Junior Division Animal Sciences

Natalie Aerni 1-01-001

The Uses of Darkling Mealworms in Plastic Degradation

In my experiment I tested what type of polystyrene plastic can get eaten the fastest by darkling mealworms. In each container of 100 mealworms, I placed 4 grams of a type of plastic, 3 containers with styrofoam, 3 containers with Red Solo plastic, 3 containers with translucent plastic, and 3 containers with clear plastic. I found that the Styrofoam was eaten the most, when all three test groups were averaged, though the Red Solo and the translucent plastic were close behind. I came up with my idea while thinking how we can reuse or deteriorate plastic, without it sitting underground for hundreds of years. I hope to open a new door into how we will deal with the rising problem of landfills. If we apply decomposition using Ideonella sakaiensis, the bacteria in the mealworm stomachs that break down the plastic, we can help decrease the continuous flow of garbage into landfills and the ocean. If we continue filling our fields and valleys with landfills that cannot be farmed on and trees cannot grow on, what will our countryside be in 100 years? There will be large swathes of land that cannot be used for anything useful. What will our oceans look like when we allow tons of plastic to drift into them, when the toxins from the plastics kill off life, breaking food webs and causing species to become extinct?

Madison Cabot 1-01-002

Beyond the Boots

The purpose of this project was to see which boot brand kept the equines' legs the coolest. In my research I found that when equines' legs get really hot it increases their susceptibility to injury so the brand that kept their legs the coolest is what medically all equine riders should use to protect their horses from injury. I hypothesized that the brand that was least popular would keep the equines' legs the coolest. What is needed to test this is a thermometer, rider, tack, equines, and the boots. To do this have the horses with boots do a pyramid like exercise to get their heartrate up. The pyramid exercise consists of walking one lap around the arena, trotting for five minutes, loping to the left five circles, loping to the right five circles, trotting for five minutes, and then walking one lap around the arena. You have to take the equine's temperature before and after their exercise. My data showed that the most popular brand in the project, Classic Equine, kept the legs the coolest. In conclusion, my hypothesis was wrong due to one of the more preferred brands keeping the equines' legs the coolest but I enjoyed this project. I would recommend this experiment for those involved with equine science or those who own equines. If I were to do this again I would do it in warmer weather due to the freezing temperature outside it made the project more difficult than it should be, though it was a great learning experience.

Marley Eisman 1-01-003

Put One Paw in Front of the Other

The purpose of my experiment was to figure out how the number of steps varies between different sizes of dogs with different step and stride lengths when they each walk a mile. This research could help dog owners understand, that while they may be walking their dogs the same amount, one could be getting way more exercise than another. I conducted an experiment to figure this out. First, I found nine dogs of vastly varying sizes. I measured the legs of each dog to determine its size. Then, I had the owners of each dog walk the dog along twenty four feet (all at the same speed) while I filmed them in slow motion. They did this three times. Then I watched the videos and counted the steps of each dog. From there, I could average out the three tests and find the average number of steps in a mile. By comparing the results from all nine dogs, I found out that the smallest dog measured took 5,757 steps more than the largest dog measured. In conclusion, a smaller dog could be taking many more steps, and therefore get a lot more exercise, than a larger dog even if they're walking the same distance.

Lilly Figueroa 1-01-004

He? She? Is It a Matter of Degree?

The purpose of my project is to accurately determine if temperature, at conception, affects the gender of a calf. Scientific studies have been done on people and cold blooded animals proving that babies conceived at above average temperatures are more likely to be females. Those conceived at below average temperatures are more likely to be males. Knowing this information can change a rancher's timing on breeding. My procedure: Collect ten years of data from at least 35 cows on one ranch. Graph each cow's name, each calf's date of birth, approximate date of conception, actual and average temperature for the day of conception and each calf's gender. Collect the actual and average temperature from Weather Underground history. Count the number of heifers and bulls at above, below and at average temperatures to create the graphs. After 10 hours of analyzing data, I concluded my hypothesis was refuted. I made a simple linear regression graph to prove that my data was not correlated and the R squared value was not close to one. The R squared value for my heifers was .089 and my bulls resulted in .037. Additionally, the data showed that there were 8% more bulls born at above average temperatures than heifers. With a refuted hypothesis, I continue to think about what the factor affecting gender could be. My subsequent prognostication is the mother cow's age.

Arushi Munjal 1-01-005

How Changes in Temperature Affect D. Melagonaster's Reproduction, Survival and Life Cycle

Climate change has taken major toll on the environment. Seasons are arriving earlier, trees are flowering sooner, and many animals are slowly becoming extinct. Will climate change cause Drosophila Melanogaster, one of our main pollinators, to undergo severe changes in their life cycle, reproduction rate, and/or survival rate? To test this, I conducted an experiment with 60 flies (30 of each gender) in a 22°C and in a 17°C environment. I made observations regarding behavior, life cycle changes, and their ability to reproduce for 9 days. I counted the flies and pupa population in each vial (10 vials, 6 flies in each), and in each environment. My results displayed that in the warmer, 22°C environment, the average population of flies was 71.8, but the average population of flies in the cooler, 17°C environment was only 5.4. At the room temperature environment, 64.5 was the average population of the pupa, but the average in the cooler environment was 1.2. The fly and pupa population had a significant reduction in the cooler temperature. These severe changes in population were caused by the slow chemical reactions that occur in a cold- blooded animal, when the surrounding temperature is lowered. It can be predicted that areas that will experience an overall cooling trend will lose most of their vital insects. This is inevitable, unless a mutation is formed in Drosophila Melanogaster and other insects, causing their chemical reactions to fasten when put in changing environments.

Jami Jo Quick 1-01-006

Grooming's Effect on a Horse's Heart Rate

For this science experiment, the researcher wanted to figure out if grooming affects a horse's heart rate? The researcher tested each of the horses more than once. One time was grooming when the horse was resting and the other time was not grooming the horses when they were resting. To do this project, the researcher also had to know how to take the horse's pulse to figure out the heart rate. To take the horse's pulse with a stethoscope, begin by placing the stethoscope on the front left leg of the horse, behind its elbow. Then, when a heartbeat is heard, count for thirty seconds. The number of beats counted will then need to be multiplied by two to get the horse's pulse per minute. The results of this project showed that grooming affects a horse's heart rate by lowering the heart rate.

Camille Rawinski 1-01-007

I'm Sensing Bias: Does Poor Conformation in Quarter Horses affect Certain Senses?

The purposes of this project are to test Quarter Horse senses of sight, hearing, and touch in relation to their conformation and to see if horse owners are biased in any way towards their horses' conformation status. My predictions were that the senses would not be affected by conformation and that horse owners would be biased against poorly conformed horses. I tested this by developing simple physical tests for sight, hearing and touch. For each physical test, I conducted 3 trials. I found that conformation does not affect horse senses. The results of the senses tests supported my hypothesis that poor conformation does not affect senses, but typically only affects balance, comfort level and gait patterns. I also developed a survey in which the horse owner would evaluate their opinions of the horse regarding such areas as likeability, performance, and abilities. I analyzed this data in relation to how many conformation faults the horse had to determine potential bias. The results of owner bias showed a slight trend towards a bias against poorly conformed horses. In other words, the more faults a horse had, the lower they were rated by their owners. This will be very important to know for future interactions involving Quarter Horses. More people can be aware of conformation and how it may affect their horses. This will help them choose the right horse for specific purposes and also to get proper care for their horses when needed.

Jensen Renquist 1-01-008

Man's Best Friend

Dogs are man's best friend! People care for their dogs and their dog's care about them too. Your dog cares about you so much that when you go out for five minutes they will greet you like you were gone for a week. They care about you so much. What about the people who don't have dog's or the dog's that don't have a family. Dogs that are in dog shelters, people usually don't want them, because they don't know how they will act with children, other animals, and they don't know how he will act with other things, so those dogs don't have a family, or a home. The hypothesis was that we can make the tests more accurate. The hypothesis was correct yes we can more accurately make behavioral tests for animal shelters to test the dogs so that they can find new homes. The hypothesis was correct because the new test was more accurate and had better data, than their test that they do. A continuation project that would go with this project is that you can release your test to an animal shelter and have them test it on some of the new dogs that come in. Then have them test their test on the rest of the dogs that come in and see which one worked the best for the dogs. Then see if the test that you made up worked better or the test that they made worked better.

Clay Robinson 1-01-009

Bite Me NOT!! The Effectiveness of Mosquito Repellent

The purpose of this project was to determine the effectiveness of natural repellents as compared to the active ingredient found in commercial repellents (DEET). There have been many studies that show DEET works better than natural repellents. This project was to determine which essential oil, lemon, eucalyptus, and cinnamon, would work better than DEET. There were eight tests conducted, two of each oil. The tests were held in a 15 inch long tube, and one inch in diameter. The data was recorded on a piece of paper, and be marked the distance from the cotton ball in inches. The mosquitoes were captured and transferred into the testing tube. Then the cotton ball will be placed in the tube with the mosquitoes. The data was recorded every 30 seconds, for five minutes. The projects data was inconclusive due to the low number of mosquitoes in each test. The project used the same mosquitoes, but not all the same amounts. Although, the data was inconclusive the data shows an indication that the essential oil (lemon) repelled the best.

Cash Walker 1-01-010

Suffocating Shrimps?

The purpose of my project is to determine how fire ash affects the oxygen saturation in lakes and its effect on the health of Brine Shrimp. My prediction was that if I add wood ash to the water that the Brine Shrimp were living in, the oxygen saturation would decrease and the Brine Shrimp will be affected in a negative way. I left one container of water with no wood Ash, the second container with 2.5 mL of wood ash, the third container with 5 mL of wood ash, and the fourth container with 7.5 mL of wood ash. Every two hours I checked the oxygen levels, and observed the activity over the course of six hours in each jar. I checked the oxygen levels, and observed the activity over the course of six hours in each jar. After collecting all data, I graphed the results for each jar. These r-values indicated the data collected shows little to no correlation. An r-value is the validity of data for the use of trend lines. The closer the r-value is to negative one for negative correlation, and one for positive correlation the better the data would be for trend line. The r-values I collected are. 405, negative. 135, negative. 312, negative. 316. I observed that the Brine Shrimp are affected by contamination of the wood ash. The oxygen level did not correlate with the death of the Brine shrimp, so there had to of been other factors affecting their health.

Alleson Schlosky & Jillian Evans 1-01-301

Animals and Sounds

The purpose of this project was to see how animals would react to different pitched sounds. We hypothesized that the younger animal would react more than the older animal. Our hypothesis was correct. The experiment involved us playing instruments to different species/different aged animals to see how they would react. What we did was we went out to Pueblo county and Rye. We went and got our instruments out and we played loud and obnoxious but after a while of playing they started to not care. The data we collected did support the original hypothesis. For the older animals the average was 49.3, and for the younger animals the average was 50.8.These findings lead us to believe that the younger animals did not like the sounds that were put out of our instruments. The older animals also didn't like it but they had a lower reaction.

Junior Division Behavioral & Social Sciences

Chloe Bennett 1-02-001

Zen Testing

The purpose of this investigation was to determine whether meditating prior to a test enhances seventh grader memories. I hypothesized that if the time that students meditate before a test was increased, then students would achieve higher averages on their test scores. The experiment involved preparing an article/test. Students were gathered (10 per subgroup), and told what they would be doing. Then the article was given to them, and they were given up to 3 minutes to read it. After the article was collected, they were told to close their eyes and meditate for the determined amount of time (30 seconds, 1 minute). The control group did not meditate. The test was distributed. It was a 10 question, multiple choice test. After the test was taken, the students were released. I would score the test based on what they got right out of the 10 questions. The data collected did not support the original hypothesis. These findings lead to the conclusion that meditation before a test did not enhance memory. Based on the evidence, it was reasonable to conclude that the time taken to meditate before a test did not affect seventh-graders' memory. The students with 1 minute to meditate, on average had test scores of 8.05 out of 10, while the students with 30 seconds to meditate, on average had test scores of 7 out of 10, and when compared to the control, there was no statistical difference.

Anna Dery 1-02-002

Middle School in Middle Age

The purpose of this experiment was to determine how much basic Middle School knowledge adults retain and use, through the administration of an online Middle School curriculum test. Twenty-five adult participants were recruited to take the 36 question test, covering basic concepts in math, science, English language arts, and history/geography. My main hypothesis was that adults would not score better than 50% overall. Further hypotheses were made regarding passing rates based on age, gender, education level, profession and whether there was a Middle-schooler in the home. The data collected did not support the main hypothesis, with an overall 71% correct average across all test-takers. Adults did better on the math and science portion of the test, and significantly worse in history/geography across almost all sub-groups studied. As hypothesized, there was no difference between genders. Regarding age, the hypothesis that the older a participant was the less well they would do was correct for math/science. However, it was incorrect with regards to the humanities- the older group did significantly better on the humanities portion of the test. Education level attained gave an advantage, with higher levels of education correlating with better test performance. Profession seemed to provide an advantage in mathematics/science, with adults who characterized themselves as having a career in the Humanities performing no better in the Humanities than other adults. Surprisingly, having a middle schooler in the home was a disadvantage both overall and with regard to the Humanities, but did offer a small advantage in Math and Science.

Sophie Eschallier 1-02-003

Do Different Types of Exercise Yield a Greater Prize?

The purpose of my project is to determine if a certain type of exercise proves to be more beneficial to brain function. Studies have been done on whether or not exercise is beneficial at all, but very few have been done on which type of exercise is most beneficial. My procedure was fairly simple, gather 16 participants and split them into two groups. Within each of these groups, explain to the participants how to play the Set game and have them each do a practice round. Then have the participants in the first group run in place for 30 seconds and the participants in the second group do jumping jacks for the same amount of time. Then finally have both groups test on a second set round to see how many "sets" they can find in one minute. The results were intriguing, those who did jumping jacks had an average score of 50%, while those who ran in place had an average score of only 40%. I therefore refuted my hypothesis that running in place would generate the most brain benefit. The most significant uncontrolled variable was that some of the participants grasped the concept of my project more easily than others. I think that if I were to do the project again, I might use a different test or test if a certain heart rate is the key to exercise benefit.

Grace Farrell 1-02-004

Bare Your Teeth!

For my science experiment, I went once around Wash Park and once around Costco smiling, then once around neutral, to see how many people would smile back at me. My hypothesis stated that if I smile at multiple people, then they will smile back at me because when you are smiled at, your brain takes in the smile and calls it a reward. I set this experiment up by making a chart and taking a clipboard to Wash Park and going once around neutral and the second time smiling. I did the same for Costco. I found that when I smiled at the people in Wash Park or Costco, most of them smiled back. When I was at Wash Park, six people smiled while 23 did not when I was neutral. When I smiled in Wash Park, 23 smiled while three did not. At Costco, three people smiled while 23 did not when I was neutral. When I was smiling, 17 smiled while nine did not. My hypothesis was proven correct because when I smiled, the people smiled at, had a chemical reaction in their brain, meaning serotonin and other such chemicals, took in the smile, called it a reward, and made them want to smile back. My results are important because the simple act of smiling at someone has the power to make them feel happy and, or improve their mood. If people smiled more, this world could become a happier and more peaceful place.

Emilly Gonzalez 1-02-005

Eyewitness Accuracy

If similar words are used then accuracy level will change by 75%. This experiment was conducted to satisfy the curiosities of the researcher as to how easily people are fooled. This experiment took about 4 weeks to complete and 60 people took part in the experiment. The people who participated were from ages 8 to 60 and above. The results were that people were usually half and half when they had false memories or not, however the hypothesis was rejected as accuracy only changed by 7% on average.

Kaenon Gossett 1-02-006

Characters Who Are Shown Compassion

If one was asked to be more kind to an old lady or a veteran, who would they pick? How about a smartly dressed business man or a creepy looking convict? Much research has gone into the actions and emotions connected to showing compassion. The purpose of this experiment is to determine what type of people are generally shown the most compassion. The experiment will involve using selected, unidentifiable images from the internet; for example a veteran, a stranger, a grandma, or an inmate and asking human subjects as to which person they are most likely to help. According to research, the act of compassion may rest in their prefrontal cortex. The prefrontal cortex is the main source of higher order emotions and decision-making. Based on the research gathered, the hypothesis of this experiment is that the veteran will be shown the most compassion out of the inmate, well-dressed stranger, and the old lady. People generally value the service given to the veterans who have given so much to their country. In conclusion, the results did support the hypothesis, most of the human subjects surveyed chose the veteran as the one they would most likely help. That being stated, the number of human subjects that took part in the survey was probably too small for the results to be valid. Secondly, the images chosen from the internet for each "stereotypical" person may have greatly influenced the results. Lastly, the images were labeled, which probably also introduced a bias.

