

**MARIAN UNIVERSITY**  
— Indianapolis —



**MARCH 13, 2021**  
**JUNIOR DIVISION**  
**PROJECT LISTING**  
**BY CATEGORY**

## PROJECT CATEGORIES

- Animal Sciences (AS)
- Behavioral and Social Sciences (BE)
- Biochemistry (BI)
- Biomedical and Health Sciences (BM)
- Chemistry (CH)
- Computer Sciences (CS)
- Earth and Environmental Science (EA)
- Engineering (EN)
- Mathematics (MA)
- Microbiology (MI)
- Physics and Astronomy (PH)
- Plant Sciences (PS)
- Robotics and Embedded Systems (RO)

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## **ANIMAL SCIENCES (AS)**

### **GRADE 5**

Fredenburg, Silas (05-09-17, AS)

Project Submission

*Fill Her Up*

"This experiment was designed to help me figure out which feed additive would best help my heifer to get good show-day fill. My hypothesis was that the Fully Loaded would work the best. For this project we did a water trial to help set up the feeding trial. Since the Optiblend showed no growth, we didn't use that additive for the feeding trial. Also since we saw growth stop or decrease after three hours we only took pictures on the last feeding three hours after we fed the five pounds. As a result the Optiblend showed the least growth while the Ultra Full showed the most growth. In the pictures of the heifer I saw more growth when the Fully Loaded was pictured. This proves that my hypothesis was partially correct. Now we know which product has the best show-day fill."

## **BEHAVIORAL AND SOCIAL SCIENCES (BE)**

### **GRADE 5**

Walsworth, Wesley (05-07-15, BE)

Project Submission

*Wifi Wars - How do I get the fastest download speed?*

"Since COVID-19 struck, everybody has been on the Wi-Fi way too much. In turn, I have had a very slow Wi-Fi download speed. So how can I get data to figure out how to get the best Wi-Fi Download speed?

My hypothesis was Wi-Fi download speed is affected by: 1. What signal you're on. 2. What is the demand. 3. If there are any physical barriers between you and the Wi-Fi router. 4. How far away you are from the router.

All we needed was an iPhone to test with and a Wi-Fi router to put the phone on the Wi-Fi. To test, first, we went to various spots in the house and on high and

low demand. Then for each location in the house, we tried the speed three times. After that, we did the same thing, but instead, we did it on the other Wi-Fi than the one that the test phone was on before. I got all four of those points in my hypothesis correct except for one thing.

We predicted that the importance of how far away from the router would not matter as much. But the significance that it played was much more critical than I thought initially.

The conclusion was that if at if you want to get the fastest download speed, you would ideally be close to the router, on the 5g, with low demand, and finally with no barriers."

Shock, Paxton (05-08-16, BE)

Project Submission

*Right Turn Preference in a Minecraft Maze*

"Right Turn Preference in a Minecraft Maze For my Science Fair project I explored if people will turn right more often when they have the choice to turn left or right and they are not sure which way to go. I have noticed people seem to turn right more often in a Minecraft maze I created. My Hypothesis is people will turn right more often when they have an option. I decided to use the Minecraft maze I created to test this hypothesis. The procedure consisted of creating a maze in Minecraft with right or left turn choices. I then had participants start at the same spot in my maze. I tracked which way each person turned the first 10 times. The participants did not know I was observing if they turned left or right in the maze. The results showed that people who went into the Minecraft maze did choose to turn right more often. Out of 100 total turns, the participants turned right 62 times. Nine of the ten participants turned right more often when given a left or right option in the maze. The one participant who turned left more often said he had been told in the past to stay to the left in mazes. The results also seem to indicate that participants seem to turn right more often when given a choice regardless of age, gender, or hand dominance. I learned from this science fair project that I can use my knowledge of the right turn preference to create more challenging mazes in Minecraft. Video game developers can also make



games more challenging using this information. The parent of one participant stated she was told to always choose the left line at Disney World because most people go to the right line. If people usually go right inside of stores, the store owners can make sure products they want to sell are on the right side of the store. In conclusion, knowing that people typically choose to go right when they have a left-right option is helpful in a number of ways."

## GRADE 7

Akkineni, Aarna (07-08-31, BE)

Project Submission

*Do gender stereotypes/bias affect the confirmation/deviation of a color-related gender stereotype?*

"My research question is "how do gender stereotypes/bias/generalizations affect the confirmation/deviation of a color-preference related gender stereotype?" Brief summary of procedures used: 1. Make four different google forms and number the surveys from 1-4. 2. Find images of the same exact object in 6-7 different colors and create a question asking which object the person taking the survey prefers most. 3. Change the description of survey #1-survey #4 to get increasingly more biased. 4. Use social media to post each survey with instructions of how to find the survey and with information about the survey. 5. Wait for 20 question responses from people on each survey. 6. Collect/analyze data. The data collected is of the percentage of times participants confirmed/deviated from color-related gender stereotypes. The following includes the percentages for the confirmation/deviation of participants in each survey: survey #1: 62.5%, 37.5%, survey #2: 32.14%, 67.86%, survey #3: 35%, 65%, survey #4: 83.33%, 16.67%. My interpretation of the data is that when subtle stereotypical statements of bias are made people tend to deviate from the stereotype since they desire uniqueness, but when a clear stereotypical statement is made, people tend to confirm the stereotype since they realize they are being influenced and the brain doesn't want to feel as if they are under influence. In conclusion, the hypothesis is inconclusive due to the experiment supporting the hypothesis in the first half

of the experiment and the last half of the experiment denying the hypothesis."

