growth a Wisconsin Fast Plants. I will plant Wisconsin Fast Plant seeds and track their growth under different types of lights, including plant lights. I hope to determine which type of lighting is best for growing plants.

MBI103: Testing the 5 Second Rule

I'm trying to find out if the five second rule really works. I will conduct this project in the cafeteria of my school because that is where you are most likely to drop your food at. If I put each slice of bread on the floor separately for 0, 5, 60, 120 and 300 seconds, then the one that's on the floor for 0 seconds will grow no mold and the one on the floor for 300 seconds will grow the most mold because it was on the floor for the longest amount of time which gave the mold and bacteria more time to get onto the slice of bread. I am doing this project because in the past I've dropped some things pieces of food on the floor and picked it up within five seconds and ate it, so I want to know if the piece of food can still gain bacteria from just a few seconds on the floor. This matters because I do not want to get sick if I can avoid it.

MBI104: Effects of Oxybenzone on Drosophila Melanogaster

Please visit student's exhibit for abstract

MBI105: The Dilution Dilemma: Killing Germs or Creating Superbugs

Bacterial superbugs that have gained resistance to disinfectants are a major healthcare problem worldwide. This research will investigate two questions at once. Does over-exposure to a disinfectant lead to the development of resistance? And If so, do the dilutions of said disinfectants affect the speed of the resistance development? We hypothesize that the overuse of different disinfectant dilutions would lead to enhanced bacterial resistance. This 6-week experiment will explore bacterial resistance development to five disinfectants through repeated exposure at varying dilutions. Utilizing a non-hazardous K-12 strain of E. coli, the method involves creating 2-fold serially diluted disinfectant-infused sterile discs which will then be placed on 4 quadrants of agar plates containing an E. coli culture. After overnight incubation at 37°C, the zone of inhibition, the disinfectant's area of effect on the bacteria, around the discs will be measured and recorded. The quadrant of bacteria exhibiting the greatest resistance will be collected and the procedure will be repeated 5 times. After a sufficiently resistant bacteria is collected, it will be compared to a non-resistant culture. Data analysis comprises the measurement of the zone of inhibition in each quadrant of the agar plate which will be repeated throughout multiple cycles and expressed as millimeters. Each measurement will be cross-referenced with previous measurements to see if bacterial resistance is being attained. This systematic approach contributes to understanding bacterial adaptation to disinfectants, informing guidelines for disinfection practices in healthcare and household settings. Testing will officially begin on February 3rd and end on March 9th.

MBI300: Botanical Photosynthetic Activity & Aquatic Pollution

In our project, we simulated the effects of fertilizer runoff on aquatic plants. To do this, we used Cabomba caroliniana and observed what happens when it is exposed to an abnormal dosage of gardening fertilizer. We found that consistently, the fertilized container's plant released the least amount of dissolved oxygen than the control and other tank. However, we did not expect to reach zero so quickly. At first, we were focusing on how fertilizer affects dissolved oxygen levels, but at the completion of our experiment, the fertilized plant has decomposed. Further research will be conducted.

Chemistry (MCH)

MCH100: How does the recipe of biodiesel affect how hot and how long it burns?

My question was, How do the ingredients in biodiesel affect how it burns? Before conducting said experiment, I first researched topics such as how to make biodiesel. Biodiesel is made through transesterification in which fatty acids from a triglycerol combine with methanol in the presence of a catalyst to make biodiesel. I also researched background information on the ingredients and commercial biodiesel fuel. After my research my hypothesis was, If I make biodiesel with canola oil, olive oil, coconut oil, pig lard, crisco, and beef tallow, then the canola oil will burn hottest and the vegetable oils will in general burn better, because the vegetable oils have unsaturated fat and the base for canola oil, rapeseed oil is used in commercial biodiesel production. After conducting my experiment the I found that the olive oil biodiesel burned the hottest on average with an average peak temperature of 512.733 degrees Fahrenheit, 94.2 degrees hotter than the canola oil biodiesel; as for coconut oil biodiesel, it burned off too soon to measure in most trials, with only the first trial being recorded at 287 degrees Fahrenheit. The solid feedstocks, the crisco, pig lard, and beef tallow all solidified during the process of burning the biodiesel, with only beef tallow yielding any biodiesel. Overall, the data show the superiority of liquid feedstocks and the success of the olive oil biodiesel.

MCH101: What type of food is better to eat before a soccer game?

This year my testable question was what type of food is best before soccer. After doing my research I now know that there are many types of food like carbohydrates, protein, fiber and many more. I also learned that the different types of food each serve different purposes for your body and can affect how you feel. Depending on the type of food it can break down faster or slower. My hypothesis was if a fruit , granola bar , and egg are tested then the granola bar will be the best because it has carbs in sugar and both of those things break down fast and turn into energy. I collected my data by having 3 participants dribble a soccer ball through cones after eating each food to see which food would cause them to dribble the fastest. In conclusion my hypothesis was incorrect and the apple caused the participants to dribble the fastest only taking 8.52 seconds on average, the eggs did the 2nd best with an average of 9.91 and my hypothesis of granola bars did the worst taking 9.96. Overall the answer didn't change that much but i still found out apple are the most beneficial to soccer.

MCH102: Is it better to knead bread with or without flour?

My testable question was Is it better to knead dough with or without flour?. My main point of research is the fact that when kneading dough all you're doing is pulling the dough and stretching the dough over and over again, my second point of research is that we knead dough to help develop the gluten. My last point of research is that gluten is made by mixing flour with water. My hypothesis is that if you do not use extra flour when kneading then the bread will be bigger because there will be less gluten to hold the bread down. I collected my data using a tape measure on the bread after it is done baking. After my data was collected I realized that my hypothesis was correct. I also noticed that bread without extra flour had a more unpredictable size.

MCH103: Normalizing Color Readings from Different Cameras for Point of Care Testing

The goal of the project is to do Point-of-care testing (POCT) in a simpler way using a generic phone and printer. POCT is a low-cost and portable thing (paper and device) that is used to obtain fast test results immediately at the point of reading. Paper-based analytical devices (Pads) are also known as lab-on-a-chip because they miniaturize the principal use of chemistry, biology, and other laboratories to a small piece of paper. Here I investigate if an a POCT method that uses color scale from a regular printer can normalize readings from different cameras/screens for use at home. I hypothesize that the color intensity measured by camera A will match the reading from camera B when using a color scale, but not without it. I will make and label a color scale with numbers 0 - 100 on a normal piece of printer paper and print out color scale and the sample. Then take pictures of papers with each camera (A and B) and upload them on a computer to take readings of them. I will upload data to Excel, label data (scale 1, 2, 3, 4 and sample a and b), and convert b to percent (255-b)/255 to digitally scale. The data is color intensity of the sample and scale. It will be presented through bar/plot graphs. Safety precautions will be taken.

MCH104: Shiver Me Kindle

The purpose of this project is to help people by making kindling last longer with natural materials. I want to find a way for the unhomed or people who like to survive in nature to have a long lasting fire. My plan is to take equal sized pieces of paper and coat it with items you can find in nature, for example, acorns, clay and sap. My hypothesis is that the sap will kindle the longest because as it melts around the paper it will form a ball of fuel.

