2020 Minnesota State Science & Engineering Fair
Middle School Project Abstracts

Project Category	Project #	Project Author(s)	Project Title	Project Abstract (Max. 250 words)
Animal Sciences (ANIM)	1001	Elise Bestrom, Sarah Coffman & Mary Watson	Does Green Tea Affect Stress-Induced Eating in Zebrafish?	75% of American adults are overweight or obese. This can increase their risk for diseases. It can also affect mental health. L theanine is a soothing acid we used to try to calm zebrafish. Green tea—our source of L-theanine—has been reported to decrease stress levels. We wanted to find out if this would decrease stress-induced eating in zebrafish. We used Fluticasone Propionate as a stress-inducer and green tea as a potential stress reducer. In this experiment we used four different Petri dishes labeled Controlled, Fluticasone Propionate Only, Green Tea Only, and Fluticasone Propionate and Green Tea. All held ten zebrafish (five days old). We added 4 milliliters of embryo water to each. We added 1 milliliter of tea solution to the Green Tea Only, and Fluticasone Propionate and Green Tea Petri dishes. We added 1 milliliter of Fluticasone Propionate solution to the Fluticasone Propionate Only, and Fluticasone Propionate and green tea Petri dishes. We added 50 rotifers to each dish and left overnight. The next day we counted the rotifers in each dish. We repeated the study twice. The results of this experiment were that the Fluticasone Propionate Only ate the most (32) and the Green Tea Only ate the least (4). Fluticasone Propionate and Green Tea ate 8, and Control ate 19. Our hypothesis was supported. We thought adding green tea to stressed fish would decrease the amount of rotifers eaten. The difference between the Fluticasone Propionate Only and Fluticasone Propionate and Green Tea dishes was significant, at 24 rotifers.
Animal Sciences (ANIM)	1003	Kloey Jensen	Happy Hermit Crab: What effect do Olfactory cues (smells) have on hermit crab behavior?	Hermit crabs don't have a single nose, they have hundreds (Brouwers, 2012). The question is: What effect do olfactory cues (smells) have on hermit crab behavior? The hypothesis is: If a hermit crab is presented with different olfactory cues (food, and conspecific, and predator), then the hermit crab will move towards the food and conspecific smell, and will go away from the predator smell. To begin this study a testing chamber was constructed, using a three foot high metal stool. Under the seat an incandescent lap was mounted and placed in a dark room and a black sheet was placed over the chamber. Four hermit crabs were each tested three times for each olfactory stimuli (conspecific, food, and predator odors), twelve times each. The hypothesis was supported. The hermit crab was more often found on the side of the chamber with a food stimuli. There did not seem to be a pattern when the conspecific smell was present in the chamber. The hermit crabs were more often found on the side away from the predator in the predator stimuli. The Hermit Crabs were very tense and cautious when the predator was presented. This testing was not done in a natural environment and the results could be different in that setting. Pet stores and scientists can benefit from knowing hermit crabs can respond to olfactory cues.
Animal Sciences (ANIM)	1004	Jaeden Allen	How do the Qualities of a Pet affect whether or not someone adopts it?	I did this project because I want to help out at animal shelters, make sure that more animals are adopted and take up a career in zoology, but I am not old enough to volunteer at animal shelters that I looked at. For my project I had people respond to different surveys, one with and one without photos, to see if the photos had an impact on whether or not they would choose to adopt the four different dogs I put in my survey. I learned that breed and photo quality can impact whether or not dogs are adopted.
Animal Sciences (ANIM)	1006	Amelia Schatteles	Just a Spoonful of Sugar	Does a spoonful of sugar actually help the medicine go down? The problem I studied was the easiest way to medicate horses. I thought that this would be an interesting question because I love horses and I wanted to help make sure they got their medications on time, and stay healthy! My results were that the apple and banana tied for 1st place, each with 5 stars. I found this surprising because I thought that they would like the fancy treats, the muffins, with 3.6 stars, because they didn't get them hardly ever, but they in fact liked the basic apples and bananas

				instead. In conclusion, if you ever need to medicate your horse, do it by hiding the medicine in an apple or banana slice. So no, don't feed your horse a spoonful of sugar, please.
Animal Sciences (ANIM)	1007	Aspen Winbigler	One Fish, Two Fish, Red Fish, Blue Fish: What effect does the genotype of zebrafish cross have on the phenotype of their progeny?	Glofish are created by inserting genes into zebrafish from other organisms such as jellyfish, or coral, causing them to be brightly colored and glow under a black light (Glofish 2019).The question was: What effect does the phenotype of zebrafish cross have on the genotype of their progeny? The hypothesis was: If the phenotype of the parent zebrafish is known, then the genotype of the progeny can be predicted. The average mass (grams) and length was measured for every phenotype (red, blue, purple, grey). Punnett squares were made to indicate possible genotypes of the parents and progeny and a Chi-square analysis was done to determine which Punnett squares (genotypes) were more likely. My hypothesis was supported. The genotype of the parents of the monohybrid cross could be predicted using two Punnett squares. The parents of the monohybrid cross were hemizygous red. There were 3 red progeny and 6 gray. If the cross was homozygous the offspring would have to have been all red. This study was unable to determine the genotype of the di-hybrid cross. When Punnett squares were made for a hemizygous and homozygous zebrafish they both predicted that there would be 25% of each color. It was surprising that the di-hybrid was unable to predict the phenotype of parents. Zebrafish are widely studied for genetic testing, understanding them is important. Next time, I would like to use a tri-hybrid cross to predict the genotype of a crosses parents
Animal Sciences (ANIM)	1008	Liam Clift	The Rusty Crayfish (Invasive species in Aquatic Minnesota)	As a growing number of people know, invasive species are a big problem. In Minnesota, with our abundant lakes and rivers, we are paying close attention to the aquatic ones. In my project, I focused on a small crustacean that is a big problem. The Rusty Crayfish. These tiny crustaceans uproot native plants while foraging and clear the way for invasive plants. My goal was to see what bait would work the best for catching the rusty, limiting bycatch. I originally thought that salmon would work better than the tuna cat food, (my baits) and I guess I was partially correct because even though neither caught the crayfish, the salmon had very little by catch which was what I was looking for.
Animal Sciences (ANIM)	1009	Eva De Grace	What Colors Are Dogs Attracted Too?	The purpose of this experiment was to try to answer the question of what colors dogs are most attracted too? My experiment could potentially help Veterinarians with making colorful medications that dogs like the most or see the best. As a result of this, dogs might take certain colored medications more efficiently. For my procedure, I first laid out four pieces of colored paper. Then, I laid treats on top of the colored paper. Next, I brought the dog in a separate room and let it pick the treat off of whatever piece of paper. After that i brought the dog into another room then I switched the colored paper around and place treats back on the paper. i then tested the dogs two more times. My results showed that four out of six dogs picked yellow and green paper. One out of six dogs picked blue. Three out of six picked red. The colors that were chosen the most was green and yellow. The color that was picked the least was blue. My results did not support my hypothesis because I said dogs would be attracted to blue because of the blue cones in their eyes. I figured out through my experiment and research that dogs see the world as yellow, blue, green and gray. This is because dogs have two cones, blue and yellow. I concluded that the dogs in my experiment picked green and yellow because those are the colors that stood out to those dogs the most.

Behavioral and Social Sciences (BEHA)	1012	Moraya Holleman	Brainy Birth Order	The title of my project is Brainy Birth Order. I studied the effect of birth order on GPA from math, science, social studies, and language arts classes and if this effect changed with age. I chose this because I did a project last year on if sibling presence in a household effected GPA and I wanted to dig deeper into this field. The steps I took to complete my project were to make an anonymous survey asking for a subjects grades, number of minors in their household, and their birth place amongst those minors to give to students and then contact teachers throughout 4th, 5th, 6th, 7th, and 8th grade and ask if they would give the survey to their students. I made sure that I would have 100 subjects in each grade. I then dropped surveys off with teachers, answered their questions, and then picked up completed surveys. The next step was to label each survey with a letter and a number: the letter represents the grade the subject is in and the number is to keep track of surveys within a grade. The last step was to calculate each subject's GPA twice, for accuracy. My results showed that birth order did not have a significant effect on GPA in any grade. I learned that siblings and most likely family in general don't play a big role in school success compared to other factors such as a person's hard work.
Behavioral and Social Sciences (BEHA)	1013	Gabrielle Kirchner	Cognitive Cache	The purpose of my experiment was to find out what strategy of memorization worked best for retaining information. I became interested in this when I wanted to know what the best way of studying would be when wanting to remember information for a test. For my experiment I had test subjects, from the second and fifth grade, remember information off a list three different ways. One way I read the test to them, another way I had them read the test aloud to themselves, and for the third test I had them read it to themselves inside their head. I found that the second graders retained the most information from me reading the list to them and the fifth graders retained the most information from reading the test in their head. I think my results turned out this way because second graders retain more information when something is read to them whereas, fifth graders have opportunities to study during class and they need to be able to retain information by reading inside their head.
Behavioral and Social Sciences (BEHA)	1014	Alora Petersen	Colors and the Eyes	Did you know that restaurants often use a lot of orange and yellow to peak food interest (Art Therapy, 2019). This study was done to determine how color affects emotion. The question was: What effect does emotion have on the colors chosen to represent them? The hypothesis was: If different emotions are examined, then the colors chosen to represent that emotion will be affected. The program presented a new screen for each trial; the screen displayed an emotion term and a prompt for the participant to select a color match using a color wheel and light/dark slider. With each emotion stimulus trial, the program recorded the RGB (Red, Green, Blue) color space values of the selected color. Results pending. The hypothesis was supported by different emotions were represented by different combinations of colors according to the green, red and blue color index. For the color index red the correlating emotion was romantic, angry, and alert. For the color index green the highest emotions were energized, happy, healthy and refreshed. The color blue index had the highest emotions of thirsty, refreshed, calm, relaxed, sad and soothed. When Gilbert (2016) was compared to this study. For this study romantic and sensual had more brown and red and Gilbert had more red and pink. Many middle school students did not know what sensual means. It was interesting that adults picked more pick and red for sensual and romantic. One can understand why advertisers use those colors for Valentine's day.
Behavioral and Social Sciences (BEHA)	1015	Adeline Heymans & Genevieve Bradshaw	Cursive versus Print	We wanted to find out if cursive or printing was better for memorizing words. We tested eight fifth graders, we had them in two groups of four. We tested them in a quiet space one at a time so there weren't any distractions. They were given one piece of paper for practice and memorizing and the other for writing down what they remember. We read them a cursive test and a printing test. They wrote down ten words in cursive and had one minute to memorize as much as they could, then wrote down that they remember. We did the same thing with printing. We found that in six out of the eight people got lower scores with cursive, while two people improved while using cursive. Our hypothesis is incorrect because we thought they would improve if they wrote in cursive, but their cursive scores were worse. We think that this is because the fifth graders are better at writing in printing than cursive. It is much faster for them to write in printing so they have

				less time to forget the words. We think that if we tested adults who have gotten used to writing in cursive, they would do better on the cursive test.
Behavioral and Social Sciences (BEHA)	1016	Teodora Kamenov	Does A Persons Identified Gender Influence Their Color Choice	The purpose of this project was to see if people are more inclined to pick their genders assigned color, or if they are more inclined to pick the opposite gender. My hypothesis was that the color won't matter to either gender, they will just pick whichever color they feel. I had participants choose which color cookie they wanted, pink or blue. Then I recorded all their data.
Behavioral and Social Sciences (BEHA)	1017	Grace Loonan	Does Hand Dominance Impact Creativity	The purpose of this project is to examine how hand dominance affects a person's creativity, and if left-handers are actually more creative than right-handers. I am conducting this experiment to reveal that although humans are prone to generalizing, we need to realize that each individual is different and has different needs and skills, no matter if they are left-handed or right-handed. Creativity isn't based on the preferred hand, but on the individual. For my experiment, I showed nine household items to a group of twenty-seven test subjects (fourteen left-handed, thirteen right-handed), giving them thirty seconds to write down as many uses as possible for each item. I then scored the subjects' uses on five aspects of creativity: elaboration, originality, appropriateness, flexibility, and fluency. My data shows left-handers as scoring higher on average in originality, elaboration, and overall creativity. Research has confirmed that being left-handed does not increase creativity. Instead, creativity is a product of brain hemispheric interaction, proving that ambidextrous people are more creative than those who strongly prefer one hand. Therefore, from these results I can conclude that the left-handed subjects in my study were most likely forced to evolve when growing up in a world dominated by right-handers and become partially mixed-handed. Although the subjects write with their left hand, they learned to use their right hand for other tasks, such as dribbling a basketball or operating a keyboard mouse. I also acknowledge the possibility of human error impacting my results.
Behavioral and Social Sciences (BEHA)	1018	Hailey Lindquist	Does Multitasking Affect Cognitive Performance for Math and Reading Tests?	It's universally agreed that it's okay to play music or talk on the phone or anything of the like while studying or driving, right? People claim to be able to work better while music or background noise is playing, but just how efficient is multitasking? I conducted an experiment to test if people really work better while multitasking. I had 16 people take a math test with music and another without. When I collected the data, it showed that the average time it took for people to complete the test with music was actually less than without music, making this the better result. This surprised me because in my research, I found that multitasking is actually worse for your brain and can make you do things slower.I learned that even though it's bad for your brain, some people work better while listening to music because they're used to it and therefore become accustomed to having that background noise.
Behavioral and Social Sciences (BEHA)	1019	Isha Kapoor	Does personality type affect attentiona nd short term memory in adults?	The purpose of my experiment was to see if personality types affect attention and short-term memory in adults. Personality types have been shown to impact how individuals process information, their academic performance and school grades. Therefore, I hypothesized that personality types will also affect attention and short-term memory in healthy adults. I studied healthy adults in the community and assessed their personality types with an online questionnaire based on the Myers-Briggs methodology. Individuals were classified as introverts versus extroverts, intuitive versus sensing, thinking versus feeling, and perceiving versus judging. The attention and short-term memory of the individuals was assessed using a 40-word list that was made of words in 5 different categories. Individuals were shown the words in random order, each word for 5 seconds, and then asked to recall the words over a 5-minute period. A score was given based on the number of words accurately recalled. There were no personality or gender-based differences in the performance on the memory test. The strengths of the study include a large sample size, wide age-range and good representation of males and females and different occupations. The limitations of the study include single type of memory test (not a battery), which may not test all facets of short-term memory. I also did not control for time of the day at the time of testing, fatigue, stress, mood, sleep deprivation-all of which are factors that could impact attention and short-term memory.

Behavioral and Social Sciences (BEHA)	1021	Shannon Reilly	How Color Affects Memory	Do you have trouble memorizing and retaining information for tests or quizzes? Many people do! So for my project I decided to test the effects of color on memory. This science fair project was performed to see if memory retention can be improved by coloring. I expected blue to score the highest by a lot. However I found that blue and green scored highest at an average of 13.5/16. I think this experiment will be useful to schools and students when they are studying. Because if you color your notes it could help you retain more information.
Behavioral and Social Sciences (BEHA)	1022	Julia Pletch	How Does The Music Genre Effect Your Work Efficiency?	The purpose of my project is to see if playing different types of music while you're performing a task like reading, affects your efficiency. I tested ten different thirteen year olds on their reading efficiency. I played five different music genres, including the songs: Rock of Ages- Def Leppard, Since U Been Gone- Kelly Clarkson, Hillbilly Bone- Blake Shelton ft. Trace Adkins, Fur Elise- Beethoven, and Fidgety Feet- Bud Freeman. I found out that Pop music is the most distracting and Rock and Roll is the least effective music genre to your reading efficiency.
Behavioral and Social Sciences (BEHA)	1023	Bennett Wartner	If Swimmers are Nationally Ranked in the Top 100 at Age 10, Will They Continue to Be Ranked in the Top 100 in 10 Years?	The purpose of this experiment is to find out whether or not swimmers who are ranked in the Top 100 in the nation at a young age still will be ranked in the Top 100 ten years later. My research can be used to predict the odds of a swimmer succeeding and making it big in the swimming world based on a vast range of variables. In my experiment, I used USA Swimming's (USAS) database to create multiple data tables, each with the names and rankings of the Top 100 10 year old swimmers in the 2009-2010 season for an array of five different events. In the data tables, I proceeded to repeat this for the following nine seasons by recording the season ranking of Top 100 rankings of the same 2009-2010 Top 100 swimmers, while disregarding those swimmers who were not ranked in the Top 100 (or may not have swum) when they were 10 years old during the 2009-2010 season. My findings show that most swimmers who were in the Top 100 at a young age did not go on to be in the Top 100 multiple years later. This may be because early bloomers, who hit puberty earlier, rely less on technique and more on raw strength. This allows the late bloomers, who had to rely mainly on technique, to gain the upper hand in the long run.
Behavioral and Social Sciences (BEHA)	1024	Ceiliah Slama	It's Not Secret	A) My purpose is to let people know how Cyber Security works. B) My Procedure was first the Parent had to sign the paper. Then they would fill out my questions with their answers. Then I would use Social Media to find the answers they wrote down. Finally, I would compare my data with their answers. C) I was able to find most of the answers to the questions. D) The more you post, the easier it will be to find data.
Behavioral and Social Sciences (BEHA)	1025	Misha Montgomery	Masculinity, Femininity, and Androgyny Associated with Musical Preference	This project examined how traditional gender identification (masculinity, femininity, and androgyny) might associate with music preference and how individuals who prefer certain types of music are classified along the gender classifications. A survey consisting of the Open Source Psychometric Project (OSPP) Sex Role Inventory (10 masculine preference questions and 10 feminine) and 12 questions about music preference was used to collect data. A link to the study was posted on a personal social media account and there were 59 participants. The results showed that people who like mellow music are clustered in the feminine section of the graph, people who enjoyed unpretentious music were in the feminine category, but closer to the undifferentiated part of the graph. People who enjoyed sophisticated music were in the middle of undifferentiated and feminine gender preferences. More masculine participants were in the intense music graph than any others, but there were some in the androgynous section and many more in the feminine category. People who enjoy contemporary music were mostly in the feminine section of the graph. In conclusion, most of my hypotheses were incorrect, but parts were right. There was a low positive correlation of 0.282 between masculinity and intense music preference scores. The correlation between unpretentious music score and femininity, 0.089, was very low. In this study, there was a small number of participants and a very high percentage of them identified more with female traits. If gender preference was more equally distributed the results might have been different.