## BIOCHEMISTRY (BI)

### GRADE 4

Ahmed, Talla Elsayed (04-01-01, BI)

Project Submission

*Which Fruit has the Most Vitamin C*

"Vitamin C or also known as ascorbic acid is an antioxidant that is essential for human nutrition. Vitamin C deficiency can lead to a disease called scurvy, which can cause abnormalities in your bones and teeth. Many fruits and vegetables contain Vitamin C. Fruits have varying amounts of Vitamin C. In some fruits, the amount of Vitamin C varies between different varieties of the same species. The Vitamin C content of many fruits is higher when it is slightly unripe and usually decreases as the fruit becomes ripe. Vitamin C content also decreased with storage. Tincture of iodine is brownish-red in color. When Vitamin C is added, it becomes colorless. This reaction can be used to test for the presence of Vitamin C and to give some idea of the amount that can be found in the fruit or vegetable. My project tested five different fruits to see which one has the most Vitamin C. My results found that kiwi had the most Vitamin C and that lemons had the least so my hypothesis was wrong. "

### GRADE 8

Bhosale, Rohan (08-04-41, BI)

Project Submission

*Covid ImmunoMeter, Measurement of the biological immunity against Covid-19 by analyzing complex molecules in a synthetic serum.*

"The Covid-19 pandemic, caused by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), has affected around 110 million people worldwide and has caused 2.4 million deaths. Interestingly, 85 million people worldwide have recovered from the disease, which is around a 77% recovery rate. Some

of the geographies have better recovery rates than others and this could be attributed to natural molecules that are part of their dietary system. Based on my literature search, molecules such as Vitamins, Flavonoids, Saponin, Alkaloids, Natural Polyphenols, Carotenoids, and Curcuminoids can offer a great degree of immunity against the SARS-CoV-2 Virus provided they are present in a good amount in human blood to offer that immunity.

Hence, to assess the immunity of an individual it's important to measure the levels of these natural molecules. In this project, I delved into the question of how we can numerically assess or grade the immunity level of an individual. I developed two prototypes of machines using the principle of a Spectrophotometer. Prototype A was based on the electronic arrangements where white light from light emitting diodes (LED) was made to pass through sample and light was received by a phototransistor which was then recorded on a digital voltmeter (DVM). I used the principle of Ohm's Law ( $V = IR$ ) to measure the voltage that was developed across the resistor (sample). The voltage that I read on the DVM is proportional to the light intensity, or power ( $P$ ). The data obtained was converted into an absolute absorbance number using a linear equation. Prototype B was developed for relative and qualitative measurements and was made using multicolored LED lights where signals were collected using a collimator lens and recorded via attached diffraction prism connected to a web camera which was monitored by open source.

Further, I used four different experiments and validated both prototypes using five different chemical classes of molecules. Both prototypes were calibrated using homemade light emitting diodes-based calibration tools. In experiment 2, the linearity of the relation between absorbance and actual concentrations of Vitamin C (vitamins), Catechin (flavonoids), anthocyanins (natural polyphenols), Lutein (Carotenoids), and Curcumin (curcuminoids) was established and I also used polysaccharide as an internal standard during measurements. In experiment 3, I deployed excel based design of experiment (DoE) to design an experiment using three different concentrations (0.1, 10, and 100 mg/ml) of each of five molecules in triplicates ( $n=3$ ) in several permutations and combinations to generate

1000s of data points which were used to generate arbitrary number using python software. These arbitrary numbers were used as a reflection of immunity against SARS-CoV-2 based literature research and were used to develop a COVID ImmunoMeter. In experiment 4, the method was translated to synthetic serum (contains 0.1% egg protein).

In conclusions, I made two prototypes of the machine which can measure the presence of active molecules qualitatively and quantitatively from the mixture from an artificially created serum solution. The simultaneous deployment of digital voltmeter and Theremino software added more confidence to the numeric data on the immunity status of an individual. When plotted on excel, the response was very linear from 0.1 mg/ml to 100 mg/ml of the molecule. The DOE reduced the need for doing experiments by 25% and helped me to collect valuable data within range (0.1-100 mg/ml) for all. Experiment suggest that Covid ImmunoMeter can grade individual's immunity between 2 (lowest immunity) and 6000 (highest immunity) units. As a next step, I would like to develop this further using Raspberry Pi and would like to make a more compact version of the device."

## BIOMEDICAL AND HEALTH SCIENCES (BM)

### GRADE 5

Albared, Sara (05-02-10, BM)

Project Submission

DIY Hand sanitizer

"I compared the results of essentials oils and hand sanitizer. I realized the essential oils did clean great like the hand sanitizer. I observed that the essential oils cleaned up most of the blue spots like the hand sanitizer did and took pictures to approve that. So my hypothesis was wrong."