MCH105: Which Homemade Crystal is Most Durable?

Homemade crystals are expected to break down more in acidic liquids than naturally grown crystals are. My experiment helped find out which homemade crystal could be the most durable around an acidic liquid. I grew 3 different homemade crystals, then placed them each in Coke for 5 days or less, and then took them out each day for measurements. I observed that the Epsom Salt crystal broke down the quickest in the Coke with the time being just as it was put in the liquid, just like I stated in my hypothesis. The Borax crystal took 5 days to dissolve all the way, which was the longest to dissolve. The Sugar crystal took just 1 day to dissolve.

MCH106: Rate of Decay of Pumpkins

Please visit student's exhibit for abstract

MCH107: Does the Base Liquid of Hot Cocoa Affect the Cooling Time?

When drinking hot chocolate in cold weather, it is best when it stays hot. So, I did an experiment using different base liquids of hot chocolate to see which would make hot chocolate stay the hottest. Fist I heated the liquid in a pot. Then pour the liquid in a mug, make it into hot chocolate, and set a 10-minute timer. After the timer went off, I took the temperature of the liquid. In the end the soy milk kept the hot chocolate the hottest the longest. I expect the liquid with the most fat in it would stay the warmest, but the soy milk (which did not have a lot of fat in it) stayed the warmest.

MCH108: Testing Electrolytes in Sports Drinks

Electrolytes are essential minerals such as sodium, magnesium, calcium, and potassium. An electrolyte is a substance that separates in a solution and can conduct an electrical current. One function of an electrolyte is to send an electrical signal to your muscles and brain. Electrolytes are key to your body's hydration. Electrolytes are popular in sports drinks to help athletes with recuperation from activity and to prevent dehydration. As an athlete, I want to know which drink has the most electrolytes. Items that will be needed to conduct the experiment will be a multimeter, 9Volt battery, copper wire, beakers and various sports drinks. A multimeter is used to measure the electrical current in various drinks to determine the level of electrolytes. The voltage source I will be using is a 9 Volt battery. The wire will be used from the 9 Volt battery to the sports drink to conduct the current. I will set up a closed circuit to get the readings from the drinks. I created the closed circuit by connecting the negative wire on the multimeter to the negative and both positive to a straw then I measured the electrolytes To do that, I measured the electrical current of different sports drinks at a room temperature

MCH109: What Floats Your Boat?

The purpose of my project is to learn and share information on the best ways to waterproof substances. My project involves using water repellent substances to waterproof boats. The purpose is to discover if soaking things in substances that repel water, like oil, can make things more waterproof. My procedure is to create a paper boat. Then I can soak a paper boat in one of the substances for 2 minutes. Then I would flat it in a sink using the same water level and changing water between each test. Helping make things waterproof would impact how different things can work.

MCH110: Milk + Vinegar = The New Plastic

The purpose of this project is to show how useful casein plastic can be. It has been proven that milk and vinegar, when combined, create a malleable plastic that is biodegradable. This project will show which amount of vinegar added to the milk (via experiment) to make the best plastic.

MCH111: Food Flavoring

Please visit student's exhibit for abstract

MCH112: What is the most efficient fuel for yeast

The purpose of my experiment is to find the most effective fuel for yeast, which can be applied to both bread baking and alcohol making. To do this I will make different batches of bread with active dry yeast and different types of sugar. To determine the most effective fuel I will time the blooming process and measure the final height of the baked bread. My experimentation is ongoing.

MCH113: Which Fruit and Vegetable Contains the Most Vitamin C?

Please visit student's exhibit for abstract

Computer Science / Math (MCM)

MCM100: Can an AI algorithm reliably identify NBA players using image classification?

My testable question was Can facial recognition AI identify NBA players better than a human? For my research I looked at three things about Facial recognition. Those things were how it works, where it is used today, and its advantages and disadvantages. My hypothesis was if an AI algorithm and a NBA fan do the same recognition test, then the AI algorithm will be better at recognizing current and former NBA players than a NBA fan because it will have more knowledge in its database. I collected my data by conducting 2 tests with pictures of the NBA players. My data told me that in Test 1 the AI did 27% better than Person 1 and 40% better than Person 2. In Test 2 the AI did 20% better than Person 1 and 13% better than Person 2 which proved to me my hypothesis was right.

MCM101: Adding Computer Vision to Statistically Understand the the Dangers of a Busy Intersection

In this project, I will be using computer vision to measure the dangers of a busy intersection statistically. People are killed every day at intersections. I had an awakening after a lady was recently killed at the intersection outside of our house. I decided I needed to figure out what makes intersections, specifically mine, (a five-way intersection) so dangerous. First, I set up a camera in my yard that keeps track of what is happening at an intersection. Then, I set up an FTP server so that the camera's data could be sent directly to it, and then I wrote a machine learning program to recognize a specific list of things in the footage, (such as when cars and pedestrians are on the road together, etc.) and then visualize this information to help people better understand how often these dangerous situations happen.

MCM102: Inside the Spectrum: Well-Being and Sensory Journal

My project is a web application designed to assist individuals with Autism Spectrum Disorder. The web application enables users to monitor their mood and sensory behavior patterns by using the three step process of recording journal entries, reviewing the data from journals, and scheduling events based on the information. My procedure to create this project involved doing extensive research, developing the project, and improving/testing it further. Currently my project is fully functional (with a dashboard, login system, and main functions), but I am adding new features. Please checkout my poster board to see the current version of the application.

MCM103: Statistical Analysis of Soccer IQ

Please visit student's exhibit for abstract

MCM104: DermAI - Detection of Skin Cancer Using Machine Learning

Skin cancer is a major public health concern, and early detection is critical for successful treatment. In this project, I investigated the potential of technology in improving skin cancer education and detection. I developed DermAI, an AI-powered assistant featuring a chatbot interface and a skin cancer detection system. The purpose of DermAI was to provide users with valuable information about skin cancer, including common risk factors, symptoms, and preventive measures. The skin cancer detection system utilizes advanced computer vision and machine learning algorithms to analyze images of skin lesions and identify potential cases of skin cancer. The chatbot interface facilitates personalized interaction with users, allowing them to ask questions and conversationally obtain information. I used a variety of procedures to develop and test DermAI, including data collection, programming, and machine learning model training. I collected a large dataset of skin lesion images and used it to train our machine-learning models. I also conducted user testing to evaluate the user-friendliness and effectiveness of DermAI. Our data showed that DermAI can accurately detect potential cases of skin cancer, providing users with valuable information and recommendations for follow-up care. User feedback indicated that DermAI was easy to use and provided useful information. The results of our project demonstrate the potential of technology in improving skin cancer education and detection. In conclusion, DermAI represents a significant technological advancement in skin cancer education and detection. With its advanced machine learning algorithms and user-friendly chatbot interface, DermAI can provide users with a valuable resource that can help them protect their health and well-being. The next steps for this project include further refinement and testing of the skin cancer detection system and exploration of potential applications in other areas of healthcare.