Josie Gundrey 1-02-007

Back Up Dude

My project is an exploration on personal space. I used twelve students, six eighth graders and six first graders three where boys and three where girls in each grade. I thought that the first grade girls would have a less amount of personal space because they haven't learned social awareness yet, and females in general because they are told to be a certain way for example usually when girls come together they usually hug but boys just high five. For my procedure I measured nine inches, eighteen inches, four feet and twelve feet. I had a subject sit on a chair on the nine inch line while I stood on the twelve foot line, as I was talking to them I would slowly get closer and closer and recorded their eye contact, posture, and facial expressions. I just use normal conversations like how their summer was or winter break was. In result the first grade girls did have a less amount of personal space I was surprised however that the eighth grade boys had the most amount of personal space even though I had known them for years. I could make this a better project by using adults as well as kids and teens or if the person testing them is a different age and gender. I learned that it is really hard working with people because everyone has a different amount of personal space.

Chloe Haerr 1-02-008

Stress Test

The purpose of this project was to determine how students of different grade and gender compare when surveyed about their current stressors and coping methods. I hypothesized that the stress level would be greatest for high school female students. This experiment involved passing out short surveys about stress levels, common stressors, coping methods, and future coping ideas to various high school and junior high students and recording and analyzing their answers. The data collected did support the original hypothesis. These findings led to the conclusion that high school females have the greatest stress level because high school females had a stress level 0.2 higher than high school males, 1.1 higher than junior high females, and 1.7 higher than junior high males. Junior high and high school students of both genders agreed that grades were their highest stressor. In junior high students, males currently cope with their stress by doing nothing specific, while females talk to a friend. High school males handle stress by playing video games, and high school females also talk to a friend. In the future, all four categories agreed that talking to a trusted adult more often would help them be more capable of coping with their stress.

Hannah Helms 1-02-009

A Ride to Remember

This experiment explores how exercise may affect your memory. The hypothesis was that exercise can increase your memory due to endorphins being released when the human body exercises. The endorphins stimulate the brain which causes it to feel joy. The endorphins could also stimulate the ability to remember information. The study design involved giving test subjects a set of words to memorize before and immediately after exercise. The exercise consisted of a pre-programmed 10 minute ride on a stationary exercise bike to achieve an elevated heart rate. Each subject's before and after exercise scores were compared. The data in the experiment shows that memory recall decreased immediately after exercise. This result could be related to the amount of stress put on the brain when exercising. When stressed, the brain is trying to provide the body with oxygen and blood. A brain under stress is distracted and cannot memorize the words as well. This information can help people know what variables they can use to improve their short term memory. For example, in standardized testing, teachers will sometimes have their kids do a quick exercise in the middle of the test. These results show that the strategy these teachers are using may not be the best thing to do in testing situations.

Kasen Hicks 1-02-010

Which Child Safe Container Is the Most Child Safe?

A problem for medicine companies around the world is choosing a container that will keep medicine safe. Many kids around the world suffer from overdose on medicine. I wanted to see, for future medicine companies, which kind of medicine container is the most child safe. Whatever container is the hardest to open for kids should be the type of container used for medicine. My hypothesis was, out of four types of child safe medicine containers, C, the line-up arrows and pop off lid would take longer for the kids to open. I predicted the kids wouldn't think to take their time to line up the arrows. I recorded the time it took for every kid to open each container. I found out my hypothesis was proven correct. My experiment showed that the most 'child safe' container is container C. The line up the arrows and pop off lid took the longest to open. Medicine companies in the future should use this type of container to hold their medicine because it is most likely to keep kids safe. If the child can't open a bottle, they will come to their parent for help opening it. This will keep the kid from opening a bottle and taking medicine they shouldn't. In the future, medicine companies could create containers that involve mental ability, like a puzzle, instead of physical ability. This could help the elderly or people with arthritis who don't have the physical ability to open certain containers.

Karsen Jorgensen 1-02-011

Brainbow

This project was about how accurately people could analyze confusing information with colors and words within a certain time period. My hypothesis stated that if I changed the color of text, background, and the written word itself then someone would have a harder time answering a question. My question was "What color is the word written in?" This question was challenging because the different colors it sees may confuse the brain. I tested over 50 human participants using a board with multicolored notecards with names of colors, written in different colors. I covered the board for privacy and made a cheat sheet for scoring the human participants. I read the directions only once for each participant, then asked them the question and started the 30 second timer. I recorded each person's results and found that on average people only answered 16 notecards out of the total 32 available within the time allotted. Most people got at least three wrong, so on average people answered less than 50% correct out of all the notecards. Not one person got through all the notecards and only three people answered all their notecards correctly. There was a wide dispersion in the number answered. My hypothesis was supported because the results indicated that it was a confusing test. I found it interesting that participants with glasses got the highest test scores. This test is important because it demonstrates how accurately different people can answer a question about information presented in confusing manner.

Kate Kaczmarek 1-02-012

The Effect of Classical Music Tempo on Competitive Run Times

The purpose of this project was to test whether the tempo of classical music (bpm) affects a runner's 800m time (seconds). I hypothesized that if the tempo was slowed down the runners time would also increase. This experiment involved having each runner run a 400m warm up lap, stretch, run three 800m's, one with no music, one with slow music (79bpm), and one with fast music (120bpm). They then completed a cool down. The times were then averaged and inputted into a table. The data collected did support the original hypothesis. These finding lead to the conclusion that the tempo of classical music (bpm) does affect a runners 800m time. The slow music average time at 250 seconds, was the slowest average time. The fast music and no music times both averaged to 210 seconds. Therefore, it is reasonable to conclude, a slower classical music tempo did cause a slower time.

Lana Kitchen 1-02-013

How Does Social Media Affect the Grades of Students?

The purpose of my experiment was to see how social media affects students' grades. Based on my research, I hypothesized that more social media apps and time spent on social media would lower students' grades. The method I used was a randomized survey of students at Roncalli STEM Academy. Their responses were collected in an Excel spreadsheet, then the data points were used to create scatter plots. A best fit slope line was added to the charts to see the average trend in data. From my initial data collection, there was a slight decline in students' GPAs with the more social media accounts they had. There was also a slight decline in students' GPAs with the more time spent on social media a day, but the points were too scattered to argue that with confidence. With collection of more data I will be able to define the results more clearly.

Marissa Martinez 1-02-014

Can I Go to the Bathroom?

My testable question was, "Why are students using excuses to get out of class?" I tested this by handing out surveys to students and analyzing the data. I predicted that females would try to get out of class more than males. I predicted that the biggest motive for all students would be how the content is taught. I predicted that the excuse used most would be to go to the bathroom. My hypothesis was that females would try to get out of class more than males because females are sometimes involved in drama and want to meet up with friends. Overall, I hypothesized the biggest motive for students would be how the content was taught because all students have different ways they like to be taught, and if it's not how they like, they get bored. I hypothesized the excuse that will be used most would be to go to the bathroom because students want to get the most time out of class and going to the bathroom can sometimes take a while. My data showed that females are using the bathroom excuse more than males. Also that students use excuses more on Monday and more in the afternoon. Also that the biggest excuse is in fact, "can I go to the bathroom". This study is important because it can help teachers make their classes more engaging. If I were to continue this study in the future, I would then ask if the hours during the school day are too long. Is this why students cannot focus? Or ask why is that your favorite class, why do you engage better in this one than the ones you don't like? I enjoyed this project because I thought it was interesting to see the different outcomes of why students use excuses to get out of class.

Olivia Medina 1-02-015

Perfect Position!

Teachers are always getting onto students for slouching while reading or doing work, but does your reading position (sitting up straight, laying on stomach, laying on back, slouching) really affect your words per minute (wpm) read correctly? Most readers find that reading comfortably is important, but they still need good fluency. Also, some people may struggle with fluency and anything may help with improving it. My project may benefit students by improving their reading fluency with simply moving to a different reading position. Sitting up with a proper posture I believed would give students better fluency. Research on fluency was done before experimentation started. The testing began with volunteers reading expository at a 6.0 level while others tracked the amount of words read correctly. When the time was up, I had the people tracking write the results on a paper and turn it into me. The reading positions were altered throughout the stories to eliminate a repeated pattern growth. The average wpm for each position was: Slouching- 217 words, Sitting Up Straight- 214 words, Laying on Stomach- 209 words, Laying on Back- 200 words. The totals show, that the best position for reading fluency, is a slouching posture. Students or readers can still read in comfortable positions they like and they don't have to worry about sacrificing fluency. My hypothesis was rejected. This means that students can improve fluency by making sure they are in a comfortable position for reading.

Tarra Miller 1-02-016

Gender and Peer Pressure

The purpose of this experiment is to investigate the effect of peer pressure on the two genders. Teenagers generally seek friendship and popularity; when this influences a person's decision making, this becomes peer pressure. The hypothesis of this experiment is that peer pressure affects females more than males. Unfortunately, this might result in greater issues in teenage girls. In this experiment there were seven males and seven females in the experimental group and six high school students acted as the control group. The experiment is based upon the classical Asch Conformity Experiment. Three sheets of paper with four different lines presented, one line as 'X' and three lines being 'A', 'B', and 'C'. The control group consisting of high school students would participate first, potentially influencing the answers from the younger middle school subjects. The high school students were told to answer the first two sheets with the correct lines that were the same as 'X', on the first it was 'A', the second was 'B'; on the third they would answer the incorrect line to resemble 'X', the correct answer being 'A', the high school students answered 'C'. In conclusion, the results were that 5/7, 71%, of the males succumbed to peer pressure, while only 3/7, 43%, of the females succumbed to peer pressure. The results did not support the hypothesis; however, that being said, the number of test subjects could have been much greater to increase the validity of the results.

Olga Rokhlenko 1-02-017

Personality Inheritance

Many discoveries have been made in the field of psychology in the last 50 years about how the brain works and how that translates to a person's life. The goal of this study was to find if a human's personality is inherited from their parents. Through using the NERIS® type explorer and conducting a survey of parents and their children, the similarities and differences of their results will be a way to discover whether personality is inherited. The pairs of a parent and their child took the NERIS® type explorer test, and sent their results to the scientist. Their results (in pairs) were then compared in each of the five trait categories: introverted vs. extroverted, observant vs. intuitive, thinking vs. feeling, judging vs. prospecting, and assertive vs. turbulent. According to the study results, 2 reviewed traits are inherited (with more than 60% of pairs having the same results), 2 are recessively inherited (with about 48% of pairs having the same results) and 1 is not inherited. For the purposes of this study, both genetic and environmental factors contribute to inheritance, and the differentiation between them is not a purpose of this study. The study also showed that the question of if personality is inherited must be answered by individual traits, since some are inheritable, whilst others are not. The understanding of personality development can influence the field and everyday life. A person's rationale and motives come from their personality. Parents can better understand how their child's personality will likely develop.

Kaleigh Schanker 1-02-018

Have You Been Persuaded?

This experiment's purpose was to discover how negative peer pressure affects the youth mind during consequential moments of eyewitness testimony. Its hypothesis was if students are exposed to negative peer pressure when giving eyewitness testimony, then their answers and decisions will alter and be very similar to that of the peer pressure because of the psychological wish to conform. The independent variable is the presence of peer pressure and was changed by exposing participants to it as well as not. The dependent variable is the percentage of answers correct per question. In this test, the constant variables are the questions asked, the video that is shown, area test is completed in, and students applying peer pressure. The averaged results show that without peer pressure students are 46.13% correct and with peer pressure are 28.63% correct. The hypothesis was accepted because the data shows that question accuracy lessens an average of 17.5% when participants are exposed to peer pressure rather than when they are not. The overall conclusion is that incorrect peer pressure does affect eyewitness testimony negatively by a margin of slightly less than 20%. Although in serious cases this could make a substantial difference, because the average accuracy is only 46.13%, this difference is not huge. This information is beneficial on a larger scale because it provides data that could be used in a courtroom on whether or not youth eyewitness testimony is accurate when the witness has been exposed to negative peer pressure.

Negha Sethuramalingam 1-02-019

How Do You Expressing Emotions Affect How You Feel?

Are we really vulnerable to others' emotions? This experiment tested an identical question, "How do people expressing an increase in certain emotions affect how much others express and feel those same emotions?" My hypothesis was, if many people near others express a certain emotion, then the others near them will feel more comfortable and express that same emotion too. This experiment was constructed with testing Group A (control group) and Group B (experimental group). Both groups had 6 participants, and they watched 3 videos. They were a laughing compilation, a sad video surrounding cancer awareness, and a happy video about US Troops coming home. Then they would take an emotional survey which was for deceiving purposes. The experimental group was affected differently because instead of having 6 test subjects, they had 1 test subject with 5 actors that were used for all 6 of my trials. The actors' purpose was to impose the certain emotions which each video was trying to convey. Group A had an approximated average of 1.17 and Group B had an average of 3.8. Group B had a greater approximating average rating of 2.64. From this data, I can make the implication that if many people near others express a certain emotion, then the others near them will feel more comfortable and express that same emotion too. There are many people with mental disorders and depression. This could potentially be a life-changing idea to be able to mimic and feel positive emotions.

Bailey Short 1-02-020

The Power of Color

The purpose of my project was to determine which text color allows people to read the fastest. I wanted to see if it was easier to read darker or lighter words. I hypothesized that subjects will be able to read more words when they are printed in a darker color than words that are printed in a lighter color due to darker colors having a higher contrast to white paper, allowing them to stand out more. The experiment involved typing six different stories in six different colors, including black, dark blue, dark green, red, light pink, and yellow. I took 25 subjects and had them read the six stories as fast and accurate as possible. I marked how many words they read and how many words that they read incorrectly. I subtracted the amount of words missed from the amount of words read to get their overall score. The data collected didn't support my hypothesis. The light pink did the best with an average of 176.56 words per minute. Then the red ink with an average of 171.36 words per minute. Then yellow ink with an average of 169.04 words per minute. Then green with an average of 153.52 words per minute. Then black with an average of 153.44 words per minute. Blue did the worst with an average of 151.08 words per minute. These findings lead me to believe that people can actually read lighter colors faster. The light colors did very well.

Molly Stanifer 1-02-021

Musical Magic?

The purpose of my experiment was to find out which genre of music best affected the test-taking skills of 7th graders. I predicted that classical would best affect the students' math test scores. Each of my five test subjects took two similar simple algebra math tests; the first test was taken listening to classical music and the second test was taken while listening to another selected genre (pop, rock, hip-hop, country, and no music). I used Ed Sheeran for pop music, Nickelback for rock, Technotronic for hip-hop, Dixie Chicks for country, and Bach for classical. In the end, the highest test score was while listening to rock music. Therefore, my data did not support my hypothesis.

Brakelle Westphal 1-02-022

Cell Phones and Anxiety

Do cell phones make us have anxiety? The purpose of this project is to monitor subjects' heart rate after their phone goes off and they can't answer or look at it. The researcher believes that the subject will have an increased heart rate while watching the video, and not being able to answer their phone, because studies show that people get anxious when not being able to answer their phones. Human are like this because we have been raised in a society of technology, so therefore we are almost "hardwired" to get negative reactions when not answering our phones. The results showed that all the test subjects' heart rate went up on average by 7.6%.

Timothy Cardenas & Austin Cox 1-02-301

Brain Blank or Purely Productive

We live in a world where everything is fast paced and multiple things need to be done at one time (especially in school), so what better to do a project on, than multi-tasking! It is always said that females are better multi-taskers than males, so we figured we'd put it to the test with our 7th grade classmates. We had our subjects read a list of facts that we provided, while we read another list of facts to them at the same time, as well as played music in the background. After the facts were read, the subject had to recall as many of their facts that they could remember, as well the facts that we read to them. Like most, we believed the females would prove superior to the males in our challenge, and our hypothesis stated just that. However, after testing 30 subjects, our data showed that the males were more successful with our multi-tasking test, which proved our hypothesis incorrect.