## GRADE 6

Alhaffar, Ayah (06-01-19, BM)

Project Submission

### *Skin Cancer Prevention: Testing the Effectiveness of Sunscreen*

“Skin cancer is caused by unprotected exposure to the sun's rays and a simple way to protect yourself is by wearing sunscreen. The UV index is a measurement of the strength of sunburn-producing UV rays. I decided to conduct this project because I learned that 20% of Americans will develop skin cancer in their lifetime. I hypothesized that for sunscreens with SPF 55 and greater, the difference in UV index will remain the same. To conduct this project, I held plastic wrap over the detector of my UV monitor and recorded the UV index before and after applying sunscreen. I looked to see how much each sunscreen decreased the UV index. I tested six different sunscreens and took 4 measurements each and averaged it. I found out my hypothesis was correct. The SPF 55, 70, and 100 sunscreens all had very similar differences in the UV index. The SPF 15 sunscreen had an average decrease of 2.75 and the SPF 100 had an average decrease of 4. At the end of the day though, any sunscreen is better than no sunscreen. Protecting yourself from UV rays is the best way to protect yourself from.”

Fareed, Nura (06-03-21, BM)

Project Submission

### *Natural Remedies for Heartburn*

“The purpose of this project is to find out which natural remedies can relieve heartburn. My hypothesis was the milk because antacids include calcium which is in milk. The remedies that I am using are turmeric powder, baking soda, almond flour, milk, yogurt, grounded ginger, apple puree, and basil with mint leaves ground with water. To test the materials first you find the ph of the vinegar and mix in the materials to each cup. Wait for 30 mins and measure the ph. I waited for 30 mins, then 1 hour, then 2 hours. In conclusion, my hypothesis was wrong. The baking soda was more effective. If you have heartburn mix 1/2 teaspoon of baking soda with water.”

## GRADE 7

Safiia, Faris (07-01-24, BM)

Project Submission

### *Reaction Time*

“Do you know what reflexes are? Why one is faster than the other? The answer to this is reaction time. Reaction time is how fast your body takes to respond to something that happens in your environment. Did you know that practice can make your reaction faster? It's true. Practicing a skill can make your reaction time faster just like playing an instrument! I decided to do my science fair on reaction time to learn about how it is measured and how I can improve my reaction time.”

Urabi, Hala (07-02-25, BM)

Project Submission

### *Exercise After You Eat Get Glucose*

“Glucose is a simple sugar in your bloodstream. It is also the primary fuel or energy source, used by all body cells. Even if it's beneficial to your body, it has to be tightly maintained and controlled. Too much glucose can result in damage to the blood vessels, increase the risk of heart disease and stroke, kidney disease, vision problems, and nerve problems. But, too little glucose can make the person unable to function. He or she can actually have seizures or become unconscious. You can use a blood monitoring system to check your blood glucose levels. A blood sugar level less than 140 (in milligram per deciliter) is normal, you are at the green line, you're good. If you read a reading of 100 to 140 that indicates prediabetes, that means you are at the yellow line, which is from now on, you got to be more careful of sugar intake, and call your doctor. Unfortunately, if you get a reading of more than 140 mg/dL that means that you are at the red line, which is diabetes. However, just because you're at the green line, doesn't mean you're safe from high glucose level for the rest of your life. If you don't control your glucose and you start eating like crazy, then your reading is going to go higher that's for sure, and you are going to be at risk for cardiovascular disease, mortality, cognitive performance, coronary heart disease, and ischemic stroke. Which is why controlling your glucose levels is crucial if you don't these risks.”

Bhai, Saleh (07-03-26, BM)

Project Submission

### *Can Fitness Trackers detect Viral Outbreaks like COVID-19*

“In my science fair project this year, I am trying to find out if Wearable Fitness Trackers such as Apple Watches, Oura rings, and Fitbits can detect viral outbreaks like COVID-19 by following a research study called DETECT. A group of scientists at Scripps Research is working on a health study called DETECT which monitors participants resting heart rates, sleep patterns, and steps via an app using their wearable fitness trackers. This app collects this data and also allows participants to record symptoms like fever or coughing. I studied their data and analyzed it, it was evident that when researchers used fitness tracker data as well as symptoms, rather than just symptoms, the results were more accurate. Researchers found that individuals who had Covid-19 typically slept a lot more than those who had symptoms but were Covid-19 negative meaning they were a lot less active which was captured via wearable fitness tracker. Resting heart rate was less of a differentiator in this study, but they did find that 30% of the individuals who had Covid-19 had a resting heart rate that went up to two standard deviations above their normal rate. So, it may be something that changes for some individuals, but not everybody. Analyzing this data helped me figure out the answer to the question and my hypothesis that the accuracy of predicting infection based on “symptoms alone” is less accurate versus “symptoms plus fitness tracker data”. What this means is, when they used fitness tracker data as well as symptoms, rather than just symptoms, the results were more accurate.”

## **CHEMISTRY (CH)**

### **GRADE 4**

Latterell, Brooke (04-04-04, CH)

Urban, Maren (04-04-04, CH)

Project Submission

Project Submission

### *Snowstorm in a Jar*

“We were interested in a winter themed experiment and found online how you can make a snowstorm in a jar. The ingredients needed was a jar, water, white paint, glitter, Alka-Seltzer and oil. We decided to do our own twist to the experiment by looking at two different oils to see if they would have the same snowstorm reaction. We thought that both the jar with the vegetable oil would have the same reaction as the jar with the baby oil. In our experiment, we had two jars which we added the same amount of water, glitter, and white paint. Then we added one cup of baby oil in one of the jars and in the other jar, we added one cup of the vegetable oil. Lastly, we added the Alka-Seltzer which is what caused the 'snowstorm' reaction and watched and observed to determine if our hypothesis was correct. We determined both the baby oil and vegetable oil did have the same reaction and so our hypothesis was proved true. We learned that water is more dense than both types of oils and they do not mix, so water is at the bottom of the jar with the paint and glitter while the oil is at the top. But when Alka-Seltzer is added to the mixture, the water reacted with the Alka-Seltzer and carried with it the glitter and white paint to the top and when it hit the oil, the bubbles became bigger and created the 'snowstorm' in a jar.”