MCM105: An application that assists a visually challenged person in reading

Optical Character Recognition (OCR) is an electronic tool that converts characters from an image into computer text. My project is to create a web application that uses OCR to read English text aloud. The purpose of my application is to aid a visually disabled person in reading. My application uses different programming languages including: Hypertext Markup Language (HTML), Cascading Style Sheets (CSS), Javascript, Python. HTML and CSS are for designing the page; Javascript is for speech to text and text to speech; Python is utilized for image to text. My application solves a well-known problem: the struggle of reading.

MCM106: What Can Detect AI Better, Humans or AI?

Science Fair Project: What Can Detect AI Better, Humans or AI? To conduct this project, I will ask human participants and AI the same survey, and see what the results are. The survey that the participants will take is 30 questions. Each section, Text, Photo, and Audio, has human-created and AI-created content having 10 questions for each section. For human text, it is written by myself on various topics, and for AI, it was generated by ChatGPT. I would say that the AIs would probably get this part quite easily with minimal errors. However, I hypothesize that human participants may struggle with this part. For human photos, I have photos of people and landscapes that were found on the Internet. Similarly, the AI consists of human-generated and AI-generated landscapes which were made by thispersondoesnotexist.com, and image-generation AI models. I hypothesize that both AI and Humans will struggle here. Finally, for Human-made Audio, I have taken clips from YouTube to use, and for AI, I have used Elevenlabs.io. In my opinion, it will be very easy for the humans and the AI to spot the AI audio. However, I wonder if they will second-guess themselves and mark the human-generated AI from YouTube as AI. I have already sent out my Cover Letter and the HIC form to the Human Participants under 18 years old. My experiment will be held on February 8th during the school day. I have also finished the survey that participants will take.

MCM300: Unveiling Pneumonia's Hidden Patterns with Machine Learning

Our science project, Unveiling Pneumonia's Hidden Patterns with Machine Learning, aims to explore the infinite applicability of artificial intelligence (AI) in identifying life-threatening diseases such as pneumonia through the analysis of biometric data, specifically X-rays. The project posits that AI, when trained on a large enough dataset, can accurately and quickly identify diseases by detecting discrepancies in the biometric data. This capability could lead to improved and early detection of life-threatening diseases, providing doctors with a valuable tool to confirm diagnoses by utilizing the AI's classification as a confluence in determining a patient's situation.

Consumer Science (MCS)

MCS100: The Comparative Analysis of Sunglass UV Blocking Performance

This experiment would benefit society because individuals will learn what to look for when buying sunglasses. I am asking whether sunglasses with a larger lens width provide UV protection of 400 nanometers in wavelength. If different types of sunglasses are tested for UV light protection, the pairs with UV 400 protection on the label and the pair with the largest surface area will be the most protective. My first step is to gather different sunglasses that have a UV 400 protection label on them and other pairs that do not. Then, I will measure the lens width of each sunglass lens. Afterward, I will acquire a UV black light flashlight and a UV light detector that measures in microwatts per centimeter squared. Afterward, I'll place the sunglasses in front of the detector, turn on the UV lamp in a dark room, and then shine the light on the sunglasses. I will then record my data for each pair of sunglasses individually. I will be measuring the UV microwatts per centimeter squared. Based on how much UV intensity the detector measured, I can determine how much UV Light the sunglasses reflect. For reference purposes, I will expose the detector to the UV flashlight without the sunglasses and to a pair of prescription eyeglasses. I will compare two groups of sunglasses to determine if there is any difference. I could be exposed to UV Rays and could experience chemically induced lesions in the retina.

MCS101: Which type of nail polish lasts the longest?

My testable question is, Which Brand Of Nail Polish Lasts The Longest, Essie or OPI? An important piece of information for this project is that nitrocellulose is a chemical that is tough and wear resistant. It is the sticky solution that is very helpful in a long lasting polish. Another piece of important information is that the resin formula in a polish is extremely important as it is the glossy hard surface that you get once a polish dries. My hypothesis is that if I use OPI nail polish and Essie nail polish, then OPI will last longer because OPI contains nitrocellulose which is a chemical that is used because it is tough and wear-resistant and Essie doesn't have any nitrocellulose in it. Also, OPI has a plasticizer in it that has camphor and ethyl tosylamide which Essie also does not contain. In terms of longevity, both Essie and OPI have long-lasting formulas. I collected my data by writing down the day I started the trial, and then the day the polish chipped. Then I wrote down how many days the trial lasted in my data table. My hypothesis was correct, OPI did last longer than Essie. This tells me that OPI has a better formula for long lasting than Essie does.

MCS102: Protein Cake

Please visit student's exhibit for abstract

MCS103: Testing the Results of Different Field Conditioners on Baseball Fields

For my science project, I tested the effects of different infield conditioners on baseball fields. A baseball field isn't considered playable when the field is uneven, too wet, or too hard(dry). However, there are ways to prevent these conditions. One way is to use infield conditioners. Infield conditioners help to keep the field at the correct moisture level even after a large rainstorm or drought. Two common infield conditioners are calcined clay and expanded shale. I hypothesize that the mix of calcined clay and expanded shale will give the field the best playability. This means that this field will have the least cleat imprints under wet conditions, the least compaction under dry conditions, and the steadiest water levels overall. To do this, I first measured out professional infield mix into Tupperware containers. Then, in the calcined clay condition, I added a layer of the calcined clay. In the mix condition, I mixed the calcined clay and expanded shale together. For my results, the control condition has the highest initial moisture level, while the other two conditions had similar moisture levels. The control had many cleat imprints, while the calcined clay had a couple, and the mixture had none. While the mixture and calcined clay conditions had the steadiest, in the middle moisture levels, the control became very hard and dry at the last measurement. Using the mixture of conditioners will let you play sooner after a rainstorm, and longer during a drought.

MCS104: Watching Paint Dry: Do You DIY?

The purpose of my experiment was to discover which type of paint would have the best colorfastness and durability for 90 days inside and outside in Western Pennsylvania during the winter. The paints tested were exterior acrylic/latex paint, interior acrylic/latex paint, and oil-based exterior/interior paint. There were six procedure steps total in my experiment. First, I painted the samples. Then, I placed 3 experimental painted wood samples outside and three experimental painted wood samples inside. Next, I compare experimental and control painted wood samples weekly. After that, I created a Likert scale visual assessment of experiment versus control paint samples. Lastly, 5 people will judge the colorfastness durability. The results of my experiment were that all the paints tested (exterior acrylic/latex paint, interior acrylic/latex paint, and oil-based exterior/interior paint) had no change in colorfastness and durability.

MCS105: The Healthiest Bottled Water

The purpose of my project is to research, test, and share information on the acidity of bottled water. My project involves using PH test strips to test how acidic different brands of bottled water are. The purpose of this is to select the healthiest brand of bottled water. My procedure is to dip the test strip into the bottle of water, and to determine if it is acidic, neutral, or alkaline. Then, I will record the results. At the end of all testing, I will also test tap water from several sources, fridge water, and water from large 4 gallon containers for reference. Determining the healthiest water will help people make better decisions on the water they drink and their overall health.

MCS106: How does string material affect the tone of an electric guitar?