Behavioral and Social Sciences (BEHA)	1026	Juliana Godina	Most Common Fingerprint & Fingerprint Personality	The question that I tried to answer was what is the most common fingerprint and what does the fingerprint shape describe about a person's personality. For the first part of my question I needed to find what is the most common fingerprint that I cold find, and for the second part of my question people needed to take a personality test. I did this project because I want to show people that fingerprint don't just describe how a person looks like but how it describes about the people's personalities. People who participated in my experiment sat down and choose their right or left thumb to be put in a fingerprint pad to a sheet of paper. Then I gave them a personality scale test,one means no not all and five means yes absolutely. loop is the most common fingerprint out all seventy fingerprint I got. Loop falls in the category of leadership, whorl seems to be the same as the loop but is more passionate. Arch seems to be more in the center of everything but is more patient, and double loop seems to be more independent than the other fingerprint shape. My hypothesis was correct and incorrect for both parts in my project. For example, first I thought the double loop by only one fingerprint.
Behavioral and Social Sciences (BEHA)	1027	Camilla Beaster	Seeing in the Dark: Do gender and/or age affect the ability of our eyes to adjust to darkness?	One night before bed I had just turned out the light and my dad wanted to play guitar to me. He said he needed to let his eyes adjust first, but I could already see the strings perfectly fine. Then I wondered, did it take his eyes longer to adjust because he was a male or because he was older? I decided to do an experiment to find out. I had people of all ages and both genders participate to see how long it took for their eyes to be able to adjust in darkness after looking at a light first for a brief amount of time. I recorded the amount of time it took them to see an object. Based on the data, I saw no difference between male and female times. However, the age of the participants did affect their time. The older members took more than 10 minutes or never were able to see in the darkness. The younger people saw in a much quicker time.
Behavioral and Social Sciences (BEHA)	1028	Patrick Morgan	Senior Assistance for Childproof Containers	Senior citizens are the main consumers of medications but struggle at times to open childproof containers. Devices or methods that might assist seniors with opening containers could prevent poor compliance, which can be detrimental to their health. This experiment tested senior citizens' ability to open childproof containers, with and without a device or method to help reduce the time and effort. Thirty-one senior citizens over the age of 70 were tested. Seniors first filled out a questionnaire and then opened three containers: a push-down and turn, squeeze and turn, and line-up and pop. Then, the time to open the push-down and turn container with device A and B, squeeze and turn with device A and line-up and pop with the arrows colored was measured. Last, seniors were asked if they found device A, device B and/or the colored arrows helpful. Neither device led to a mean decrease in time to open the containers. The time to open the line-up and pop container with the colored arrows decreased in 28 of 31 seniors; these 28 felt this method was helpful. More seniors found device A to be helpful than device B. Ninety percent of seniors with arthritis felt device A was helpful. This study showed that although the time to open containers did not improve with two assistance devices, senior citizens still found these devices helpful. Device A seemed particularly helpful to seniors with arthritis. Coloring the arrow on the line-up and pop container made opening easier for most participants.
Behavioral and Social Sciences (BEHA)	1029	Tristan Engelmann	Speed Accuracy Tradeoff in Video Games	I wanted to know how a user's speed in applications such as video games and UI's (User Interfaces) affects the user's accuracy when playing/using the program. I did research on the question, finding things like Fitts law and the speed accuracy tradeoff to have a basis for testing, modified an old video game I created and coded to fit the needs for testing, and gathered participants. In the game, the player is moving through a field full of cubes, with the speed that they are moving at changed in each of the three levels. The participants played the game, first having a minute of practice, then going through the game at 0.7, 0.8, 0.9 speeds. The data

				gathered didn't fit any patterns, with no clear correlation to the Positive or Negative hypothesis, pointing to the Null hypothesis.
Behavioral and Social Sciences (BEHA)	1031	Natalie Homme	Turn, Turn Tourniquet	Background: Tourniquet application by lay individuals is being taught through a national “Stop the Bleed” initiative in response to increasing violence. This initiative takes considerable time and effort and has not focused on middle school students. Methods: Subjects were asked to watch a brief instructional video on one of two types of tourniquets, after which their ability to properly apply the tourniquet to an adult male’s arm and leg with the prompt “I am bleeding from this arm/leg, please save my life” was tested. Time to application and success in achieving arterial occlusion were measured. If location or tightness were incorrect, they were prompted with the phrase, “There is still bleeding, what would you do?” Up to three attempts were permitted with arterial occlusion confirmed by doppler ultrasound. This process was repeated with a second video and tourniquet type for each study subject. Results: 18 subjects were tested. First attempt location and arterial occlusion success rates for the upper extremity (UE) and lower extremity (LE) were 86.5% UE, 89% LE, and 53.5% UE, 54% LE respectively. Overall success rates for location were 92% UE, 97.5% LE and arterial occlusion 86.5% UE, 81% LE. Conclusion: This experiment demonstrates that most middle school students are capable of properly applying a tourniquet in a simulated patient after brief instructional videos. These results suggest that the development of an abbreviated instructional program directed towards middle school students could be successful in achieving desirable rates of competence in tourniquet application in a simulated scenario.
Behavioral and Social Sciences (BEHA)	1034	Catelyn Calverly	What effect does gender have on if a person can tell the difference between medicine and candy?	Did you know that around 60,000 children go to the ER each year due to accidental medicine ingestion, and that 95% of accidental medicine poisonings involving children happen when their parents are not watching them (Seattle Children's Hospital, 1995)? The question is: What effect does gender have on the ability of a person to tell the difference between medicine and candy? The hypothesis was: If gender is examined females will be better at telling the difference between medicine and candy. Participants were shown pictures of candy and medicine and they checked whether they were candy or medicine. My hypothesis was partially supported. Females correctly identified whether it was medicine or candy 73.8% of the time, while males identified the correct choice 70.6% of the time. It appears that males and females are just as likely to identify medicine as candy. They both identified medicine correctly about 70% of the time. The worrisome thing is that they said medicine was candy about 30% of the time. This could lead to emergency room visits. Dr. Mowry claims that around 50% of calls to poison centers are for children aged 6 and under, and many of these calls are due to accidental medicine ingestion (Riley Hospital for Children, 2019). In the future I would like to compare more age groups

Biochemistry (BCHM)	1036	Josiah Butler	Cellulosic Biofuel Production Via Acid Pretreatment and Enzymatic Hydrolysis	Clean and affordable renewable energy sources must be found to, not only reduce the pollution of fossil fuels, but to guarantee humanity's future when petroleum is depleted. Bioethanol shows enormous potential as the world's primary energy source, especially for transportation, and when it is derived from renewable lignocellulosic biomass. In this study, five biomass products were chosen to be converted from lignocellulosic biomass into bioethanol. Corn stover, oat hulls, switch grass, aspen, and spruce. All were subjected to a two-percent sulfuric acid pretreatment to hydrolyze the hemicellulose by destroying the polymeric bonds, making the cellulose available. Then enzymatic hydrolysis was employed using Cellulase, an enzyme blend. Samples were run through the HPLC to determine the glucose content. Corn Stover produced the highest yield with 11.7 mg/ml of Glucose, followed by spruce with 11.3 mg/ml then Switch grass with 8.9 mg/ml, oat hulls with 8.4 mg/ml, followed by the poorest performer, Aspen with 8 mg/ml. Potential ethanol was calculated and measured in theoretical yields. Corn produced the best yield with 5.8 mg/ml, followed by spruce with 5.7 mg/ml, then Switch grass 4.4 mg/ml, oat hulls 4.2 mg/ml, followed by the poorest performer, Aspen with 4 mg/ml.
Biomedical and Health Sciences (BMED)	1037	Trenton Bonin	Are Fingerprint Patterns Inherited?	Fingerprints are typically something that most people do not pay attention to, but they are very interesting when you learn about the patterns. The purpose of this science fair project is to see if fingerprint patterns are an inherited trait. Fingerprints of blood relatives were collected to see if there were similar patterns throughout generations. The project was created in order to analyze two unrelated pairs to see if they will have different patterns. 12 out of 15 of the related pairs had the same fingerprint patterns and 10 out of 15 of the unrelated pairs had different patterns. My hypothesis is that fingerprint patterns are an inherited trait. My experiment supported my hypothesis.
Biomedical and Health Sciences (BMED)	1038	Paige Jacobson & Adam Jacobson	Are you a ticking Lyme Bomb?	Major issues face our world today, including wars, concerns about water and air quality, global warming, and deer ticks. Yes, deer ticks are a major threat and can leave mass destruction in their paths. The Ixodes scapularis, black-legged deer tick, weighing less than a poppy seed and possibly smaller than a pencil point, is a real danger. One in three deer ticks carry a bacteria called Borellia burgdorferi. People bitten by these ticks can develop Lyme disease which may cause immense infections and serious negative health conditions. More needs to be done in the fight against Lyme disease and that is where our project, big data science, and precision medicine combine to give people hope for a healthier future. We want to keep people from experiencing the negative effects of this horrible infection. It matters. According to the CDC about one-half million people are affected with Lyme disease annually in the United States. Our study examined: What variables increase a person's risk for developing symptoms of Lyme disease. A homemade survey was given to 548 study participants. Through detailed analysis using Design Expert, we found a risk score for determining a person's Lyme symptoms. The scores discovered using a composite of symptoms, including some habits, and also considering a person's age, gender, and home location. We were able to determine variables that are significant in evaluating risk for Lyme disease.
Biomedical and Health Sciences (BMED)	1039	Jordin Kading	Bacteria: More than MEATS the Eye	My question is "What cleaning solution is most effective for raw meat?" I researched about bacteria and different disinfectants and I learned a lot. After my research I thought that the Lysol-Hydrogen Peroxide would work the best. My cleaners that I chose to use were Lysol-Hydrogen Peroxide, bleach, vinegar, Thieves essential oil cleaner, a homemade cleaner, and lemon water. I rubbed raw meat on the counter and then sprayed the counter with the cleaner. I left the cleaner for 30 seconds then I took a cotton swab and wiped the surface. Next, I wiped the petri dish and set it in the incubator. I ran it twice and Lysol had no bacterial colonies both times; bleach had just a few at the end. The rest of the cleaners had many bacterial colonies. I learned that the best disinfectant is the Lysol-Hydrogen Peroxide Spray.

Biomedical and Health Sciences (BMED)	1040	Ethan Parcon	Do Sugary Drinks Affect the Color of Your Teeth	The question I answered during this experiment is, “Do Sugary drinks Affect the Color of your Teeth?” The purpose of doing my experiment was because I want to teach kids how meaningful it is to brush your teeth properly, and I am not just teaching kids about dental hygiene, but also adults about it as well. My procedure for this experiment is that I put eggshells (because eggshells are made out of calcium, and teeth are made of a compound of calcium) into cups of water, juice, Gatorade, soda, and coffee, then I would observe the eggs after five minutes and put down my observations, the next thing I did was that I would wait until the next day, and record my observations on the eggs, then I recorded my observations for a week, and finally, after the final day, I brushed each egg and recorded the observations. The drink that affected the eggshell’s color the most was the soda, the sugar from the soda stuck onto the egg, and when I brushed the egg, barely any of the sugar came off. The egg that was affected the least was obviously water, because water has no sugar or chemicals that can harm your teeth. In conclusion, most of the egg’s color changed a lot, mostly because of the sugar, and others because of the chemicals in the sugar.
Biomedical and Health Sciences (BMED)	1041	Chelsey Nelmark	Does Age Affect Whether You Hear Yanny Or Laurel?	Yanny or Laurel, the sound track that is “ breaking the Internet”. This sound track interested me because people can hear different things either Yanny or Laurel. After a while listening to this soundtrack I wanted to know if age affected whether a person heard Yanny or Laurel.In this project you will learn about different sound frequencies and if age affects whether you hear Yanny or Laurel. I took 8 different people in their 10s, 20s, 30s, 40s, 50s, 60s, 70s and 80s and I had them play the Yanny/Laurel soundtrack to see what they hear and then I collected all of the data to see if there was a pattern. My Hypothesis was that the older half of the group will hear Yanny and the younger half will hear Laurel. The collected data results showed that there really was no specific pattern in who heard what because the results were mixed and because of this I have decided to reject my Hypothesis. Thank you and enjoy!
Biomedical and Health Sciences (BMED)	1042	Sydney Klee	Gene Editing and Anxiety	Gene editing has been around since the 1970s, but have you ever stopped and wondered if genetically modifying organisms have a consequence on mental health? I wanted to know if gene editing technology such as CRISPR has an impact on mental health, specifically anxiety and stress. Ordinary anxiety and anxiety as a mental disorder are two different things, ordinary anxiety comes and goes, well-diagnosed anxiety stays the same and even gets worse. CRISPR is a gene editing technology that uses the protein Cas9 to replace a segment of DNA and change the code. I tested to see if any anxiety symptoms are shown during a stress assay and wall hugging assay. I hypothesized that the fish with the most genetically modified genes will have higher levels of anxiety. This project requires eight Petri dishes with four fish in each dish for the fli-gada cross. For the fli glofish you will need eight Petri dishes with two fish in each dish. After I sorted the fish I proceeded to use a light table with graph paper and wall hugging assay. I video taped the fish for twelve minutes starting data at two minutes for the stress assay. For the anxiety assay I exposed the fish to the light table for ten minutes, then recorded for five minutes. These tests helped me determine if gene editing had impact on mental health.
Biomedical and Health Sciences (BMED)	1043	Robbie Wollan	Guard Your Gourd On The Gridiron: Does the Fit of Your Football Helmet Affect Your Risk of Suffering a Concussion	I am testing to see if the fit of a football helmet affects a player’s risk of suffering a concussion. I am completing this project because I am a multi-sport athlete who has suffered from two concussions, one of which was from football. I conducted my experiment by using pumpkins, the best replica of a brain, and dropping them from inside of a football helmet from 5 feet, 10 feet and 15 feet. When I increased the height and used the smaller pumpkins, they had an enlarged amount of damage. The pumpkins smashed around inside of the helmet, which was unable to do its job to protect the player’s “head”. I stated that this would happen in my hypothesis because if the helmet is improperly fit, it’s value of protection is much weaker leading to even more severe head injuries like a concussion. Since the smaller pumpkins suffered the most amount of damage, helmet fit is a factor in making sure players are safe and, hopefully, concussion free.

Biomedical and Health Sciences (BMED)	1044	Brady Wedin & Jason Maki	How do video games affect your health (heart rate and blood pressure)?	The question was: What effect do video games have on heart rate/blood pressure? Our hypothesis is: If it is a fast paced video game, then your heart rate will go up the most and possibly increasing your blood pressure when compared to a slow paced video game and when a video game is not played. Participants will have their blood pressure checked and heart rate using a blood pressure cuff that also measures heart rate, millimeters of mercury (mmHg) in beats per minute. The hypothesis was supported. When playing a fast paced video game the people tested blood pressure went up, unlike when tested playing slow paced game their blood pressure stayed the same or went down. Smyth (2014) did a study that looked at 630 children age 8-12 about their habits and had their blood pressure monitored over a week those who spent the longest time had a slight increase in blood pressure then those who don't spend much time on a screen (Smyth, 2014). This study found that fast paced games caused negative physiological effects, yet the slow pace game did lower blood pressure and heart rate, therefore not all video games have a negative effect. As we age our blood pressure naturally rises, maybe adults would be more affected. Parents can understand that fast paced games have more of an effect on their children than slow paced. In the future we would like to test adults.
Biomedical and Health Sciences (BMED)	1047	James Mellen	Rough-Ruff Allergies	The purpose of my experiment is to tell if hypoallergenic dogs are actually hypoallergenic. In my experiment, I selected four dogs that are supposed to be hypoallergenic (a Goldendoodle, a Berna doodle, a Newfypoo, and a Papillon-mix) and five participants (my family). In each experiment the participants played with a dog and then reported any allergic reactions that they had. I requested scores for five potential allergic reactions on a scale of 0 to 5 For each person and dog combination I calculated an Allergy Score. I then totaled the Allergy Scores for each person and dog to get Total Allergy Scores. Four of my participants have been tested and are known to have allergies to dogs. One participant (my mother) does not have any known allergies to dogs. The results of the experiments showed that despite being advertised as hypoallergenic, participants with known allergies to dogs still experienced allergic reactions. The level of the allergic reactions varied by participant. My dad, who is very allergic to dogs, had the highest Allergy Scores for each dog (23), but some dogs were worse than others (Fozzie the Newfypoo was the worst at 8, Ellie the Papillon-mix was the least at 3). My brother, sister and I had some allergic reactions to all but Ellie the Papillon-mix. My mother, who does not have dog allergies, had no reaction to any of the dogs. In conclusion, the outcome of my project is there is no such thing as a hypoallergenic dog.
Biomedical and Health Sciences (BMED)	1049	Yusuf Sheikh	Testing Bluetooth For Radiation	The reason I did my project is because i always wondered why would use Air-Pods if scientist say it is bad for them. Some people say its bad for you. Some say that it is not true. Which gives off more radiation? Air-Pods, or a TV. I predicted the Air-Pods would give off more radiation than a TV but would not exceed 40mG. First, I placed my Air-Pods on a wooden table. I scanned for 5 seconds 3 times, 10 seconds 3 times , and 15 seconds 3 times. I then approached the TV and did the same. When it comes to results, the Air-Pods did give off much more radiation than the TV. But the TV did not give off a lot of radiation . My hypothesis was partially supported. The Air-Pods did give off more radiation but during all of the scans it exceeded 40mG. The results from the TV was not what I expected.

Biomedical and Health Sciences (BMED)	1050	Azrianna Johnson	Tetrachromacy: What effect does gender and age have on the likelihood of a person having tetrachromacy?	Tetrachromacy is an ability with your eye when you can see four times the amount of color compared to the average human (Krucik, 2016). The question was: What effect does gender and age have on the likelihood of a person having tetrachromacy? The hypothesis was: If gender and age are examined, then female adolescents will be more likely to have tetrachromacy. Participants were given an image used to test for tetrachromacy. They look at the image and count how many colors they see. People with the condition can see more colors than others. The hypothesis was partially supported. Middle School females did have a higher percentage of people with tetrachromacy, when compared to all adults. Yet, middle school males had a higher percentage of people with the enhanced color vision and adult females had the lowest. It appears age has more to do with enhanced color vision than gender. Research does support my findings. Lippincott, Williams & Wilkins (2014) report that abnormal color vision does increase with age, yet not totally impaired until a person is over 70. Surprisingly, Jain et. al (2010) found that The original hypothesis was if gender and age are examined, then female adolescents will be more likely to have tetrachromacy.
Biomedical and Health Sciences (BMED)	1051	Lyndsey Burke, Noah Winter, & Julia Sanchez	The Long Term Effects of Vaping Essential Oils	In 2019, the number of people vaping went up by 6% in middle school and 19% in high school, over 18 deaths have occurred from vaping in 2019. Vaping has become an issue recently and hurts more people than you know. Many people vape, inhaling unnecessary chemicals that can lead to lung cancer and severe damage to the lungs (creating "popcorn lung"). We used Zebra fish in this experiment; they will give us the closest results because we share 70-80% of our DNA. We started by sorting the fish in different solutions of the most common vaped essential oils and embryo water. We did this to determine which solution had the most impact. During the second round of testing, we retested everything with lavender and control groups. Then we tested eye size, yolk size, heart rate, and the angle of the fish. We found some fish's yolk would swell; meaning that metabolism is being affected. Some fish would keep near the same size which is slowing their metabolism, while some ate yolk faster than others, most had swelling or slower metabolism. Some had heart defects and we also saw brain deformities. To conclude, we want to make a change in the world of science and help people. We saw big effects that could show people what happens when you vape. We could show them what happened when it came to metabolism, heart rate, and brain/eye deformities. If we did this experiment again, we would expand the amount of essential oils and would do further testing.
Biomedical and Health Sciences (BMED)	1052	Linden Loos, Addison Short, & Janaea Bellingar	The Power of Vegetables	Is Sulforaphane too good to be true? We discovered the compound called Sulforaphane. Out of all our research we couldn't find a negative study on this compound. That is what led us to do this project. Sulforaphane is a natural compound in cruciferous vegetables such as broccoli, broccoli sprouts, brussels sprouts, cauliflower, kale, etc.(4). Sulforaphane can be consumed by taking supplements or eating the vegetables listed. We did this experiment because studies have shown that sulforaphane can help DNA protection, lung disease, antioxidants, weight loss; these are all positive effects. We tested to see how different amounts of sulforaphane affect the zebrafish heart rate, death rate, and development. We are using zebrafish because zebrafish DNA is very similar to humans, they're easy to work with, and develop quickly. With our results, we found out that the yolk sac sizes (radius) were the smallest with 0.5 x, with an average of 69.78px then 1x, with an average of 70.64 ox and then control, with 72.42 ox. Right away all of the 2x fish died. With the heart rate, the more sulforaphane the zebrafish had, the lower the heart rate; Control had an average of 168 bpm, 0.5x had an average of 136 bpm, and 1x had an average of 125 bpm. To conclude this project, we found out that sulforaphane can be helpful, but only with taking a certain amount.