### **GRADE 5**

Arila, Jour'nee (05-10-18, CH)

Project Submission

### *Naked Egg Experiment*

“I had a question about eggshells. I wondered when an egg is submerged in liquid, how does the type of liquid affect the eggshell? My hypothesis was I think that with a higher concentration of vinegar the shell will dissolve more slowly. I think that the shell will break off and disintegrate, and the egg will be white

and rubbery. I gathered these materials around the house: 4 glass jars, 4 eggs, traditional vinegar, concentrated vinegar, Sprite, and corn syrup. I found labels for each jar. My procedure was to: Get the glass jar Gently put the egg into the jar Pour each liquid into their designated jars. Label each jar Put the experiment into the fridge. Check on eggs every hour I used an egg in water as the control variable. The other four liquids the eggs were submerged in were my experimental variables. I made several observations. The vinegar was bubbling around after several hours. The concentrated vinegar was bubbling all over the egg. The Sprite egg sunk to the bottom and bubbles at the top I had some interesting results. The traditional egg Shell completely solidified, The concentrated vinegar shell was semi-soft, the eggshell was not dissolved yet. The sprite had a slower reaction to the eggshell but the shell was not dissolved yet. The corn syrup in the eggshell was still hard and intact. My conclusion is that the components in the traditional vinegar broke down the chemical structure of the eggshell faster."

Sabry, Huda (05-03-11, CH)

Project Submission

*Put out the Fire*

"This experiment is demonstrating how the chemical reaction between vinegar and baking soda create carbon dioxide to put out a fire. I conducted two experiments, which the first one, the vinegar touched the flame, which put out the fire before a chemical could have occurred between the baking soda and vinegar. For the second trial of experiment, my procedure worked just as I expected. Within 15 seconds, the flame of the candle was out. It answered my question of how vinegar and baking soda react to put out a fire. "

## GRADE 6

Clark, Courtney (06-05-23, CH)

Project Submission

*The effects of sugary drinks on your teeth*

"For my project I wanted to see"

## GRADE 7

Mountassar, Douaa (07-05-28, CH)

Project Submission

*How does the substance an "ice cube" is made of affect the rate at which it melts?*

"This question interests me because as a younger child my mother would freeze orange juice into ice cubes so that when they melted into the liquid orange juice the "juice cubes" would melt and cool my drink, but not water down like ice would. I aspire to find how the ice cubes with different liquids melt and if the speed would change in water. In science class we are currently learning about how temperature affects matter and what degrees celsius it takes to freeze, melt and boil."

## GRADE 8

AbuMahfouz, Laila (08-01-38, CH)

Project Submission

*Analysis of Antioxidants in Different Dietary Intake*

"The main purpose of my project is to analyze antioxidant activity between vitamin supplements, like C, E, and melatonin, and natural products. This experiment was conducted using the Briggs-Rauscher reaction, and using several chemical agents: hydrogen peroxide, sulfuric acid, potassium iodate, malonic acid, and manganese sulfate. At the end, I found that some of the vitamin supplements such as vitamin C and vitamin E were be more effective as antioxidants than the natural products. My hypothesis was correct; I hypothesized that vitamins have been researched over the years and are proved to have an adequate level of antioxidants. The vitamin supplements are also more relied on and are always thought of first when experiencing oxidative stress."

## COMPUTER SCIENCE (CS)

### GRADE 7

Xia, Megan (07-12-35, CS)

#### Project Submission

#### *Effective Computer Network Traffic Monitoring Against Malicious Attacks*

"About a third of the world's total web traffic is now made up of malicious bots, and malicious bots are responsible for many of the most serious security threats that online businesses are facing today. The project aims to develop effective methods to detect bot traffic and defend against it. We use Python programming language and a number of network modules to analyze network messages, parse the header of each message and extract the IP address of the source of the message. A spreadsheet is then created to record all the IP addresses of network access to a website, and the time of the access is also recorded. Given all the information, the website administrator can use statistical tools to analyze the data and find IP addresses with suspiciously high requests or other attacking behavior and then block requests from those addresses."

## EARTH AND ENVIRONMENTAL SCIENCE (EA)

### GRADE 4

Shah, Anwasha (04-02-02, EA)

#### Project Submission

#### *Safe Drinking Water*

"My project is titled Safe Drinking Water and I chose this project because I wanted to check how the water at school and home are different. My hypothesis is that tap water is the least safe and that boiled water is the safest. While doing my experiment I checked each sample of water for pH, copper, chlorine, and nitrates in the water. At the end, I found out that all 4 samples of water (tap water, boiled water, filtered water, and water from school) are safe when tested for the 3 minerals and pH. Even though my experiment is complete, I plan

to perform a few additional tests to check if the results would change if I collect the water samples at different times of the day or on different days of the week."