I tested three different material guitar strings (Steel, Cobalt, and Nickel) on how they affect the tone of an electric guitar. My hypothesis for this is, 'If I use three different material guitar strings Nickel, Steel, and Cobalt with the same gauge, then Nickel will produce the most average sound levels; Steel will have the highest treble, and Cobalt will have a more bass-filled tone lasting the longest.' Because Nickel is the most commonly used material, which would likely imply it is the most well-rounded. Steel is a lightweight, strong metal that would vibrate faster or at higher frequencies, and Cobalt is a brittle material that would flex less before breaking. Since it is less malleable, it would vibrate less, causing a lower average pitch. To complete the experiment, I used a single guitar, played all strings open, and recorded the loudness of the frequency groups (Treble, mid-range, and bass). I also recorded how long the strings stayed audible. I found that the nickel strings were the quietest overall at ~36 dB. Nickel strings also had significantly lower mid-range levels than the others. Cobalt strings lasted audibly the least amount of time, with 14 seconds. Steel strings were the loudest in mid-range, bass, and overall. They also lasted the longest. There was an error in my procedure with using uncontrolled picking strength, which severely affected my results, possibly not giving me accurate data. If I could redo my experiment, I would find a way to control that variable better.

MCS107: Flex Shoot

The question I will be answering for the science fair is Does hockey flex matter when making hockey goals? I am experimenting with this because I play hockey and I believe it does matter but I like to use a higher flex on my stick than needed. Hockey flex is how many pounds it takes to flex a stick. You have to divide half of your weight to find your hockey flex. For this experiment, I am going to use three different places to shoot three different goals in a hockey net to see if it makes a difference. I am going to make a data chart with my findings. I think this information will help our hockey players because if the higher flex stick works to get me more goals then I am sharing this information with ours.

MCS108: What type of sunscreen produces the most oil?

Please visit student's exhibit for abstract

MCS109: Keeping Your Body Warm: An Insulation Investigation, Part 3

In cold temperatures and chilly wind, we depend on our insulating fabrics to keep us warm. We want these fabrics to be thick and loosely woven, to trap warm air for optimum insulation. Unfortunately, retailers often sacrifice our planet's well-being to spend less money, with our garments being worn out and thrown away quickly. This releases harmful dyes and chemicals into the environment, not to mention the water pollution and energy usage that the industry wastes in the creation of traditional fabrics. Luckily, sustainable materials are being used to make fabrics like bamboo, cork, and pineapple fabric. Companies are recycling old materials to make cloths like recycled polyester and recycled cashmere, and companies like Gore-Tex are making sustainable promises for the future. In my experiment, I wrapped different fabrics around mason jars, added body temperature water, then transported them outside, where it averaged 50 degrees Fahrenheit, with a wind speed of up to 12 mph. Next, I measured the water inside the jar's temperature at ten- and twenty-minute intervals. I conducted three trails and calculated the averages. Wool came in first, closely followed by pineapple, an eco-friendly fabric. This is because they are both thick enough to retain heat, while they have pores small enough to let water vapor escape. After them followed fleece, recycled cashmere, flannel, cotton, bamboo, recycled polyester, cork, and Gore-Tex. This shows that while conventional fabrics insulate well, eco-friendly fabrics can keep you just as warm, and keep the earth safe.

MCS300: Hair We Go!

Please visit student's exhibit for abstract

MCS301: Neck Guard

The questions we will be asking for the science fair is Would it be helpful to add rubber, plastic, or stuffing to a neck guard to prevent a person from getting a neck injury in hockey? This is important due to a death that happened recently with a former Penguins hockey player. To start my experiment I will cut the bottom of the neck guard I have and place the plastic piece into the guard. Then, I will put the neck guard on my mannequin head and push an ice skate on to the guard. I will see if any marks have been made on the neck. Then, I will run the skate across the neck with the guard and see if any marks have been made on the neck. I am going to write notes and take pictures of these results. I will do the same process to test the rubber and stuffing in the neck guard. This experiment is important for helping hockey players stay safe. We believe the plastic will work the best.

Engineering / Robotics (MER)

MER100: Parachute Pandamonium

The purpose of my project is to determine the best design factors for a parachute intended for recreational and non-militant purposes only. We will make a number of parachutes, then drop them from different heights with different payloads to test their effectiveness. Then, we will compare the data and determine the best model. From the data, we can see that larger parachutes are more effective. Some parameters that make a parachute more effective are material (tissue paper is best for large parachutes) and size (larger parachutes are more effective).

MER101: (RPPF) Recyclable 3D printing Press Filament

My project is about recycling plastics such as water bottles and utensils and turning them into 3D print filaments. This project aims to reduce the amount of plastic that is not recycled, meaning that the wasted plastic can be repurposed into 3D print filament, which is already very expensive in today's economy. To solve this problem I have created two prototypes. To design each prototype I followed a design process that started with using the Fusion 360 platform to assist me in CAD, having around 6 versions for each prototype I made. Each version had small changes before I fabricated them. Both prototypes have a muzzle that gets smaller as it goes further, resulting in the plastic having to endure friction to make it melt into filament. The muzzle creates the 3D printer filament with plastics such as small water bottle pieces, cutlery, and plastic pieces. The muzzle has a hole at the top with a diameter of 15 mm. In conclusion, prototype number 2 was better than prototype number 1 because the larger hole allowed for the input of more plastics into it. Another key takeaway was that the muzzle is more effective for getting smaller as it goes further, resulting in the plastic having to endure friction to make it melt into filament.

MER102: Arduino Device for Early Wildfire Detection

In 2023, 56,580 wildfires burned approximately 2.7 million acres in the U.S. In Canada alone, wildfires generated about 480 million tonnes of carbon emissions. The purpose of my experiment is to find more functional and effective ways to prevent forest fires, through monitoring and early detection. I made a device consisting of two Arduino circuits to measure carbon monoxide (ppm) and temperature/heat (Fahrenheit). I wrote codes to get the readings. The carbon monoxide circuit included an MQ-2 sensor to record carbon monoxide levels. The temperature sensor included a 100K ohms thermistor and a 100K ohms resistor to record temperature. Both circuits utilized jumper wires to connect to an Arduino Uno board. I tested the circuits using matchsticks and a lighter and obtained rational live readings which helped to determine the threshold values. Experimentation is ongoing with the next step of simulating a wildfire in a firepit to see which circuit goes over the threshold level first. The results will determine which factor, temperature or carbon monoxide, is more sensitive during the early stages of a wildfire. The data will be analyzed by creating a table showing how much time elapsed until both sensors crossed the threshold. I will create graphs to determine the trend and detection levels for each sensor. Climate change and extreme weather cause more wildfires, putting communities and land at risk. This device can be placed in vulnerable ecosystems and strategic locations within forests for scientists to collect and analyze information.

MER103: Optimization of the Fermentation Process for Making Sweet Rice Wine by the Response Surface Methodology

This study investigated the effects of fermentation conditions on the fermentation process to make sweet rice wine, aiming to obtain the best tasting sweet rice wine. The fermentation process and the final product quality depends on several variables, including time, temperature, the amount of yeast, water content, the type of yeast, the type of rice, and possibly other unknown variables. The first three variables were investigated in this study. The sweet rice wine making process consisted of (1) soaking the rice, (2) steaming the rice until fully cooked, (3) cooling the rice to room temperature, (4) mixing the rice with yeast and water, and finally (5) fermenting the mixture at a controlled temperature for a certain period of time. The resulting product was separated into solid and liquid using a filtration cup. A sample of the liquid was centrifuged prior to further analysis. The amount of liquid, the pH, the TDS, the Brix %, and the Specific Gravity were determined. The data acquired will be analyzed using the Response Surface Methodology to determine the optimal processing conditions. Preliminary results indicate that the amount of liquid received after the fermentation process increased as time increased and leveled off after 6 days. The TDS and pH of the liquid seemed to be irrelevant to the process condition. The experiments are ongoing and data acquisition and analysis will be continued and the results will be shared on the day of the competition.