Elizabeth Koenck & Aveline Hwang 1-02-302

2+8≠10

As teenagers, peer pressure impacts our daily lives everywhere. In our project, we asked how peer pressure affects classroom behavior and low-stakes decision making. We predicted that when peer pressure was a variable, students would choose a socially safe option. To test this, we asked 3 high school classes to let us conduct a mock classroom situation, similar to a Prisoner's Dilemma, where students would be asked to pick one of two numbers that could boost their grade. After this, the students were asked to complete a short, online survey. Our results showed that only 12-18% of students would choose the less socially safe option, and that there was little difference when peer pressure was and was not a variable. After conducting this experiment, we determined that we cannot support our hypothesis. Our results showed that peer pressure made little to no difference in the decision making of the high school students. However, there were many uncontrollable and unexpected variables that may have severely influenced our results. Because of this, it would be ideal to continue to survey additional participants to see if the same trends continue.

Junior Division Chemistry & Biochemistry

Jonathan Acosta-Soto 1-03-001

Can Veggie Power Outlast the Energizer Bunny?

The reason we ever did this project was to see if vegetables were the way to go truly “green” or Eco-friendly. Instead of the state wasting millions to billions of dollars and raising the tax rate to build a whole new solar, wind, or hydro power plant. What choice would you make as a governor: spend millions to be Eco-friendly or spend a couple of hundred dollars for a whole system of veggie power. Yes the fruit will go bad but will last for about a week maybe longer refrigerated. States pollute the air just to provide heat and a light source. Eco-friendly plants still cost a fortune and, for example, a cloud move in front of the sun, a solar plant will start losing power. I set out to find the most powerful, longest lasting produce and fell upon the kiwi. I thought the bigger the fruit, the bigger the electricity output. The output was determined by a standard multimeter using DC or direct current setting. After I tested all the produce, kiwi was at a whopping 24 DC! The contributions are that scientist don't have to spend two years trying to make a new renewable resource. Energy companies don’t spend millions making their own resource. The Earth has already provided us with energy, produce.

Parker Ford 1-03-002

Magnetic Oil?

Oil spills can be a dangerous thing they can affect wildlife pollute the water and make it harmful. With each oil spill it is harder to clean up and can take a long time also cost a lot of money the longer it takes to clean up an oil spill the more dangerous it gets and the more harmful it is to the marine and wildlife. I chose to do a project that helps with this subject making it more efficient and less harmful. You might think what other way is there to clean up an oil spill? Well there is a chemical called ferrofluid this is a very magnetic chemical and it is believed that if you apply ferrofluid to the area affected by oil it will pull up the oil along with the ferrofluid leaving the water. In my project I tested it by using three dishes filled with water and adding 1 drop of oil to one dish 2 drops to the second and three drops to the third and for each dish the same amount of Ferrofluid. This experiment worked after applying ferrofluid to oil the magnet was able to pull up the ferrofluid and oil.

Emma Frey 1-03-003

Black Snake

The purpose of this experiment was to test how tall the black snake homemade firework would grow, adding two different amounts of lighter fluid I tested. My hypothesis stated that if I added 10 teaspoons of lighter fluid it would grow the tallest. For this experiment I had to set a pie pan on the patio. Place 1 pound of sand in the pie pan. Then I made a small dip in the mound of sand, and soaked the dip with lighter fluid. Next I mixed 4 tablespoon of baking soda and 1 tablespoons of powdered sugar, and then placed that mixture in the dip in the mound of sand. Then I added either 5 teaspoons or 10 teaspoons of lighter fluid to the top of the pile. Lastly, I ignited the mound on fire. The data that I collected did not support my hypothesis. The total length of the snakes using five teaspoons of lighter fluid was 38.875 inches, and the total length for the ten teaspoons was 34.6875. Using five teaspoons of lighter fluid grew more by .041875 percent or 4.1875 inches. My result lead me to believe that if you use ten teaspoons of lighter fluid, then the length of your black snake firework will decrease. The amount of lighter fluid that worked the best was using five teaspoons.

Isabella Garcia 1-03-004

Certified Cookie Monster Approved

The purpose of this project to determine whether the temperature of gluten free cookie dough makes a better cookie. I hypothesized that the temperature (refrigerated/room temperature) of the cookie dough is decreased, then the taste and texture of the cookie will increase, and the gluten free cookie will receive higher taste ratings in a cookie survey. The experiment involved making a gluten free cookie dough, separating it in half and place half in the refrigerator and half on the kitchen counter. After waiting 24 hours, the cookies were served to students, whom sampled the cookies and filled out a cookie survey with questions regarding the cookies. The data collected did not support the original hypothesis. As cookies "A" was done in the oven they appeared quite dry and crummy versus when cookie "B" was done they held their muffin like shape. According to the surveys taken by 7th graders cookie "B" (room temperature) was given a higher score in both taste and texture, when compared to cookie "A" (refrigerated).

Hailey Green 1-03-005

The Effects of Salt on the Rate of Ice Melting

The purpose of this experiment was to see if Ice Melt is really the most efficient way to lower the freezing point of ice on streets. I hypothesized that there would be a more effective, less damaging way to lower the freezing point of ice with salt. I chose edible salts to compare to Ice Melt because edible salts are not as harmful to the environment which will possibly be a good change. The experiment involved making even test ice and pilot work to create equal surface area amount. In one of the tests, 23 grams of salt were placed on the test ice. The amount of water in the ramekin was measured every 30 minutes. Additional cleaning of the beaker was done after each 30 minute interval. The data collected supported my hypothesis in the surface area test, however my hypothesis was not supported in the 23 gram test. In the 23 gram test, flake kosher salt melted 98 of the 100 milliliters of tap water. I guessed that Pink Himalayan salt would do the best, which it did on the surface area test, almost completely melted. These findings lead me to believe that if we switch the type of salt we will not only have less ice on the streets and a less harmful environment.

Radhika Gupta 1-03-006

Analyzing the Effectiveness of Various Whiteboard Cleaners

The purpose of this investigation was to determine if different type of whiteboard cleaners affect the amount of residue left on the whiteboard. I hypothesize that Expo had more residue left on the whiteboard compared to other cleaners. This experiment involved cutting 12, 6 inch by 4 inch boxes on a whiteboard size (2 feet by 3 feet) card stock and taping the card stock on the board. Then coloring the whiteboard with a dry erase marker in the boxes cut out. Then we waited 2 days for the marker to dry. Once dried, then spray the cloth with a testing cleaner and wipe away the marker with only 1 wipe. The residue left on the whiteboard was measured by a Lux Meter. The data collected did support the original hypothesis. Based on the evidence, it is reasonable to conclude that Windex was the best whiteboard cleaner because it had the highest average 'Percentage Change in Light Reflection Value'(93.61%), meaning that it left the least amount of residue on the whiteboard. 'H2O + Vinegar' solution was the cheapest alternative cleaner and was very close to Windex in performance. The average 'Percentage Change in Light Reflection Value' for Expo (the store bought cleaner) was only 62.98%.

Hailey Harris 1-03-007

Bones vs. Liquids

Have you ever thought about what liquids help your bones stay strong? My project is going to test liquids and see which one makes bones lose their strength the most. I used five liquids: milk, vinegar, pure water, detergent, and bleach. My hypothesis was I think that the bone in the milk is going to maintain its strength better than the bone in the vinegar. I think the bone in the vinegar will be able to bend. Also, the pure water will have no effect on the bone. Detergent will most likely change colors. The bleach will most likely corrode. I tested the bones at 5:00 every day for a week. I put all of the liquids in a separate container. I put the containers in the refrigerator, so the milk wouldn't spoil. Every day I got the bones out of the containers with tongs. After every time I got a bone out of a different substance I would run water under water so it wouldn't be contaminated. Every day I would take pictures after I recorded my findings in my logbook.

Adyn Jara 1-03-008

Potato Power

What type of potato (room temperature, frozen, microwaved) will produce enough electricity to power a digital clock the longest? The digital clock was tested on Russett potatoes under three different conditions. The first potato tested was at room temperature. Results of this experiment produced enough electricity to power the digital clock for over one hour six minutes and thirteen seconds. The second trial lasted for 24 hours 28 minutes 53 seconds. For the last trial for the room temperature potato it lasted for 22 hours 2 minutes 3 seconds. The second potato tested was microwaved for three minutes. Resulting in producing one hour two minutes and twenty-three seconds of electricity powering the digital clock. The second trial lasted for 74 hours 5 minutes and 3 seconds. Potato number three was a frozen potato that was placed in the freezer overnight. This resulted in the digital clock being powered for one hour one minute and twenty seconds. The last trial lasted for 74 hours 10 minutes 33 seconds This experiment does not support my hypothesis. The microwave potato did not produce power longer than the room temperature potato. However, some could look at this experiment having inconclusive results based off the tiniest of difference in minutes each potato powered the digital clock.

Chris Larson 1-03-009

How Does Fabric Softener Affect the Flammability of Different Cloth?

The purpose of my project was to find out if fabric softener really does affect the flammability of different fabrics, or the reaction time of the fabric to the flame. I later found out that fabric softener does indeed make the flammability level increase. For my experiment I used Snuggle Exhilarations as my fabric softener. I could not find a list of the ingredients in the fabric softener. Therefore I cannot identify the culprit in the weakening of flammability levels. I learned that fabric softeners weaken the level of flame resistance, but the flame level can be restored with a single wash without fabric softener. If different fabrics are washed continuously with detergent and fabric softener, then the flame resistance will decrease, and will decrease most in 100% cotton fabrics, but flame resistance will be able to be restored after one or more washings without fabric softeners. I believe that fabric softeners will reduce the flammability of different cloth. The softener will reduce the ignition time my goal was to prove fabric softener reduces ignition time of different cloth.

Analise Minjarez 1-03-010

Lemon Volcano

The purpose of this project was to determine which fruit has the most powerful acid. For this experiment I used a lemon, lime, and orange. My hypothesis stated that the lemon would have the strongest acid. I measured the reaction of the fruits by cutting them in half and putting them in a measuring cup. I then added baking soda and dish soap to the fruit. I recorded how much foam was produced by the reaction to determine which fruit would have the strongest acid. My hypothesis was supported because the lemon produced the most foam.

Liv Moritz 1-03-011

Life in the Fast Lane

My project, Life in the Fast Lane, is designed to test which soccer snack has the most glucose. I wanted to determine which snack would be the best for a soccer game because glucose is the quickest way to get energy to the body. Out of all of my tests, Gatorade had the highest average amount of glucose.

Gitanjali Rao 1-03-012

Detection of Chemical Contaminants in Water Using Carbon Nanotube Sensors

Millions of people around the world are exposed to water containing lead and its harmful side effects. Exposure to lead, especially in children, have lasting effects to development of brain, nervous system, and organs. It is estimated that over 5000 water systems and over 10 million service lines, in US alone, have lead contamination issues. The problem is compounded by the fact that accurate and actionable detection of lead in water today is a time consuming process. My solution addresses the core issue of speedy detection of lead contamination, potentially helping people take preventative measures and maybe even save lives! It uses the latest development in nanotechnology, is easy to use, fast, accurate, inexpensive and portable. It is a portable device, and uses nanotechnology materials to detect contaminants and almost immediately provides readout on mobile phones. Carbon nanotubes are strong conductors of electricity, due to their unique shape and structure. Any resistance in the structure causes measurable drop in the flow of current. My idea is to introduce, or dope, ions of elements that have strong affinity to lead, into the nanotube structure. When introduced to lead compounds in water, the resultant reaction with the sensor causes build-up of molecules, adding resistance to electron flow and drop in current. The change in current flow is measured and mapped to proportional parts per billion scale of lead contamination levels in water. To make the reading user friendly, I added a Bluetooth attachment to my Arduino, that sends the data to mobile phones. A custom app I developed takes the PPB scale, using EPA standards, show the safety levels of their water. Based on the timing and conclusion, I intend to enhance this for other chemical contaminants in water such as mercury, arsenic and cadmium.

Pearl Soundron 1-03-013

Ions Can't Fly

Water sustains life. Its forms found on Earth—solid, liquid, and gas—serve us in many ways. We drink it to refresh us, breathe it in saunas, and use it to make ice cream. Made up of two hydrogen and one oxygen atoms, it has many attributes—minerals, solubility, pH, and electrolytes. My experiment tested how heat affects just one of these properties—pH. I tested water every 5°C starting at 10°C and ending at 40°C, to discover if, why and in what way water's pH changes when heated. My hypothesis said that the water would become more acidic. To test my hypothesis, I heated distilled chilled water from 10°- 40° C, testing the pH every 5°. I repeated this method 15 times and as I anticipated, the water became more acidic. The findings from this experiment may be easily applied in the real world: in cities, to serve users more neutral water; in the study of climate change, to anticipate climate changes' effect on the oceans; and in astronomy, to discover water on other planets. Students of science can stand in awe of God's complexity with the marvel at the surprising pH difference between hot and cold water.

Bailey Spotz 1-03-014

Which Method Makes the Softest Water?

As a teenage girl, I have noticed showering in some homes gives clean pretty hair, but other homes, the shampoo barely works. My hair is hard to rinse out and feels dirty even after I washed it. I decided to find out more. Nearly 90 percent of American homes have hard water – water containing high levels of calcium and magnesium. We think there must be so many ways to soften water, but not all live up to the standards. The methods I will be testing are an ion exchange water softener, a magnetic water softener, a water softening shower head, and distillation. I, personally, think that the ion exchange method will work. I tested this by filtering water through all the methods separately. Then I used a water softness test kit and a soap suds test to test the water hardness. My hypothesis was partially correct because the ion exchange did soften the water. The distillation method worked some, and the other two methods didn't. All in all, it's worth the money to buy a real ion exchange water softener, and the other three methods are not worth it.

Madison Tajchman 1-03-015

Water U Drinkin'?!

The purpose of my experiment was to determine if carbon water filters reduce the acidity of tap water to a safe enough level to drink? I hypothesized that the pitcher filter will perform better in decreasing the acidity of water to a safe pH level. For this experiment I simulated different pH levels that could be found in some areas of the country and world. I used water, as well as it mixed with vinegar, lemon juice, and ammonia. I filtered these four different solutions into three filters. I took the pH and saw how much the filter altered it. The faucet filter, on average, changed the pH of the solutions by 0.9. The pitcher water filter altered the pH by about 0.7. The water bottle filter had an average change of 2.1 on the pH scale. The water bottle outperformed the others because it changed the pH the most out of all the filters. This was the second most expensive filter. People around the country live in continually growing cities that cause acids of all sorts to be released into the world. These acids make its way into people's houses and water supply. Exposure to these levels of acids can cause diseases to your body. There are so many different water filters that are "supposed" to get rid of these chemicals and acids. This would allow anyone to buy a filter that could potentially save their life.

Levi Tichi 1-03-016

Fluorocarbon to Eco-Friendly

The purpose of my project was to create a unique and environmentally friendly ski wax. Most ski waxes use a substance called fluorocarbon which causes health and environment problems. If you intake too much fluorocarbons or PFC (perfluorocarbons) it can cause variations of tumors, neonatal death, and toxic effects on immune system, liver, and endocrine system. PFC's are considered to be a non-biodegradable hazardous substance and also a potent greenhouse gas. If a certain amount of C20-24 is added to a hydrocarbonated based wax, then the melting point of the wax will be lowered, allowing to create a rub on or spray on wax, because of the chemical compounds and structures of the combination of the two substances. I added a substance called C20-24 to an environmentally friendly ski wax. C20-24 is used in oil and gas companies, and is a biodegradable, non-hazardous substance. The wax that I have constructed is not only eco-friendly but it is also the only wax of its type in the world.

Analisa Vega 1-03-017

Over the Counter Medications vs. Herbal Remedies: Which Is More Potent?