Hopkins, Gabby (04-06-06, EA)

#### Project Submission

#### *Can Mangroves Lessen the Force of Tsunamis?*

"What is a tsunami? A tsunami is a powerful wall of ocean water that can ruin crops, lives, and homes. They can be caused by underwater earthquakes, which can happen when a volcano erupts. Tsunamis can also happen when a large piece of land falls into the water, and rarely, when an object falls from space. The worst tsunami ever recorded was on December 26th, 2004, and it killed 300,000 people! That is why it is so important to try and stop the destruction tsunamis can cause. A mangrove, which is a type of tree that grows near the coastline, is thought to help slow the force of a tsunamis powerful waves by creating a wall of branches. However, lots of them have been cut down due to the creation of new civilizations. I think that if there were more mangroves, then it would lessen the force of the tsunami and help prevent more destruction. They may help to give people more time to get out of the way. For my experiment, I demonstrated making large waves, and compared the results both with and without the mangrove trees. I built a shoreline complete with homes and people that will help to show whether there's less of an impact when the mangroves are put in place. The results of my experiment showed me that yes, the mangroves didn't allow as much water to come to shore when I created the waves. This told me that in a real tsunami situation, mangrove trees could help lessen the force of destructive tsunamis."

### GRADE 5

Mosso, Leah (05-06-14, EA)

#### Project Submission

#### *Fresh Flower Frenzy*

"I wanted to use my project to find out what would keep fresh flowers fresh the longest by using household ingredients: vinegar, bleach, sugar, and

soda (Sprite). I observed and measured the flowers daily to see which would shrink and which would stay the same. Some of the flowers did not do so well, and some did very well.”

## GRADE 6

Martin, Ay’Anna (06-04-22, EA)

Project Submission

*The Rock Candy Experiment*

“Candy rock crystals in many flavors and or colors!”

## GRADE 7

Alcantara, Benjamin (07-11-34, EA)

Project Submission

*Acid Rain: What Do You Want on Your Tombstone? Using Moh’s Scale of Hardness as a Predictor of Stonemasonry Resistance to Weathering & Pollution*

"The Purpose of my experiment was to determine which kinds of stone are most resistant to acid rain and weathering. Hypothesis: Stones will resist weathering in the following order, strongest to weakest: Granite >Slate> Marble and stones exposed to vinegar will be weakened more than stones exposed to rain. Null Hypothesis: Stone type and solution exposure will have no bearing on stone strength. Procedure: Using 84 samples of Brown Granite, Grey Granite, Slate, and Marble, I weighed each stone and evaluated it with a Moh’s Hardness Test Kit, then exposed each stone to Rainwater or Vinegar for a week with Control samples left in air. After a week, I repeated Moh’s testing and weight measurements to see if there was any difference. Results: Moh’s testing showed that rainwater did not soften any of the samples except marble, however vinegar softened all the samples by approximately 1 point or more. Weight measurements showed Brown Granite didn’t lose any mass in vinegar or rain. Slate came in 2nd and lost more percent mass in vinegar than rain, followed by Grey Granite, which also lost more percent mass in vinegar than rain. Marble came in last place and lost a lot of mass in vinegar compared to rain. Conclusion: The results partially support my hypothesis since the predicted order was maintained

only with Moh’s Testing in the rainwater samples. Moh’s Testing with the vinegar samples, and weight measurements with both rain and vinegar samples showed that Brown Granite remained the strongest and Marble remained the weakest, but Slate and Grey Granite switched places. Controls remained unchanged. In addition to Moh’s Scale of Hardness testing, mineral composition is an important predictor of a stone’s resistance to acid rain and weathering."

Nuthakki, Mira (07-13-36, EA)

Project Submission

*A low cost, sustainable, recycled natural barrier to mitigate detrimental indoor air particulate matter*

" Particulate matter, as a component of air pollution, has been associated with nine causes of death and decreased life expectancy. These affect socioeconomically disadvantaged communities and developing countries disproportionately. Cooking, heating, and particle resuspension are the main sources of indoor particulate matter. Research into means of decreasing indoor particulate matter spikes found no low-cost and sustainable alternatives that could benefit both developing and developed countries. Inspired by a previously discovered adsorbent silica fume and alginate industrial by-product composite that helped decrease particulate matter, a slurry was made from rice husk ash and guar gum. This was painted onto a stretch-wrap barrier. Low-cost PM 2.5 and PM 10 (particulate matter sized 2.5 microns and 10 microns) sensors integrated into raspberry pi were placed in front and behind the barrier and remotely monitored. There was a statistically significant difference of the PM 2.5 and PM 10 measurements placed behind and in front of the barrier. While further studies may be needed under different conditions, this low-cost, recycled, sustainable, plant-based adsorbent material can be incorporated into paint on walls, roofs, and streets to potentially help decrease the global health burden of air pollution, either independently or with other mitigation strategies."

Dahlstrom, Lukas (07-14-37, EA)