Biomedical and Health Sciences (BMED)	1053	Trever Nikolai, Jack Nagele, & Hayden Mathern	What are the Best Non-Plastic Alternatives for Phthalates and Plastics	Phthalates are toxic chemicals found in many everyday items. Research suggests phthalates are harmful to major organs. Phthalates are in toys, wrappers, cleaning products, blood tubes, and more. Laws passed making it illegal to use phthalates in foods, but phthalates still sneak into foods because the packaging includes phthalates used for a non-stick. One alternative to phthalates is beeswax; beeswax has many health benefits over phthalates, it's eco-friendly and natural. Beeswax does not have any known risks. Another replacement for phthalates is Argos; Argos is seaweed meaning it's all natural, and any risks are unknown. This test included yolk sac size, eye size, heart rate, death rate, and angle of development; there are six groups including 50ppm phthalates, 100ppm phthalates, 50ppm Argos, 100ppm Argos, beeswax, and control. This test had zebrafish in groups of 10; using zebrafish tests how it affects sea life, and it tests the effects on humans because zebrafish share DNA. This experiment concluded that phthalates, like hypothesized, were the most dangerous group. They had 6 deaths, slowed the heart rate to 70bpm, made the eye size grow to unnatural levels, and slowed the development of the yolk sac size. Argos and beeswax had a natural heart rate, yolk sac size, and angle of development. The argos group had 4 deaths, and the beeswax had an unnatural eye size. This means beeswax and argos are imperfect solutions, but if companies switch to argos it will be safer than phthalates and unlike beeswax it'll be hardly more expensive.
Biomedical and Health Sciences (BMED)	1054	Paige Goranson & Erin Keating	What effect does gender and braces have on oral hygiene and self-esteem	The question was: What effect does gender and braces have on oral hygiene and self-esteem? The hypothesis was: If gender is examined, then females will have better oral hygiene and decreased self-esteem with braces. A survey was written on a password protected site in an online form. The survey was posted on an online learning management system by the teacher. Participants were asked questions about their oral hygiene (how often they brush their teeth and floss, and how often do they visit the dentist. Also, if they had braces and what their self-esteem level was) (see example survey). The average time participants brush their teeth, floss and visit the dentist will be graphed using a bar graph. The average self-esteem rating of the students that have braces will be compared to the students that do not in a bar graph. The hypothesis was supported. All females had better oral hygiene. Females brush their teeth more. Females floss their teeth more, visit the dentist more, and males have higher self-esteem. This study found that females had better oral hygiene, while surprisingly, a group of scientists from Oxford University found that females tended to have worse oral status. Yet, they agreed with this study when they also found that girls experience worse psycho-social impacts after having braces put on. Orthodontists will benefit from knowing they may need to give their female patients more support after they have braces put on. Also, they should council parents and males to improve their oral hygiene.
Biomedical Engineering (ENBM)	1055	Ashlee Modjeski	Don't Shatter Your Shins	Shins are one of the most easily damaged parts of the body, so good quality shin guards are essential for staying safe and having fun, but unfortunately, shin injuries can still occur even if you are wearing a shin guard. This experiment tested which of the four most common types of shin guard shells best protect your shin from impact. To test this, each type of shin guard, a dial indicator, a four-pound double-headed hammer, a protractor, and clamps were bought. The clamps were used to secure the shin guard so that it cannot move. The dial indicator was set behind the shin guard so that the needle was barely touching the inside of the shin guard. The hammer was used to swing down and hit the shin guard at 10 degrees three times. The impact of the shin guard is recorded by videotaping the movement of the dial indicator and played back in slow motion to find the maximum impact of the hammer. Repeat this process with each shin guard. Whichever shin guard bends inward the most will impact shins the most. Before testing, the hypothesis was that the carbon fiber shin guard would prevent the most impact. This proved correct and the results showed that Carbon Fiber shin guards protect the best, then 69 percent K-resin/31 percent Ethylene-vinyl acetate(EVA) combination, 45 percent Acrylonitrile Butadiene Styrene(ABS)/45 percent Ethylene-vinyl acetate(EVA)/5 percent polyester/5 percent rubber combination, and last 100 percent polypropylene (PP).

Biomedical Engineering (ENBM)	1056	Adnaan Said	Engineering New Transmitting Insulin Pen For Type 1 Diabetics.	I chose this experiment because my little sister was recently diagnosed with type 1 diabetes. She is using an Insulin Pen and the problem I saw was that unless you wrote the number of units given down on paper, you forget how many units were given within 24hrs. This is hard, especially when she is at school and not all the data is communicated. I believe my experiment is important scientifically because it provides people with more information about their diabetic management. Since there is no insulin pen with memory in the market,I know that everyone who has diabetes would benefit from it and manage their diabetes a little better. My engineering goal is to create an insulin pen that stores and transmits data (number of units given) to devices. My engineering project solves the confusion surrounding the amount of insulin given and makes managing the diabetes process a little bit easier. I worked with Raspberry Pi system in coding the schedule runs to dispense insulin dosages. I ran multiple schedules to get the most accurate flow. Each schedule ran for 5 seconds which measured 2ML. From there I was able to see how many schedules that happen in a day and multiple the 2ML's to get the 24 hours insulin dose. This info was visible via screen attached to the raspberry pi. I learned that 1 in 5 Americans are predisposed to becoming diabetes in the USA. This is an area I want to help by designing easy, advanced pen which will benefit all diabetes in need of insulin and their guardians.
Biomedical Engineering (ENBM)	1057	Ali Weingartz	Stinky Shoe	The purpose of this experiment is when people take off their shoes their shoes stink the house. The procedure for this experiment was first off choose a tennis shoe that has not been worn for months. Then go to Joann Fabrics to have grey nylon to be cut a half yard. Also buy from Joann fabrics double sided Scotch tape. Order a pack of two lemon essential rollers on Amazon. Using lemon essential oils is safe on the skin. When the essential oils are delivered apply them by rolling the lemon roller twice vertically, do this twice. Take one piece of double-sided tape per shoe from Joann fabrics, the insert was taped on the back side of where the lemon oil was applied. When you have the tape on attach the insert to the shoe.The data showed that the insert with the insert was 20% approved the other 60% was the no preference and the shoe without the insert. This experiment can be used in the real world in many different ways. Athletes for example they are sweaty and full of odor this leads to taking their shoes. Another example is people who have a condition called Kyetococcus Sedentarius which means they have a worse foot odor than others. This is the reason experiments are happening all the time. This was not a success but there are different ways to control the results and how to do things different.

Biomedical Engineering (ENBM)	1058	Ella Lynn Holleran	WISP - Wearable, Individualized, Sensory Product - A Therapy Tool for Those with Autism & Sensory Processing Challenges	The purpose of this project was to build an individualized massaging vest for people with autism and other sensory processing needs who can be easily overwhelmed in settings neurotypical individuals find manageable. Sensory therapy is shown to help people cope and find success at home, in the classroom, and in the community. I hypothesized a massaging vest would help students with sensory needs remain calm and engaged in the classroom. I built the vest using a vibrating motor, a battery pack, and intensity controller. Neurotypical and neurodiverse students most often like to fit in with their peers, so the vest snaps into any zip-up or button-up clothing such as a hoodie or jean jacket. The vest was tested by general and special education students at an elementary school. Students used a three-point scale to rate how they felt before and while using the vest. In total, 83 trials were completed - 54 with general education students and 29 with students receiving special education services with sensory needs. Overall, 54% of participants reported being calmer and more engaged while wearing the vest. 65% of participants receiving services reported this improvement compared to 48% of general education participants. Only 3% of participants receiving services reported feeling worse with the vest, compared to 11% for general education participants, and 8% overall. In conclusion, the vest helped a majority of students receiving special education services. They liked the vest and found it helped them stay calm and engaged in learning.
Chemistry (CHEM)	1059	Myla Baudek	Best Oil For Popcorn	The purpose of this experiment was to figure out what oil makes the best quality popcorn. By researching it showed that coconut oil is the healthiest/most natural oil to use when popping popcorn. A “good quality” popcorn was defined as popping almost all the kernels without burning the popcorn. 1 tablespoon of oil was measured. Each popcorn trial was popped and labeled with the type of oil used. The 15 trial results were analyzed to determine which oil made the best quality popcorn. The hypothesis was supported. The different types of oils were tested, and researched to see which is the healthiest. Coconut oil made the best quality popcorn, meaning that it made the popcorn flavorful, fluffy, and least amount of burnt popcorn than the other oils resulted in. The results show that coconut oil took longer to cook for two minutes but resulted in better quality popcorn, and the vegetable oil and peanut oil took less time to cook but made poor quality popcorn.
Chemistry (CHEM)	1060	Karen Claire Miller	Camphor: Is it Worth It?	Camphor is a controversial ingredient that is often found in nail polish. Not only is it expensive but it can also cause health problems. I did my science fair experiment on nail polish and if the ingredient camphor is worth the extra cost. I love nail polish and nail art but it always seems to come off in the first week. I was going through so much polish. When thinking about the Science Fair, my problem came to mind. So I started researching what makes nail polish stronger and what do long-lasting nail polishes have in common. It brought me to the ingredient camphor. Camphor is an ingredient in nail polish that makes it more flexible and durable or at least claims to. I was skeptical so I decided to run an experiment. I put ½ inch of nail polish from six different nail polish brands on ping-pong balls and put them through a series of tests for 3 days. After each test, I measured the polish left. My data shows that the Non- Camphor side lost less polish it ended up only losing a combined 0.3595 square inches compared to 0.5628 square inches on the camphor side. I enjoyed this project and it helped me with a real problem I have.

Chemistry (CHEM)	1061	Katelyn Ubl	Cold Wars	The purpose of this experiment was to find out whether a Hydro Flask, Yeti, or plastic cup will keep water the coldest for a seven hour period. I choose this topic because I am very interested in the popularity of water bottles. My hypothesis was that the Yeti water bottle would keep the water coldest over a seven hour period. For this experiment I filled each water bottle with two cups of water. I made sure to record the starting temperature of the water in each bottle to keep the data consistent. I then tested the temperature of each water bottle every hour for a seven hour period. I then recorded all of my data and found the average temperature change from start to finish. I also found the average temperature change per hour. I found out that the Yeti kept the water the coldest for the seven hour period. However, the Yeti and Hydro Flask had very similar results. The Yeti kept the water coldest on average over the four tests by 0.1 degree Fahrenheit. This slight difference made my hypothesis correct.
Chemistry (CHEM)	1062	Amelie Isom	Cupcake Concoctions	We were interested in finding if baking soda, baking powder or both rose higher. We were also interested in if baking powder, baking soda or both tasted better. We were interested in this because we wanted to know what rose and tasted better, so that in the future, we know what to use. This is important to other people because then they can see which one is most effective to use in their cupcakes. After learning that baking powder and baking soda have different ingredients, we decided to test which one rose higher and which one tasted the best. We started with making the recipe, not adding any baking soda or baking powder. Then, we weighed out the batter exactly into 3 evenly weighted bowls. We did this by taking the weight of the batter and splitting it into 3 parts, weighing at exactly 429 grams. After that, we whisked the 1 teaspoon of baking powder in one bowl, ⅓ of a teaspoon in baking soda in another bowl, and ⅕ teaspoon of baking soda, and ½ a teaspoon of baking powder in the last bowl. From our data, we concluded that the cupcakes with baking soda rose the most and tasted the best, and the cupcakes with baking powder was the smallest and tasted the worst.
Chemistry (CHEM)	1063	Rachel Mohr	Curds & Whey	I did this project because I like finding out different ways to do things with food. I wanted to figure out what acid makes the most cheese curds, by weight, when making cheese. I tried four different acids which were rennet, vinegar, lemon juice, and lime juice. I thought that the rennet would work the best when making cheese. I found out that the rennet did make the heaviest curds, and the lime juice produced the lightest curds out of all the acids. If I did this experiment again, I might try out even more acids to make the curds. I would also try cooking the curds longer to see what they do. I could make bigger batches to see if I get the same results. I enjoyed this experiment and I had fun doing it.
Chemistry (CHEM)	1064	Maggie Banks	Currently Knocking On Wood: Toward a Biodegradable Piezoelectric Transducer From Rochelle Salt and Wood	The purpose of this experiment was to create an biodegradable piezoelectric transducer to be used as an eco-friendly energy source. Initially, two different piezoelectric materials, Rochelle salt (RS) and quartz, were tested. A projectile was dropped through a tube to strike the crystal. Height was converted to potential energy to allow for comparison between the two crystal materials. Five readings were taken on three crystals of each material using an oscilloscope. The quartz crystals had a low electrical output, peaking at 290mV, while the RS crystals reached up to 3870mV. Quartz and RS had significant standard deviations of 235mV and 1853mV, respectively. RS crystals gave a higher average electrical output, but broke easily. Brittleness was remedied by soaking two types of wood (pine and maple) in a supersaturated solution of RS over 27 days. Five tests were run on five pieces of wood every nine days. Both woods peaked after the first nine days, with averages reaching 2794mV for maple and 2125mV for pine. Statistically, maple had two outlying data points. When removed, the maple average was lowered to 2248mV. This showed that both woods gave approximately equivalent results. Electrode placement and alignment of tracheids, structures inside the vascular system of the wood, was optimized by testing end and long grain orientations. End grain proved to be more effective, with average 902mV, and electrode placement didn't have significant impact. Different thicknesses were also compared, showing thicker wood created higher outputs. Future ideas include trying different geometries and types of wood.

Chemistry (CHEM)	1065	Sophia Kyba	Do expiration dates correspond with milk spoilage over time	The purpose of this experiment was to see if milk expiration dates are truly representative of the milk's spoilage. The information gained from this experiment could potentially help decrease food waste and educate families about the meaning of expiration dates. To conduct my experiment, I grew bacteria out of milk samples on Agar plates. My results show that bacteria does not grow in milk cartons until after they have been opened. One of my test milks had been expired for twenty-one days before opened, and nevertheless did not grow bacteria. From research, I gather that this happens because acidic conditions are not all that spoils milk. Bacteria cannot multiply in milk until it enters, and it does not enter until opened.
Chemistry (CHEM)	1066	Allison Fox	Does Salt Really Help Ice Melt?	My project is about how salt actually effects ice. I put out 3 cups of water and 4 ice cubes. Then in the first cup I poured in a tablespoon of salt. In my second cup I poured in a tablespoon of sugar. In my third cup I just left empty with the ice and water. Then I timed how fast each melted. My hypothesis was I thought the cup with the ice and salt would melt fastest. Interestingly the cup with nothing but ice and water melted fastest. Although three trials were run with the same result, I would suggest additional testing.
Chemistry (CHEM)	1067	Lyndsey Sellner	Does the Type of Fabric Affect the Brightness of the Dye?	The purpose of this experiment was to determine which of the four types of fabrics will dye the brightest so people can cloth manufacturing with preferred colors. Cotton, linen, nylon, and polyester were cut into ten 20 cm by 20 cm squares. The fabrics were pre-washed, then soaked in a bag of dye for an hour. Rinsed under running water to remove excess dye, and were washed again. The fabrics were left to air dry. Different fabrics were compared to observe how fabric type affected the brightness of the dyed fabric. Linen had the best results by averaging 7.9 out of 10 on a rating scale, 10 being the brightness. The cotton averaged of 6.2, nylon averaged of 2 and polyester 1. Polyester is a synthetic fabric and is water resistant and made from oil based products becoming nonabsorbent. The nylon fabric was thin and also had a coating which did not allow the dye to soak in. Linen and cotton had the best results because they are natural fabrics and can form bonds with water molecules which means that the fabric can absorb a significant amount of water. A softer texture allowed the dye to be absorbed more readily. The initial hypothesis stated that if different types of fabrics are compared, then cotton and linen will absorb the most dye and be the brightest. The results did support the initial hypothesis.
Chemistry (CHEM)	1068	Sharon Kimaiga	Electrolyte Challenge	The purpose of this experiment was to show that Orange juice is a healthier alternative to Gatorade Sports Drinks. My hypothesis was, If I measure the amount of electrolytes in 100% orange juice and Gatorade sports drinks, then the results will show that Orange Juice has the most electrolytes because my research argues Orange Juice has more of the needed minerals to create electrolytes. To conduct this experiment, I measured the electrolyte conductance in Orange Juice, 3 different types of Gatorade drinks, and dH2O, using a digital multimeter and a conductance sensor. I tested these liquids in three trials. In the end, I found that Orange juice has the highest amount of electrolytes, then Gatorade and dH2O. The results came out as expected and supported my hypothesis.

Chemistry (CHEM)	1069	Aidan Rosen & Xander Ripley-Jaakola	Elephant Toothpaste: What effect does different percentages of hydrogen peroxide and potassium iodine have on the foaminess of elephant toothpaste?	The question was: What effect does different percentages of hydrogen peroxide and potassium iodine have on the foaminess of elephant toothpaste? The hypothesis was: If we change the amount of hydrogen peroxide and potassium iodine, then the amount of foam should either increase or decrease. Outside a large container with a water bottle inside was used and poured ingredients inside. Tape a ruler to the side of the container. Pour hydrogen peroxide and potassium iodine in a bottle. Back up. measure how much the container filled up. Repeat experiment with different amounts of hydrogen peroxide and potassium iodine. The hypothesis was supported. Each time we doubled the amount of potassium iodine the volume of bubbles changed. When the volume was doubled there was a 43% increase in bubbles. Potassium iodine helps release the oxygen from the peroxide molecule. The released oxygen makes the fizz. When the volume was tripled there was an 80% decrease. Possibly, the chemical reaction went too quickly, and it was done before we could even measure it. Also, there might not have been enough peroxide to react with all of the Potassium iodine. Chemists will understand that too much of a chemical is not always better. Instead of foaming, the reaction just bubbles a little bit. The weather was not in my control. We did this project outside in 10 degree Fahrenheit weather. This may have slowed down the reaction so that we did not make real elephant toothpaste.
Chemistry (CHEM)	1070	Milan Darji	Freezing Point Depression of Salt Water	Salt is used to lower the freezing point of water for many purposes such as melting ice on roads and cooling power plants or buildings, but which salt is most effective at lowering the freezing point, and which concentration is best? This experiment looks at how three different salts lower the freezing point of water at three different concentrations. The freezing point depression phenomenon were tested by making solutions of sodium chloride (NaCl), calcium chloride (CaCl2), and potassium chloride (KCl) (independent variable) at concentrations of 5%, 10%, and 15% (also an independent variable). The solutions were frozen and the temperature of the melting point for each solution and concentration was measured (dependent variable). Five trials were performed for each combination of salt and concentration. The results showed that as the concentration of the salt solution increases, the freezing point is depressed. Furthermore, sodium chloride or ordinary table salt depresses the freezing more than calcium chloride, and potassium was the least effective.
Chemistry (CHEM)	1074	Aunesti Farley	How Does The Type Of Flour Affect The Size Of The Cookie	The reason I picked cookies for my science fair project was because I'm decently good at baking and calculating measurements, so this project was fun for me to do. To do my project, I needed to first find a cookie recipe that includes flour. I ended up choosing a sugar cookie recipe because it was pretty simple to do and wouldn't take long. Next I researched different types of flour, and their effects on cookies then chose four to test for my project. The types of flour I chose are Pastry flour, Cake flour, Bread flour and All Purpose flour. I used the sugar cookie recipe I found and switched out the four different types of flour and made 3 cookies for each flour so that I had multiple results and could average them out. From my research, my results were very expected from my hypothesis, which wasn't a surprise but I knew that there was a possibility my results being the complete opposite of my hypothesis considering that hypotheses are educated guesses based on research and can always be proven wrong.
Chemistry (CHEM)	1076	Paige Padilla & Hannah Olstad	How Long Does Gum Last?	Do you ever wonder which brand of gum lasts the longest? This is how we found out. The purpose of our experiment was to determine which brand of mint gum lasts the longest. Our hypothesis was that if a brand of gum has more xylitol than another brand, then its flavor will last longer because depending on how much xylitol is in the gum, the flavor will last longer or shorter. To prove our hypothesis, we created an experiment to test whether the Extra, Mentos, Trident, 5 Gum, or Orbit brand of gum lasts the longest. We collected our data by having participants chewing gum, and then reporting the time the flavor ran out in a group chat. Once all the data was collected, we concluded that our hypothesis was true because the Trident gum lasted the longest, which has the most xylitol and sorbitol in it.