My data showed that Alka Seltzer raised the pH level of the "stomach" the most. Tums raised the pH level the second most. Both herbal remedies caused a very small difference in the pH level, and did not prove to be very potent. But, the over the counter medications may have worked too well, bringing the pH of the stomach to a very basic level that is unhealthy. A healthy pH level for the stomach is 2 or 3, and the medicine brought the pH to a 5 or 6. This can cause problems in the digestion process by not allowing the stomach to break down food. And although over the counter medications are more potent than herbal remedies, they are not necessarily better in treating indigestion.

Ethan Wurman 1-03-018

Electrolysis of Salt Water Solutions

About 90% of hydrogen production is completed by fossil fuels; however, the electrolysis of water is a more environmentally-friendly process of its creation ("Hydrogen Production"). When a substance is dissolved in water, it is broken down into atoms ("6.3.2: Solubility of Ionic Compounds: Salts"). Different concentrations of sodium bicarbonate in distilled water were electrolyzed for two minutes with a 9 Volt battery to find the effects of the volume of oxygen and hydrogen gas collected in test tubes, which were collected in test tubes. The volume of oxygen and hydrogen gas changed at a constant rate. On average, the oxygen increased by 0.0584 mL/1% of sodium bicarbonate in distilled water; the volume of hydrogen increased by 0.104mL per 1% of sodium bicarbonate. The increase of the concentration of sodium bicarbonate in distilled water caused more ions in the water, increasing the conductivity of the water. Because of this, there was a constant increase in the volume of hydrogen and oxygen produced after the sodium bicarbonate solution had been electrolyzed.

Maddisun Ellithorpe & Josh Sawyer 1-03-301

Hemp . . . A Hot Topic

Have you ever wondered if there is an alternative to heat other than wood? Well hemp is the groundbreaking solution to that. My partner and I decided to test which pellet is more efficient, hemp or wood. Thousands across the nation have pellet stoves and thousands of people across the nation haven't heard about hemp. We decided to bring those two together and put it to the test. We had an aluminum can and filled it with exactly 100 mL of water. Then we put each pellet under the can and lit the pellets on fire until they burned out. The hemp pellet performed exceptionally and burned longer. The wood pellets burned faster and didn't give off as much heat. With the hemp, you won't need as many bags of it and will keep your house nice and toasty with half of what you would want to pay. The final question was do hemp pellets work better than wood pellets and we have proven that they are.

James Mars & Tyler Barnes 1-03-302

Let's Get Fired Up!

In choosing our project, we both shared a similar interest in firefighting and have close connections to firemen. This led us to a project centered on the safety of firefighters. We settled on testing fire resistant materials to determine which material is more likely to self-extinguish one ignited. We burned several pieces of fire resistant and regular clothing in a controlled environment and documented the performance of each material. Our results showed that the fire resistant clothing that was 88% cotton and 12% nylon was the fastest to self-extinguish. This study concluded that the fire resistant material containing 88% cotton and 12% nylon was the most suitable fabric to resist direct flame. If we were to use this information to fashion a new material, we would use an 88%/12% cotton and nylon blend, lined with a 100% aramid fiber.

Michael Stone & Tanner Hall 1-03-303

How Acid Affects the Rate of Corrosion

In this experiment, we decided to see the corrosion rate of steel. We used three different types of acid (vinegar and lemon juice) and distilled water as our control. Each container had the same 1 inch by 1 inch steel wool pad. After many days of observing, we concluded that vinegar corroded the most. The distilled water rusted the most but the vinegar dissolved the wool completely, the lemon juice created a new chemical called thiol, which is a sulfur, so it smelled really bad.

Veronica Wolf & Preston Schmidt 1-03-304

Different Concentrations of Vinegar Affecting the Staleness of Eggs

Before conducting the experiment, a hypothesis was needed to come up with the correct result. The hypothesis was: a higher concentration of vinegar will preserve the eggs at a faster rate and as a result, eggs will be preserved longer. In addition, because the vinegar acids decay the egg shell, but doesn't go through the membrane, will increase the strength of the membrane, so bacteria cannot affect the egg itself. During the experiment there were five containers filled with different amounts of vinegar and water. The solution were comprised of 0% vinegar (water only), 25% vinegar, 50% vinegar, 75% vinegar and 100% vinegar (no water added). To see if all the eggs were fresh before setting them in the solution, a float test was done. If the eggs floated in cold water, they were stale, and if they sank in cold water, they were fresh. After, the fresh eggs were put into the vinegar and water. During the experiment, the eggs with less vinegar became stale faster than the eggs with more vinegar. This could be seen because the eggs were tilting. When an egg tilts, this means they are getting stale because air is getting inside the eggs. After some further research about the topic, it was found that a chemical reaction that dissolves the calcium carbonate shell makes the membrane stronger.

Junior Division Earth & Space Sciences

Morgan Cragin 1-04-001

Starring Materials

Can the light of a star tell us the contents of the star? I am doing this experiment because most of space is unexplored. Depending on what we find in space can be a revolutionary change not just to our world but for our universe. It can also change or save many lives whether it is a new planet to live on or a material or gas that can cure a disease. The first step I took was figuring out which stars are best to examine and when I can observe them. On a clear night we set up the equipment to test the telescope, camera, filter, and software together by recording a star named Vega. We then calibrated the software to our camera using the Vega spectrum we captured and a reference spectrum available online. On a warm, clear night we finished examining the stars and recording their spectrums so we could analyze all the stars and come to a conclusion. Then, we examined the spectrums that we recorded using the software we found and referencing it to professional spectrums we found online to make sure we had correct spectrums to finish analyzing our data. Finally, we came to a conclusion after analyzing our data. We can determine the composition of a star by using stellar spectrography. By using spectrography we can determine the contents of a star by its spectrum. Using the Hydrogen-Balmer lines we can calibrate the spectrum of each star. After we have calibrated the spectrum with the Hydrogen-Balmer lines we can compare the absorption lines to known sets to find the other unknown elements in the star. We can later compare the absorption lines of other known elements to check for their presence in the current spectrum. By checking for each element that is likely in the star (helium, argon, calcium, etc.) we can determine the composition of a star. In conclusion, my science fair project is star spectrograph. My question is can the light of a star tell us the contents of the star? I am doing this because most of space is unexplored, and what we find in space can be a revolutionary change to our world. What we learn by exploring space can help to address problems we face today or might face in the future

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Keanu Cruz 1-04-002

Mission Filtration

The purpose of my science fair project is to find out which filtration works best using pond water. My hypothesis for this project is that the sand will filter out more of the contaminants/debris. The constant or controlled variable in my experiment are the coffee filters and pond water. The independent variables in my experiment are the types of filtration including gravel, sand, newspaper, and cotton. The dependent variable is the clarity scale. The results of this experiment were the gravel had a clarity of 4 which was murky, the sand had a clarity of 3 which was cloudy, and the newspaper had a clarity of 2 which was transparent. The results indicate that my hypothesis should not be accepted because the cotton had the best outcome. If I were to conduct this science fair project again I would use different types of filters. My project relates to the real world because there are many different types of filtration systems in the world. These systems are being utilized and improved every day for the greater good of humanity.

Serenity Foutz 1-04-003

Plants vs. Water: A Battle of Soil Erosion

Many people ask, 'What is erosion? Erosion is the wearing away of rocks, soil, dirt, and sand by wind, rushing water, or glaciers. The purpose of this experiment is to find the best vegetation that will prevent erosion. So, that leads to my question, 'Which plant out of Alfalfa, Perennial Rye or Tall Fescue would prevent erosion the best?. My hypothesis is, 'The Tall Fescue would be the best because the stems are tall and they clump together and would prevent erosion'. However, in my experiment, I found that Alfalfa was the best erosion prevention choice because the root system was long and sturdy. Along the sides of the root there were little roots branching off and would grip the soil, preventing the soil from getting swept away. The second best choice was Tall Fescue. The least efficient choice was the Perennial Rye because it didn't have a sturdy or long root system. From the data I gathered I would recommend Alfalfa for erosion prevention.

Abby Klapp 1-04-004

Surviving a Drought

Many regions of the U.S. are frequently affected by drought. During these conditions superabsorbent polymers can benefit the soil and ecosystem by absorbing up to 1,000 times their mass in liquids; over time, the polymer release the liquid into the immediate surroundings. My study examined the effects of the physical size of superabsorbent polymers on the growth of grass in drought conditions. This experiment had a control and two experimental groups consisted of 30 samples each of soil, soil with 30g saturated fine grit polymer, and soil with 30g of saturated medium grit polymer. The samples were watered every 4 days with 40 ml of water (4 cm of rainfall) until the grass was established, and then watering stopped to simulate drought conditions. While the large polymer samples exhibited greater growth and less runoff ($p < .01$) than the control, the small polymer group did not show significant difference in growth or runoff from either the control or large polymer groups. Findings from this study demonstrate that medium grit polymer will help the soil retain more moisture over time during a drought. Applications of these results can help in the agriculture business, farming, as well as everyday gardening by adding polymers to the soil admixture.

Ashlyn Rockey 1-04-005

Flow or No: Will You Grow? Water Deficit of Quinoa

Drought conditions are being experienced in areas throughout the world. It affects farmers who grow crops for human consumption worldwide. Learning to adapt to these conditions are an important part of a farmer's job. Quinoa farmers are a part of this struggle to keep crops alive. Therefore, testing different amounts of water to give a crop of Quinoa can help determine the best yield of the crop. I hypothesized that 27.63 centimeters of water was the best amount of water to give a crop of quinoa. My experiment was based on 31.19cm, 27.63cm, 23.52cm, and 19.53 centimeters of water sporadically given to a crop of quinoa. With these amounts of water, I grew a crop of quinoa that lacked production, or seed. This was due to insect pressure. I discovered which had the best potential yield, using the reproductive weight and plant population. I determined that when we watered the crop of quinoa 31.19 centimeters of water, we got the highest yield. Thus, my hypothesis wasn't supported.

Abigail Ross 1-04-006

Sunspots

This is a project about which of the two apparatus will observe the better quantity and quality of sunspots. Sunspots affect much of the world around us so it is important to know how many sunspots are on the sun. My hypothesis for this project was the Seben Reflector Telescope would observe more sunspots because of the stronger lenses. Every day for two weeks I go outside with each of the telescopes. I get a projection and mark sunspots if any. The SunGazer showed a significant amount more sunspots than the Seben Reflector Telescope. I also compared my data to two websites for SILSO and ESA websites to find the percent accuracy averages for the data. The SunGazer's percent accuracy average is 13% and 8.83% for the Seben Reflector Telescope. During the research in November and December, we had a high percentage of overcast days. The end of 2017 was also a solar minimum according to NASA websites. The Seben Reflector Telescope was modified to cast a projection of the sun. The modifications reduced the amount of light coming through the telescope. This caused the Seben Reflector Telescope to observe less sunspots. I could have used a filter but I wanted a drawn projection of the sun. Some possible improvements would be attaching a camera with a sun filter to the telescopes to reduce human error and increase the amount of light in. To conclude, this is a brief overview of my project on sunspots.

Haiyan Wang 1-04-007

Plant Growth in Varied Soil Type and Air Pressure

The Earth cannot sustain humans eternally, and the prospect of an extraterrestrial colony on Mars has become increasingly popularized recently as technology progresses. Due to restraints posed by transportation, it will be impossible to transport food to Mars as often as necessary. Therefore, a sustainable and efficient agriculture system must be developed for Martian farming, which is the basis of this experiment. Plants were grown in environments with air pressures and soil compositions that differed from the normal environment on Earth. Data about plant growth (mass and length of plants) was collected and grouped based on the environment in which the plant grew. This data was analyzed to show a relationship (or lack thereof) between a variable and the growth of plants. Based on past studies, growth of plants should be affected by such changes. At the end of the experiment, air pressure could be clearly seen affecting the mass of plants. A t-test carried out between the changes in masses of plants grown in Martian soil simulant and with the same amounts of fertilizer showed a t-test value of 0.0019, which shows that the two datasets are significantly different and therefore the growth of mass in plants are affected . This relationship and the data collected can be used to determine the ideal air pressure, amount of fertilizer, and soil type for plant growth which, if the ideal air pressure is lowered, could make Martian agriculture easier as Mars already has a significantly lower air pressure than Earth.

Julia Warnock 1-04-008

Structural Geology of the Fountain Formation in Lory State Park

Lory State Park is located in the foothills of the Rocky Mountains and is where the Paleozoic sedimentary rocks come into contact with Precambrian igneous and metamorphic rocks. The main valley of the park has igneous and metamorphic rocks on the west side and hogbacks of sandstone on the east side. The valley is underlain by the Fountain Formation which consists of siltstone, sandstone, and conglomerate. There is a hill at the parking area for the Arthur's Rock Trailhead that has some of the only rock outcrops of Fountain Formation in the valley. The geologic map does not show the geologic cause for this hill. Three simple possibilities may explain the presence of this hill. It could either be 1) a fold, 2) a fault, of 3) a difference in the resistance to erosion. The purpose of this project is to test the hypothesis that the high point in Lory State Park is caused by one or more of the three possibilities. In order to test this, I took strike and dip measurements and estimated grain size at 60 locations in the park. Out of my three initial possibilities, my data show that a combination of a fold and a fault formed the hill. This conclusion is important because knowing about the faults around Horsetooth Reservoir is crucial for safety reasons. Since Arthur's Rock is such a popular hiking destination, an improved understanding of its formation could help visitors to the park better appreciate the landscape around them.

Taylor Filler, Liliana Smith & Andrew Tamosaitis 1-04-301

Mars Survival

The purpose of this project is to show which insulator will allow the citizens of a Mars colony (hand warmers) to stay the hottest when surrounded by cold (ice) and see which insulator keeps the colonists warmest after 30 minutes. We're doing this project to possibly help cononists on Mars in some 4 years (from SpaceX) stay warm in extreme weather circumstances. While real coloinsts will have to consider more than just cotton and cardboard and more of a higher-graded insulator for their survival, this project may help them to get an idea on what variables are important for living. We hypothesized that cotton would be the best insulator. We believed that cotton would keep the hand warmers hot and the coloists safe. The data collected supported our original hypothesis because the colony that had cotton as the insulator contained the hottest hand warmers after 30 minutes. They were 100°F at activation and ended up being about 75°F after being surrounded by cold. These findings lead us to believe that a professional insulator most like cotton would keep the Mars colonists the warmest during a power outage or cold snap. Our research could help SpaceX and their journey to getting a civilization built and prepared on the red planet because without a good insulator for these colonists, results could be devastating. Due to circumstances unheard of on Earth, colonists could be risking their lives to Mars' cold and be unaware.

Junior Division Energy

River Johnson 1-05-001

The Battery of Baghdad

The purpose of this experiment was to test the efficiency of the Baghdad Battery; whether or not it worked, and if so, what size of container would work the best. The original battery was built around the Parthian period (250 B.C.E. to 250 C.E.). The existence of the Baghdad Battery was first discovered in Khujut Rabu, just outside of Baghdad in 1938. It was hypothesized that the larger the container, the larger the amount of electricity that would be created. This experiment was done using as many of the original materials as possible in order to keep the battery authentic; these materials include, Copper (anode), Iron (cathode), and Vinegar 5% (conductor). The original battery was made from a ceramic pot and sealed with an asphalt lid. For this experiment, cork board and glass jars were used. Three different sizes of glass jars were tested in this experiment; 1 ½ pint, 1 quart, and ½ gallon. The results of the experiment concluded that the most electricity, 557 mv. was created in the 1 Quart container. While the highest reading for the 1 ½ pint was 548, and the highest reading for the ½ gallon was 547 mv. The results of the experiment did not support the hypothesis but did prove that electricity can be generated. The low levels of electricity generated in this test do not support the idea that the original battery was used for lighting purposes, but more to the theory that the battery was used for electroplating metals.