MER104: RFID Animal Feeder

The purpose of my project is to determine if I can create a RFID Animal Feeder. I became interested in this project because I noticed that pets often eat whatever pet food is out, even if it is not theirs. Sometimes animals with special diets need access to their food. I hope to make a collar and feeder that work together so that when the RFID collar is by the feeder, the food for that specific pet will be dispensed. I hope to use coding to get the collar and feeder to work together.

MER105: The effect of heat on magnetic properties of metals

Please visit student's exhibit for abstract

MER107: Picking Up Steam: Improving Microwave Oven Heating Performance

Microwave ovens are a common heating appliance, but they can heat food unevenly and inefficiently. What if there was a way to increase the efficiency of a microwave oven without making a change to the appliance itself? Such a method would allow for a shorter heating time and therefore less electricity being used to heat food. This project looks at the effect of different humidity levels on the heating performance of a microwave oven. My hypothesis was that increasing the level of humidity within the microwave would lead to increased heating of the food by the microwave. My planned procedure is to test two different levels of humidity as the independent variable normal humidity and increased humidity. The resulting temperatures of the food are my dependent variable. These tests will be implemented on different types of food. So far, I have calibrated my methods for testing and measuring results through various pre-tests. These pre-tests have shown that microwave heat output is influenced by multiple variables, which I have to control. My experiments and analysis will be completed by February 15, 2024.

MER108: Water conservation by measuring soil moisture with Raspberry Pi

Please visit student's exhibit for abstract

MER109: Egg Drop

I'm doing this project because I would like to see how we could protect eggs from large falls and forces. I believe that this will have potential future impacts when considering how to safely package items without having a large environmental impact. I would like to find an option that not only protects delicate items (like eggs), but also has a small impact on the environment. As a future business owner, I would like to know my options but also do so cheaply, effectively, and with little to no environmental impacts. For this project I will package eggs in boxes with different interior package materials and follow this up by dropping a bowling ball on each package from a consistent height. I believe that if I use Styrofoam, then the egg will be protected most effectively because it is already used to ship larger packages. However, I do not believe this is the most environmentally friendly option for sustainable packaging.

MER110: Verbrennunosmotor0 Which Engine Produces the Most Power?

I wanted to find out which engine type produces the most horsepower (HP) and torque (LB-Ft) most efficiently. I used an app called Engine Simulator that realistically simulated internal combustion engines.

Earth / Space / Environment (MES)

MEE100: Can Crowdsourced Weather Monitoring Work?

Please visit student's exhibit for abstract

MEE101: What is the radiation of former industrial sites in Pittsburgh?

My question is What is the Radiation of Former Industrial Sites in Pittsburgh?. Slag is naturally radioactive and gets treated as radioactive waste. Not all radiation is harmful to humans but can be in high exposures. My hypothesis is If visiting three or more places, then the site where people used to dump steel slag will have the highest amount of radiation because steel slag is a naturally radioactive source.. I collected my data with a radiation detector that I got from amazon. In conclusion my hypothesis was correct. The old slag dump had the highest average which was 42 cpm and the lowest was Frick Park which had an average of 21.6 cpm.

MEE102: How does car traffic affect the air quality?

How does car traffic affect air quality? During the research period of the project, there were many different and interesting things about my experiment but the most important include CO2, a gas that cars emit is a greenhouse gas that causes the earth to warm up. Another thing is that living near CO2 and being exposed to it for long periods can be damaging to your health, but trees and soils can hold onto CO2 and keep it out of the atmosphere. The hypothesis for my experiment was, If there are many cars on a highway at once, then the air quality will rise and decline in the quality because the vehicles on the road that use gasses emit high amounts of CO2 into the air when driven. The way the data was collected was whenever an area was being tested the air quality detector was being used for only two minutes to make sure that the data collected didn't have any errors from the other tests. In conclusion, the data collected tells me that car traffic produces a lot more CO2 than other things but, it could change depending on how strong the wind is or what the weather is like. The data also tells me that using either hybrid or electric cars can help with the amount of CO2 that we push into the atmosphere every year.

MEE103: Who's Lichen the Air Quality Around Here?

I am testing the hypothesis that the amount or presence of lichen on trees can help indicate the air quality of that area. Traveling to 13 locations in Allegheny County, I am testing for five air quality components and surveying 20 trees for lichen growth. After completing these tests, I will formally present my data and draw conclusions based on whether it supports or contradicts my hypothesis.

MEE104: Can plants help stop soil erosion?

Allegheny County is one of the most substantially affected areas in Pennsylvania by landslides because of hilly terrain. In 2018 alone, the city of Pittsburgh spent more than $6,000,000 in landslide and erosion damage repairs. In 2018, about 80 landslides occurred in Allegheny and Beaver Counties. The purpose of this project is to find more cost effective solutions to prevent soil erosion and landslides. To demonstrate this experiment, I will make prototypes to simulate slopes where landslides typically occur. In each model, there will be a different type of ground cover on the soil. There will be gravel, grass and one prototype without ground cover. Then I will simulate rainfall by watering the models. Data will be collected based on how much soil is eroded out of each model. The conclusion of this project will determine that if trees and appropriate vegetation is planted on slopes that are prone to landslides, the soil erosion will be mitigated. If these appropriate erosion and sediment controls are implemented it will save the the millions of dollars for DOTs and government agencies.

MEE105: Effect of Different Soil Brands on Bean Plant Growth

The objective of this experiment was to assess which brand of soil contributes to the optimal growth of a healthy bean plant, considering factors such as strength, growth rate, sprouting time, and the ability to produce beans or flowers. The study involved four distinct types of soil: Miracle-Gro Garden soil, Sta-Green Garden soil, and Garden Scape potting soil, each containing unique ingredients tailored to benefit the respective plants. Additionally, three different bean colors green, purple, and yellow were introduced to add complexity to the experiment and generate diverse conclusions. The hypothesis posited that plants cultivated in Miracle-Gro's soil would exhibit the highest level of health and strength among the three soil types. A Null-Hypothesis suggested that the varying colors of the beans would not impact their health or growth. However, the findings contradicted the Null-Hypothesis, revealing that the color of the seed did influence the outcome. Notably, purple beans emerged as the healthiest, displaying the earliest sprouting and the longest plant type. Conversely, yellow beans exhibited weaker characteristics and took longer to sprout compared to the other colors. Analyzing the average growth rates, it was observed that, in Miracle Gro, purple bean plants grew at 0.8 cm per day, yellow at 0.7 cm per day, and green at 0.6 cm per day. For Sta-Green, the averages were 0.6 cm per day for purple, 0.7 cm per day for yellow, and 0.7 cm per day for green. In Garden Scape, the figures were 0.6 cm per day for purple, 0.3 cm per day for yellow, and 0.8 cm per day for green. These results indicated that Sta-Green's plants did not perform as well as the others, with Miracle Gro proving to be the most effective in promoting growth. In conclusion, the hypothesis was substantiated as Miracle Gro's soil indeed facilitated the healthiest and strongest growth of bean plants compared to Sta-Green and Garden Scape. The experiment underscored the significance of soil type and seed color in influencing plant development, providing valuable insights for future agricultural considerations.