Chemistry (CHEM)	1077	Ilee Byom	Keeping Raspberries Fresh Longer	This project was designed to see if raspberries would mold slower when soaked in aloe vera juice. Two different liquids were used to test if the berries would stay fresh longer if soaked in aloe vera juice or water. The berries were soaked in the liquids for the same amount of time and after they were soaked, they were put on paper towels to dry off (moisture is one of the sources of mold). The goal of this experiment was to find a way to keep raspberries fresh for a longer time period. This experiment took 8 days for mold to start to occur on the berries. The berries were put on a tray with parchment paper dividing each trial with a sharpie marker. The number of berries were compared by averaging the moldy berries. A total of 75 berries were on each tray (150 total berries). A total average of 2.7 aloe raspberries were moldy and a total of 3.3 water berries were moldy. The results showed that the aloe berries got less moldy in 8 days vs. the water berries.
Chemistry (CHEM)	1078	Ellie Rogness	Light the Fire	People will often have a hard time starting their wood on fire and usually don't have enough time to get a fire starter that won't be harmful to the environment. This tested different homemade fire starters and their time to make, ignite and burn. The hypothesis of this experiment is that the fire starter made of an egg carton, dryer lint, and candle wax will work the best. First, each fire starter was made. The time to make each type was recorded. They were each burned 3 times on a piece of glass to test the ignition and burn time. Next, one person timed while the other person lit the fire starter on fire. The timer started when it began to light and lapped when the fire starter caught on fire. The data was recorded and averaged to see which one was best. The results showed that the best fire starter was the 4th fire starter. It had the most points in all over the other four fire starters, coming in at 18 points. The results support the hypothesis because the 4th fire starter, (made of an egg carton, dryer lint, and wax), was the overall best fire starter.
Chemistry (CHEM)	1079	Collin Elliott	Rust Buster	Have you ever wondered why your parent's cars are rusting? This project is designed to help figure out why. Cars are made from galvanized steel, which is zinc coated to prevent rusting. I wanted to find out what liquids could rust galvanized steel. To test this, I put galvanized steel bolts into beakers filled with various liquids. What I found was that vinegar was the most corrosive liquid because of its extremely high acidity level which ate through the zinc coating.
Chemistry (CHEM)	1080	Ginger Giddings	The Effect of Betulinic Acid on Strawberry Mold Growth	Many fruits use Shellac Wax coating to protect the fruit from mold; shellac wax has no known benefits to your health, and has had effects on intestinal systems on some people. So, The current purpose for this project is to one day create a safe replacement to Shellac Wax. The results will show the effects that Betulinic Acid has on the mold growth on strawberries, because strawberries have one of the fastest time before mold. Mold was measured based on time before it first appeared. Instead of pure Betulinic Acid extract, we used Bet-U-Birch Betulinic Tea. Each strawberry was dipped into a solution going up 4 ml each solution based on the serving size for the tea, 4 ml per 236 ml of water. The original idea was to create a liquid that would coat on wood planks to stop or slow the decay. Because the rot of wood takes around a year, I switched my thinking to fruits. The age of the strawberries was unknown, which would have affected the results; Because of this, two trials varied drastically. That factor does not matter considering you never know how old they were anyway. The most effective solution was 4 ml per 236 ml of water, lasting longest with the most freshness on average, while 19 ml per 236 ml lasted the shortest amount of time.

Chemistry (CHEM)	1082	Nora Thaler & Amelia Houle	What effect does temperature have on crystal growth	The question was: What effect does temperature variation have on crystal growth? The hypothesis was: If the water is warmer, then there will be smaller crystals, but more individual crystals. First I gather my materials, which in this experiment include a glass jar, a measuring cup, a pencil, a piece of string, a pipe cleaner, and either borax, sugar, or salt. Follow the directions to make the mixture. Place three containers of the mixture in the refrigerator and in the classroom. Then you measure the faces and masses the crystals. My hypothesis was partially supported. On the warm crystals, there were smaller crystals, which resulted in more mass. The colder ones had smaller crystals, and less individual crystals, which resulted in less mass. I believe this happened because of the evaporation levels. A key component in crystallization, for this type of solution, is evaporation. Water evaporates rapidly whilst warm. We put the other crystals in the fridge, so the water evaporated less rapidly than the warmer ones did. I was surprised by two things. One was that the crystals didn't grow as fast as I thought they would. The sugar and salt crystals took quite a lot of thyme to grow, whilst the borax just grew very fast. Two, was that the crystals didn't have more of a shape. They didn't grow in their own distinct shape, they grew subtly, and that wasn't what I had anticipated.
Chemistry (CHEM)	1083	Rhys Abramowski & Lilyana Rosen	What effect does temperature have on the viscosity of oobleck and possibly other non-Newtonian fluids?	Oobleck is, its a mixture of two ingredients, corn starch, and water and is referred to as a non-Newtonian fluid (Stoffel, 2019). The question was: What effect does temperature have on the viscosity of oobleck and possibly other non-Newtonian fluids? The hypothesis was: If heat is applied, it will become more watery, therefore, viscosity will decrease, and the opposite will happen if it is exposed to cold temperatures. To begin, 100 grams of non-Newtonian fluid at room temperature was placed in a 1000 milliliter graduated cylinder. Ten times a weight was dropped onto the mixture. The number of milliliters the ooblieck deformed was recorded. Next, this same procedure will be repeated at four degrees Celcius after being in a refrigerator overnight. The hypothesis was supported. When the temperature was warmer the oobleck was indented the most. When the force increased on the oobleck. This shows that oobleck could be used as a non-military suit or equipment, perhaps a bike helmet or knee pads. Another application could be sports shoes. The thought would be that when walking the oobleck would be a liquid, comfortable under the foot, and when put under high stress would turn into a solid in the shape of the sole, to provide support (Stoffel, 2019). It was surprising how watery the oobleck became when hot.It was hard to keep the temperature the same throughout the experiment. Athletes and the military will benefit from knowing that a non-Newtonian fluid could be used as armor or for equipment.
Chemistry (CHEM)	1084	Liya Elias	What pH is it?	What pH will different substances be? My hypothesis was that most of the substance that I was going to test were going to be acidic, but almost all of them were basic. When I was doing my science fair project most of my substances weren't clear they were either very dark or they would barely change. When I was doing the milk they were the same color but they were either darker or lighter shade of the same color. My hypothesis was wrong, I thought that the sparkling water was going to be acidic because the water was fizzy. When I was doing the coffee the indicator turned brown, when I looked up if brown is a pH color nothing showed up for it and when I looked up the pH of coffee it said it had a pH of 5. The oil didn't even mix in when I looked up the pH of olive oil it said that because the indicator has water in it you can't find the pH.
Chemistry (CHEM)	1085	Elizabeth Grace Smith	What's With all These Dyes?	Fiber dyeing is important because it has been an important part of human culture and lifestyle as well as a way to express your creativity. Also, the fabric industry is a very important part of our economy and it makes us a lot of revenue. I tested different dyes like, acidic dye and basic dye on different types of fabric like, cellulose, protein-based, and synthetic. I observed that different fabrics take different types of dye very differently. In conclusion it is important to consider the type of fabric and the type of dye you use when you are dyeing things because they can turn out very differently.

Chemistry (CHEM)	1086	Carter Wieser	Yuck! There Is Brown On My Apple!	This project was designed to find out how to prevent the browning of apples. Research suggests lemon juice is the best to prevent browning. Apples and different liquids were used for this experiment. The liquids were: lemon juice, pineapple juice, honey water, and nothing for the control. Then the apples got sliced into eight pieces. Next the apple slice was damped with the different liquids. 4 hours went by, the results of the trials were recorded and averaged the results from this experiment indicate that lemon juice worked the best. Then pineapple juice, honey water, and the control. All the tables show the same thing for the results but a couple were different like the pineapple juice came in first in only one trial,the brownness of the apple was rated from 1-5, 1 meaning the brown 5 meaning most brown. Since lemon juice was the one that worked the best, the hypothesis was supported. So people that like apples pour some lemon juice on them the night before, so you will not have brown on your apple.
Earth and Environmental Sciences (EAEV)	1087	Emaleigh Olesiak	Air Air Everywhere	For my science board I asked the question: Does the amount of students in a room affect the air quality of that room? I did this experiment because I was curious to see if students really do affect the air quality as much as some people say. The first step is to walk into a room and hold the Q-TRAK instrument out in front of you. Wait until the CO2 number pauses for a moment. Then record all the numbers on the instrument at that time. Repeat those steps for the remainder of the rooms. Room one has 18 students in it, and the CO2 measured 1108. The temperature was 72 degrees Fahrenheit, and the relative humidity was 19.3%.There were 7 students in room two, and the CO2 measured 1084. The relative humidity was 23.7% and the temperature was 71 degrees Fahrenheit. There were 15 students in room three. The CO2 was 883 and the relative humidity was 19.5%. The temperature was 71 degrees Fahrenheit. I also record the air quality of the air outside the school building. There wasn't anybody outside, and the temperature was 20 degrees Fahrenheit. The CO2 was 410 and the relative humidity was 75%. The answer to my question is that students do not affect the air quality, but I would have to run the test many more times to come up with a more definitive answer.
Earth and Environmental Sciences (EAEV)	1088	Reed Johnson	Beauty is the Better Buffer	The title of my project is Beauty is the Better Buffer. I chose this science project because I wanted to show people that native plants will keep our lakes cleaner than mowing down to the edge of the lake. The steps I took were growing native plants in one planter and non native grass in another. I then put the planters at an angle and ran various amounts of water through them. My results showed that native plants stop water and sediment from flowing in to lakes better than grass. I learned that one reason native plants are better at holding soil together and capturing rain water is because the native plant roots are deeper than non native grass roots.
Earth and Environmental Sciences (EAEV)	1089	Muhammad Ali Qureshi & Tarek Sid	Beware Of Radon Gas	Radon is a colorless, tasteless, odorless, and radioactive gas.it is formed in the natural breakdown of Uranium, in soil, rocks, and water. It exists in the ground and can seep in the cracks and holes. Nationally the Environmental Protection Agency (EPA) estimates that about 21,000 people die each year from radon related lung cancer. The levels are considered dangerous according to EPA is 4 pci/ liter or higher. The mitigation pump is an underground ventilation system that helps reduce radon gas inside homes. So the purpose of this project is to compare one house with a mitigation pump (unfinished basement) with a house without a mitigation pump (finished basement). The house with the mitigation pump was tested before the mitigation pump was installed, and had a concentration of 4pci/l liter. Short term charcoal radon test kits were sent to laboratory in North Carolina where they used a system called a gamma spectroscopy to find the exact amount of radon radon concentration at different levels in both houses. It was hypothesized that radon levels would be high in the house without the mitigation pump. However when the data was collected, the amount of radon gas in both houses were similar. The reason for the similarity was that the house with a mitigation pump had and unfinished basement with cracks and had granite in the kitchen, which increases radon concentration.

Earth and Environmental Sciences (EAEV)	1090	Graham Hinton	Comparison of Water Filtration Methods	Roughly 2.2 billion people around the world don't have access to clean drinking water. The goal of this project is to find a relatively inexpensive, simple method to filter water with commonly found materials. Water filters were constructed using soda bottles and natural and inexpensive filter materials. I used activated coconut carbon, gravel, and sand for my filter materials. Dirty water obtained from the St. Louis River was filtered in each water filter. Each filter's success was determined by measuring color, turbidity, pH, and conductivity relative to the same values for tap water. The filter with all gravel had a negligible effect on Color, pH, and Conductivity. However, it had a favorable impact on Turbidity. The filter with all sand did have a negligible effect on pH and Conductivity. However, it also had a negligible impact on Turbidity and Color. The filter with all activated carbon had a favorable impact on Color, Turbidity, & pH. However, it had an unfavorable effect on Conductivity. The results show that Activated Carbon is effective at improving pH, Color, and Turbidity. Sand is ineffective at improving water quality. Gravel was only effective in improving Turbidity. None of these filter materials improved Conductivity. Overall, the composite filters were not as effective as improving water quality as Carbon alone. The filter materials used in this project would allow poor communities to effectively filter water for an affordable price.
Earth and Environmental Sciences (EAEV)	1091	Josiah Copeland	Digging Decomposers	The problem for the project was to see if adding different food ingredients would add more nutrients to the soil. The hypothesis for the project was that if coffee grounds and egg shells were added to the soil, it would increase the nutritional value in the soil. Two tubs were created to be habitats for red wiggler worms. Each tub was created with the same materials, placed in the same environments, and the worms were fed the same type and amount of food scraps. Then we took three different tests at the beginning, middle, and end of the observation which included measuring the levels of pH, phosphorus, nitrogen, and potash. There was not a big change in the tests overall, except for the potash for test number 3. The color for tub 2 was surplus (4), and for tub 1 was deficient (1). The tests indicated that coffee grounds and eggshells had a positive effect on the level of potash. However, the other nutrients remained virtually the same between the two tubs.

Earth and Environmental Sciences (EAEV)	1092	Lilly Timmerman & Emily West	Does Oil Absorbing Powder Remove Enough Oil for Algae to Live?	Over 1.3 million gallons of oil is spilled into U.S. waters each year, impacting thousands of species, including algae (1). Algae is the base of the food chain and, when exposed to oil, cannot access the nutrients needed to perform photosynthesis.(5). Without algae, the entire ocean ecosystem is affected. The current methods for oil clean-up are ineffective as they harm marine life (12). Using oil absorbing powder (OS powder) is a new method to clean up oil spills. The purpose of this project was to see if this technique is able to sustain algae growth, making OS powder an environmentally friendly way to clean up oil spills. A common seawater algae, tetraselmis chuii, was grown and then equally separated into three groups; a control group, an oil-only group, and a group with oil removed by OS Powder. Over 7 days, each group's growth was recorded. The Control group's cell count first declined, then slowly increased, ending at 66 cells. The OS group grew the most algae, increasing most days and ending with 324 cells. The Oil group had the least for all 7 days, ending with 57 cells. This project was done two times, the first time the Control group grew the most algae, making it dark green. The Oil group's algae mostly died off, making it a pale green. The OS group grew significantly better than the Oil group, but still less than the Control, making it a Medium green. Our hypothesis was correct both times— the algae in the OS group grew similar to the Control group, and the algae in the Oil group grew the least. In the future, different micro-organisms would be tested together as an ecosystem. In conclusion, OS powder could be used in oceans because it proves to be an environmentally friendly solution to oil spills.
Earth and Environmental Sciences (EAEV)	1094	Molly Monahan	Filter Fad	The purpose of this project was to determine if those expensive filters and water pitchers people buy were really what the company says they are. If what people say about these filters are really all that good. Do they make the water taste different or is it the same? Do they protect people from all the chemicals in your water or not? Data was collected by taking a test strip from Test Lab and holding it in an equal amount of water in containers. Tap water first. Hold test strip in water for five seconds. It was collected by taking another test strip and dipping it in filtered water for five seconds. Then record the results. After this experiment was conducted it was determined that the lead, iron, fluoride, chlorine had no contaminants in the water. The P h had a steady level always in the normal range in both tap and filter. The filter water did not differ from tap because the tap was always in the normal range and so it did not make a difference. This information is important to our health because contaminants like lead and chlorine are bad for the human body. It is important because it is easy to test the water in a home, school etc. just to see if it is healthy. To the people in Oakdale testing water is important to make sure it is health to use and drink.
Earth and Environmental Sciences (EAEV)	1095	Olivia Hamann	Fired Up!	Problem: Which material when burnt will leave the most particulate matter on the sponges – leaves, paper or plastic bags? Hypothesis: I predict that if you burn plastic bags it is more likely to have more damage and effect on your lungs than paper and leave, because I think it has more chemicals in them than paper and leaves. Procedure: Sponge and jar weights were obtained prior to the study beginning and after each of the five burns to assess smoke particulate accumulation on sponges and unburned materials in jars. Results: After burning the respective materials the study sponge for leaves gained 0.534 grams, the sponge for paper gained 0.472 grams, and the sponge for plastic bags gained 0.323 grams. After burning the respective materials the study jar for leaves gained 11 grams, the jar for paper gained 11 grams, and the jar for plastic bags gained 14 grams. Conclusion: The data showed that my hypothesis was incorrect in regards to particulate matter accumulation on the sponges. My experiment demonstrated that the leaves accounted for most particulate matter on the sponge. Even though my research showed that the chemical release by burning plastics was the worst to the health of humans.

Earth and Environmental Sciences (EAEV)	1096	Quinn Hughes & Tyler Clair	Fueling the Planet with Coffee: Engineering a Better Biofuel with Synergistic Enzymatic Compounds	Biofuels can potentially reduce greenhouse gases by 65% and are renewable. Biofuels today are produced from corn and sugar, which drives up commodity prices. A big improvement would be converting waste cellulose into biofuel. Methods are being developed using enzymes to turn unused plant cellulose, the most abundant ingredient in the world, into biofuel. Its usefulness as a raw material for biofuel depends on our ability to hydrolyze it into glucose, which is a significant challenge today. There are two main opportunities: finding a source of plant biomass that does not compete with human consumption and/or finding an enzyme or enzymes that can efficiently hydrolyze cellulose. Coffee grounds were tested because they are waste material that has high calorific value. In 2015, over 500,000 tons of coffee ground waste was sent to landfills. Cel7A is the most abundant enzyme used to make biofuels today. Other enzymes or combinations of enzymes could potentially improve the energy output from the hydrolysis of cellulose. It was hypothesized that the combination of three synergistic enzymes – endocellulase, exocellulase and beta-glucosidase – could increase glucose output. This experiment showed that the Cel7A could produce biofuel from coffee grounds in a concentration of 0.35 mL CO 2 per minute (0.313% sugar solution). The interaction enzymes doubled the sugar output: 0.626% glucose solution. This combination could significantly improve the hydrolysis of cellulose for biofuel and coffee grounds could become a large source, yielding approximately 1.87 million gallons of biofuel annually.
Earth and Environmental Sciences (EAEV)	1097	Shyla Thompson & Nyla Button Swenson	Global Warming: Is It Your Problem?	Background: Despite abundant scientific data, some still doubt that global warming is a problem. The purpose of this project is to determine a) level of awareness of global warming; b) what are people doing to help reduce the problem; and c) for those who doubt that global warming is a problem, are they open to change in their opinion? Hypothesis: We hypothesize that most people may be aware of global warming but many are not doing much about it. We predict that after people do this survey they will know more about global warming and take action to help and stop it. Methods: We put together a survey of 24 questions about awareness and action on global warming, which was uploaded online and sent to classmates and family (and their friends/co-workers). The survey contained no identifying information to ensure anonymity. All responses were transferred to a spreadsheet (more than 15,000 data points) and then analyzed to determine attitude on global warming. Results/Conclusions: We received responses from 265 individuals! >90% believe global warming is an important problem. This was not affected by age, gender, education, or income. Most people are doing things to reduce global warming, but more importantly most want to do even more! But even among the 'non believers' (about 10%), many responded that family/friends/teachers/news can help to change their viewpoint. And… just taking this survey made 64% want to take more action… a survey put together by two 7th grade students… imagine what more can be done!!!
Earth and Environmental Sciences (EAEV)	1099	Danica Sundblad	How do Rocks Buffer Acid Rain	I live in an area where there is a lot of controversy about sulfide mining. I did some research and I learned that some kinds of rocks can naturally buffer acid rain. I tested this out by crushing up rocks and putting some of the samples in test tubes and vinegar and water. I tested the pH of the vinegar and water mixture, then I tested the pH of the rocks and vinegar and water mixture. I found some results right away. I then waited 48 hours then proceeded to test the pH and I found out that marble and limestone neutralizes the "acid rain" (water and vinegar mixture). Acid rain has a pH 4, while normal rain is slightly acidic, normal rain has a pH of 5. pH is a scale from 0-7-14, 0 is acidic, 7 is neutral, and 14 is alkaline. This is important because some of the rocks in our area could potentially prevent acid mine drainage.
Earth and Environmental Sciences (EAEV)	1100	Cecilia Shelby Vazquez	How Does the Color of a Liquid Affect the Amount of Heat Absorbed	My project focuses on how the color of a liquid can affect the amount of heat it absorbs. I was interested in the topic because I wanted to know why a Coke heated up faster than a Sprite. So I explored my topic and I realized that others, such as Benjamin Franklin did something similar. I tested it out using some materials from home and I found out that my hypothesis was correct.