Maxwell Benedict 1-05-002

The Effect of Vane Pitch on Turbine Efficiency

In 2017, 5.5 % of the United States of America's electricity was generated by wind power and by 2030 it will be over 20%. New technologies such as wind energy help us reduce reliance on fossil fuels and reduce carbon emissions. This experiment investigated the effect of vane pitch on rotational energy recovered by a turbine. A turbine was created and placed in front of a fan in order to measure the rotational energy extracted. The pitch of the turbine vanes (independent variable) were changed and the rotational energy (dependent variable) was measured. The hypothesis that the 45 degree angle would extract the most energy was disproven. The experiment proved that the 22.5 degree angle recovered the most energy. This research can help scientists and engineers design more efficient turbines to harness the most power from the wind

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Owen Doherty 1-05-003

Burn Baby Burn: The Effect of Wood Type on Heat Produced in a Wood Burning Stove

The purpose of this experiment was to determine which of three wood types readily available in Southeastern Colorado (Elm, Pinon Pine, and Cedar) burns the hottest in an enclosed wood burning stove. This is useful information for people interested in heating their homes using wood, a renewable resource. In particular, it's important to my family because we live in an off-grid, solar-powered home and 100% of our heat comes from our wood stove. Three types of wood were tested. Three trials were conducted for each type of wood. The fire temperature (°C) was measured with an infrared thermometer on two locations on the wood burning stove before being lit, every 30 minutes for 3 hours, and then again at 6:00 a.m. the next morning. The cedar fires burned the hottest with the highest average temperature (M=246°C). Pinon pine was similar to cedar (M=235°C). The elm fires had the lowest average temperature (M=203°C). Mean Absolute Deviation (MAD)=17. At 6:00 a.m. the next morning the average temperature of the residual elm fire was 75°C, the pinon pine fire was 54°C, and the cedar fire was 72°C. The wood type did affect the temperature of the fire. This experiment showed that cedar fires burned the hottest followed by pinon pine. The elm fires had the lowest average temperature, although the residual heat in the wood burning stove was highest the following morning. Data trials are ongoing to confirm the trend.

Mohamed Ibrahim 1-05-004

Influencing Electricity Output of MFCs Using Electron Acceptors

Microbial fuel cells (MFCs) have the potential of providing a reliable, alternative energy source. The purpose of the investigation was to determine if the combination of electron acceptors potassium ferricyanide and potassium permanganate would influence the electrical output of MFCs. A total of 4 - 2-chamber MFCs connected by a proton exchange membrane were constructed with the following cathode mixtures in an aerobic environment: 1) no electron acceptors (control), 2) potassium permanganate electron acceptor (control), 3) potassium ferricyanide electron acceptor (control), and 4) combination of potassium permanganate and potassium ferricyanide electron acceptors (experimental). Each anode contained South Platte River benthic zone sediment contained in an anaerobic environment. The experimentation lasted a total of eight days where the electrical output measured in volts was collected every 24 hours from each MFC. The Experimental MFC had an average daily output of 1.33 volts. Control 1, which had no electron acceptors, averaged 0.13 volts after the eight days of data collection. Control 2, which had only potassium ferricyanide, had an average daily output 0.54 volts. Control 3, which had only potassium permanganate, had an average daily output of 0.84 volts. This data supports the hypothesis, and shows electron acceptor combination is a way to improve MFC electrical output. If the experiment were to be repeated, a minimum of four trials would be done to create a more accurate statistical analysis, a different choice of sealant would be used, and the length of data collection would be extended to 30 days.

Jared Ingmire 1-05-005

3D Solar

How does the shape of a solar panel affect the amount of energy produced? The purpose of this project was to determine how much energy is produced from 3 different 3D shaped solar panel in comparison to a 2D solar panel. I hypothesis that a pyramid shaped solar cell, with one edge of the pyramid facing Southeast and one facing Southwest, will produce the most power. I believe this because the pyramid will have maximum exposure to the sun as the sun rises in the East and sets in the West. The pyramid 3D shape will have the most surface area exposed to the sun throughout the day. For my procedure I used styrofoam 3D shapes and made three different design and had a flat panel as my control. Each design had 24 solar cells connected in a series. The energy produced was measured using a amperage meter with a built-in resistor and recorded. Testing was completed on three different days, with the majority of the day having full sun. The results were recorded and then entered into an Excel Spreadsheet for analysis. The pyramid produced the highest amount of power(watts) as an average from the three days of testing. My hypothesis was correct related to the pyramid producing the highest amount of energy and higher amounts than the flat control. This experiment could be used for future design of houses, commercial buildings, and possibly transportation.

Evan Morozowich 1-05-006

Solar Charging at Different Angles

My question was how does the angle of a solar panel affect its efficiency? I found out that 1998 was the warmest year on the records of climate scientists. During the 20th century, sea levels rose between 6-8 inches and that can be terrible for future time. However, solar cells are becoming more efficient, and they have been since 2009. I found that now the solar energy usage is 1%, but by 2025 it should be 10%. My hypothesis is if a solar panel is placed at 3 different angles, 0 degrees, 15 degrees, or 45 degrees, then 45 degrees will be the fastest. What I did is I got a 21 watt solar cell, umbrella, giant protractor, and a stand. I was outside for an hour and 20 minutes collecting data in a three day period. My results showed that 15 degrees worked the best. At an hour the iPod was at 85% and at an hour and 20 minutes the iPod was at 88%. In conclusion, my hypothesis was not supported. 45 degrees was a high angle, but sometimes higher isn't always better. Ways I could improve my experiment next year if I did it again, I could have the angle range closer like 15 degrees, 20 degrees, and 25 degrees. Another way is to use a light bulb at full brightness since I had problems with clouds. I learned that 15 degrees worked the best.

Zachary Mustard 1-05-007

Magnetic Energy

In today's world, no matter what type of electricity, with the exception of solar, all forms of energy generation need an electrical generator to create electricity. While there is emphasis in today's world of different types of electrical generation (i.e.: wind, hydro, nuclear, and different types of fossil fuels to make energy), one thing we can look at improving is the generator itself. My step father, while working at a power plant, explained to me that everything at a power plant was to improve efficiency of energy. While there are already many alternative forms of energy; if we can improve in the efficiency of the generator, it could be life altering. The reduction in fuel usage with an improved generator would save countless amounts of fuel. My hypothesis was that I could create an electrical generator and improve its output with minimal changes. On http://www.amasci.com/amateur/coilgen.html, I found a basic generator that I could build at home. I then made a second generator, exactly like the first, with the variable of doubling the length of winding. I built a third generator, exactly like the second, with the variable of stronger magnets. Through testing, I discovered the second generator made six times the power as the first. I also discovered the third generator made over four times the power as the second, proving my theory of improved efficiency in electrical generation.

Nikhila Narayana 1-05-008

Let It Shine: Altering the Wavelength of Bioluminescent Light to Power a Photovoltaic Cell

Bioluminescence is the emission of light by living organisms. Since this light production doesn't consume fossil fuels, can bioluminescence be harnessed to power photovoltaic cells? I used Pyrocystis fusiformis, a dinoflagellate that produces blue light when shaken. Since conventional solar cells are inefficient at absorbing blue light, and blue-light absorbing solar panels are expensive, is it possible to alter the blue light to their ideal absorption wavelength, i.e., green-yellow? I used fluorescein, which absorbs blue photons and re-emits them as green-yellow. Due to survival of only a few organisms in shipment, I simulated their bioluminescence with a blue LED of the same wavelength. I "sandwiched" a plastic bag containing fluorescein between two sheets of glass, mounted it on styrofoam, placing the LED on one side of the "sandwich" and solar panel on the other. Turning on the LED allowed the panel to absorb green light emitted by fluorescein. The glow time after being charged by blue vs. green light for each solar panel was analyzed. I concluded that fluorescein does convert the LED's blue light to green-yellow, and this green-yellow light does power a solar panel. But, blue light was more efficient than green-yellow in powering the panels, likely due to poor capture of green-yellow light, improving which has tremendous potential to increase solar panel efficiency, cutting energy costs. Further research is required to optimize green-yellow light capture. Larger volume of organisms and sodium sulphide addition to reduce fluorescein photodegradation may enhance this study and help harness this earth-friendly light.

Liliana Petrecca 1-05-009

Help for Hurricane Victims: Creating Fresh Water Using Solar Power

This project was designed to find a more efficient way to evaporate water because solar-powered desalination is not very efficient. Different colored materials were tested in absorbing sunlight to desalinate water. It was expected that black (B) would absorb more sunlight than metallic silver (A) or colorless (C) because the dark particles that made up the black paint were expected to attract the radiation from the sun more quickly than the other two materials. To perform the experiment, three desalination setups were created using plastic storage tubs, straws, funnels, cups, and plastic wrap. The design was made so the salt water in the tub would evaporate onto plastic wrap covering it and fall into a funnel, through a straw, and into a collection cup. They were left near a sunny window to absorb the sun's radiation and desalinate the water for nine days. At the end of the nine days, the amount of water in each collection cup was measured. At the end of the experiment, the hypothesis was accepted; setup (B) did collect the most fresh water. Setup (A) collected 13.59 grams of water, setup (B) collected 38.84 grams, and setup (C) collected 25.31 grams. The purpose of the project was to find a more efficient way to evaporate salt water, so victims of all the recent hurricanes can desalinate seawater and obtain fresh water faster. It is possible that the results of this project can somehow help increase the efficiency of solar powered water desalination.

Connor Takenaka 1-05-010

Energy Efficiency: The New Curve

The purpose of this project was to test if the air duct corner shape (rectangular or curved) caused a change in the wind speed. I hypothesized that the curved air duct corner would create a faster wind speed. This experiment involved using a fan, anemometer, computer interface and cut PVC pipes to measure the wind speed (meters per second). The wind speed was recorded after one minute. The data collected did support the original hypothesis. These findings lead to the conclusion that the wind speed did differ when traveling through different shaped air duct corners. The curved air duct corner was faster (1.205 meters per second) when compared to the rectangular air duct corner (0.980 meters per second); therefore, it is reasonable to conclude that when comparing different air duct corners, curved corners had a faster wind speed than rectangular corners.

Alexander Vermillion 1-05-011

Frightened Grasshopper Solar Energy

The purpose of this project was to find out if solar panels would still work efficiently even if sun was blocked. I did this by using frosted bulbs and different wattage bulbs. I hypothesized that the different wattage bulbs will affect the solar panel's efficiency because the solar panel is getting different amounts of light. The experiment involved a 25 watt, 60 watt, 100 watt, and 150 watt bulbs all frosted. A grasshopper robot that has a solar panel on the back connected to a motor. The robot would stay in a tile for different times to see how much it would move. The data collected did support the original hypothesis I had used a lamp that was 18 ½ inches away from the robot. The robot was placed in the middle of a tile square that was 5 11/16 by 5 11/16. Then I put one of the bulbs in the lamp. These findings lead me to believe that solar panels do work when the sun is blocked but not as efficiently as if the sun was not blocked.

Joshua Vu 1-05-012

Maximizing Efficiency When Generating Clean Energy

The purpose of this project was to determine which formation of wind turbines (1, 2, or 3) would generate the most energy. I hypothesized the pressure increase behind the turbines in formation three could cause the rotations per minute to be the highest. This experiment involved creating a gust of wind with a fan to move different formations of wind turbines for one minute. The rotations per minute were counted on a slow motion video of the experiment. The data collected did not support the original hypothesis. These findings led to the conclusion that the formation of wind turbines (1, 2, 3) did cause a change in rotations per minute. Formation 3 with an average of 907 rotations per minute had the highest rpm when compared to formation one (641 rpm) and formation two (463 rpm); therefore, it is reasonable to conclude that when comparing different formations of wind turbines, formation three had a higher rpm compared to other formations.

Austen McCue & Kyle Alcorn 1-05-301

Diesel Engine Economics

This was the project to find what type of diesel-type fuel that can substitute and be better than normal diesel. The goal of this project was to determine which type of diesel-type fuel receives the most economy, RPM, and voltage output. First, the production of the Biodiesel was started. After that, other fuels were acquired that were used in the project. Finally, all the fuels were tested, including Jet Fuel A, corn and sunflower biodiesel, and diesel type 1. It was found out that the jet fuel was the best fuel with respect to engine run time and RPM, and corn biodiesel was the worst fuel with respect to engine run time and RPM. Sunflower and normal biodiesel had the highest voltage readings. This project is important because if a fuel is found that creates more torque, economy, and voltage output, and the results are shared, maybe the world will start mass production of that fuel.

Junior Division Engineering

Trevor Paquin 1-06-001

Wood Splitter

In my experiment, my question was can I build a homemade wood splitter that works and how many pumps with a homemade hand pump wood splitter will it take to split different types of wood? I predicted that I could build a homemade hand pump wood splitter that works, and for the softer wood it will take 10-20 pumps from when it touches the log and for the harder wood it will take 12-20 pumps from when it touches the log to split. My procedure is to take a dolly and metal and weld it together to make a wood splitter. My results for Aspen were 18, 17, 15, 20, 21 pumps, for Oak it took 13, 10, 15, 12, 14 pumps, Pine took 11, 9, 13, 10, 12 pumps, and for Cottonwood it took 20, 22, 18, 24, 19 pumps. At the end of my experiment I accepted my hypothesis, I was able to successfully build a wood splitter and the average number of pumps were around my estimations.

Braxton Dennison 1-06-002

How Big Is Too Big?

In my experiment, my question was how I can base my project on real planes. Hypothesis was that 20 inch wing would not fly or decrease in flight. My procedure, build a box from plywood and screws, attach a dimmer light switch to the fan, put a string and something to sit the plane on. Take wrapping paper and take the paper, then cut into sizes of three inches. After you cut them glue them together. Only the amount to fill the area of the fan. Cut balsa wood for a fuselage and wings size, intervals of two. Cut a pen, take one part of the cut pen that is one inch. Glue to the fuselage. After all that is completed I put the first size of wings put it on the string turn up the fan slowly until the plane take flight record speed it took off at then turn fan down slowly until it lands then record speed it landed at take the plane of the string and repeat the process. My result are in order from 12 inch to 20 inch wings first take off 7.0 landed 5.6 second 6.2 and 5.5 third 6.5 and 6.0 fourth 7.0 and 6.3 fifth 7.5 and 6.5. My data analysis was that I accept and reject my hypothesis, 20 inch wings were decreasing in flight and I reject for not building a big enough box to test more wing sizes.

Austin Cantor 1-06-003

It's All in the Movement

Consumers of solar panels need solar panels to receive full light because it will improve energy output and lower the cost of energy. This investigation involved creating a more efficient solar panel. The essential design criteria included the following: (1) the solar panel received full sun intensity, and (2) the solar panel needed to track the sun. The prototype met all of the design criteria. The solar panel received full sun intensity throughout the duration of the tests. The solar panel did track the sun. Based on the analysis, the next prototype would have the "brain" on the top of the robot. This would make it easier to replace the batteries and make the screen more legible.

Ellie Clark 1-06-004

Smart Fabric – Microelectronic Properties of Textiles Coated with Carbon Nanotubes

Can fabric be used like a computer and/or protect sensitive electronic equipment? The purpose of this investigation was to determine if the application of a carbon nanotube (CNT) bioplastic film could impart useful microelectronic properties to a treated textile. I hypothesized that coating cotton fabric with a carbon nanotube-starch composite would enhance electrical conductance, electromagnetic interference, and static interference, with a magnitude of effect inversely related to nanotube size. This experiment involved test samples created from the combination of plasticized starch and carbon nanotubes of different sizes. Each sample was then applied as a finish to cotton fabric using the dip-dry method and then tested for electrical conductance, electromagnetic interference, and static interference. Compared to an untreated control, each of the finished fabric samples demonstrated electrical conductance with a ten-fold greater mean conductance for smaller CNT (10-20 nm) than larger CNT (50-80 nm). Treated textiles shielded an electromagnetic field with a magnitude of effect over five times greater for smaller CNT than larger CNT. Also, compared to the control, each fabric test sample exhibited static interference, but the relative magnitude of effect could not be determined due to the measurement being qualitative rather than quantitative. These findings lead me to believe that a fabric coating resulting from the combination of plasticized starch and carbon nanotubes can be engineered to confer microelectronic properties to textiles, with size-based efficiency. Applications of this technology include digital static protection, bio-sensing, and avionics- including use in military uniforms and equipment.