Project Submission

*The Dirt-y Root Solution to Soil Erosion*

" Soil runoff from farm fields is a problem in Indiana that affects local watersheds because it contains large amounts of nitrate from fertilizer. This is often caused by rain water that breaks up the soil, causing erosion and carrying nitrates and pesticides from farms to streams and other low-lying areas. Fertilizer contains nitrates and when this ends up in water it can cause dead zones (an area of low to no oxygen in the water) that can kill fish and other marine life. The purpose of this project is to analyze how effective different methods are at reducing soil erosion and nitrates in dirt during heavy rain. This experiment also developed a portable rain lab that simulates rainfall. The hypothesis was if mulch is added on top of dirt then it will reduce the nitrate levels more than the other methods tested. The methods tested in this experiment were placing rocks in the soil, adding mulch on top of the soil, and adding plants and roots to the soil. The experimental results did not support the hypothesis as the plants reduced the nitrate level in the runoff water the most. The results show that the methods with rocks, mulch, and plants had on average 100, 58, and 30 mg per liter of nitrate respectively. This is due to the fact the roots of the plants do a better job at binding the soil together than the other methods. The roots increase the strength of the soil and prevent it from washing away. The mulch did not bind together the soil since it only laid on the top of the soil. This initially stopped the impact of the water but once water pooled up, the light mulch pieces were easily washed away. In conclusion, methods that bind together the soil are better at reducing soil erosion and nitrate levels than methods that don't. In the real world, cover crops resemble the plants method in this experiment. The fact that plants had the lowest amount of nitrate confirms that cover crops is an effective way to reduce soil erosion. This research and the portable rainmaker can help spread awareness and educate farmers and landowners to use cover crops to reduce nitrate in local watersheds and minimize downstream dead zones."

## GRADE 8

Akin-Olukunle, Inioluwa (08-03-40, EA)

Project Submission

*How do different concentrations of food preservatives affect the growth of microbes?*

"In my experiment I was trying to find out if water purity affects the surface tension of water and how much weight the surface tension of water can hold. I wanted to study this because I have never questioned the surface tension of water and it seemed like an interesting topic so I decided to learn about it. I hope to discover if the purity/ type of water affects the strength or weakness of the surface tension of water and how much weight the surface tension of water can hold. This science project falls under earth science."

## ENGINEERING (EN)

### GRADE 4

Alcantara, Joshua (04-05-05, EN)

Project Submission

*How to Build a Better Mousepad: Calculating the Coefficient of Static Friction to Test Mouse Responsiveness on Different Surfaces*

"The Purpose of my experiment was to determine what types of surfaces work best as a mousepad, and if we really need them at all. Hypothesis: Most smooth, opaque surfaces will work well as a mousepad, but textured, transparent, or reflective surfaces will confuse the mouse and it will be less responsive. Null Hypothesis: Different mousepad surfaces will not affect mouse responsiveness. Procedure: I tested 12 different surface materials to see how responsive a mouse is on them. To make a fair comparison, I calculated the Coefficient of Static Friction between the mouse and each surface, then using those angles, I put the material on a slope and let the mouse slide down each surface over 32 cm and measured the pixels traveled by the cursor on the screen. The Results show that the mouse responded similarly on smooth, opaque surfaces including 2 mousepads, wood, leather, 2 books, paper, and smooth cloth. The mouse was less responsive on textured cloth. The mouse was completely



unresponsive on glass, a mirror and silver metal. Conclusion: The results support my hypothesis, so I accept my hypothesis and reject my null hypothesis. The surface you mouse on really does make a difference!"

## GRADE 8

Maddi, Adam (08-02-39, EN)

Project Submission

*the Brachistochrone*

"I'm sure you have heard the statement, 'the fastest way to travel from point A to point B is the direct route, which makes perfect sense. No need to go around anything or take a longer route. But what if I told you that there is a faster way? Would you believe me? I didn't until I learned about the brachistochrone. The brachistochrone is the fastest descending curve with the inclusion of the concept of gravity. The brachistochrone is one of the oldest problems in the history of calculating variations. The first time it was thought to be solved by Johann Bernoulli in 1696, other mathematicians and physicists gave solutions as well. Including Jacob Bernoulli, Leibniz, and Newton."

## MATHEMATICS (MA)

-

## MICROBIOLOGY (MI)

-

## PHYSICS AND ASTRONOMY (PH)

### GRADE 4

Miller, Temple (04-03-03, PH)

Project Submission

*The Magnificent Magnet Car - "How do magnets work?"*

"Magnetism is what gives magnets their ability to attract objects made of iron or steel. A magnet creates around itself a region of space with special properties. This region is known as a magnetic field. When two magnets come near each other, their

fields create forces that attract or repel. My question for my experiment was how do the size of the magnets affect the strength of the magnetism. My hypothesis was would changing the size of the magnets affect the distance of magnetic attraction and create a faster attraction. My theory was proven by changing the size of the variable magnet for each data collection. If I were to alter the method for another experiment, I would change the size of the constant magnet attached to the car to understand if that would effect the magnetic attraction based on distance."

Bridges, Keegan (04-07-07, PH)

Project Submission

*How to be TOE-tally Warm*

"Which type of sock material is the warmest on a cold day? I want to know this information because I want to stay warm outside when it is cold. I think that a 100% wool sock will be the best insulator because it is woven tightly so it doesn't let as much heat out and wool helps a sheep stay warm in the winter. I covered glass jars with different types of socks except for the control which were not covered by a sock. I poured 150 F water in each jar and recorded temperatures immediately then every 10 minutes for 60 minutes then, repeat indoors and outside. My results were that 100% wool sock did the best insulation. The athletic sock was very close to wool. The running sock did the worst for insulation. Outside wool was the best insulation. The dress socks had the least insulating effects. The result of my experiment was that wool is a good sock to wear anywhere. Therefore my hypothesis was correct. I also found that if you are doing an activity in a warm climate a running sock is a good choice."