Earth and Environmental Sciences (EAEV)	1101	Anna Imbertson	How does the material in a disposable plate affect how long it takes to compost.	I buried each plate in an inch of compost. After 30 days I dug one third of the plates. After 60 days I dug up the second one third of the plates. Finally, after 90 days I dug up the last of the plates. I was not surprised about some of the results except for the palm leaf plate which I thought it would compost a lot faster. The supported hypothesis is that the paper plate decomposes first and the plastic plate will decompose last. This is supported by the fact that the paper was decomposed after 1 month and the plastic was the same after 3 months.
Earth and Environmental Sciences (EAEV)	1104	Hazel Thrasher & Alexa Pundsack	How Does the Type of Pollutant Affect Growth in Bacteria?	Have you ever noticed the increase of pollutants in your neighboring lakes or ponds, and wondered what is going on in the plant and bacteria growth that could possibly be affecting the ecosystem around you? Water pollution is a major problem. It affects people, animals, plants and entire ecosystems all over the world. This project looks at which type of pollutant causes the most substantial suffering to water organisms and bacteria. To follow out this experiment, we disturbed the normal bacteria and organism growth in pond water by adding motor oil as an example of an oil spill, detergent as an example of high amounts of soap, and vinegar as an example of high levels of acidity, which are some of the most common types of pollution. Then, we recorded the amount of bacteria left in the soil for each of the different types of pollutants. Our hypothesis was that the motor oil would have the largest affect in the soil compared to the other pollutants. After all of the data had been collected, the data showed that the jars with vinegar had the most negative effect in the soil, with an average of 35.6 colonies. The jars with laundry detergent had the second largest effect, with an average of 158, the motor oil with an average of 211 colonies, and the jars with no pollution having the least effect in the soil with an average of 216.6 colonies.
Earth and Environmental Sciences (EAEV)	1107	Sriram Sureshkumar	Residual Pesticides on Produce	The purpose of my project was to understand if homemade washing agents helped remove residual pesticides and wax on fresh produce. We consume a lot of food in our lifetime and fruits and vegetables are an important part of our food intake. It is essential to understand what goes into our body in smaller quantities as residues when we consume produce everyday. I started my project by understanding about first generation pesticides used prior to 1940 consisting of compounds like arsenic, lead and mercury to second generation pesticides used after 1940 consisting of synthetic organic compounds. The impact pesticides had during the green revolution, the benefits and environmental concerns it has created globally and the search for alternatives. I used various agents like baking soda, vinegar, salt and lemon juice to clean apples. I measured the nitrate, nitrite, chlorine, pH levels, lead, pesticides and hardness levels in water before and after the apples were cleaned. The reading remained the same for both the before and after water samples because strips provide a range instead of specific readings. There was no way of knowing what residual pesticides existed in the apples and what was eliminated after the cleaning. An analyte test with the MN Department Health accredited private laboratory would be the best resource for water testing or another source would be using a mass spectrometry or liquid chromatography.
Earth and Environmental Sciences (EAEV)	1108	Grace Lavan	Seasonal movements of Canis lupus (gray wolf) in northeastern Minnesota	This study used a mapping tool (ArcGIS Online) to generate wolf location maps. Maps generated from this project will allow the Fond du Lac Band to gain a better understanding of wolf movement within their reservation. Researchers organized shapefiles into folders by wolf for the student to generate into maps. The wolf movement per day was measured, and was seasonally compared (summer, spring, fall, winter) using measurements from the mapping software. The question was: If the daily movements of Canis lupus are measured, what season (summer, spring, fall, winter) will the wolves be most active in? The hypothesis was: If the daily movements of Canis lupus are measured and seasonally compared, then the wolves will be more active in the summer than in the winter. My hypothesis was not supported. Overall, there was more wolf movement in the winter than the summer. The wolves are moving more in the winter than in the summer most likely because in their prey is spread further apart than it is in the summer. The distance traveled is possibly different due to the landscape and topography within the packs home range. The DNR will benefit from this by gaining a greater understanding of wolf movements in the different seasons. I was surprised that the wolves moved more in the winter than in the summer, because I

				believe that it would be easier for them to move through the trees in the summer than through the snow in the winter.
Earth and Environmental Sciences (EAEV)	1109	Hailey Rehrauer	Shocking Shells	The burning of fossil fuels is not only causing climate change but also causing another big problem called ocean acidification, also known as the increase in the acidity of seawater. Ocean acidification can cause the dissolution of shells of calcifying organisms as well as many other problems. This experiment was to test the effects of ocean acidification on a calcifying organism's shell (mussel shells). In the experiment we used water, treated it to be the same pH and concentration of oceans, and made the pH of the water 8.2, 8.1, and 7.5. After that, the shells were tested in each different pH water to measure how much they dissolved in the more acidic water. This experiment had no change meaning none of the shells dissolved/ weighed any less grams after being in the lower pH waters. The results may have been inconclusive because the pH of the waters wasn't low enough to make a change is the small amount of time as well as many other reasons.
Earth and Environmental Sciences (EAEV)	1110	Catalina Connell	Soil Substitutes Which Works Best?	I chose this topic for my science fair project because I wanted to find alternate ways to grow plants. I planted beans into cotton, compost and coffee grounds and recorded how much each plant grew over the course of four weeks. My hypothesis is that the beans will grow best in cotton because the fibers inside attract water while allowing air and sunlight to pass in and out of the plant. My experiment started off by planting bean seeds into my three soil substitutes (coffee grounds, compost and cotton) Once I planted my seeds I watered them three times per day (ten sprays out of spray bottle). Lastly, once my plants began to grow I recorded how much they grew. Over all my hypothesis was correct because my cotton plant grew the largest. I believe this plant grew significantly more than the coffee grounds and compost seeds because the cotton absorbed water which helped the bean seeds stay hydrated. In addition because fibers inside allow air and sunlight to pass in and out of the plant. For these reasons, I have proven that cotton is a great substance in which to grow seeds in.
Earth and Environmental Sciences (EAEV)	1111	Regine Frederick	The Dirt on Dirt	Every year my mom says our yard’s soil isn’t fertile enough for gardening, but I wonder what type of soil is in my yard, and what is the difference between it and average gardening soil? This project compares three samples of my yard’s soil to three samples of a popular gardening soil brand called Miracle-Gro Potting Mix. I mixed each sample with water and Home Made Simple detergent in a jar, and marked each layer of soil that formed over 48 hours. Then, based on the percentages of each layer, I used the Soil Texture Triangle to determine their types of soil. I hypothesized my yard’s soil would have 80% clay and 20% sand, and the gardening soil would be loam, a mix of the types of soils that’s very fertile. I found my yard’s soil was mainly the type Sandy Clay Loam, though one sample was Loamy Sand. The gardening soil was the type Sandy Loam. This showed my yard’s soil is mostly the type Sandy Clay Loam with a bit of Loamy Sand, and is only one type different from average gardening soil, according to the Soil Texture Triangle. However, it also showed the gardening soil wasn’t as fertile as I predicted, as it wasn’t pure loam. Now that I know the types of soil I’m dealing with, I will try adding organic matter like humus to our soil this spring, as it should help the sand hold nutrients and the clay drain water at a healthier rate.
Earth and Environmental Sciences (EAEV)	1112	Emily Brenner	The ph of rain versus snow	The system used to test the pH of rainwater and snow consisted of taking multiple samples from multiple locations during each rainstorm over a two-month+ period. The pH of rainwater over this period averaged 5.6 and the snow averaged 6.2.

Earth and Environmental Sciences (EAEV)	1113	Quinn Kelly	The pond snail's ability to filter-feed fertilizer	Can freshwater mussels naturally filter run-off fertilizers? My background supports that mussels will successfully filter run-off grass fertilizers from water because of their filter-feeding method. This is important because getting rid of the fertilizers from the water will help the fish population go up which will intern help the ecosystem. This will help our lakes ecosystems by getting rid of one of the problems. I hypothesize that the snails will effectively be able to filter the fertilizers. My expected outcome was that the Snails would successfully be able to filter the fertilizers. I think that this will happen because the snails are effective filter-feeders which will help filter the fertilizers out of the water. To start my experiment I will put 25 pond snails in a 5-gallon tank of water. I will then put in 1 tablespoon of Scott's turf builder into the tank, and see with my vernier probe how much electrolytes are in the 5-gallon tank to start. Every day after that I will check to see if the pond snails have taken fertilizers out by checking with the vernier probe by checking the electrolytes. After 5 days I will see the progress of the snails. I will then try Scotts lawn fertilizer. The only potential risk is fertilizer. I will use a vernier probe to tell the electrolytes in the tank to see if the fertilizer has changed.
Embedded System (EBED)	1115	Eve Kitt	Baking Raspberry Pi	I decided to do a project on computer science because I think it's an interesting topic and I want to learn more about it. My question was this: exactly how does temperature affect computer performance (how fast a computer can calculate)? In order to answer this question, I used a raspberry pi computer and a thermal box to put it in. I also needed a heat mat and ice cubes to change the temperature in the box. While testing I noticed that the numbers rose and fell quite rapidly as I added and removed heat from the environment. This proves that heat does affect computers, and the hotter a computer is, the slower it will operate.
Embedded System (EBED)	1116	Jorgen Rankin	I <3 My Heart: A novel Design for a Heart Rate Monitor	Blood flows throughout your body, your heart pumps blood, and heart rate is the speed at which your heart beats. There are many reasons a person would want to have a heart rate monitor. They have become popular in recent years. There are a few different kinds of them as well. In this Science Fair project, the goal is to build a heart rate monitor for the head. The procedures consist of resting or walking for 10 minutes; or running for 2 minutes. After that, the heart rate would be measured. The averages are expected for the range they should be in. Averages for the resting trials are 99.6, 98.2, and 92.2. The averages for walking trials are 113.2, 116.5, and 106.8. The running trial averages are 126.3, 126.7, and 129.8. Some of the averages are different than others. Some of the trials were not very accurate. Resting trials 3, 7, and 10 were not in the range that they should. The average resting heart rate is 60-100 bpm. They were not normal. Most resting rates that were recorded were 80-99 bpm. 3, 7, and 5 were 78, 71, and 122. Because of those rates, the averages were thrown off.

Embedded System (EBED)	1117	Peter Mendez	Wi-Fi Blockers	Wi-Fi is a type of communication that transports data between electronic devices wirelessly using a radio wave frequency signal. Decibel-milliwatts or dBm is the unit of measure used to determine the strength of a wireless signal. The closer a signal is to 0 dBm, the stronger it is. Attenuation is a general term that refers to any reduction in the strength of a signal. This reduction is a natural consequence of signal transmission over long distances. When electromagnetic radiation passes through materials it can be attenuated, or weakened. I want to know what household building material (cardboard, pink insulation foam, ceramic tile, medium density fiberboard, sheet metal, plywood sub-floor, drywall and carpet) will cause the greatest attenuation of the Wi-Fi signal as measured by dBm or decibel-milliwatts. If I hold up eight different household building materials in front of my Wi-Fi router, then I predict that the sheet metal will cause the greatest attenuation of the Wi-Fi signal as measured by dBm or decibel-milliwatts. In conclusion, I found that the sheet metal caused a greater attenuation of the Wi-Fi signal than any of the other materials I tested. My experiment yielded very low attenuation numbers. Even the sheet metal, which I predicted would cause the greatest attenuation, only had an attenuation of 2. In the future, I wonder if creating some sort of box out of the building materials to put over the router might cause a greater attenuation number than just putting the material in front of the router.

Energy: Chemical (EGCH)	1118	Madeline Larson	The Effects of Pressurizing a Hydrogen Fuel Cell	Introduction: Hydrogen fuel cell applications are being researched and developed for energy storage as a means to provide cleaner energy solutions to power many types of electric utilities including motor vehicles. My research aims to determine if pressurizing the hydrogen and oxygen in a Proton Exchange Membrane (PEM) Fuel Cell will produce more power. This research is important because developing better ways to utilize, store, and transfer energy will provide benefits to society. Problem Statement: It is generally understood that as a gas is compressed to a higher pressure the gas is a higher density with atoms more tightly packed in the same volume. If both hydrogen and oxygen are pressurized there will be more atom density to act on the membrane of a hydrogen fuel cell, will the fuel cell become more efficient? Engineering Goals: Modify the hydrogen generator apparatus that was used in last years (7th grade) project in order to generate hydrogen and oxygen to be used to power a hydrogen fuel cell. 1. Continuation of test from last year (7th grade) to determine the most efficient concentration of potassium hydroxide. 2. Develop method to connect a small hydrogen fuel cell to hydrogen and oxygen chambers of the hydrogen generator. 3. Develop a safe method to increase the pressure incrementally from atmospheric pressure as the base line to 15 psi. 4. Keep the size of the test equipment limited to consumer available parts and components and Make the testing apparatus configurable to conduct a range of testing so future research can continue. Results / Conclusions: The test results fully support the hypothesis whereas the increase in pressure from 0 through 15 psig resulted in 2.454 watts at 0 psig to 2.627 watts at 15 psig, an increase of power by 7.06%. The practical application could be substantial considering that the results we observed were at a relatively low pressure which is a fraction of the pressure that could be applied to a commercial application. Future Work: The results indicate the trend was continuing upward in a relative linear fashion so it is reasonable to believe that higher pressures above what I tested will yield higher power output. Further testing at higher pressures could be done to see where any power increase may slow, stop, or reverse.
Energy: Physical (EGPH)	1119	Zainab Lodhi	‘Fidgeting’ with a Fidget Spinner - Can a fidget spinner be put to scientific use using magnets and solar energy?	The Law of Conservation of Energy states that energy can neither be created nor destroyed; it can only be transformed from one form to another. The goal of my project was to utilize this fact and try to convert solar energy to electrical energy using magnets. I wanted to design an experiment using the above to find an alternative source of energy and to check if we can utilize this to make a fidget spinner motor and then to check how efficient was it. After several prototypes and trials, my experiment was able to achieve my engineering goal, and I was able to engineer an efficient fidget spinner motor with alternative source of electricity utilizing magnets and solar energy. Also, my experiment and conclusion supported my hypothesis as proven by the three trials each, with 4, 3 and 2 magnets, which showed that the speed of the fidget spinner decreased with decreasing the number of magnets on it and this was supported by consistent results.

Energy: Physical (EGPH)	1120	Carissa Chow	A Wind-Wind Solution: Effectiveness of Blade Angle	Wind turbines and green energy are currently a big solution to climate change. Therefore, this experiment was conducted to determine what wind turbine blade angle generated the most electricity. The blade angles tested were 25, 35, and 45 degrees, with 10 trials each, on a three bladed wind turbine. First, the maximum wind speed out of 30 seconds was recorded with the fan on the highest setting with an anemometer. Then, the timer was reset and the electricity generated at 30 seconds by each of the wind turbines was recorded, still with the highest fan setting, with a multimeter. After each of the three blade angles had 10 trials each, the data was then averaged and analyzed. The data showed that the 25 degree blade angle generated the most electricity with an average of 1.033 volts, followed by the 45 degree blade angle with an average of 0.5391 volts, then the 35 degree blade angle with an average of 0.5309 volts. This shows that the 25 degree blade angle generates the most electricity. This data shows that the hypothesis of the 35 degree blade angle will generate the most electricity is incorrect. Instead, the 25 degree blade angle generated the most electricity with an average of 1.033 volts.
Energy: Physical (EGPH)	1121	Josh Bleskacek	Effect of Window Blinds on Heat Loss	Homes can lose up to 20 percent of their heat through windows (eco-home-essential.co.uk, 2016). The question was: What effect do window blinds have on the heat loss of a house or building? The hypothesis was: With the sealed blind you will reduce your heat loss by 33 percent. To begin this study an insulated chamber was built. The chamber was made out of three stacked one and a half inch thick fiberglass panels. A hole was cut in the center of the panel so that two picture frames could be inserted to create a double paned window. There were two thermometer probes, one in the freezer and one in the chamber. The two thermometers and the stopwatch were filmed. The chamber was warmed up to 21.7 degrees Celsius by letting the chamber sit on a heated vent. Next, the chamber was placed in a freezer with the measurement devices recorded. The camera and timer were started once the chamber got to 21.1 degrees Celsius. Once the chamber got below 0 degrees Celsius the camera was stopped. Later, data was collected from the camera. This procedure was repeated with only the window, a loose and sealed blind over the window and when fiberglass was placed over the window. The hypothesis was partially supported. There was a reduction in heat loss, yet not to the 33 percent level. The sealed blind had a 22.9 percent heat loss reduction and the loose blind a 13.5 percent reduction.
Energy: Physical (EGPH)	1122	Mitchel Masters	how does a trebuchet arm length and arm length effect the projectile distance	A.I chose this project to see how the arm length and counterweight mass affects the projectile distance of an object, similar to the design of a trebuchet used in the middle ages. B.How does a trebuchet arm length and its counterweight mass affect the projectile distance? I feel the greater the weight the more distance an object will travel. I believe there will be an ideal arm length to obtain the most distance. C.First I will collect wood and screws from Ace Hardware. Then I will build a basic trebuchet as my control. I will launch a rock and measure the distance it travels. Then I will alter arm length and counterweight mass for different trials to see the impact of changing those components. I will record and graph the results. D.The 10 inch arm with 8 batteries launched the best. I believe this was because the arm was not too long. I also had the heaviest counterweight. I predict if there is more weight the marshmallow would launch further due to inertia. If I would have used different materials for launching, I predict that the projectiles would have went a different distance.

Energy: Physical (EGPH)	1123	Emily Llapa	How Does the Blade Length of a Wind Turbine Affect the Amount of Energy It Will Produce?	The question I tries to answer in this experiment was; "how does the blade length of a wind turbine affect the amount of energy it will produce? For my procedures, three wind turbines were created. Each pinwheel had different measurements and colors. The colors were yellow, red, and blue and their measurements were 4", 6.5", and 8" respectively. Wood was then shaped into three long columns six inches, one foot, and two feet respectively. An opening was formed near the top of each column. The openings were used for the motor and the wheel, which was a base for the blades to attach to the motor. Two alligator clip leads were then attached to each end of the motor. The other ends of the alligator clip leads were connected to the multimeter. Once the turbines were complete, they were set on a table. Then a blow dryer was used to blow on each turbine. Three trials were conducted on each turbine for a total of nine trails. I found out the blue 8" turbine produced an average of .159V. The red 6.5" turbine created an average of .248 V. The yellow 4" turbine made an average of .289 V. In conclusion, the yellow 4" turbine created the most energy on average.
Energy: Physical (EGPH)	1125	Livia Kabele	Which temperature of battery lasts longest?	This experiment was done to find out if the temperature of a battery affected the length it lasted. With these results, it can be found out if putting batteries in the freezer makes it last longer or not. Two electric toothbrushes were used for the cold batteries, and two 4 electric toothbrushes for the hot batteries. One AAA battery was heated to 43 °C for each 'hot' toothbrush, and one AAA battery was chilled to -6 °C for each 'cold' toothbrush. The batteries were put into the toothbrushes, and ran until they died. The times they started and ended were recorded. The results from the experiment were looked at, and the average of the hot batteries was 922.9 minutes, while the average for the cold batteries was 946.1 minutes. It should be noted, that on the 8th trial with the 'hot' toothbrush, the toothbrush started wearing out. After that, whenever that toothbrush was turned on, it felt weaker than the others. The results show that the cold batteries last only a small amount longer, although some of the times would bounce around, and the amount the toothbrushes lasted slowly started to be shorter, so the toothbrushes probably started wearing out.
Engineering: Mechanics (ENMC)	1126	Spencer Miller	Are Sharp Skates That Great?	After playing hockey for six years i wanted to know if the common belief that skates needed to be sharpened after every 4-5 uses, was correct. To answer this question I designed a experiment in witch I conducted timed tests after every usage to see if there was any loss in the quality of the blades. After each one hour practice we would go to a outdoor ice rink, set up four cones in a box measured by paces, complete three passes at three different tests (one designed for speed and two where for turning), recording the time for each pass. After five of these events we calculated the average for each test and observed no noticeable change.
Engineering: Mechanics (ENMC)	1127	Sophia Jesse	Band It Together	The purpose of my project was to see if temperature affected the elasticity in a rubber band. I did this by putting a rubber band on a pencil or pen and I then added washers to the end of the rubber band. I had to add another step in my experiment. When I added the washers, I did not have enough weight at the end of the rubber band so, I added an extra rubber band and changed it so that I measured the bottom rubber band. Rubber bands in room temperature water (about 20 degrees Celsius) stretches with an average 5-6 ml. When the water temperature is at 50 degrees Celsius the rubber band stretches 4ml. When it is at 50 degrees you may notice it slightly goes down which is due to test trial 3 of water temperature 37 the rubber band stretched 10 ml. From there the amount the rubber band stretches grow. For my experiment I found out that rubber bands tend to stretch farther when put into warmer temperatures.