Nicholas Foster 1-06-005

Robotic Exoskeleton

The purpose of this engineering project was to design and build a robotic exoskeleton that would help factory/truck/shipyard workers, soldiers, elderly people, and paralyzed people by giving them a way to move faster, be agiler, and become stronger. More than 100 men and women in the United States die every day as a result of their work, according to a report from the AFL-CIO. This project could prevent over 50 deaths a day. This project could prevent over half of those deaths. This investigation involved designing, building, and testing the two prototypes against a set of criteria. The second prototype met 100% of the design criteria, even though there were some minor bugs. Based on the prototype analysis, my next prototype will have metal and 3D printed parts, better servos, better batteries, and have a more user-friendly interface.

Nicholas Huber 1-06-006

Stirling Engines: Harnessing and Utilizing Heat Energy

Stirling engines use temperature differentials to convert heat energy into usable mechanical energy. They have many applications, and can be used with nearly any heat source, making them a safe and quiet alternative to other types of engines. The question was: Can Stirling engines be used as practical machines to harness and utilize wasted heat energy? The Hypothesis was: If a gamma type Stirling engine is constructed using relatively available materials, then the Stirling engine will be a practical way to harness and utilize wasted heat energy, because the engine can produce a usable amount of work while using minimal resources. The procedure was accomplished using the engineering design process. Two gamma type Stirling engines were constructed using mainly pop cans, balloons, wire, steel wool, and cardboard. After the first engine was constructed, it was tested on various heat sources, modified, and tested again. The second engine was then built and tested, and specific results such as revolutions per minute and temperature differential were recorded. The second engine's cardboard flywheel was replaced with fan blades to prove its usefulness. The results showed that the greater the engine's temperature differential, the faster the flywheel spun. In conclusion, Stirling engines are practical machines to harness and utilize wasted heat energy, because a usable engine was constructed while using minimal resources, proving the hypothesis correct. The design of the engines could be further modified for efficiency and more tests could be conducted using different and more precise temperature variables.

Miles Johnston 1-06-007

Don't Let Charging Up Run You Down: A Study on Portable Power

My project, "Don't Let Charging Up Run You Down: A Study on Portable Power," was based on the idea that people need a way to generate power when they are in places where they can't just "plug in." If we could harness the power created by natural human motions, we could have a convenient power source anywhere. I created my prototype from a shakable wilderness flashlight that I modified by removing the casing and light so that I could attach wires to the prongs on the circuit board that previously fed power to the light bulb. The power is generated by shaking movements, which move magnets inside the flashlight tube, and the changes in the magnetic field then move electrons through the copper wire. I tested comfort during exercise by strapping the prototype to my arm, similar to the way people use an armband for their phones. I tested to see if the device's electricity generating parts would function during exercise, then measured maximum outputs by attaching the charged (post-exercise) prototype to an amp meter and a voltmeter for one hundred seconds, and analyzed the resulting data. The prototype did meet the design criteria. In future prototypes, I intend on improving my design by adding a more convenient way to not just generate power, but actually charge devices, and an easier way to make more power with less work.

Tate Schrock 1-06-008

Electronic Automated Product Dispensing

The researcher often assists in the production and packaging of a granular product to help a local business. The production line requires excessive manual labor in the handling of thousands of pounds of product every day. This problem sparked an engineering idea to refine the process by automation. A working prototype will be designed and fabricated to ultimately be scaled-up to life-size automated product dispensing. It was hypothesized that the system should have at least +/- 5 grams deviation from the weight pre-sets of 150 g, 175 g and 200 g. The basic design included adapting a load cell equipped with a HX711 module, a stepper motor powering a conveyor made from Erector Set pieces, a hopper bin made from a plastic bottle mounted on a wooden frame, Raspberry Pi equipped with a breadboard, 3 push button switches for weight pre-sets, a power supply, transistor, and a monitor, keyboard, and a mouse. The design and fabrication of an electronic automated product dispenser was successful in dispensing accurate weights of product. For 150 g dispensed, there was a 1.4 standard of deviation, the 175 g pre-set showed a 1.3 deviation, and 200 g of product dispensed demonstrated a 1.3 deviation.

Gabriel Wu 1-06-009

Magnificent Mounted Magnetic Bearings

Engineers need magnetic passive friction-less bearings because current designs are expensive, unstable, or inefficient. This investigation involved designing and building a more stable and efficient magnetic passive friction-less bearing because magnetic bearings can produce less friction than ball bearings. Therefore, there is less non-usable energy created from friction, so that people can use the saved energy to help in other areas such as housing, transportation, or food production. The essential needs for the design criteria included the following: (1) see if the only type of resistance/friction on the bearing was air resistance, (2) see if the bearings spun 100rpm or higher, and (3) make sure it only took up to 10 minutes to repair the prototype. The prototype met most of the design criteria. The second prototype spun at an average of 270rpm, 170% more than the minimum of the design criteria. The average time taken to repair was 7.5 minutes. Both prototypes did have a little rolling friction, but 99.8% of the bearing had only air resistance on it. Based on the analysis, the next prototype would have stronger magnets and be more compact. Also, it would have more layered magnets and either completely levitate or have a glass friction point. This would allow the prototype to spin faster, replace ball bearings, and be easier to use.

Gregory Mackintosh 1-06-010

BioLine: The Biodegradable Fishing Line

The composition of a fishing line affects its biodegradability and ultimately impacts the riparian environment. The design of the BioLine should be clear to blend with the environment. The BioLine must cast like a regular tippet. In order to meet these criteria, I braided white horse-tail hairs together to create three 30.5 centimeter sections and covered the strands with Knox gelatin. I then tied the sections together with blood knots to create a tippet of BioLine. To discover if the BioLine cast the same as a regular tippet and as a silk tippet, I used my design on a regular fly rod. I placed the three tippets in a small aquarium with pond water and added a filter and a lamp to simulate a natural environment. After one week, I took photographs of the tippets under a microscope. I used a scale to weigh the tippets and a caliper to measure their thickness. I continued this for eight weeks. Mid-testing, I placed each of the tippets in a rock tumbler to simulate them being thrown around in a river. In conclusion, I confirmed the silk tippet remained intact initially before degrading, while BioLine was destroyed more quickly. All lines cast the same, revealing sufficient performance. The regular tippet which is made out of monofilament showed no degradation, which negatively affects the riparian environment. BioLine maintains adequate performance while degrading completely in the natural environment.

Nico Martinez 1-06-011

Self-Folding Origami

The study of Origami can be a valuable tool in future technology development. The science of Origami can meet demands in many industries. Even though origami has been around for some time, recent studies are unlocking new frontiers in engineering. My hypothesis was that the higher the heat is from a light bulb the faster a Polymer Origami shape will transform from a two dimensional shape into a three dimensional shape. The experiments using the 250 watt light bulbs were successful. The 60 watt light bulb experiment on all three shapes was unsuccessful in self folding. This is how I gathered the data, analyzed the results and entered the information into a graph. For each experiment I placed a Origami template inside a clear plastic box. Making sure that the starting temperature was 75 degrees. Then I put a watt light bulb inside the box, 8 inches from the template. I timed how long it took for the polymer paper to self fold. Then I recorded the time and the temperature. My hypothesis was proven by my data. The heat from the 250 watt light bulbs transformed the templates from a two dimensional shape into a three dimensional shape. The 60 watt bulb did not generate enough heat to transform into a three dimensional shape. This project was a basic concept of self-folding origami using polymer paper. In a more advance model I would apply machinery to perform self-folding origami concepts.

Augustus Miller 1-06-012

Stop Horsing Around with My Hydration

Using electricity in the winter to run a tank heater to provide water for our horses is very expensive and not environmentally friendly. I wanted to design and build a solar-powered device to keep the water trough from freezing over. Knowing that moving water freezes slower than standing water, I thought if I could engineer a device to churn the water, it might keep the water from freezing. The purpose of this project was: 1) to engineer (design and build) a device powered by solar energy that will keep a water trough from freezing, and 2) to test the effectiveness of the device. The device that I engineered is called the “Agitator”. The Agitator made out of a PVC pipe with a small motor which spins a long shaft with a fan attached, is powered by a 12 volt deep cycle battery charged by solar panels. One end of the Agitator is immersed in the water and the fan churns the water, keeping it from freezing. When tested, the Agitator performed very well, keeping ice from forming as fast when compared to a trough without an Agitator. When temperatures dropped below approximately -5° Celsius, the Agitator became less effective at keeping ice from forming. Results from this project showed that my invention, the Agitator, is effective at keeping water troughs ice free if temperatures are not too cold, such as during the fall or spring.

Luke Nielsen 1-06-013

Still Sitting?

The purpose of this engineering project was to limit the amount of time people spend sitting down. According to recent studies, prolonged sitting has been linked to various health problems including chronic diseases, cancers, diabetes and early death. This investigation involved creating and programming a device that would alert someone after they had been sitting for too long. The essential design criteria included the following: (1) able to prevent people from sitting for more than 10 minutes (2) measures less than 13 centimeters (3) sensors are accurate enough to know if a subject was sitting or standing. Prototype 2 met all of the essential design criteria. Prototype 1 met an average of 96.2% of all design criteria, and prototype 2 met an average of 99.7% of all design criteria. Based on the analysis, the next prototype will have more flexible straps, and a smaller battery; this would allow the device to cut off circulation less as well as be smaller in size.

Landry Peeples 1-06-014

What Roof Shape Is the Most Resistant to a Hurricane Force Wind Simulation?

The purpose of this project was to find out which of 3 different roof shapes would hold up the best in a wind simulation. The hypothesis was that the slanted roof would have the best results. After the materials were collected, it was time to construct the buildings. They were cardboard, and had craft sticks glued vertically around the outside of them, and there were a total of 3; one for each roof type. After they were built, it was time to construct each of the roofs. The flat roof was 7 craft stick glued together with cardstock paper glued to the top. The lean to roof had a rise, with craft sticks glued slanting toward the opposite side. The Gable roof was a cardstock paper cut to length, with craft sticks glued across it as well. After the roofs were attached, it was time to test the roofs resistance to the leaf blower. After all the tests, the interpretation of the data was that the overhang/lean to roof design had the most resistance to the winds with no repairs. This information can be further used for buildings in areas with hurricane winds. There are many factors to consider when building certain roof types such as precipitation. This is one thing that can be handled by this roof type and could be a very important part of our future. When it comes to building homes in these hurricane zones, the lean to design might be one of the best types to build.

Elizabeth Petersen 1-06-015

Electricity from Heat

Everyone knows the purpose of an electric generator: to convert various kinds of energy into electricity, but has anyone ever built an electric generator that converts heat into electricity? The purpose of this STEM project was to discover an answer to this question. The answer is yes, and in this project, a replica of a thermoelectric generator was constructed. This design, though similar to others, is at a slight advantage due to the modifications made to make it easier to manage. In order to construct this device, thermoelectric plates were soldered together at the wires, glued between a hood and a bread tin, connected to a voltage regulator, and a stand for the device was constructed out of steel. It was hypothesized that the generator would be able to produce a measurable voltage that would be able to power another device. After some testing, it was confirmed that the hypothesis was correct because the completed generator did indeed have the ability to charge an iPhone. It can be concluded that this project successfully met its objectives as it functioned as predicted and confirmed the hypothesis.

Norah Quirk 1-06-016

Energy Down the Drain!

People need alternative energy because current sources (fossil fuels) create pollution which endangers life on Earth. This investigation involved creating a hydroelectric turbine as a source of renewable energy. The essential design criteria included the following: (1) 13 volts of electricity must be generated, (2) the turbine must fit inside of a 7.5 cm pipe and spin 360 degrees, and (3) the generator or voltage probe was not damaged by water. The prototype met most of the design criteria. The turbine fit in the pipe 100%, and none of the electrical equipment was damaged; however, 13 volts of electricity was not generated. Based on the analysis, the next prototype would have a larger generator with a higher voltage, and 12 blades on the turbine. This would allow the turbine to catch more water and generate more electricity.

Allison Rose 1-06-017

Maxime Lingura

People with Parkinson's Disease and Essential tremors need an improved Maddak BG2 "half covered" plastic spoon. A key feature identified from research was a spoon "fully covered" that does not spill contents when lifted from bowl and placed in the user's mouth. The design strategy was to use principles from: a) kinematic analysis and synthesis; b) tribology for reducing friction between moving parts and; c) basic science of thermoplastics. Each spoon was tested until failure occurred against six design criteria by a trained human participant simulating a Parkinson's person tremor. Pass or fail was documented at dipping in a bowl of water, moving a spoonful to mouth, and placing in mouth without spilling. The benchmark BG2 spoon passed only 10% without spilling. This demonstrated the need for a fully covered spoon. First prototypes, P1 and P2, used a first order lever with spring force to maintain closure by default. It included parts from the BG2 spoon. Although passing 50% for spilling during movement, this design failed for safety because the cover struck the user's face. Kinematic analysis ruled out a solution (Works Cited 9). The final prototype, P3, used a sliding cover with parts from the BG2 spoon attached to a pneumatic piston and passed 75% for not spilling during movement. Pressure was created by the tremoring user's manual squeeze/grip force (Works Cited 8 and 10). All spoons passed 100% for all other criteria. Prototype P3 pneumatically kept the cover over the spoon fully during movement. It demonstrated that a sliding cover was sufficient in performance to recommend as a design strategy for the next prototype.

Kyleena Lathram 1-06-018

SKHEAT

I built two designs of a heated speed suit. I wanted to build a heated speed suit because on the skill hill when alpine athletes are training and racing, we get really, really cold. If you go into the lodge to warm-up, then you are missing out on key training that could really help you in your season. This invention would make our ski day much more productive plus enjoyable when it is so cold outside. In order to develop my invention, I came up with several different materials that I could use to heat the speed suit. They ranged from heat-generating fabric to complete heating systems. I chose two different ideas to try. I mocked up two different suits to see which idea might work better. While designing the suits I had to make several changes to my design as the process went on. I went out in the cold weather and I tried the two suits on to see which one worked the best. In the end, I was able to create a speed suite that has a heating element that will keep you warm in the cold weather while you are training or racing.

Gavin Livick 1-06-019

Tail Light

My hypothesis was that if you put an energy capturing circuit in a bike seat, you can harness body heat and power a safety light. I designed a prototype bike seat that created a small amount of energy (less than 1 volt) through a temperature difference of 20 degrees Fahrenheit. I put a 90 degrees Fahrenheit pot of water on the Peltier tiles and lit three lights. To get to that point though, there was a lot of experimentation. Through that experimentation, I learned that running things in parallel can be better than running things in series. For example, when you run two Peltier tiles in series you will get the same amount of voltage if you just use one, but when you put them in parallel, you get double the power.

Anna Sundheim 1-06-020

Use It or Lose It: Using Human Waste in Adobe Construction

Knowing that the Anasazi used urine to make adobe, this project tested whether this strengthened or weakened the adobe bricks, compared to bricks made with water. Urea and salt are found in fracking fluid and urine, so the hypothesis was that those compounds would weaken the adobe. Adobe blocks were made in four different groups, one set containing garden dirt and tap water, another containing urea, water, and dirt, another containing sodium chloride, or salt, along with water and dirt, and a final group containing urea, salt, dirt, and water. Bricks were put through tests including being crushed in a vise, exposed to dripping water followed by weight compression, and dropped onto concrete. Through all the tests, the bricks made with urea held up the longest, then the bricks made with water, then the bricks made with urea and salt, and lastly, the bricks made with salt. Synthetic urine made the adobe weaker, most likely because of the salt in the urine. One possible explanation for this is that salt increases the water content in the brick, while urea helps repel water.

Neil Sury 1-06-021

Enhancing Gecko Adhesive Technology Using Micro Filter Nano Moulding and Carbon Nano-tubes

Since the majority of gecko adhesive technologies is unavailable for purchase by the general public, through my science project I sought to create/improve a reliable adhesive inspired by the gecko, by using simple affordable materials that could be replicated in a very large scale. This would be accessible to the public as well as use a process to build the gecko tape that is straight forward and one that I created at home. Could existing adhesive technology be replaced by a cheaper and more reliable gecko tape? I found that my results support the fact that “Gecko tape” could be enhanced by the effects of carbon fiber nano-tubes. The weight limits set by the control gecko tape were ether met or exceeded BY two of the three versions of the enhanced gecko tape containing carbon Nano tubes that were tested. This overall supports that pre-existing gecko adhesives can be enhanced by Carbon Nano tubes. Gecko tape itself (from my results) has proven itself to be not just a viable way for adhesion but also a beneficial one as well. My goal of using the gecko tape to rethink our modern adhesive tapes and I felt that I found a good alternative. I also found a new improvement to the design by adding Carbon Nanotubes. I found that the nanotubes helped the gecko tape perform better than the pre-existing design. Nanotubes with the nanomoulding (from a microfilter) did worse than the gecko tape control. Adding nanotubes to the gecko tape design increased its adhesion ability.