MEE106: Sweet or Salty: What Do Crystals Like More?

Crystals grow many places on Earth, and are composed of various elements. They always have a very organized molecular structure. They begin from a liquid that is cooled or by evaporation. In this experiment, the cooling process of crystals will be observed by varying the rate of cooling. It will also explore the differences in sugar and salt crystallization while measuring the volume of crystals and rate of growth. It is hypothesized that the salt crystals will have the higher volume and rate of growth, and the crystals will have the largest volume when cooled at medium temperature.

MEE107: Solar Panel Energy

I'm doing this experiment because it is something I am interested in learning more about. Based on research, I believe that this will have real world applications as more countries transition to increasing solar energy. Solar energy is a powerful source of energy that can be used to heat, cool, and light homes and businesses (National Renewable Energy Laboratory). With this increase in usage of solar panels, it is important to find ways to clean and make them as efficient as possible. Although cleaning on a large scale may not be worth the cost, I am focusing my research on panels that could be purchased and installed into a home system. For this project, the solar panel energy will be captured over a period where cleaning frequency is changed each week. My hypothesis is that if the cleaning occurs more frequently, then the panels will collect more energy because there will be less debris blocking the energy path from the sun. Based on my data, I will be able to determine the frequency in which the panel should be cleaned moving forward to maximize the energy captured.

MEE108: How prepared is the city of Pittsburgh for climate change??

The purpose of this project is to analyze if the city of Pittsburgh is ready to survive the changes to the weather that are coming with climate change. I will analyze data about the city plans and the plans that are created for a year away. I will also check predictions that the city has and compare those predictions to see if the infrastructure will survive the amount of rain that is coming. The other day I saw in the news that Point State Park had been flooded with only 6 days of rain, what’s gonna happen when it starts raining every day and night and amount of rain, will the whole area close to Point State Park be flooded? Will the height where the bridge is now resist the river when it continues growing every time it rains? Will the north side be more flooded than it is now, will the river sides survive? They say it will, but will it? In my project, I will find the truth.

MEE300: What Keeps Cut Flowers Freshest?

Usually after a couple of days to a week, your flowers die when cut and put into a vase with water. We are trying to solve this problem. We are testing what helps cut flowers stay the freshest the longest. We will do this by putting different liquids into vases with the same kind of flowers in each one. This will ensure that we find the correct result. This will help other people know what to use to keep their flowers the freshest. It will help us and others to not waste flowers and save money because you won't have to buy more flowers as often. The results of our experiment will be posted on fair day.

MEE301: The Mystery of the Musical Pulse

The name of our project is The Mystery of the Musical Pulse. Our research question is how do different types of music affect the heart rate of individuals? As demonstrated, this research covers many fields, helping us understand more about how music affects people in different ways. We are going to perform this experiment by gathering five participants. After checking their heart rate with a smart watch, we will play them songs of different genres of music. After each song, we will take note of their new heart rate and give them time for their heart rate to return back to normal before the next song. At the end, we will find the mean value of how much each genre increased or decreased the participants' heart rates. We will graph the mean heart rate values and the average normal heart rate to visually show how much each genre affected the heart rate. We will also find the mean normal heart rate. We believe that the softer music will probably set the heart rate below the mean.

MEE302: Compact Energy Generator: Harnessing Power in Your Palm

This PRSEF Project, Compact Energy Generator: Harnessing Power in Your Palm aims to investigate the reliability of wind energy as a sustainable power source compared to traditional fossil fuel-based systems. Realizing the urgent need for renewable energy sources, this project explores wind-powered generators as a possible alternative. Emphasizing sustainability and efficiency, the research involves the cost-effectiveness and environmental impact of wind energy compared to traditional methods. Operating on distinct principles from dynamo-based systems, wind-powered generators harness wind energy to produce usable power, potentially revolutionizing energy production. This project hypothesizes that wind and solar-powered generators will prove to be more environmentally-friendly than fossil fuel-based systems in terms of cost-effectiveness and sustainability. Through experimentation and analysis, this project aims to provide important evidence supporting the superiority of wind and solar-powered generators. By also recognizing the urgent need for sustainable energy solutions, this project helps to reduce climate change and our reliance on finite fossil fuel resources. Ultimately, the project seeks to pave the way for the widespread adoption of wind energy as a cleaner and more sustainable alternative to meet our growing energy demands. This transition promises to significantly reduce carbon emissions and provide a more environmentally conscious approach to energy production and consumption.

MEE304: Mask Mania

We are conducting this experiment in order to discover which mask acts as the best barrier from germs. To start, we will cut two slits into a box. Construction paper will be placed in one, and the mask will be placed in the other. We will then spray the hairspray at the mask. Using the black light, we will observe how much hairspray passed through the mask and reached the construction paper. Whichever mask allowed the least amount of hairspray to reach the paper is the most efficient. Results will be provided on fair day.

MEE305: Rising Confections

This is the abstract for Rising Confections We are conducting this experiment to understand why baking soda, baking powder, and bicarbonate of soda all differently affect the end result of a cookie. To perform this experiment, we will first gather all of our ingredients: flour, eggs, milk, vanilla extract, chocolate chips, granulated sugar, brown sugar, unsalted butter, salt, baking soda, bicarbonate of soda, and baking powder. Then, we will preheat our oven to around three hundred fifty degrees. After, we will soften the butter, and combine it with the granulated and brown sugar. We will add milk and vanilla extract to this after. After, we will combine our remaining dry ingredients (flour, salt, and either baking soda, baking powder, or bicarbonate of soda.) We will then slowly sift the dry ingredients' mixture into the wet ingredients' mixture. Then, we will crack our eggs into the bowl and mix thoroughly. Once all ingredients are combined, we will stir in our chocolate chips. We will create balls with the batter, and place it on a baking sheet lined with parchment paper. After, we will set the cookies in the oven to bake for around ten to fifteen minutes. Finally, we will repeat this process for the remaining rising ingredients, and compare our results to record our data. Results will be presented on fair day.

Medicine / Health / Microbiology (MMH)

MMH101: How has the Covid-19 pandemic impacted hesitancy for various vaccines?

The COVID-19 pandemic has resulted in a variety of serious impacts, one of which is a widespread increase in hesitancy in a variety of vaccines for diseases other than COVID-19. The purpose of this project was to examine data surrounding vaccine hesitancy in Pennsylvania and identify or disprove possible causes and effects of this vaccine hesitancy. Using data collected on four important vaccines (HepB, TDAP, MMR, and Polio) for Pennsylvania kindergarteners in 2019 and 2022, I made several models to show the drop in vaccine rates after the COVID-19 Pandemic and the issues that are related to this. I did not find correlations between vaccine hesitancy and politics or vaccine hesitancy and availability of medical facilities, indicating that hesitancy is based primarily on a change in personal mindset and some more specific factors. I found that the measles, mumps, and rubella vaccine (MMR) has experienced the most vaccine hesitancy on average and then examined the possible impacts of this in Pennsylvania. This project used data analysis and a variety of models to represent vaccine hesitancy in Pennsylvania and analyze potential causes and effects in order to solve this serious problem.