Engineering: Mechanics (ENMC)	1128	Isabella Gutierrez	Burning Down The House, Or Not!	The objective of this project was to find a way to prevent house fires. My engineering goal is the design and construction of an automated over the range fire extinguisher that would put out a grease fire without human intervention. The first part of the experiment was to research the leading causes of house fires. Research shows the most common cause is cooking fires. I built a mockup of the extinguisher and brought it to a local fire extinguisher servicing company. They gave me some tips and I went back to work. I completed the construction of my fire extinguisher and returned to a fire extinguisher servicer where they added halon. I also pressurized the system with nitrogen. I tested the system in my garage, over a single burner with the grease from a hamburger patty as a fuel source. The apparatus extinguished the grease fire without human intervention.
Engineering: Mechanics (ENMC)	1129	Isaac Weinacht	Don't Be A Drag: How making semi trucks more aerodynamic reduces CO2 emission	In this experiment, the main purpose is to reduce CO2 emissions by way of reducing drag on semi-trucks making them more fuel-efficient. The problem with CO2 is that it is one of the main causes of global warming. Global warming causes a number of bad things anywhere from acidifying the ocean to making heat waves more powerful. One way to make semi-trucks more fuel-efficient is by reducing the drag by putting flaps on the end of the trucks. The project was tested with a to-scale semi-truck in a wind tunnel and different attachments were put on and hooked up to a spring scale and when the wind blew it pushed the wood back and pulled on the sale. The independent variable for this experiment is the different extensions tested. The dependent variable is the grams of pull on the truck..The results were that the four flap extension had the biggest impact of the extensions built and over not having an extension, If this project could be done again it would have started way sooner and done the things that took more time first “i.e.” ordering materials from amazon first, or doing the experiment in the summer with daylight, and deciding on one topic instead of switching in the middle of the project.
Engineering: Mechanics (ENMC)	1131	Annika Bartucz	Lift	The purpose of my experiment was to see how the angle of attack affected the lift of a Clark Y airfoil and where the stalling point was. My hypothesis was that when the angle of attack (AOA) was greater the lift would get bigger too. The AOA will max out and create a stall and lift will decline sharply. I set a 3D printed airfoil on a stand that is made so the AOA can be changed on top of a scale in front of a fan. I set the scale so the weight of the airfoil was 0, turned on the fan and recorded the weight of the airfoil. I changed the angle and repeated the process. The less the airfoil weighs, the more lift (upward force) the airfoil is generating. My data supported my hypothesis by showing the lift going up as the AOA got bigger, maxing out at approx 20 degrees when lift started decreasing.
Engineering: Mechanics (ENMC)	1132	Riley Schuldt	We Didn't Start The Fire	This project was designed to see what building material burns the slowest. In this experiment, different types of wood are burned and recorded when they collapse inward. The hypothesis is if three different types of building materials are burned and timed, then the most natural wood (which is Douglas Fir in this case) will take the longest to burn because it has the least amount of oxygen trapped inside it. The three types of wood this project involves are Douglas Fir, Oriented Strand Board (OSB), and Laminated Strand Lumber (LSL). First, a structure for burning the wood was built. Then, the building materials are cut into correct burning lengths. In this experiment, a 500-gram weight was used to represent the weight of things in a house. Then, the three different types of wood were burned and recorded. After each trial, the weight was then dipped into a bucket of cool water until the weight turns back into room temp. The results of the experiment were used to find the averages, minimums, and maximums of the procedure. The data showed that the hypothesis was supported. The Douglas Fir wood burned the slowest out of the three types of woods. The timer might not have been stopped at the exact same time that the wood collapsed inward. The variance of the flame might have been slightly different between trials. This might have been caused by the size of the flame being tweaked if it didn’t look like the correct height.

Environmental Engineering (ENEV)	1133	Abdur-Rahman Lodhi	'Tapping' Clean Energy - One Step at a Time	With increasing population and increasing number of electronics, the electricity demand is also increasing, and it is becoming hard to overcome this global issue by using the traditional power generating sources. Demand and supply gap is the major issue of energy crisis. The main aim of this project is to overcome the power crisis by trying to help change and decrease reliance on old methods of generating electricity. 'Tapping Clean Energy' project is to develop a new source of renewable energy by cost-effective, durable, and efficient means. The footstep power generation system is designed to capture the typically wasted kinetic energy of footsteps and transforming it into electrical energy. The footstep power generation system proposed here uses the piezo electric sensors to generate power through footsteps as a source of renewable energy that we can obtain while walking on a certain arrangement like stepping on a piezo tile. These sensors are placed in order to get the maximum output voltage. This output is provided to the monitoring circuitry which is microcontroller-based circuit that allows the user to monitor the voltage and charges a battery at the same time. Then, the voltage stored in the battery can be used to charge a mobile phone etc. This project represents a footstep piezoelectric energy harvesting model which is cost effective and easy to implement.
Environmental Engineering (ENEV)	1135	Takeo Haertel-Strehlow	Can the Color of Your House Save You Money?	This project will determine if the color of your house can affect the amount of energy necessary to heat or cool your home. I will be using equal sized cardboard boxes painted different colors to represent a house with different colored siding and using a heat lamp to simulate the sun.
Environmental Engineering (ENEV)	1136	David Hovey	Coolest Color	The purpose of my project was to see what color of paint absorbs the least amount of heat. I tested the colors red, white, green, brown, tan, yellow, light green and maroon. The paint samples were placed 4 inches from the light, and I used a thermocouple pressed against the back of the samples to test the temperature. I found that the white paint absorbed the least amount of heat and reflected more energy than any other color. Which answers my original question; what color paint is the coolest to paint your house with? The brown paint and green paint absorbed the most heat and reflected the least amount of energy. From the least amount of heat absorbed to the most heat absorbed the order is: white, red, tan, green, and brown. The darker colors absorbed more heat than the light colors. Also, none of the colors temperatures during testing went below 90°, and none of the temperatures exceeded 131°. The biggest temperature difference between tests in a single-color was 7°, which was red. The least amount of temperature difference between tests was 3°, which was white. The difference between all the colors temperatures was 41°.
Environmental Engineering (ENEV)	1137	Oskar Helgen	Drains on the Brain: How can we reduce the amount of water and contaminants entering our lakes and rivers through our storm drains, which are increasingly overloaded due to climate change?	How can we reduce the amount of water and contaminants entering our lakes and rivers through our storm drains, which are increasingly overloaded due to climate change? This experiment addresses this question by testing various filter media used in a pre-filter, such as a bioswale, to study their ability to reduce the amount of contaminants in stormwater runoff. A bioswale, incorporating plants, rocks and other filter media, is a possible adaptation of an existing storm drain, where runoff would be diverted into a vegetated ditch to be retained and absorbed. I tested gravel, sand, and soil to see how well they absorbed water and filtered out oil and debris. Soil absorbed the most water out of the three. However, more soil ended up in the runoff, because some of the soil came through the filter. While sand didn't absorb much water, the water that flowed through the sand was the cleanest. The gravel did not retain any water, because unlike sand, the gravel's larger size allowed the water to flow through more easily, but it also allowed debris to flow through. The results of my experiment could be beneficial to the design of an actual bioswale, because it gives insight on which material absorbs the most water and removes the most contaminants. My next step would be to study various combinations of materials that make best use of their properties to reduce the amount of water and contaminants entering our lakes and rivers through our storm drains.

Environmental Engineering (ENEV)	1138	Calla Gieser	Green Tops-Hot or not	The title of my project is “Green Tops-Hot or Not?”. I chose this science project because I thought it would be interesting to find out if having a rooftop garden can impact our environment. The steps I took were taping two identical boxes shut, then lining the tops of them with tar paper. Then after I grew my grass I put the grass on top of one of the boxes and set it under a heat lamp. I measured the temperature every hour for five hours, then tested it again with the box without the grass on top of it. My results showed that having a rooftop garden does help cool the inside of a building. I learned that on a rooftop garden, the garden portion will act like an insulator and help keep a lot of unnecessary heat form entering the building. I also learned that the regular roofs will heat more rapidly then gradually raise in temperature.
Environmental Engineering (ENEV)	1139	Tyler Morse	Make the Wind Work for You	With the use of renewable energy sources like wind turbines on the rise you can imagine there are a lot of different designs for the actual blades of the turbines. As a result many of the designs are less effective than others. I want to identify what type of two winged blade works better. My question is what type of rotor design will work the best out of the three. My hypothesis is that my third design will work best. I will test each blade’s max weight by putting more and more weight on it until it can no longer haul up the line. Then I will take off all of the weights and test how long it takes for the line to wind up. I will then analyze the results to see which design had the best average time. The potentially hazards of my projects are getting cut by paper or scissors.
Environmental Engineering (ENEV)	1140	Isaac Coudron	Radon Reveal	Question - Can I build an inexpensive radon detector? Hypothesis - I think an older house built on rock will have more radon than a newer house. Procedure - I will begin making a radon detector and start testing radon in houses. I will record the data and what houses have the most radon. Then, I will see if my hypothesis is correct. Conclusion - My hypothesis is correct. An older house built on rock has more radon than a newer house.
Environmental Engineering (ENEV)	1141	John Attesey	Self-Sustaining Touchless Faucet	Inside the typical four-person household, faucet water use accounts for 15%-18% of the overall water consumption (1). Battery-powered, hands-free "touchless" faucets use less water on average than hand-valved faucets. Touchless faucets also allow for a safe way to wash hands without the risk of viral and bacterial contamination from handles. Touchless faucets need to be close to an electrical outlet or need batteries to operate. Routing 120V power is expensive and there are potential building code violations to consider. Batteries can be used, but need to be replaced often. This can get expensive (5). Water passes through faucets with enough pressure and velocity to potentially generate enough electricity to keep the touchless faucet batteries charged. This project uses water that flows inside a faucet to spin a turbine that generates electricity. The hypothesis that enough electricity can be generated to keep rechargeable batteries fully charged or, at least, sufficiently charged to power a touchless faucet indefinitely is investigated. This project tested the amount of electricity a faucet can produce. Research on generators and water turbines were done, an apparatus was built and testing was conducted. After the apparatus was built and tested, the results of the project were shown. The data showed the amount of electricity the apparatus produced. To conclude, this project showed the usefulness of a faucet to create electricity to charge batteries for use in touchless operation.

Environmental Engineering (ENEV)	1142	Noor Omar & Muminah Mohammed	The Invisible Carcinogen in Your Home	Radon is a cancer causing radioactive gas. You cannot see, smell, or taste radon, but it's a major problem in our homes. It is the second leading cause of lung cancer and the 1st for smokers, causing around 20,000 deaths and costing the United States over 2 Billion dollars each year. Current Radon Mitigation Systems (RMS) are incredibly expensive and aren't available to everyone; Renters and apartment owners don't have the luxury of drilling through their basements to install one, not to mention the expenses ranging from $800-$1,200. With this project we have constructed an affordable and commercially available solution. We constructed our RMS with insulation material as well as a one way fan, making sure there was a layer of mesh in front to prevent insects and sediments from entering the home. The fan was secured within the insulator and with painter's tape to prevent air leakage onto the window. We made sure to test the radon concentration at 3 points of our experiment, before, during, and after our RMS was on. In comparison to a commercial option our RMS cost just $45 to make & install! In conclusion to our project, data shows that our RMS accomplished a significant decrease in radon gas and the overall toxicity levels of the environment, lowering the average concentration from 3.8 to 3.4 pi/cL. That is an overall decrease of .4 pi/cL, which can be the difference between a life threat and a fixable problem.
Environmental Engineering (ENEV)	1143	Hannah Driver	Using Solar Energy to Desalinate Water	Drinkable water is a necessity for everyone, but many people lack this essential resource. Though many water desalination methods exist, there are flaws to each of them. This is why I decided to use solar power to increase the amount of water desalinated when the water is boiled. During this project, the first step was to charge a battery using a solar panel. Then, using a metal coil, heating water. Finally, the heated water was desalinated. Because the water was already warm, it reached the boiling point faster, and therefore desalinated more water over the one-hour timeframe. Overall, the pre-heated water desalinated 264.52 ml of water on average, whereas the control groups averaged 236.56 ml. Once the water reached the boiling point, it desalinated at 4.7 ml per minute consistently. This is why, when my equipment broke, the trials could be simulated once I found each boiling point. In conclusion, this project was very time consuming, and very interesting. I like projects that involve real-world problems, so this was in all a fun experience. If i were to do this project again, I would use my desalination equipment throughout the entire process, because It broke during this process. These findings can easily be applied to real life. In just this small amount, the pre-heated water desalinated about 30 ml more than the room temperature. If this idea is scaled up, for instance in a desalination plant, this difference will be much more.
Environmental Engineering (ENEV)	1144	Oliver Nelson	Which Direction is Most Efficient and Faster for Circulating Air in a House	The purpose of my experiment was to see which direction airflow, either up or down, would be the most energy-efficient and fastest for circulating hot air in a room rather than having it get stuck at the ceiling. I ran two experiments (one up and one down) and measured the ceiling temperature, floor temperature, and air temperature near the ceiling and the floor every five minutes. I analyzed the data, and it showed that with downward airflow, the air near the floor got warmer than the air near the ceiling.
Materials Science (MATS)	1145	Julian Plumer	Butterless Baker	Do you want to bake healthier but can't find a recipe that is moist enough? I have been wondering about ways to do this, so for my science fair project, I tested which substitute for butter in lemon poppyseed muffins is the moistest. I tested three different substitutes (applesauce, yogurt, and avocado) along with the original recipe containing butter as the control group. I had expected applesauce was going to be the moistest because of how runny it is. I was correct. Applesauce is the moistest substitute for butter, but it is almost too wet. Even though applesauce is the moistest substitute, I recommended using avocado instead because it is the closest to the original recipe and has the best texture.

Materials Science (MATS)	1146	Abdullah Musani & Mohammed Yahya Elkhamlichi	Cellulose or Fiberglass: Which is the more Effective Insulator?	Living in a state where we experience extremely low temperatures during the winters, we naturally wonder of the best ways to keep ourselves and our homes warm – especially if you're in the process of getting a new house built. With so many different insulating options available in the market, the purpose of our project was to explore two of the most common thermal insulators, Cellulose and Fiberglass, and determine which one is more effective. Our Engineering Goal was to build a 3D wooden box to test out the effectiveness of each of the two insulators. We accomplished this with the use of Waferboard Wood, screws, and silicone. We divided the box into two sides: the Heating Chamber and the Insulating Chamber. We further divided the Insulating Chamber into two sub-chambers; one to be filled with Cellulose and the other with Fiberglass. During the trials, we covered the front of the Insulating Chamber with Plexiglass (attached with silicone), and the Heating Chamber was covered with a wooden plank. We hypothesized that Cellulose would be more effective, due to its higher R-value, density and thickness. This was tested by transmitting heat from the lamps towards the Insulating Chamber and monitoring the sub-chambers' temperatures. Indeed, our results supported our hypothesis and showed the flow of heat into the Cellulose sub-chamber was comparably slower than that of Fiberglass. We concluded that although both insulators allowed minimal heat to flow through, Cellulose was proven to be the more effective insulator.
Materials Science (MATS)	1147	Isabelle Voss	Cold Weather Warm Hands	In winter your hands often get cold when you are outside, even in your gloves. To solve this problem lots of people buy single use hand warmers from the store. Wouldn't it be nice if all the materials to make your own hand warmer were right in your own home? This project looked at which of six different types of homemade hand warmers was the most practical and efficient in a glove. I tested each hand warmer type in a glove with and with out a hand by taking the temperature every five minutes for an hour. My hypothesis was that if I tested the hand warmers then I would find a hand warmer that was effective and practical. I tested several hand warmers, five of which were chemical reactions and one non-chemical reaction. I had expected the chemical reaction hand warmers to perform the best but was surprised when the non-chemical hand warmer out performed the others. The chemical hand warmers' performance results were also quite different in that one of them produced 37F more heat than the other chemical hand warmer. Overall the non-chemical hand warmer was the best, not only in efficiency but also in practicality.
Materials Science (MATS)	1148	Jocelyn Veum	Ice, Ice, Baby	The purpose of my project is to see which liquids melt ice the fastest. The solutions I used were salt, kitty litter, wind shield wiper fluid, rubbing alcohol, and putting nothing on it. I poured 1 teaspoon of the solution on each ice cube, which contained 1 tablespoon of water. The results were that rubbing alcohol melted the fasted with an average of 53 minutes, which was followed by salt at 66 minutes and wind shield wiper fluid at 71 minutes. The least efficient solutions to use when melting ice were kitty litter at 113 minutes and putting nothing on the ice at 119 minutes. Rubbing alcohol melts ice the fastest.

Materials Science (MATS)	1149	Annika Clift	Making Paper and Testing Its Durability	For my project I decided to make paper. My question was how do different kinds of handmade and office paper compare in how they hold weight and different writing mediums? I tested office, recycled office, daylily, and banana papers. I expected that the office paper would perform the best. After the office paper, I thought the banana paper would come next, then the daylily. I believe that the recycled office paper would come last in performance. The office paper would likely perform best because it is professionally made. After I made my paper, which was a long but fun process, I tested the paper two different ways - strength and writing tests. The strength tests were very surprising when the banana paper held 1,088 quarters! Before I could start putting the quarters on the sheet, I had to count and bag them up so they wouldn't slide off. For the writing tests I took some markers, pencils, erasers, and a micron pen to see how each paper reacted to the different materials. This process was easy because I just had to make a little square of each material and record what happened. To test ink bleeding, I put a drop of water on a line of the medium and saw how it reacted. My hypothesis was mostly supported in both tests, but not all correct. The banana performed the best with the office paper close behind in the strength test, and the daylily performed the worst for the writing test.
Materials Science (MATS)	1150	Maryam Shahkhan	Pharma Pack: Engineering a Medicine Packaging Container using Insulation to Transport Medicines to Homes	The purpose of this experiment was to measure the internal temperature of an insulated container that could keep medications at controlled room temperatures between 15 °C and 25 °C in the summer. The stainless steel medication container was tested with silica aerogel, fiberglass, and extruded polystyrene as independent variables. The container without insulation acted as a control. I predicted that the container with silica aerogel would meet the controlled room temperature requirements for medication storage. The procedure included cutting the different insulation materials according to specific dimensions, insulating the container with one variable at a time, and placing it into an incubator for 5 hours. The temperature at the start and after every hour for 5 hours was recorded for each type of insulated container and the control. Three trials were conducted for each variable. The data supported my hypothesis. The average temperature was calculated that showed that the container with silica aerogel met the controlled temperature requirements while container with fiberglass came at the temperature requirement borderline. Pharma Pack with polystyrene did not meet the controlled temperature requirements. In conclusion, the results established that silica aerogel is an ideal insulator for medication shipping containers. It is an easily available, cost-effective, lightweight, and environmentally-friendly. The results are significant for medications that require controlled room temperature as it can help improve shipping pharmaceuticals to residential homes during summer temperatures where the efficacy of medication is preserved until the patient picks up the package from the mailbox or the front porch.
Materials Science (MATS)	1151	Tristen Cone	Using Kevlar to Increase Your Safety at School	Purpose of experiment: The purpose or goal for my experiment was to engineer an impenetrable curtain that could efficiently secure a classroom door to prevent entry by unwanted assailants or bullets from a wide array of firearms in the event of a school security breach. Procedures Used: Firearms with different ballistic characteristics were utilized to determine Kevlar curtain layer needs to ensure adequate penetration protection was achieved while supporting the Scientific Method to guide my project initiatives. Observation/Data/Results: all calibers tested from a BB gun, 22 cal Rimfire, .45 Auto and variations within these calibers did not penetrate any more than 16 layers of ballistic Kevlar. Conclusion: by adding a 2.0 service factor, a curtain consisting of 30 layers of ballistic Kevlar properly securing a doorway will stop all mainstream handgun rounds from 22 cal to .45 Auto from entry into the protected space.