Braden Wedel 1-06-022

The Effect of Sand/Gravel Ratio on the Strength of Concrete

I performed my experiment to see how changing the ratio of sand to gravel in concrete affects its strength. This experiment is important because it should show how to produce stronger, higher quality concrete. My hypothesis was that the batch of concrete with the most sand would be the strongest. To start my experiment, I built 14’’by 2’’ by 2’’ forms. Then I mixed concrete with different ratios of sand to gravel. A month later, I broke the concrete bars with weights and recorded my results. The two batches with the least and most sand basically tied in strength, and the batch with an even ratio lost by twenty pounds. I believe that two batches tied because there was not enough difference in the ratios to make a difference in strength. Technically, my hypothesis was correct, but I was very surprised that the concrete with an even ratio lost badly, because I thought it would be second place.

Chandler Wilburn 1-06-023

What's the Deal with Two Wheels?

Drivers need vehicles that are more fuel efficient because fuel-efficient cars will be less expensive to operate, consume fewer fossil fuels, and generate less pollution than current car designs. This investigation involved creating a two-wheeled, fuel efficient vehicle. The essential design criteria included the following: (1) creating a control, standard vehicle model and testing its remaining battery power after traveling 0.25 miles; (2) testing the two-wheeled prototypes' battery power after traveling 0.25 miles; (3) testing the prototypes' resistance upon impact; and (4) testing the prototypes' reliability when traveling on uneven terrain, uphill, and for extended periods of time. The final prototype (prototype #2) met most of the design criteria. This prototype was, on average, 292% more fuel efficient than the standard vehicle model, based on battery power remaining. The prototype was consistently resistant to impact, able to drive uphill, and able to travel for long periods of time, yet not quite as consistent on uneven terrain. Based on the analysis, the next prototype will be oriented with its battery pack farther underneath the prototype instead of toward the front. This will cause the prototype to be more stable on uneven ground because it would not press its back wheel into the ground as hard.

Justin Wright 1-06-024

Propeller to the Air, Part 2

What are propellers you may ask? Propellers are screws for the sky. This is because the propeller is a circular wing, it produces thrust in a backwards direction to propeller the aircraft forward. This keeps the aircraft in the sky and moving in the forward direction. This project was based on how the different angles of blades could affect the thrust produced and the air displaced. We tested this project by setting up a testing apparatus to use different blades. Next for each blade we calculate the thrust produced using a fish scale and the air displaced using an anemometer. The angles used where 20, 30, 40, 50, 60, and 70 degrees. This project was to see if different angles affected the thrust and air displacement and if it did by how much. The 60 degree blade had an average of 2.14 pounds of thrust and 10.36 air displaced. The best angle was the 50 degree angle because it had just enough of an angle to displace air and create thrust but not so much that it slowed the whole blade down and hurt itself. The 50 degree blade had an average 3.52 pounds of thrust with an average of 10.36 mph of air displacement. During this experiment everything was kept charged so that we didn't have any variables and everything was tested the same time.

Logan Wright 1-06-025

Robotic Car Claw

The purpose of this engineering project is to design and construct a robotic color sorting car. The car will be coded using Arduino IDE language to sort two colors of flour cans lined up so the red colored cans will be sorted right and blue cans will be removed from the line and moved to the left. It is hypothesized that the experimenter will successfully construct a color sorting robot. Construction began with building the wooden base of the robot to provide a place to mount two small DC high torque motors to each wheel on either side. An Arduino Uno microprocessor will be attached to the top along with a battery pack and Radio Shack Make: It PCB Shield to allow robot modification. The researcher did in fact construct a working color-sorting robotic car that is capable of sorting blue from red cans.

Dylan Sellers 1-06-026

A Boat Built for Kicks: Using the Flutter Kick for Propulsion

The objective was to build an apparatus to quantify the thrust produced by varying dive fins. This project is important because having more efficient fins helps scuba divers conserve oxygen. Currently, consumers can only get qualitative and sometimes conflicting information on fins, based on discussions and reviews. This method doesn't provide the objective, quantitative information which is needed to make a fully informed choice. A mechanical way to measure the thrust of different fins, in the form of a boat, was designed and built using recycled materials. The boat converts the circular motion of a motor into the kicking motion of a human. To do this, a power window motor from a junkyard drives a bicycle sprocket via 3D printed adapter. A chain goes over the sprocket and is driven by the motor. The chain drives a bicycle crank with the pedals removed. Connecting rods attach where the pedals used to be. Pivot points allow them to move freely as they go up and down as the gear turns. The connecting rods then move up and down, creating a force on the legs which drives the fins. The boat provides the ability to collect thrust data, leading directly to a better way to compare fins. The tests were each conducted using a fully charged 12V battery attached to the boat. The Cressi Frog Plus' average thrust was 1.3 pounds, a significantly better thrust than next best brand's thrust of 1.16 pounds.

Junior Division Environmental Sciences

Stella Addis 1-07-001

Salty Studies

My experiment was to determine if the different levels of salt content from different oceans affect the evaporation of the ocean water. I thought that if there is more salt, it could take a longer amount of time to evaporate because salt impacts evaporation rates. I tested water from 4 different oceans and tap water. I measured the salinities and volumes using a refractometer and graduated cylinder. The data reflected that the Antarctic ocean has the highest salinity level, and lowest amount of change in volume. Tap water has the lowest salinity, and highest amount of change in volume. My hypothesis was correct, and background research helped show why my data made sense. If an ocean has a higher amount of salt, it will have a higher salinity and a lower amount of change in volume because when salt water evaporates, it has to break through all the sodium which takes longer that just freshwater evaporating. In the future, this could impact marine life because of global warming, which is continuing to happen every day.

Nickita Alexeyev 1-07-002

Is CO2 Making Earth Greener?

Carbon dioxide does not always have disadvantages, has benefits for most plants! This project tested which atmospheric gas grows a plant best: carbon dioxide or oxygen. The hypothesis states that carbon dioxide grows a plant best because a plant goes through the photosynthesis cycle by taking in carbon dioxide and light through its leaves along with water from the roots to make sugars and oxygen. The first step was to put three ivy plants and three wheatgrass plants into separate bottles and then surround each plant with oxygen or carbon dioxide, then left to grow for six days. The results concluded that the carbon dioxide filled ivy plant showed growth of 1.45 inches and the oxygen filled ivy plant only showed growth of 1.40 inches. The wheatgrass plant showed different results. The oxygen filled plant grew the best with a growth height of 7.05 inches while the plant filled with carbon dioxide only grew 0.05 inches. This project supported that a carbon dioxide atmosphere grows a plant better than an oxygen atmosphere. The plants in the bottle of carbon dioxide showed growth heights significantly higher, than the plants grown in normal air. There was little change in the wheatgrass for any atmosphere. Through this project the hype around how terrible carbon dioxide is to the atmosphere is not so bad if there were more plants to process the carbon dioxide.

Raymos Castillo 1-07-003

What Eco Friendly Insulation Is the Best?

Insulations such as fiberglass are usually put into houses. This insulation is bad for your health because it irritates your skin and it is harmful to breath. My study examined the temperature of 5 model houses with 5 different insulations. Fiberglass, Sheep's Wool, Recycled Denim, Cork, and Newspaper were put into cardboard houses to study the environmental friendliness and effectiveness of the different insulations when compared with fiberglass. First, 5 houses were made out of cardboard and then filled with the 5 different insulations. The houses were then placed outside for a total of 12 days and the temperature inside each house was recorded at 6:30 A.M. and 4:30 P.M. It was found that newspaper had the best results, and fiberglass, sheep's wool, and recycled denim performed about the same. Cork had the worst results compared to the other 4 insulation types. This study shows that there are many more options other than fiberglass to insulate one's house, and they will be just as effective as it. By conducting this experiment, one can conclude that newspaper, sheep's wool, and recycled denim are just as effective, yet more environmentally friendly than fiberglass.

Ava Warner 1-07-004

The pHoo Project: Testing Branson Soil

The goal of this experiment was to study if different types of manure and compost were added to local, clay-like soil, would the amendments affect the overall pH. It was hypothesized that the manures would add acidity to the soil because of the acids within the animal, that broke down the food. First, Branson soil, compost, fresh and old manure samples from cows, horses, and goats were collected. The following tests were conducted: the pH of plain Branson soil; the pH of the manures individually; the pH of compost; the 50/50 combinations of the different manure types and soil, and the compost and soil mixture. Four different experiments were then conducted: the cabbage juice indicator test, the vinegar test, the baking soda test, and water (the control test) which was measured with pH paper. Each of these tests were performed three times ensuring that the experiment results were consistent. The pH of plain Branson soil was 7.75. All of the manure and soil combination samples tested in the alkaline range: pH 7.5-9. The compost plus soil tested acidic: average pH 6.7. The pH levels of the manure did not have a large variation from old to fresh samples. All of the manure sample results were fairly consistent; which was not expected, therefore the hypothesis was not supported. Adding manure to the Branson soil resulted in increasing the pH by becoming more alkaline and adding compost to the soil resulted in an acidic pH.

Mikailah Feinman 1-07-005

Produced Gas Well Water: Can It Be Repurposed for Agricultural Use? Year 2

Can produced gas well water from the Raton Basin be reused for agriculture to meet the needs of both producers of natural gas and the environment? This year, this project tested to determine if produced water can support the growth of a wider variety of plants including medicago sativa, foothills mix poaceae, Hyton's medicago sativa, and agropyron cristatum. Also this project tested the chemical composition of the produced water as well as water from other sources to determine what affects the water has chemically on the plants. My hypothesis was that the water from Trinidad Lake and the produced water from the Raton Basin would support the growth of plants the best; the Trinidad Lake water and the produced water from the Raton Basin would be very rich in minerals and low in harmful chemical when tested; and the plants watered with the Trinidad Lake water and the produced water from the Raton Basin would see no negative chemical effects. To test this, I placed the seeds in mason jars and watered them using the types of water. Each day, I would record growth and would water the seeds with 70 cc's of the water. Overall, plants grown using Trinidad Lake water grew the best, then plants using produced water from the Raton Basin, then the tap water, and finally, the distilled water. Also, no harmful chemicals were found in the produced water, or the plants grown using produced water. All three parts of my hypotheses were proven correct.

Sirinya Frankel 1-07-006

The Effect of Impermeable Surfaces on Soil Biodiversity

This experiment studied the effects of the impermeable surfaces commonly used in infrastructure on soil bacterial biodiversity. Soil is one of the largest carbon reservoirs on Earth. Healthy, diverse soil has the potential to mitigate climate change. Soil samples were kept under varying conditions, intended to model real-world scenarios. Some samples were completely covered with either cold asphalt or concrete, whereas others were two-thirds covered by cold asphalt or concrete with the middle third being either completely bare soil or sod such that the impermeable surfaces were disrupted. Controls were either completely bare soil, or completely covered in sod. After two weeks of samples being under their respective conditions, the pH of each sample was measured using pH paper weekly for five weeks. The pH of each sample was used as a surrogate marker for bacterial biodiversity. Control samples with continuous sod had pH measurements closest to neutral, indicating greater biodiversity, whereas the samples completely covered with impermeable surfaces had the most acidic pH, indicating lower levels of bacterial biodiversity. Samples with a disrupted surface had an intermediate pH suggesting that the presence of sod or soil improved bacterial biodiversity. These results support my hypothesis that uninterrupted impermeable surfaces would result in decreased soil bacterial biodiversity, but this could be improved with interruptions in the surfaces with bare soil or sod. Simple actions, such as adding medians to more roads, may be taken to improve biodiversity in the soil underneath common infrastructure, which can help to mitigate climate change.

Ethan Gavin 1-07-007

A Bug's Death: A Study of Diatomaceous Earth and pesticides

The purpose of this experiment was to determine whether or not diatomaceous earth could be used as an effective insect killer to kill the tree destroying insect, the pine bark beetle. I hypothesized that the micro-fossils that the diatomaceous earth is made up of would kill the insects faster than a leading pine bark beetle pesticide, cypermethrin. This experiment involved putting mealworms into plastic containers with one cup of oatmeal inside, and adding diatomaceous earth to one container, and cypermethrin to another container with mealworms. The death rate of the mealworms was measured in days. The maximum number of days each trial could take was 14 days. The data collected did support the original hypothesis. These findings lead to the conclusion that diatomaceous earth is a more effective insect killer than cypermethrin. Diatomaceous earth, on average, had a kill rate of 5.3, while cypermethrin had an average kill rate of 3.0, making diatomaceous earth a more effective killer in a controlled environment. The range between the two insect killers is 2.3 kills, making it reasonable to conclude that diatomaceous earth is a more effective insect killer in a controlled environment.

Amber Gilmore 1-07-008

Purifying the Arkansas

My project is about purifying water from the Arkansas River. This project is important because it is very important that we know how to purify water in case you get stuck in a natural disaster. I tested water from the Arkansas River for chlorine, nitrate, phosphate, and dissolved oxygen. My hypothesis was that the boiling method of purification will be the most effective method. I thought that it would be the boiling method because when you boil water all of the bacteria in the water dies when water reaches its boiling point. For the filtration method, I built a slow sand filter and poured 500ml of water for it. For the boiling method I would pour 500ml in the pot and let it boil for 3 three minutes. For the chemical method I poured 250ml of river water in to a collection bottle and put 1 drop of bleach in the water and let it sit for 30 minutes. For the distillation method I poured 500 ml of water in to a flask and I would let all of the water evaporate in to the collection bottle on the other side of the tube. When I performed my experiments I found that the boiling method, and distillation method were the most effective. My results were partially consistent with my initial hypothesis because both the boiling and the distillation methods were the most effective .With both the boiling and distillation method the dissolved oxygen and phosphate went down.

Juno Gregg 1-07-009

The Effect of Salt on the Translucent Quality of Water

A method that identifies salinity levels in water is useful to marine biologists, helping them predict what organisms live in a certain location. A method using a small water sample in a laboratory setting is a cheaper and more time efficient that field observations. This experiment focuses on how increasing amounts of salt in distilled water affect the translucent quality of the water. The hypothesis was that as the amount of salt in the water increases, the translucent quality of water will decrease because the salt will disperse light passing through the water. This experiment was conducted by building a test apparatus that would shine light through water and use a photographic light receptor to record the foot candles received. Increments of 78.5 grams salt were added to 7.85 liters of distilled water, starting at a baseline of zero up to 235.5 grams of salt. As the salt content increased, the translucent quality decreased. At first the translucent quality decreased rapidly: there were 250.33 foot candles difference between 0% and 1% salt. As more salt was added, the translucent quality decreased at a lower more constant rate. In conclusion, as the amount of salt increased, the translucent quality of the water decreased. This method can determine baseline data points that can later be applied to water samples in the field. Applications of these findings are in water bodies, where increased salinity may result in decreased translucent quality and impact existing biomes found at varying locations in the water body.

Alex Huerta 1-07-010

To Aerate or Not to Aerate: That Is the Question?

The purpose of this investigation was to determine if different types of fertilizer (Natural, Scott's, and Fertilixir) made a difference of the permeability on grass. I hypothesized that the Fertilixir fertilizer would be best. This experiment included adding different fertilizers (natural, Scott's, and Fertilixir) to the soil and measuring the permeability. The control was no fertilizer. The permeability was measured by how many seconds it took for the water to come through the container. Based on evidence, it is reasonable to conclude that the commercial fertilizer and the Fertilixir were the best options to create a permeable lawn, because the commercial fertilizer, on average, had an increase in permeability of the soil by 3.01% when compared to the Fertilixir fertilizer, 24.69% when compared to the natural fertilizer, and 42.77% when compared to the control.