MMH102: Does nail polish affect pulse oximeter readings?

Pulse oximeters are useful tools for measuring blood oxygen levels (oxygen saturations), especially in patients at risk for hypoxia. During the COVID-19 pandemic, pulse oximeters were commonly used by the public to check their oxygen saturations. However, it relies on the pulsatile flow of arterial blood and the readings can be altered by factors such as cold hands or wearing nail polish. My hypothesis is that different colors of nail polish affect the readings of the pulse oximeter. I first obtained baseline readings of my fingernails without any nail polish. Next, I painted my nails red, yellow-orange, green, blue, purple, white, black, peach, brown, and clear. I measured the oxygen levels on each of my fingers. Then, I painted the press-on nails with the same nail colors and attached them to my nails. I took the oxygen readings again with the fake nails on. I performed three trials. On my third trial, I additionally measured the time it took for each nail to read the oxygen saturation. I also noted how many attempts it took for the reading to be picked up. My conclusion found that black, green, and blue nail polish, applied on both bare and press-on nails, affected the readings the most, and also took the most time to receive a reading.

MMH103: What Humidifier Setting Gives you the Ideal Humidity in a Room?

It is important to be mindful of the humidity level in your home as it can significantly affect your health and well-being. Too much humidity can lead to mold growth, unpleasant odors, and skin irritation, while low humidity can cause nosebleeds, dry skin, and respiratory issues. To determine the ideal humidity, I conducted an experiment. I decided to do this project because I faced issues with the humidity level in my room, which caused me to have frequent nose bleeds. I tested different humidifier settings (one, two, and three) to see which setting would achieve the best humidity level of around 50%. I used a hygrometer to measure the humidity of my room before and after running the humidifier for 10 hours. After one week of using setting one, I switched to setting two, and then to setting three. The results showed that the average humidity for setting one was 49.40%, for setting two it was 51.40%, and for setting three it was 53.90%. These results support my hypothesis that setting one will give you the best humidity level, closest to 50%.

MMH104: Painful to Pain Free Modalities: A Community Based Survey

Please visit student's exhibit for abstract

MMH105: Vascular Anastomosis: Measuring Efficiency of a New Method

For my project, I'm finding and testing a new way to reconnect two blood vessels. This is normally done by suturing, or sewing the two veins together. Suturing proposes many drawbacks, including being time consuming and irreversible tissue damage. The timing varies upon size of the vessels, the surgeon, and the patient, but the average vascular anastomosis time is thirty minutes per connection. I hypothesize that the new procedure will reduce the amount of time per each connection significantly. Although I am still experimenting for the most efficient solutions, currently I am considering using custom sized ice pellets and a device to push the two vessels together. To create ice pellets for different sized vessels, I'll create custom molds using silicone molding and 3-d printing. After the vessels are cut, one side will have the ice put inside while the other is pushed towards it. Then, the vessels would be exposed to a short burst of energy to seal them. This would produce heat that melts the ice and unblocks the vessel. I also am researching the properties of blood and blood vessels to make sure that the whole procedure would be safe and possible on a human. I'll test this process on fake plastic and nylon vessels, and water in the place of blood. I will take the measurement of water lost and time taken to compare to the average statistics in suturing. My results will be shown at the fair, along with the different attempts and their success.

MMH106: Superbug: Which bacteria will survive?

Please visit student's exhibit for abstract

MMH107: Does plyometrics work?

Please visit student's exhibit for abstract

MMH108: Impact of Pre-Workout Snack Choice

Please visit student's exhibit for abstract

MMH109: Dark Energy: The Effect of Common Energy Drinks on the Rate of Tumor Growth

Please visit student's exhibit for abstract

MMH110: Prediction of 10-Year Coronary Heart Disease Risks in Patients 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.

Physics (MPH)

MPA100: Factors Affecting Home Electricity Usage

Climate change has impacted our society in many different ways. It has caused the sea level to increase, which means that it could damage properties near the ocean. Droughts could threaten agriculture, production and food supply. It is important for people to work together and slow down climate change. Energy consumption is a major source of factors that contribute to climate change. One important step that we can take to slow down climate change is to reduce energy usage. In order to reduce energy usage, it is important to understand what the major reason of energy is. The goal of my research project is to identify the factors impacting energy consumption. By analyzing the energy usage of my family, I have been able to collect hourly electricity usage data from the past five years with the corresponding weather data analysis. The data showed a significant increase of energy usage during March 2020. This is when the country started to lock down parents and students stayed home. Further data collection and analysis has been planned and is currently in progress. Usage of major appliances is being tracked and will be added into the analysis. The relationship between the use of energy and weather will be analyzed. The ultimate goal of my research project is to provide an energy usage profile that can help provide information, and to help identify the pressure that can be taken to reduce energy consumption.

MPA101: Analysis of Hunting Equipment

Rationale The project is to compare the differences in velocity and elevation change between a 30-06 and a 308, which are two commonly used guns in Pennsylvania deer hunting. Procedures Inspect casings for cracks and deformation Clean primer pocket to prepare for primers -Install the primers Set powder dispenser to designated weight Install powder into casing Set bullet in casing and with press seat the bullet REPEAT FOR ALL Store loaded ammunition in designated containers. Once all ammunition is loaded and organized it can then be transported to the approved gun range. At the range you must follow all of the range's rules Set lead sled on the bench.- Set targets- Install target at 100 yards for experiment load rifle one shell at a time.- Place rifle on lead sled and adjust so it is at the center of the target.- Shoot the rifle.- -Repeat this for both rifles and for factory loaded and reloaded projectiles. The data I collected supported my hypothesis. I wanted to know which projectile is best for hunting. The independent did make a difference because it changed the velocity. The 30-06 with the reloaded projectile had the greatest velocity.

MPA102: Football Frenzy

The purpose of this project was to see which football size will go the furthest. To do this experiment, you must first go to an open space like a field. Second, place a cone near where you stand. Then, throw the pee-wee sized football three times. Then, place a yellow cone where the football landed the farthest. Next, throw the junior size, youth size and official size three times. Place a cone next to where the football landed the farthest. Measure the distance using a meterstick. The pee-wee size went further in the 3rd trial with 15 meters. The junior size football was 2nd on both 2nd and 3rd trials but was 3rd during the 1st trial. The junior size went further on the 3rd trial with 14 meters. The youth size football went further on the 1st trial with 13 meters. The official size football went further in the second and third trial with 12 meters. The data collected did support the hypothesis. The pee wee size went the furthest in all trials due to the mass of the football in relation to the other balls. According to Newton's second law, the mass of an object will affect its acceleration.