Materials Science (MATS)	1152	Abby Loney	What's the Pointe?	There are many different materials that make up pointe shoes. The combination of labor and materials drive the cost of pointe shoes up. As a result of all these variables, the durability of these shoes change for each dancer. The purpose of the project was to create a shoe that uses less expensive materials and maintains the same durability, or to find a way that pointe shoes are more durable and last longer, is key. This project had to do with the testing of the durability of different products, and consisted of dropping artificial sweat onto 4 products, then measuring the thickness of each with a caliper in millimeters for 30 days. The results in this experiment were 26mm for the pointe shoe, 25.854mm for Grade C Cork, 25.846mm for the Neoprene Rubber, and 24.606mm for the water-resistant cell foam. The conclusion for this experiment was that the goal was to try and find a better, stronger, more durable product to replace the toe box of a pointe shoe, however, in the end, the pointe shoe really is the best product of the four products tested.
Materials Science (MATS)	1153	George Schwint III	Which Type of Glue Creates the Best Bond Between Wood?	Which Type of Glue Creates the Best Bond Between Wood? George Schwint St. Mary's Catholic School, Sleepy Eye MN USA Glue is a common adhesive often used to bond two pieces of wood together. Each type of glue provides a different adhesive strength. The purpose of this experiment was to determine which type of glue creates the best bond so it would be easier to choose the appropriate glue for woodworking projects. The hypothesis stated that if three types of glue were used to bond two pieces of wood together and a weight was applied to try to break the bond, wood glue would be the strongest. To test the strength of the bond two pieces of 5.08 cm x 5.08 cm lumber were glued together with different types of glue and allowed to cure according to the manufacturer recommendations. One end of the bonded piece of wood was secured to a strong platform and on the other end a bucket was hung. Water was added to the bucket until the bond broke. Some trials needed more mass to break the bond so the bucket was removed and a strong platform was suspended where larger amounts of mass were placed until the bond broke. The results for school glue show that it was the weakest with an average mass of 2.1 kilograms before the bond broke. The polyurethane glue did much better than school glue as it held an average mass of 22.7 kilograms. The wood glue created the best bond as it was able to hold an average mass of 28.9 kilograms. This happened because of the Polyvinyl acetate in the wood glue which is a chemical compound designed to bond wood. The results did support the initial hypothesis because the strongest glue was wood glue.
Mathematics (MATH)	1154	Bella Salmi	Confectionary Erosion	My science fair topic is answering the question of how many licks it takes to get to the center of the Tootsie Roll Tootsie Pop. My hypothesis was that if 25 people each systematically lick a tootsie roll tootsie pop, then it will take 600 licks to get to the center of a tootsie roll tootsie pop. I built an automated licking machine to offer consistency in licking and remove the human related variables. After multiple tests with the licking machine, the machine produced a wide range in the number of licks from 261 to 700, with an average of 452. My conclusion is that the wide range of data is due, in part, to the inconsistency of the candy manufacturing with the placement of the tootsie roll center within the sucker. So the world may truly never know how many licks it takes to get to the center of a Tootsie Roll Tootsie Pop.

Microbiology (MCRO)	1155	Maria Schwartz	Analysis of the Frequency of Detection of PRRSv, Rotavirus and Parvovirus with Air Collection and Other Methods	Porcine Reproductive and Respiratory Syndrome virus (PRRSv) affects pigs in most countries of the world since the first occurrence of the virus in the United States in the late 1980's. PRRSv is an RNA virus that mutates rapidly in pig populations and infects pigs of all ages including the fetus, baby, and adults and causes reproductive and respiratory disease. The annual estimated cost to the United States swine producers alone is approximately $700,000,000. Researchers and veterinarians continue to work to understand how this virus is introduced to PRRS negative populations. Rotavirus also affects pigs in all countries of the world. It can be mild in most ages of pigs but cause severe diarrhea in pigs from birth to four weeks of age. Rotavirus A,B, and C are the types that infect pigs. Parvovirus is a common virus in all pig populations. The two types of parvovirus in pigs are types 1 and 2 and are referred to as PPV1 and PPV2. Parvovirus cause reproductive failure and embryonic death. This study was designed to measure the frequency of detection of PRRSv, rotavirus, and parvovirus with air collection, with an exterior environment, fomite, and hands. The Polymerase chain reaction(PCR) was for virus detection.
Microbiology (MCRO)	1156	Samuel McHugh	Do dog foods meet their probiotic label claims?	According to the WHO, Probiotics are "live microorganisms that when administered in adequate amounts confer health benefits to the host." Probiotics are found in many foods and beverages and many manufacturers are even adding probiotics to pet food. Pet owners want to give their pets the best health and nutrition so people are buying pet foods with probiotics, but are the probiotics actually in the food so the pets get the benefits? The goal of this study was to see if the probiotics added to dog foods were present in the amounts claimed on the nutrition label. To investigate this question, I enumerated the total number of microbes in aerobic conditions in each of 10 different dog foods using standard microbiological techniques including serial dilutions and spread plating. All of the 10 dog foods I tested had microbes listed in their ingredients list but only 8 of them had a specific label claim for number of probiotics. My hypothesis was that at least 4 of these 8 foods would meet their label claims for number of microbes that should be present. Of these 8, only 1 of the foods met their label claim by having the number of microbes listed on the nutrition label.
Microbiology (MCRO)	1157	Miley Behnken & Amelia Calderon	Essential oils as the new anti-microbial agent	Do use of essential oil's as aromatherapy and household cleaners are increasing in popularity. Essential oils are common ingredients in illness remedies and other anti-microbial mixtures and compounds. Do essential oils really work? This study tests if oils are effective cleaners capable of eliminating bacteria, reducing the inhalation and consumption of bacteria and chemicals. The essential oil's peppermint, Teatree, lavender, thieves, clove were tested. Hand sanitizer and almond oil are used as a negative and positive control group. Filter paper circles were cut and soaked in each product tested. The circles were placed on each plate containing coliform bacteria during its growth phase. After two days of growth and observations, the diameter of the translucent areas underneath and around the circles (zone of clearance) were measured and recorded with the use of light tables and microscopes. This experiment shows clove and Teatree oil made little difference, the almond oil had a definite clearing zone. It was hypothesized that clove oil would work best to deter the growth or eliminate the presence of bacteria due to its higher concentration of its anti-bacterial property (eugenol) (1). However, it was not supported, even though one Agar plate Successfully grew a colony of bacteria. All oils failed to remove the thin layer of minimal growth. In conclusion, it's not recommended to use essential oil's as an in-home cleaner. They do not successfully eliminate bacteria. Results do reveal that the negative control, almond oil, kills all bacteria it is in contact with. This explains why Manny include this product into their skin regimen's.
Microbiology (MCRO)	1158	Alejandra Cruz	How Does the Concentration of Clover Honey Affect the Number of Surviving Bacteria	This experiment investigated how the concentration of clover honey affected the number of surviving bacteria. I did this by growing bacteria and seeing how different amounts of clover honey mixed with water affected the growth of bacteria. I found that as the concentration of clover honey increases the number of surviving bacteria decreases.

Microbiology (MCRO)	1159	Emma Dempsey	How to keep our household drain tiles clear! Killing the Ochre!!	My home, like some others, has bacteria that clog their drain tiles and can cost 1,000+ dollars to fix and make it difficult to warranty the basement. The repair workers (for my basement) said it is Iron Ochre, which is an iron eating bacteria, clogging our drain tiles. They suggested that chlorine or UVc light may kill it. I wanted to test the idea. What kills Iron Ochre? I used blood agar plates for the potential iron as well as nutrient agar plates to grow the samples. I learned about and used sterile techniques in the lab. To best measure the growth, I divided the agar plates into 4ths and used a sterile swab to put one in each 4th of seven dishes. I let both types of plates grow in an incubator for 2 days then took photos. I used UVC, Bleach, Hydrogen Peroxide (H2O2), and cold 17°C conditions to try and kill the controlled growth. More specifically, with supervision, I exposed to the two dishes labeled 1, 1.5 mL H2O2 3% concentration, dishes 2, 1.5 mL H2O2 6% concentration, dishes 3, 1.5 mL 5% household bleach, 4, 1.5 mL 10% household bleach, 5, control in incubator, 6, 17°C and dark, 7, 15 minutes of UVC. My results proved that my hypothesis was wrong about growth, the blood agar plates grew less than the nutrient plates. Overall, my hypothesis was supported because all agents killed the bacteria.
Physics and Astronomy (PHYS)	1162	Jairo Cordoba	Bottle Instruments, Truth or Myth?	This project was all about blowing on bottles. The reason I did this experiment was because I like music and I saw this experiment of blowing on bottles. The fact that you could blow on bottles and it would respond amazed me so I decided to test what determines the sound the bottle makes. The question I answered was, “Do different bottles produce different sounds or frequencies when you blow one them?” For my procedure first you must get at least five different brands of bottles, second, you must blow on the mouth end of each of them, one at a time, while also recording the note and frequency of the bottle you are testing. After, you must then repeat step two for all the other bottles. If possible do this experiment with a machine that blows controlled amounts of air. One will find that glass bottles, on average, produce a lower frequency and note, for example an average of 231.09 Hz. The plastic bottles, on average, create a higher frequency and note, for example an average of 313.77 Hz. Hz stands for Hertz which is a common measuring unit for sound. In conclusion my data did not support my hypothesis. I also could have changed a few things like the air blowing machine to get more accurate results.
Physics and Astronomy (PHYS)	1163	Ivan Reindl	Candy Crush: How Much Force Does It Take to Crush a Jawbreaker?	Everybody knows jawbreakers are hard to break, but how hard are they really? The goal of the project was to find that out. The purpose of the project was to see how many kilograms (kg) of force it took to break different sizes of jawbreakers, and to see what factors most affected breaking point. I chose 7 different types of jawbreakers, and I hypothesized the larger jawbreakers would take the most force to crush. The diameter, roundness, mass volume, density, and breaking point was found for 12 samples of each type of jawbreaker. I used a manual hydraulic press and a Wii balance board connected to a computer and software program to determine the breaking point for all 84 jawbreakers. The jawbreaker with the largest diameter and mass, Jaw Bruiser, had the highest breaking point of 217.2 +/- 42.2 kg. The jawbreaker with the smallest diameter and mass, Gobstoppers, had the lowest breaking point of 26.1 +/- 2.8 kg. These data supported my hypothesis. The factors that most affected breaking point were diameter, mass, and volume. Surprisingly, density did not seem to have as much of an effect on breaking point. I learned if you want to crush a jawbreaker, save your teeth and use a hydraulic press instead.

Physics and Astronomy (PHYS)	1164	Catriona Formby	Color in the Darkness	This project was meant to test how perceptible different colors are when they are tinted down. First, basic color swatches were created and tinted down to different levels of darkness; the levels were 100% color, 50% color, 25%, 10%, 7.5%, 5%, and 2.5%. The basic colors of the visible spectrum were used: red, orange, yellow, green, blue, and violet. The swatches were printed out and mixed up, and the participants then attempted to put the swatches in rainbow order. The levels were tested in descending order. The results showed that green was the most perceptible with an average score of 1.25/2 at 2.5%. Then yellow, blue, and orange were next most perceptible with 1.17/2, 1/2, and 0.67/2 respectively at 2.5%. Although red had higher score at 2.5%, 1.5/2, it is considered less perceptible because it had lower scores at higher light levels and probably only went back up because the participants learned how to recognize it. This project contributes to its field of study in that it tests color vision in a different way; many of the studies similar to it test color perceptibility when there is less light in a room rather then when the color has been tinted down. It could be used to know what colors to make street sign so that they are visible. This project is in a field of study that, although well-tested, could be applied in so used in so many more ways.
Physics and Astronomy (PHYS)	1165	Abby Koivisto	does drag affect swimming times?	Swimmers are always trying to find ways to decrease drag so they can get faster times. Being a swimmer and watching the Olympics, the swimmers wear a type of suit known as the tech suit. This is a type of suit that is supposed to reduce the most drag. For the section meet, my team wears these types of suits and I wanted to know if they actually help decrease your swimming times. In my project I am trying to figure out if olympic style suits help decrease drag more than the standard competitive swimming suit. For my procedure I took times from four events from the swim season. The events chose were the 100 freestyle, 100 backstroke, 100 butterfly, amd the 100 breaststroke. I took two people from each event and compared their times from the season to the section meet where we wore the olympic style suits. My results were that through the course of the year the times were getting faster. The last slant on the graph showed if the time got faster or not. My conclusion was that seven out of the eight swimmers decreased drag, time, and had a good race.
Physics and Astronomy (PHYS)	1167	Jonathan Harms	Going Ballistic	This experiment was designed to figure out some of the best 9mm cartridges that penetrate far into Ballistics gelatin. If the research is correct then the depth of the bullet penetration depends on the type of bullet, the amount of gunpowder, and its expansion because different bullets have different expansions and speeds. The experiment procedures were to first set up the stand then cut open the gelatin on the stands then step back ten feet and shoot the gel three times with each type of bullet then measure the distance the bullets penetrated. The hollow points averaged 59.005 cm. into the gel going the second farthest. The hydra shoks, the third farthest averaged 50.11 cm. into the gel. An odd thing that happened was that the full metal jackets curved around instead of going straight through. The conclusion is that the full metal jackets work the best with all three of the tests going all the way through the gelatin. One real life application is that this could tell what some of the best self-defense rounds. For hunting purposes a person wouldn’t want a bull to be curving around ruining anything so full metal jackets wouldn’t always be ideal.

Physics and Astronomy (PHYS)	1168	Brennan Glawe	Growing Green on the Red Planet	This project is a continuation of my experiments that tests seed germination in a simulated Mars environment. Last year, testing was on germination rates in different mixes of Mars regolith. This year, all seeds will be planted in the most successful simulant but the germination temperature will change. This doesn't cover other factors in plant growth on Mars. For one, it doesn't cover toxic chemicals in the regolith, or the lack of oxygen in the atmosphere. This project is important because NASA and SpaceX talk increasingly about exploration of Mars, and possibly sending people to it. The requirements for a plant include water, sunlight, nutrients, a healthy environment, and often warm temperatures, all of these requirements will have to be met, before a proficient colony can be set up. A proficient colony could be like the one in "The Dream" from the book How We'll Live On Mars by the author Stephen L. Petranek that covered the needs of such a massive Martian colony, and talked about how these needs would need to be met. This experiment sought the knowledge of the germination, and root health of radishes (Raphanus sativus), and kale (Brassica oleracea). The results showed that Trial One, (15 degrees celsius was the optimal temperature for radishes (Raphanus sativus), and kale (Brassica oleracea) to emerge, germanate, and establish the longest roots.
Physics and Astronomy (PHYS)	1169	Megan Smith	Hair Raising Electricity	The purpose of my experiment was to determine in hair color affects how it reacts to static electricity. I used foxfur, a metal rod, a ruler, and 12 subjects (3 per color). You rub the rod with a fox fur about 10 times or as much as needed (make sure to keep going the same direction.)Hold rod about an inch over their head and raise it as it gathers more hair And measure the amount it rises with a ruler. Repeat with all of the subjects. Record your results. The first blond subject's hair rose 12 inches off of their head, the second's rose 1 inch, the third's rose 5 inches. The first black haired subject's hair rose 6.5 inches, the second's rose 1 inch, the third's rose 7.5 inches. The first red haired subjects hair rose 5.5 inches, the second's rose 3 inches, and the third's rose 3 inches. The first brown haired subject's rose 7 inches, the second's rose 10 inches, and the third's rose 2 inches. The blonds averaged out to about 6 inches, the reds averaged to about 3.8 inches, the black hairs averaged out to about 7.5, and the browns averaged out to about 6.3. In conclusion, the black haired subjects' hair stood up the most. However, many variables could have impacted it such as how curly, straight, clean, or greasy the hair was. One subject also had their hair up.
Physics and Astronomy (PHYS)	1170	Elliott Gieser	Heat in a box	Abstract The topic of my experiment is solar air heaters. The reason why I chose this experiment was because I like solar panels and wanted to learn more about their benefits and disadvantages. I decided that I would make a pop can solar air heater from twelve ounce cans for my project. Some facts I learned about solar air heaters is that it can be a substantial secondary heat source for small houses or a room in a house. Solar air heaters do not use fossil fuels to get heat which makes them environmentally friendly. in winter you can have over a one hundred degrees fahrenheit difference when it is in the sun and on cloudy days it is shown to still have a slight difference in temperature
Physics and Astronomy (PHYS)	1171	Isaac Rose	How Does Temperature Affect Magnetic Force?	Magnets are all around us and exposed to extreme temperature. This experiment was set up to see how temperatures affect magnetic force. Magnets were tested at three different temperatures. There magnetic forces were measured using a spring scale. My hypothesis was that the colder a magnet gets, the weaker the magnetic force. My hypothesis was proven false because when the magnet gets colder its magnetic force increases.

Physics and Astronomy (PHYS)	1172	Abel Mekonnen	Out of This World	QUESTION: How do different galactical disasters and situations affect the solar system, Earth, and it's neighboring planets? HYPOTHESIS: The hypothesis for this experiment is that a disaster involving the orbit of any of the planets would eventually become lethal for life on Earth. DATA: If Mercury, Venus, Saturn, Uranus or Mars were to disappear, the only difference would probably be an unnoticeable change in Earth's orbit. If Jupiter disappeared all of the asteroids in the asteroid belt would come speeding towards the Sun. The inner planets would be in trouble. This scenario would have devastating effects on the solar system. RESULTS: When Jupiter disappeared, Mercury, Venus, Earth, and Mars were almost always affected. They were affected by the asteroids which smashed into the inner planets at extremely fast speeds. The collisions are probably enough to affect life on Earth drastically, if not ending it completely. PROCEDURE: The procedure in this experiment differs from others because it is a coding based project and not one that can be done physically or necessarily in steps, so to speak. The website that will be used to code with is as follows: https://scratch.mit.edu/. In the website, a model of the solar system will be constructed. A model will be created where the observer can see how various planets disappearing would affect the solar system and Earth. SOURCES OF ERROR: Sources of error are extremely unlikely in the experiment. Misuse of the computer may result in injury.
Physics and Astronomy (PHYS)	1173	Rebekah Ojard	Photovoltaic Cell Efficiency	The purpose of this experiment is to explore the efficiency of a Photovoltaic (PV) cell and also to learn about how a PV cell compares to a battery in power output. Solar energy is energy that is produced by the sun. This energy is produced from nuclear reactions in the sun's core. Some of this energy travels to earth in the form of light. A PV cell or solar cells, make light energy into electrical energy. With this energy, you could power your calculator or even a house. What is the efficiency of a Photovoltaic Cell when converting sunlight to electrical energy? Is workload or sunlight the limiting factor for efficiency? How does a small Photovoltaic Cell compare to a small battery? The basic procedure for this experiment was to connect the Vernier probes to the circuit and the computer running Vernier Graphical Analysis 4 software. Do three trials and analyze the data. The results showed that the efficiency of the PV cell at 220Ohm resistance was 0.09% at 50300 lux and the PV cell at 100Ohm resistance was 0.25% efficient at 18,621 lux. The limiting factor seemed to be the load level (Ohms). The battery produced more voltage 5.3V and more sustained current 0.2A compared to the PV cell 0.06A at 100Ohm resistance. In conclusion, the PV cell depends on lots of sunlight and large volume to compete with battery power.