Kempers, Kaylee (04-08-08, PH)

Project Submission

*Bottle Rocket Fuel*

"Bottle Rocket Fuel Kaylee Kempers 4th Grade Robey Elementary Experimental Design I wanted to determine the best fuel mixture for bottle rockets. I chose my project because it would be fun to try out, and a lot of people would want to know the answer. My hypothesis was Mentos in Diet Coke would be the

best because of videos showing how high the diet coke would shoot out of the bottle. Experimental Design My dad and I integrated a bike tire valve stem into the cap of a soda bottle so that we could use a tire gauge to measure the pressure due to the gas created by the reaction inside the bottle. Experimental Design – Release Mechanism I needed to make sure no gasses escaped while tightening the cap so I had to devise various methods to keep the solids from mixing with the liquids until the lid was closed. I taped the Mentos to a magnet and held it to the side of the bottle with another magnet. For the baking soda, I created a cone that would hold baking soda out of the liquid until the lid was tightened. Once Baking Soda and Vinegar were shown to produce the most pressure, I varied the amount of liquid and solids to see if the pressure would change. Results & Data Analysis Please see my presentation for details on my data. A 12 to 1 vinegar to baking soda ratio produced the best reaction. Conclusion My hypothesis was incorrect, Mentos and Diet Coke do not make the most pressure.”

## GRADE 5

Gopal, Anirudh (05-04-12, PH)

Project Submission

### *Mind Blowing Magnets*

“Magnets pull metallic objects and (sometimes) other magnets towards themselves. Magnets are used in various applications, from headphones to home security. Understanding how magnets behave allows us to use them to solve many problems. This project measured the force and visualized the field to understand how shape and size of magnets affect their behavior. Force was measured using a scale and two repelling magnets. Field was visualized by spreading iron filings evenly over a paper, and placing the paper over a magnet. Magnets of various shapes and sizes were studied. The results showed that shape and size both affected behavior of a magnet.”

Krishnan, Ashwin (05-05-13, PH)

Project Submission

### *Raindrops Keep Falling on My Head*

“I noticed during a car ride in rain that the windshield wipers run faster at higher car speeds and confirmed this through background research. I wondered if a person would, similarly, get wetter if they ran through rain, instead of walking. So, I experimentally tested this by placing a plastic cup on the roof of a toy car and running it at different constant speeds under a shower stall, by creating a simulated environment of controlled, vertical, constant-rate rainfall using a kitchen stand with uniform holes (to create vertical rain from an angled showerhead) and a stacking shelf with racks (to pull the car in a straight line). I controlled the speed of the toy car by pulling it through the rain using a cord connected to a pulling-mechanism machine created using a Vex-IQ Robotics motor (and other parts) running at fixed speeds for a constant distance through the rain. My windshield-wiper behavior driven hypothesis was that the amount of water collected would linearly increase as the car speed increased. My multiple-sample results conclusively demonstrated that the amount of water gathered by the cup decreased inversely (nonlinearly) with the car speed. My hypothesis was not supported. My results were explained through additional research: The time exposed to the rain by the cup (top of car) has an inverse relationship to the car speed. In contrast, the windshield (front of car) encounters a constant volume of water for a constant distance, and, so, the wipers run faster at higher car speeds.”

## GRADE 7

Wharton, Akeem (07-04-27, PH)

Project Submission

### *Does the type of model rocket (store bought or homemade) affect its height and speed?*

" I came up with this idea when I was looking around and saw model rockets lying around and I wondered whether there would be a difference between homemade rockets or the ones I have here. I wondered if because of the size and shape of the type of rocket I use affects the speed and height based on wind pressure, in reality that's not all I'm looking for.

I'm also questioning if the size of the bottle or canister affects how many molecules of air get pushed into the rocket and pushing it out farther. I'm using the experiment to build my knowledge. In class we are learning about mass and matter takes up space as that is how the rockets get propelled forward and I am basing on aerodynamics of how the rockets move through the air."

## PLANT SCIENCES (PS)

### GRADE 5

Erdogan, Zeynep (05-01-09, PS)

#### Project Submission

##### *Which plant is better for my room?*

"In this experiment, I tested which plant is better for my room. For this, I had to test three plants to see which one of them would release the least amount of carbon dioxide in the night. Dracaena, Epipremnum, and Broiled were used. First, I got a hole puncher/paper puncher and started to cut out 20 leaf circles of every three plants. When I finished cutting them out, I used aluminum foil to cover three bottles so their inside could be dark. And I started to put those leaf circles in the bottles. Lastly, I used a carbon dioxide sensor to see which plant gave less carbon dioxide, and when I got the results the plant called Dracaena had gave the least amount."

### GRADE 7

Koltuniuk, Adam (07-06-29, PS)

#### Project Submission

##### *Plants on Pulse Lighting*

"The question in this lab was chosen because the results could affect the efficiency of plant growth: What effect does Pulse Lighting have on Plant Growth Height? In this lab, four light boxes were built and controlled by a small microcomputer. One box was a control box and stayed turned on for a total of 10 hours each day. Boxes two, three, and four stayed toggled their lights on and off every second, minute, and hour, respectively. The pulsating lights were toggling for twenty hours each day, so in total they were lit up for ten hours. All the boxes were turned

on for the same amount of time in total. There are eight plants in each box. In the lab, each box had eight data points collected per day for ten days. When the data was processed, all of the plants that didn't grow were taken out. The data was also based off of the number of days after a plant has sprouted to only measure the impact of light. After the data was collected and processed, it was determined that pulse lighting did not negatively impact plant growth and made most of the experimental groups grow faster and better than the control. The testing done in the lab concluded that Pulse Lighting could be used to benefit plant growth. After the data was processed, the group of plants that had the best overall plant growth were the ones in box number three"