MPA103: Drumstick Rebound

The purpose of this experiment was to determine which length of a drumstick would have the highest rebound upon impact on a snare drum, and I hypothesized that the longest stick would have the highest average rebound off the drum. Here are the procedures I followed: First I Nailed the yard stick to the wall and put the phone on the tripod. Next, I picked a drop height where I would let the drumstick drop. After that, I set up the shortest stick and align it with the drop point on the yard stick (15 Inches). Then, I started recording in slow motion. Next, from where I had the stick, I let it drop and hit the snare. Then, I recorded the highest point of rebound from the video I recorded. Then I repeated these steps with the other two sticks. Lastly, I repeated this three times for each stick and recorded each average height. From these trials I found that the 15.5 cm stick had an average rebound of 1.27 cm, the 16 cm stick had an average rebound of4.65 cm, and the 16.5 cm stick had an average rebound of 5.50 cm. The data collected supported my hypothesis, and showed that the longest stick,(16.5 cm) had the highest rebound overall.

MPA104: What is keeping us warm?

Choosing the right insulation can be very confusing. My experiment is designed to select the right insulation for a home. I wanted to figure out what types of insulation work well. To do that, I took measurements of these 5 various insulations, with drywall as the baseline: fiberglass, cellulose, ceramic fiber, aerogel, and foam panels. I measured density, R-value, temperature, and cost of insulation. R-value is the industry-accepted approach on the effectiveness of an insulation. I put these types of insulations into a wooden casing, mimicking a typical wall, using the space heater as the heat source. By taking the temperature output, it seems that ceramic fiber has performed better than the rest, but very costly. Cellulose, which is recycled materials, performed well and much less expensive than ceramic fiber! My hypothesis, which was to assume the more expensive an insulation is, the better it will perform, did not work out, per the data I had collected. In conclusion, I also measured different variables that would inform me about different ways that the insulation may be more effective.

MPA105: Satellite Speed Compared to a Planet's Gravity

Please visit student's exhibit for abstract

MPA106: Wind Turbines vs. Water Wheels

Please visit student's exhibit for abstract

MPA107: PSI's Effect on Ball Distance

The PSI in a ball can effect and waste time in a game to fix. In my experiment I am finding out how the pressure affects the ball on distance. I used a machine I made with a cleat that swings down on a soccer ball inflated to different PSI. I tested each ball 3 times at 5 different PSI's ranging from 3 PSI to 15 PSI. My results were not what I hypothesized because based on the averages the 9 PSI ball had the longest average. My hypothesis was that the 15 PSI ball would go the furthest, but I was wrong.

MPA108: Cacophonous Commercials

The purpose of my project, Cacophonous Commercials, is to prove whether a commercial is louder than the show it is played in. I became interested in this project when I first heard about the CALM law, or the Commercial Advertisement Loudness Mitigation Act, which prohibits a commercial aired on television from being louder than the TV material it is shown in. I will measure the volume of both the commercial and the show in which it is being aired using units of volume such as decibels and amplitude to determine if there is a detectable variation. My data will be the average amplitude for the shows and commercials recorded from an app that measures sound. I believe I will learn more about measuring volume and reading sound waves from my studies.

MPA109: The Effect of Temperature on Ferrofluid

Ferrofluids used for rocket fuel have convective heat transfer due to nonuniform magnetic body pressure. This can enhance thermal conductivity in small microscale devices or low-gravity situations. Put on protection so you do not get skin irritation. Get your Ferrofluid and divide them into 4 containers.-Take the first container and put it in the freezer for 1 day. Make sure it is below 38 C. Take the second container and do nothing to it. Make sure it stays at room temperature. Put the third container in it. Heat up the-3rd ferrofluid in the pot. Put the thermometer in and check that it is 65 to 70 degrees C. Put the fourth ferrofluid in and make sure it is more than 93 degrees C. Get all your containers. Label each container. See how each one reacts without a magnet. The first container reacted just like the control. The control did not drip. The 3rd one acted the same way. The fourth was different. It turned solid. The ferrofluid did have magnetism but some of the ferrfluid didn't.

MPA110: Reflection versus Diffusion

The purpose of my project is to investigate how the shape of different surfaces causes variations in the return of light from surfaces with different microscopic geometries and explore potential applications in design and visual perception. I want to see how the shape of the surface impacts what the application of a material looks like. I think that this project lends itself to the application of make up or paint. I hope to see what shape reflects the best.

MPA111: Running in the Rain

My experiment will find out whether you stay drier by running or walking in the rain. I will have a total of twelve trials for walking and six trials for running. I will have a cardboard box held level and on 6 of the trials I will count water drops and on the other six, I will use Photoshop to see what percentage of the box is covered in water.

MPA112: How much weight can different materials support?

This project Is about how much weight common household materials like tape and ribbon can support. I set out to do this project because I wanted to see what I can reasonably expect to support so I can use them for tasks.

MPA113: What is the best way to put flour into measuring cups?

My project is about measuring flour with measuring cups as accurately as possible. I wanted to study this because I like cooking and my family members have different methods for putting the flour into measuring cups. I wanted to find the best way. The methods I considered were: Method 1: scooping flour out of the bag with the 1 cup measuring cup, then stabbing the flour with a knife to remove air bubbles, and finally leveling off the top with the knife. Method 2: scooping small amounts of flour into the 1 cup measuring cup, and finally leveling off the top. Method 3: Using a spoon to fluff the flour while it is in the bag, then spooning small amounts of flour into the 1 cup measuring cup, and then leveling off the top. Method 4: sifting the flour into the 1 cup measuring cup, then leveling off the top. My hypothesis is If flour shouldn't be compacted into the measuring cup when getting a proper measurement, then the last way of putting flour into the measuring cup is the best, because during my research I found that it is not a good idea to compact flour. I found that Method 1 was 32g off the ideal flour weight, Method 2 was 7g off, Method 3 was 3g off, and Method 4 was 2g off. Even though Method 4 is best, it is very messy to sift flour, so I would recommend Method 3 which is cleaner and easier.

MPA114: Cell Phones Radiation: Impact of Different Function

Cell phones emit low levels of radio-frequency (RF) energy, a type of non-ionizing radiation that has been classified by the International Agency for Research on Cancer as a possible human carcinogen. I came across an article about the detrimental effects of cell phone radiation and wondered if there is a correlation between the cell phone radiation and cell phone mode while watching a video. In the experiment, the investigator measured the RF radiation of different cell phones while playing a video in six different modes: airplane mode on with the screen off (control), playing a downloaded video on airplane mode, playing a downloaded video on WiFi, actively streaming a video on WiFi, and actively streaming a video on 4G/5G cellular network. I predicted that the cell phones would have the least RF radiation while on airplane mode. Based on the results, playing a video on airplane mode or WiFi had less RF radiation. Actively streaming video on cellular 4G/5G had the highest RF radiation that exceeded the safe limit of 10 mW/cm2. I believe this information can help other people avoid the risks of prolonged exposure to RF radiation by avoiding actively streaming videos on cellular networks.

MPA115: The Magnetic Pull of Solenoids: Engineering a Magnetically Propelled Train

Please visit student's exhibit for abstract

MPA116: Magnetic Linear Accelerator

Please visit student's exhibit for abstract

MPA117: Air Cannon

I built a large and small air cannon with a trash can and a shower curtain. I wanted to see if the size of the cannon made a difference in how far a fog ring would travel.