Physics and Astronomy (PHYS)	1174	Haden Marshall	Speed Planes	I am doing this experiment because I love planes. I love to draw and design futuristic planes. I also thought it would be a fun experiment to launch toothpick planes. My question is, “Does the wing design affect the speed of a plane?” The stakeholders for my project would be people who build airplanes like Ace Aircraft Manufacturing Company and Advanced Aircraft. Also this information could be used by NASA to help with fast space travel. First I built the planes and the launcher then I launched the planes 20 times each and record the data. The average data for the biplane was 5.2525 for the speed blane 6.23 then the monoplane with 6.8815 finally the X wing with 8.5165. My Question is, dose different wings and placement affect the speed of the plane. In this experiment I found that the biplane was the fastest. This supports my hypothesis. I thought speed plane would be third but it was second only because i didn’t control the weight but if I did, I think my data would have been more spaced out with a clearer winner.
Physics and Astronomy (PHYS)	1176	Aubree Gerlovich	The Physics Behind a Figure Skating Jump	Figure skating is one of the more graceful and aesthetic Olympic level sports. And yet what goes into figure skating is anything but graceful, extreme strength is needed to throw yourself off the ice at great speeds and height. The purpose of this project is to break down the physics of this sport, and how understanding the physics can help you jump better in general. The problem that was investigated was how a very important factor, arm positioning, affects your jump in mid air. For the procedure, I performed several different single jumps while video taping myself with my arms in three different positions, both arms up, both arms out, and arms pulled in. I then found out what the velocity was using the formula v = d/t (velocity = distance / time). Time varied for each jump and each position but distance was about .61 meters for every jump. For example the flip jump time for arms pulled in was .4 seconds. Making the velocity for arms pulled in 2.04 miles per hour. As for arm positioning it was proven that it didn’t affect your rotation but it does affect your landing, on all the jumps with arms out the landing always felt unbalanced and unsteady. I believe that this project will benefit figure skaters who want to learn new jumps step by step. I also think that knowing the physics of any sport itself can benefit the way you play and understand the sport itself.
Physics and Astronomy (PHYS)	1177	Dane Mason	What Is The Easiest Way To Catch a Football?	When catching a low pass try your best to align yourself with the ball (Wall Street Journal, 2016).The question was: What effect does the arm position when catching a football have on catching success? The hypothesis is: If different arm positions (overhead, below waist and at chest) are used, then the chest position will be more accurate. The participants caught the ball in each of the catching positions (above the head, chest and waist). The hypothesis was partially supported. The chest was one of the best arm positions to use for catching a football (92%), but the overhead position was the same (92%), both were better than the waist (70%). The Wall Street Journal (2016) reports that when catching a low pass try your best to align yourself with the ball. Possibly, the people catching the balls in my research did not have their body aligned. It was surprising that the high catch was just as good as the low, because less catches are done that way and it is harder to see the ball. It was cold outside, winter, this could have affected the results. Pro football players will benefit from knowing that the quarterback would have the most completions if they throw the ball to their wide receivers in the overhead or chest position. In the future, I would like to have more people and do the catching in different weather conditions. Also, use a Jugs machine (throws the ball consistently) and test high school players.

Plant Sciences (PLNT)	1178	Sophie Nolle	"How Does Coriandrum sativum Affect Lead Concentrated Soil?"	This experiment determines the effect Coriandrum sativum (cilantro) has on lead concentrated soil and the effect of plant concentration on growth. Hypotheses: Will increased concentration of plants negatively impact their growth? Will cilantro, when planted in soil containing a high concentration of lead, test positive for lead due to phytoaccumulation? Lead can remain in the environment as dust, indefinitely. Lead in fuels contributes to pollution. Exposure to lead may cause anemia, weakness, kidney, and brain damage. Solutions to these problems could be made based on the results of this experiment. Presence of lead will be determined by growing cilantro in soil harvested from a trap range in different plant concentrations. Plants will be tested for lead using a lead test kit with strips. I will measure the stems of the leaves to determine the best growing group.. I will measure the average leaf area of each plant. Test results show that the cilantro plants did not test positive for lead. Thus not proving my hypothesis to be either correct or incorrect based on the data that I have gathered. The results of the measurements showed that the plants don't grow well in smaller quantities. This suggests my hypothesis about the growth patterns of the cilantro plant is not correct. Conclusions of this project are that a) Coriandrum sativum does not phyto-accumulate lead from soil during growth and b) Coriandrum sativum grows better in larger quantities.
Plant Sciences (PLNT)	1179	Yahye Abdullahi & Hamsa Abdikarim	Cornflowers Vs Nutrients	This experiment was testing NPK fertilizer and the effect it has on a Cornflower. Since farmers use fertilizers and there have been studies done on Cornflowers, we hypothesize that the nutrients (NPK) 33% Nitrogen, 33% Phosphorus, and 33% Potassium in the fertilizer will have the highest growth rate on a Cornflower. We first planted our Cornflowers, then watered them and waited 3 days for the germination period to end. We then crushed our fertilizers to powder and added them to our plants. We then measured the growth of the plants every week. In our results, we discovered that 100% Potassium had the highest growth but the control had the most surviving plants. In conclusion, our 100% Potassium had the highest growth and the most successful ratio of fertilizer.
Plant Sciences (PLNT)	1180	Miret Anchamo Grant	Does Coral in Soil Affect the Height, Sprouting and Biomass of Wheatgrass Plants?	Karibass (country in Oceania) is surrounded by coral atolls, which are ring shaped coral reef islands that surround a lagoon and affect their farming soil. For my experiment, I'm planting wheatgrass plants in different sizes of crushed up coral mixed with compost to see in which mixture the wheatgrass plant can grow in the healthiest manner. I'll experiment for ten days and collect data on the plant's height, sprouting and biomass. My hypothesis is that the smallest size of coral and the largest ratio of compost to coral will be the most effective for the growth of the wheatgrass plants, because it's most like the habitat for which wheatgrass plants grow. I prepared 12 cups of soil and divided them into three groups by coral sizes (¼ inch, ⅛ inch and 1/16 inch) in diameter. Each group contained four cups with different combination of soil and coral by percentage (100%,67%33% and 0% coral). The data shows that 100% small diameter of coral showed the first sprouting of all the groups,but only had 2/4 plants grow at the end and had the lowest average height. The 67% medium diameter group had the most sprouting at once and led the way throughout the experiment with the highest average plant height of 12.5cm and the fastest growing. The containers with 100% coral had lowest average height then all the groups that contained compost. The 33% and 67% medium coral are similar in plant average height.
Plant Sciences (PLNT)	1182	Halina Tompkins	How does the amount of fertilizer affect the growth of little bluestem?	This project tested how the amount of fertilizer affects the germination and growth of little bluestem, a prairie grass native to Minnesota. Twelve pots with little bluestem seeds were watered with a mix of 0g, 1g, 2g, or 4g of fertilizer and 100 mL of water every 3 days. The pots were kept in a controlled environment. While all the pots showed signs of germination, the pots given 2g and 4g of fertilizer didn't grow into plants, the pots given 1g of fertilizer grew very little (average plant mass of 0.118g), and the plants given no fertilizer grew a lot (average mass of

				1.001g). In conclusion, this study found that fertilizer did not improve growth and also affected how the seeds germinated.
Plant Sciences (PLNT)	1183	Arya Mehta	HYDROPONICS VS SOIL	This experiment was conducted to find out if plants grown with hydroponics grow taller than plants grown in soil. For the experiment 14 garden pots were used. 7 pots were filled with soil and had pea seeds placed 4 centimeters below the surface, then they were sprinkled with water. Then the seeds were placed in the peat pellets to germinate. After germination, the pellets were put in the 16" hydroponic nets, which were then placed in the remaining 7 pots which had been filled with water. Every three days the plants grown in soil were watered with 2 cups of water and every day the peat pellets were sprinkled with 1⁄4 cup of water. The average growth for the two groups was 27 cm (hydroponics) and 25 cm (soil). The results didn't show as much of a difference as the research suggested, but the hydroponic plants grew taller. However, the plants grown in soil started growing before the hydroponic ones did. I also found that the hydroponic plants grew a lot while the soil plants stopped growing for a week.
Plant Sciences (PLNT)	1184	Elizabeth Levinshteyn	Living in the Shadows: Can Plants Live Without Light?	Most plants are autotrophs, so they make their food from carbon dioxide and other inorganic matter through photosynthesis. Green algae Chlamydomonas reinhardtii can be cultured in the Lab and is easy to mutate and has a long enough life to study. My question was "Can Chlamydomonas reinhardtii efficiently use glucose in the media as a source of energy in the absence of light?" I hypothesized that Chlamydomonas reinhardtii cells will regenerate their flagella using glucose in the media as an energy source (as a heterotroph), but less effectively than using solely sunlight (as an autotroph). Chlamydomonas cells were cultured in TAP media (pH of 6.8) containing ions, phosphate, nitrogen, and acetic acid under continuous light. Flagella were removed by lowering pH to 5.5. Media pH was neutralized and the cells were allowed to recover under four different conditions. The length of flagella was estimated before acidic treatment and for 80 minutes of recovery. Based on my research, Chlamydomonas reinhardtii can regenerate their flagella in the absence of light using glucose as a sugar source. In the presence of glucose in darkness, Chlamydomonas cells regenerated faster than when they relied only on photosynthesis. Cells grown under light without glucose in the media took longer to regenerate their flagella, likely because they needed more time to make energy. Increasing the efficiency of photosynthesis could help increase the production of crops, especially in the conditions of changing climate.

Plant Sciences (PLNT)	1185	Adithi Rupireddy	Plant Growth In An Enriched Carbon Environment: Sucess of Vigna Radiata and Brassica Nigra (Year 2)	Human actions are causing a decline in plant biodiversity with increasing atmospheric Carbon concentrations, Nitrogen depositions etc. This change in biodiversity may negatively impact ecosystem functioning which might be particularly important in the face of other global changes such as global warming and an increasing need for food production. The goal of this research project was to find the difference in plant response when grown in soil from an enriched carbon dioxide environment and compared to a control. Plant response includes germination rates, plant growth, height, biomass, and root growth. Soil has been acquired from Cedar Creek Ecosystem Reserve and is a representative of enriched carbon dioxide and nitrogen research through the BioCON research at the U of MN. A secondary goal of this research project is to use LaMotte tests to quantify differences in pH and Nitrogen, Phosphorus and Potassium levels between both soil samples. This research project was conducted at my home. Plants were grown in soil exposed from an elevated carbon dioxide environment and were compared to those grown in the control. The difference in plant response has been assessed to study how it will affect our ecosystem and ultimately its effect on global environmental change. Similarly, soil testing quantifies the difference in microbial communities of both soil samples.
Plant Sciences (PLNT)	1187	Anggelo Mendoza Fierro	Rainbow Flowers	I constructed a box with 3 dividers and 4 different holes then my dad and I hooked up some wires to some light bulb which are red, yellow, blue and green in those holders. Then I put soil in 4 different pots and planted 4 sunflower seeds inside each pot. After that was done I put plates under the pots so they would not make a mess and then I put them under the different colored lights. I plugged the in and watered them everyday and once my project was coming to an end I measured the final growth of each flower. And the result was that the yellow light grew the tallest out of the 4 colors.
Plant Sciences (PLNT)	1188	Matthew Beekman	Tomayto Tomahto Is There a Difference Between Traditional and Vertical Farming?	Vertical Farming is the practice of growing plants vertically. The purpose of this project is to show that plants can grow vertically without a big impact on the environment. The results of this project will help prove this statement that vertical farms will still grow as much if not more food than regular farms. The problem this project is focused on is a lot of land is being destroyed because of farming and people in places where people can't have a garden can grow food vertically. The procedures where to buy materials, prep buckets for plants, set up PVC pipe, hang tomatoes, and then check the tomatoes daily. The independent variables of this project are the tomato plants, vertical or natural, and if there are carrots on top. The dependent variable was the amount of tomatoes produced. The results found in this experiment was that the plants upside down grew as much food as the other plants on the ground (Cherry Tomatoes not Super Fantastic) but the food size was smaller. The plants with carrots on them grew less food. Minnesota is a big agricultural state so this could help people in this area.

Robotics and Intelligent Machines (ROBO)	1189	Isabel Qi	Teaching AI to Write Poems	This project focuses on the use of machine learning on a dataset to carry out a specific task. Recurrent Neural Networks are a family of neural networks designed for sequences. Using past training data as input, they are able to predict the most likely outcome as output. Computers in the past have been able to use RNNs and other neural networks to imitate text. About 14,000 poems were put together in a single file as training data. Loss will be used to measure how often the program makes errors. To have the best results, loss should be as low as possible. Usually the longer it trains, it becomes better at predicting. For example, the loss at one minute is greater than loss at 15 minutes. The longer it trains, the better it seems to be at predicting the next character. For the better results, the program should be left overnight. The program was shown to be able to somewhat learn this text, although they aren't legible. Given enough time, it would be able to replicate the poems pretty well. Too soon, and it wouldn't be able to process enough information, like where to put punctuation and capitalization.
Robotics and Intelligent Machines (ROBO)	1190	Omar Abou Zahr & Yusuf Malik	The EV3 Lego Robot Swiffer	There are many disabled people who aren't able to clean their messes. The purpose of our project is to help these people clean messes. This Ev3 Lego robot's main parts are an Ev3 color sensor, an Ev3 Brick, the Swiffer platform, and 3 Ev3 large motors. To make the robot work, we had to conduct many trials in order to perfect it. Now, as soon as it senses a color different from the color of the floor it will lower the Swiffer and clean. Our first trials weren't very successful due to the weight that the Swiffer it adds. This makes the robot lean on the platform and get stuck instead of moving. To solve this problem, we lowered the treads that move the robot. The other problem was that the front motor and the Swiffer would break off when the robot turns. We added a few pieces on the bottom of the robot to solve this problem. We tested this robot in all our trials (including our experiment) by spilling some water with food coloring on the floor in order to cover a specific surface area. Then, we let the robot run so it can clean the mess. In the first trial of our experiment, the robot cleaned 69 blocks. In the second trial, it cleaned 60 blocks. In the third trial, it cleaned 66 blocks. This robot was able to clean the course, but there are some limitations to it, so further experimentation needs to be done.
Systems Software (SOFT)	1191	Noah Simonsen	Do Different Apps Affect the Amount of Mobile Data Used in a Certain Period of Time?	Excessive use of data frequently occurs with cell phone use which can result in high phone bills and constant warning notifications. The objective was to determine if the use of certain apps would affect the data usage when accessed in a certain period of time. The best way to test this was to use a variety of apps for selected amounts of time. This was chosen to understand which app would accumulate the most mobile data, and in turn, understand why the overall data usage was so high. Data showed that Instagram and YouTube had relatively close numbers, however Snapchat had an average that wasn't close to the others. All of them had averages that were between the two-hundred and three-hundred megabyte range. Data that was found was all relatively consistent, with no outliers due to the fact that the same procedure was done for each app. The conclusion is that Instagram had the highest data usage because it had more to process and gather from the internet than the other apps. Knowing this fact, measures to slowly diminish the apps accumulation of data have been set. This has resulted in a lower overall cost of the phone bill, accomplishing the goal that was set from the beginning. The research time taken was completely essential to complete this goal.

Systems Software (SOFT)	1192	Audrey Sheehan	Spy-Phone	The purpose of this experiment is to see if phones are taking personal information, reading texts, listening to phone calls and sending us advertisements that relate to the things we talk about. This experiment is important because a big problem in the world right now is security and if iPhones are taking information that is not intentionally given to them. In my experiment I said a phrase in text, another one in a phone call, and another one near my phone with all the microphones off, and then checked apps for advertisements. I repeated this procedure with different phrases and with all the microphones turned on. I found that amazon took information from my text messages and created advertisements with the microphones turned on. I think my results turned out this way because it is easier to take written information, texts, and make advertisements rather then take vocal, phone call, information. It is also very possible that it is not Apple that is taking and giving away this information, it may be hackers. But, either way, we all need to more careful about what we are talking about texting with our phones.
Systems Software (SOFT)	1193	Coolsjes B. Singhvi	What is in a Tone! Sentiment and Emotion Analysis of School Email Communication Using Artificial Intelligence	Currently, approximately 76.47 million students attend K-12 schools across the US with middle schoolers (grades 6-8) making approximately 23% of this population. Middle school is the “make it or break it” period for students and the staff’s tone of communication can be instrumental in student’s success or failure. Email communication requires more emphasis on tone and words as compared to verbal communication. It also generates a massive amount of unstructured data. Textual analysis is the automated process of using Artificial Intelligence (AI) to analyze this kind of data and to get meaningful insights from the data. An AI-based system was developed to analyze the staff to student communication at a middle school. The analysis indicated that 67.12% of the communication was either Positive or Neutral on the sentiment polarity. The 60.27% of emotions conveyed in communication were Happy and Excited. However, Negative sentiment polarity was 32.88% and the Anger represented 23.29% of the emotions in the communication analyzed. STEM staff had a less positive tone in their communication than the non-STEM staff but were higher in negative communication tone. For a more in-depth analysis of the communication, a novel sentiment-emotion paired analysis was developed. This analysis showed a need for improvement in the Negative-Angry pair for all staff, which can be achieved by training, using different words and tone in emails, and a real-time system to guide users. A real-time sentiment-emotion system is proposed to help all stakeholders in middle schools to communicate more effectively with each other.
Systems Software (SOFT)	1194	Shreshth Shrivastava	Wi-C.A.R.E ,- Being There Always . Designing Patient Specific Application s for Elder Care	As America ages, it is estimated that by 2024, nearly 40% of the country's population will be over the age of 50. Although the increasing number of older adults presents many challenges, one of the most intimidating concerns focuses on health care. Studies predict that by 2025, the United States will experience a massive shortage of healthcare professionals, marked by deficits of about 155,000 physicians and 500,000 nurses. With more elderly patients requiring care and insufficient numbers of healthcare professionals to provide it, it is imperative that we find new solutions to help older adults remain healthy and happy with involvement from family members and extended families also. My project has two main parts: 1. Understanding the daily needs of elderly patients and bringing emotional care and perspective to elderly care and 2. Developing technology to bridge the gap between in-person care and helping with elderly adult’s emotional needs. Elderly care does not only mean just medications and sick care, but my project also focuses on needs of emotional care and attention. This project brings technology and emotional care together, which goes a long way in elderly care. I am building a technology that will allow older adults to listen to their grandkids schedule in their grandkid’s voices and am also working on voice-enabled devices to remind them of important daily routines. The application is being developed to address medication, daily activities, nutrition, and self-care.

Translational Medical Science (TMED)	1195	Bailey Grinsteinner	The Sunscreen of Your Dreams	The potential problem I am solving is to prevent humans from getting sunburn and potentially various skin cancers in the future. This project is important for me because when I camp in the summertime I want to protect my skin and my family's skin. I hypothesize that Neutrogena Beach Defense will protect you from sunburn the best because the label claims this sunscreen will protect you for a total of 2 hours before you will need to reapply. To complete the project I coved UV light beads with various brands of SPF 30 sunscreen. Then placed them under the UVA light for 12 minutes. I kept the amount of UVA light that comes in contact with the beads, the amount of sunscreen on the beads, and the type of beads the same. The only thing I changed was the brand of sunscreen, and I measured the brightness of the beads. While testing the different sunscreens the less color that showed on the bead the better the sunscreen protected the bead from the harmful UVA rays. In conclusion, the sunscreen that protects your skin from the harmful UVA rays is Banana Boat. This lotion had the most significant protection out of all the other beads. Skin with sun damage can sometimes lead to various skin cancers. If you use the right sunscreen to protect you, you may protect yourself in the future.