Kohlenberger, Braedon (07-07-30, PS)

#### Project Submission

##### *Mustard Powder's Effect on Plant Growth*

"The problem being investigated was "How does mustard powder effect plant growth?" This topic was chosen because if mustard powder did boost plant growth, it could be used by farmers to help boost plant's growth if they're experiencing crop failure, which would in turn allow them to feed their families and the people they trade with. The procedure was simple: put 4 grams of soil and a seed in thirty egg carton cavities, put half a gram of mustard powder in a third of them and give another third a whole gram, and then water them with two grams of water every twenty-four hours, at which time measurements and observations would be recorded. There were nineteen quantitative observations, eighteen qualitative observations, six-hundred ninety-three data pieces describing the height of plants (two-hundred thirty-one per each group), and thirty observations about where each plant ended up. The hypothesis was supported (none of the control group grew), but the results may not have been scientifically accurate, as there were problems that negatively effected the growth of all the plants."

Desilva Corson, Jonathan (07-09-32, PS)

[Project Submission](#)

### *How a green roof can affect the temperature inside a building*

“The question of my experiment was “Do rooftop gardens affect the temperature inside a building?”. I designed a experiment to mimic three buildings, one with a green roof, one with a roof covered in soil, and one with a normal roof. These buildings would be a cardboard box with a thermometer inside, the roof being a plastic tray covered with soil and plants, soil, or nothing. I created different testing conditions mirroring different temperatures outside. My six “weather types” were created using a heat lamp at varying heights and external room light. First, the temperature inside the box would be measured, then the box would be left in a temperature controlled room for one hour and the temperature inside the box would be measured, and compared to the starting temperature. This would be done once for every weather type for each box, totaling at 18 different tests, so 18 different pieces of quantitative data. My Hypothesis was “If there are plants on the roof of a building, then it will be cooler inside the building, because the plants will absorb some heat from the sun.” So, I believed that the green roof box would have the lowest temperatures difference. Out of the six tests for each roof type, the average difference between starting and ending temperatures for the green roof was -0.31666 Celsius; for the soil roof 0.28333 Celsius; and for the normal roof 0.5666 Celsius. My hypothesis was correct and the green roof had a negative average difference.”

Talbot, Owen (07-10-33, PS)

[Project Submission](#)

### *Sunflower Growth with Glass Cleaner*

“Do certain amounts of glass cleaner increase or decrease the height of a plant? Important steps were: Step 1-4 The Process of Scarification; Step 8 Securing the Styrofoam Cups; Step 10 Pouring out the Soil; Step 12 Planting the Seed; Step 17 and 19 Recording the Heights of the Plants; 20-21 Watering the Plants. The data collected was the height of the plants. The amount was in millimeters. From the data, I was able to interpret good things. Since the experimental group gave positive feedback, farmers are able to use

glass cleaner when playing crops and plants. From the data that was given to myself, people around the country and even around the world are able to use glass cleaner to help with planting. It just makes playing crops and other greenery a lot quicker that way they are able to produce more then just using water.”

## **ROBOTICS AND EMBEDDED SYSTEMS (RO)**

### **GRADE 6**

Safia, Abdullah (06-02-20, RO)

Sethi, Musa (06-02-20, RO)

[Project Submission](#)

[Project Submission](#)

### *Bristlebot*

“You’ve probably heard about using renewable energy sources like solar and wind power to provide electricity to buildings and homes, along with hybrid or fully electric cars that use no gasoline. But what about solar-powered robots? As robots are becoming more common, it is really important to use 'Green' energy sources to power them. In this project, we will build and test a popular robot called a bristlebot, a tiny robot made using toothbrushes that can operate on either solar power or battery. We will also investigate how well it performs in different weather conditions. We will also observe if a battery powered robot will operate better than a solar powered robot or if a solar powered robot will operate better than a battery powered robot.”

### **GRADE 8**

Shinkle, Chase (08-05-42, RO)

[Project Submission](#)

### *Comparison of Different Software Controllers for Making a Robot Drive Straight*

“The purpose of this experiment is to find out what the best software control loop method is to make a robot drive straight. The problem with making a robot drive straight is there are many factors influencing the robot. My hypothesis was that with a PID controller, I could make a robot drive straight. This is the

procedure I followed. First, I built a Vex robot with optical shaft encoders and a gyroscope. Then I programmed the robot with basic code to drive. Next, I programmed the bot with a Proportional-Integral-Derivative control loop (PID), a simple control loop using encoders (Encoders) and Gyroscope (Gyro) control loop. After that, I laid a 20 foot straight piece of tape on the floor and marked it with different measurements. Then I ran the robot at three different speeds (31, 63, 93) and two distances (2500, 5000 encoder ticks). I did this ten times at each speed and distance. Last I calculated the results. My results in this experiment showed that PID tested the best at driving straight, Gyro and Encoders were pretty equal, and no control loop the worst. Any control loop I tested was better than no control loop. In conclusion, PID provided the best results, however it needs tuning. The PID also appeared the best at driving an exact distance. Encoders did just fine at small distances, but as the distance increased the accuracy went down. Gyro was the worst control loop for driving straight, but can be useful if needing to turn exactly. Use a PID if you can tune it accurately. If you are not able to tune, use Encoders. I don't recommend using Gyro for driving straight."

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