Kadence Kunselman 1-07-011

I've Got the Power, Part 2

"As yet the wind is an untamed, unharnessed force; and quite possibly one of the greatest discoveries hereafter to be made, will be taming and harnessing of it." This quote came from Abraham Lincoln during his lecture on discoveries and invention Young Men's Association of Bloomington, Illinois, April, 6, 1856. Daniel Hallaway started designing and inventing the windmill in 1854. Although he designed them in the USA they were made in China 2000 B.C. One windmill can power 500 homes. Thanks to him in the us windmills are supporting 50,000 jobs, in 2050 there will be 600,000 jobs. In this project windmills and waterwheels will be tested to see which one is better to use. That will be found out by how quickly the weight will rise. The Hypothesis was incorrect water was not as fast as air. One reason that water was not as fast as air might be because there was only two paddles which made it turn really slow. Even though the hypothesis is not correct it can help people who are wanting to use renewable energy and wondering what to switch to. Next year a project that can be tested is does the amount of paddles on a water wheel or wind turbine affect how quickly it goes.

Madison Miller 1-07-012

Well, Well, Well, What Do We Have Here?

Mining has occurred at Summitville since the 1700s. Contamination on the site from heavy metals including copper, cadmium, manganese, zinc, lead, nickel, aluminum and iron led to its designation as a Superfund Site in 1994. A Public Health Assessment (1997) reported no public health risks found in wells along the Alamosa River 20 miles below Summitville Mine. Because previous studies found that heavy metal-laden sediments have been deposited throughout the watershed, I wanted to study current well water and river water quality to determine the presence of any elevated heavy metal concentrations 21 years after the initial report. I collected water from 6 household wells and 1 from the Alamosa River and analyzed them for levels of aluminum, arsenic, iron, lead, and zinc. I hypothesized that the deeper a well and the farther it was from the river, the lower the level of heavy metals, as heavy metals would have more opportunity to leach out into the soil. I also hypothesized there would be a correlation between levels of heavy metals in the river and the levels in the wells. My results indicated that only iron levels were exceeding secondary drinking water standards (2 wells that are infrequently used). My hypothesis that deeper wells would be correlated with lower levels of heavy metals held true for iron. No other results showed any strong correlation. Important findings include the need for continued water quality monitoring and the flushing of infrequently used wells to reduce risk of high levels of iron accumulation.

Darian Rosenbloom 1-07-013

Creating Hurricanes on Bubbles

In this project I will use bubbles to demonstrate global warming's effect on storms. My question is that will global warming create stronger storms on the bubble. I believe that increasing the heat on the bubbles will increase the strength and number of storms on the bubble. I will start by placing a metal cup upside down on the stove, I will fill the basin on the bottom of the cup with water then blow a bubble on top of the water, then I will increase the heat on the cup and observe the effect on the storm systems. My results were as follows: At 225F (107C) there were strong winds and many hurricanes, also lots of colors. At 250F (120C)- Strong winds, medium sized hurricane, and good amount of color. At 275 F (135C) I noted medium winds, small hurricane, and very little color, also occasional popping. Finally at 300F (150C) I observed medium winds, medium tropical storm, and no color, also frequent popping. In conclusion my hypothesis was incorrect but still showed that global warming can have devastating effects on storm systems because heating planet causes bodies of water to disappear, also wind speeds increase, the final effect is the possibility of the atmosphere imploding.

Liam Ryan 1-07-014

H2O on the Rocks

The question being answered in this experiment is: "Do different rocks affect the clarity of filtered water?" The hypothesis for the experiment is: If a more porous rocks is used to filter dirty water, then it will clean the water better than a less porous rock. 13 ounces of soil were mixed with 12 ounces of pond water to create the water that would filtered. Four different rocks - pea gravel, volcanic rock, white marble, and slate - were used along with coffee filters, sand and activated filter carbon to filter the dirty water. The results of the twelve tests -- three for each type of rock -- proved the hypothesis correct. To test the clarity of water, pretest and posttest, a 1-10 scale was used. This scale was created by changing the amount of dirty and clear water (100% dirty and 0% clean, 90% dirty and 10% clean, 80% dirty and 20% clean, 70% dirty and 30% clean, 40% dirty and 60% clean, 50% dirty and 50% clean, etc.) The filtered water from the volcanic filter, which was the most porous, resulted in the clearest water of the four. The second clearest filtered water was the white marble, which also proved the hypothesis correct. The third clearest water was the slate and the dirtiest filtered water was the pea gravel. This was unexpected, however, as the pea gravel was the control rock.

Alexander Pabst Krammer 1-07-015

Lawnmower for Plastic: Removing Plastic from Sand on Beaches

UV light causes significant changes to occur in plastic, making the plastic release and bond with various gases. Different types of plastics were placed under a UV light with mass measurements made daily, and volume measurements made weekly. These pieces of plastic were then analyzed for change in density over time. For each plastic except polyvinyl chloride and polyethylene terephthalate, there was greater change overall for the manipulated sets of plastic than there was for the control sets. UV light induces photo-oxidation in plastics and increases the density of said plastics. Some plastic’s densities decrease naturally, and the photo-oxidation process does not change density enough to overcome that, so the density still decreases when exposed to UV light. This research could be used to determine how plastics change when undergoing photo-oxidation, and when they aren’t. We could effectively predict the changes that would occur, and adapt existing machinery that removes plastics from the ocean to remove most plastics at any or several stages of photo-oxidation, instead of one type of plastic at one stage of photo-oxidation. We could also use this data to inexpensively predict how long any piece of plastic has been in the ocean, on land, or in/on both. This would help environmental cleanup organizations to show how long plastic has been changing things for the worse, and what changes it has undergone. It would help show the harmful effects, like marine deaths, chemical emissions, and most of all, the need to stop using and producing plastics.

Phillip Hernandez & Joey Stines 1-07-301

Edible Water Bottle

The purpose of this project is so we can find a way to reduce the amount of landfill. The amount of landfill from a plastic water bottles increases each year. This is why we wanted to investigate the Edible Water Bottle to help cut down the amount of plastic water bottles. We followed the procedure to make the water bottles and wondered if we added more Sodium Alginate and Calcium Lactate the stronger and bigger the bottle would become. The procedure of the project was to add sodium alginate to a bowl with water. Then add Calcium Lactate to a different bowl with water. After, stir/blend both mixtures until completely dissolved. Wait for 20 minutes or until there are no more air bubbles. We did discover that by adding more chemicals the bigger and stronger the bottle gets. If we had more chemical then we can make more so that the amount of plastic bottles are reduced.

Junior Division Math & Computer Sciences

Barrett Aronson 1-08-001

What Is Wrong with My WiFi signal?

Understanding aspects of getting good wireless reception and what materials can physically block a WiFi signal are important in the wireless world we live in. A router is a networking device that forwards data packets between computer networks. WiFi is important because it lets us use the internet without the hassle of wires. If cardboard, aluminum foil and plastic are placed in front of a wireless router then aluminum foil will decrease the signal the most because it is the strongest. Place the wireless router in a room where there are no walls or doors interfering with the signal. Have an assistant hold the materials that are the same thickness at the very bottom corner. Measure the signal strength (dBm) using a WiFi analyzer app. The data collected shows that the readings for each material used to block the signal, including the control measured similarly each cycle it was measured. As predicted aluminum foil blocked the signal the most while plastic blocked the signal slightly less than cardboard. We use WiFi for our everyday internet connections and knowing what things could potentially block these signals is important information. By changing the material in order to block the WiFi signal the dBm readings changed for each item so the idea of materials blocking the signal strength was supported. I do not think it would be a truly significant blockage reading, only mildly different.

Dylan Boyes 1-08-002

It's a Flipping Machine

I am trying to make a wearable device that tracks my flips and spins when I ski. My expectation is to be able to see my flips and spins on my computer. This year I was trying to improve on last year's project and make the code so I can track bigger and better flips. Buy all hardware needed to run the wearable. Construct the wearable using the hardware that you got. Test the hardware to make sure it is working. Next program the software, using the app on your computer. Test the software to make sure that works right. Next test the wearable using trampolines or snow. In conclusion, I was able to successfully improve on my project and find a way to make little tricks spot big tricks. I was able to find a few new tricks along the way, despite not getting on tramps or snow. I also had to use a new method to find tricks. I would use videos of skiing and write pseudo code to match the trick. I was able to do everything but get on snow or trampolines to test this thing. The only hardware change was putting in a new battery.

Ethan Chapman 1-08-003

NASA HUNCH: ISS Location App

While astronauts are on the International Space Station (ISS) are talking with their families and other people around the world, they are sometimes asked where they are above the Earth. The problem is, the astronauts have no way of answering this question unless they have access to the cupola, which is often not available. The goal of this project was to make an app that allows astronauts on the International Space Station (ISS) to identify where they are above the Earth, as outlined in the associated NASA HUNCH Design and Prototype project. My app meets the specifications of the HUNCH project and can function as a completely self-contained app on the ISS, displaying the position on Earth directly beneath the space station and reporting the nearest city and the time of day in that city.

Leo Ge 1-08-004

How CPU Specifications Affect Performance

Computer enthusiasts are always looking for ways to save money yet get good specifications. Generally, other than the graphics card, enthusiasts put the most money into finding a processor that does not cost very expensive and provides reasonable specs for the money. To enhance the performance of their processors and to further enhance the specifications, enthusiasts also change the amount of calculations their processor can do through a process called overclocking. However, there is much disagreement in the enthusiast community about which processor or processors provide the best value for the money spent, and subsequently which specification combination is best. Many enthusiasts claim that overclocking is a worthwhile way to improve performance, but to what extent? Data from a major online processor benchmark was collected and compared to various processor metrics (such as the wattage used, or the price), and then a value winner was decided. Various other comparisons were completed to show improvements in processor design, and to show differences between manufacturers. Finally, overclocking was done on an overclockable system to find out if overclocking is worth it. The best processor for the money was found to be a processor in the cheapest budget range, from $0-$100 (with rather average specifications for its budget range), and it was discovered that overclocking made a significant difference in performance that was predictable, with a R^2 of 0.99. This relationship encourages enthusiasts to buy cheaper processors that they can overclock to have the best specs at the lowest cost.

Chance Hill 1-08-005

Combating Pick Pockets of Future

The purpose of this project was to find out which material would protect an RFID card at the closest position to a RFID reader. I hypothesized that if I tested different materials to try to protect a RFID card from being read at the closest position to a RFID reader, I will find that the copper foil will protect it the most because copper is one of the number one things used in RFID shielding wallets. The experiment involved placing a RFID reader and tag in two separate wooden boxes (to keep them stable), then taking a control test, and then placing a shielding material in between the tag and the reader. I then slowly moved the tag (covered in the shielding material) closer to the reader. As soon as the tag's reading came through on the computer, I stopped moving the tag and measured (in cm.) how far the tag was from the reader. I then subtracted the experimental test distance from the control test distance to get the difference for a more controlled reading. Whichever tag had the biggest difference was the best shielding material. The data collected did support my original hypothesis. The copper foil was the biggest difference from the control. The copper foil had an average difference of 12.53cm of three tests. This data lead me to believe that copper and aluminum are the best materials to use to keep your RFID tags & cards safe.

Gryphon Patlin 1-08-006

Drop Notice

Phone users need a faster way to know when they drop their devices because locating a phone is not reliable and costs time and energy. This investigation involved designing an app to detect falls and alert its user. It had two essential design criteria, (1) to give an alert when it was dropped from fifty to one hundred fifty centimeters, and (2) to not give an alert in a normal environment such as being carried while the user is walking or driving. The final prototype passed both design criteria. It gave an alert when dropped 93.33 percent of the time, and it never was set off in a normal environment. Based on the analysis, my next prototype would detect whether or not it was being held. This would allow for increased sensitivity which would increase its success rate when it was dropped.

Carlos Rayos 1-08-007

Fruity Controller

The purpose of my project was to see if I could build a video game controller to play online video games on my computer. I first learned how to program the Makey Makey microcontroller to create the video game controller. As I got further along I wanted to learn to program my own video game. I then went through a long process of learning to program in Scratch. I really struggled with Scratch. I watched many Youtube videos that had programs that could help me program but none of them worked and finally I found a video that would help me and I was able to program my own game. In conclusion, the language of programming was very hard for me, but now I feel like I can do it and want to program more. I think kids should learn to program video games, learning to program makes me think about video games different and empowers me to create with a computer rather than just listening or watching.

Sean Sager 1-08-008

Raspberry Pi Cluster

For my first science fair project, I built a raspberry pi supercomputer. A raspberry pi is basically a cheap as dirt computer board the size of a credit card with, I believe is a quad-core processor. I took four raspberry pi mark 3 model B's and after converting them to terminal I took the master pi and input the necessary coding to make it more of a node. I then I copied all of the information from the SD card and put it on all the other nodes (the operating system is housed on that SD card. Then I put them on their own network and put in key pairs so that they could talk independently of using putty and or passwords. Once it was evident that it worked I then used matrix multiplying software to test the effectiveness. First I tested with all 4 nodes, then with one less worker node, then one less again, until I ran it with just the master and one worker. The basis of the matrix multiplier is that the master node is given an assortment of problems via a matrix (I used 200 by 200) then the master node divides the problems into manageable chunks for each worker node and then keeps track of how much time it took for each node to complete their task. What I learned is that the cluster is working flawlessly and that I now have a vessel for future projects such as A.I or data collection for other projects. I believe that for a future project I will make an A.I like Jarvis from Iron Man. Going more in-depth on the raspberry pi's, unedited the pis have a browser, java scripts, python scripts, scratch, games, and a version of Minecraft, that all fit on a micro SD card, but I am using them for other purposes. Overall this was an awesome project and I am thankful for the opportunity to express it to others.

Kevin Smith 1-08-009

Cracking Computers

The purpose of this investigation was to test whether the raspberry pi zero w or a laptop would be able to go through a list of passwords faster. I hypothesized that the laptop would go through the list faster than the raspberry pi zero w because it had more room for a larger processor. The experiment involved setting up the raspberry pi by downloading the software on a micro SD card. There was then programming a program in Thonny. This program used mostly time, for, in, and range commands. The laptop and the raspberry pi zero w were then each tested twenty-five times generation a list of 10,000 timestamps for all 10,000 PIN combinations. The data collected did support my original hypothesis. The overall average for the laptop was 10.08 seconds. However, the raspberry pi zero w overall average was 22.47 seconds. The raspberry pi zero w took over two times the amount of time the laptop did. These findings lead me to believe that the laptop will work faster than the raspberry pi zero w. This is because due to its lack in size it doesn't have as good of a processor as the laptop.

Sheryas Sriram 1-08-010

Using Artificial Intelligence and Raspberry Pi to Monitor and Conserve Household Water Usage

With the purpose of increasing awareness towards household water over usage, the goal of this project was to design an artificial intelligence program that could predict and help conserve future water usages. Another aim was to use a Raspberry Pi microcomputer to import data from online to be used as inputs in the artificial intelligence program. To accomplish these goals, I learned about multi-layer neural networks, and soon, began developing the first edition. Meeting with local water companies helped detail plans for monitoring water usages efficiently, by attaching sensors on appliances. To maximize efficiency in the program, I updated the program's criteria as Science Fair progressed. For the first volume, the program was able to receive simple inputs of data and present predictions of future usages based on previous inputs. For the second volume, the neural network was able to take larger sets of data and was shortened to make it faster. Additionally, sensors were able to monitor water usage and track how much water various appliances and fixtures used, revealing an efficient way for the network to pinpoint ways to conserve water. Using a python program, the Raspberry Pi could import data to be used as inputs in the network. I was able to consult with artificial intelligence experts later to expand the functionalities of the program. Data showed that water usages decreased when the network targeted ways to conserve water. This experiment accomplished goals of reducing water usages, and future goals include expanding functionalities to monitor sprinkler systems.

Edward Wawrzynek 1-08-011

A Novel Approach to Authorship Attribution Using Word Vectors and Stylistic Features

Writers have distinctly different styles of writing that stay consistent across all the texts they write. Authorship attribution attempts to utilize these differences to guess the author of a document by calculating features of text and comparing them across different authors. This particular approach to authorship attribution used features of word frequency, punctuation, word and sentence length, word diversity, as well as a novel approach involving the frequency of certain types of words, as determined by groups of semantic word vectors, and tried weighting each feature in a number of different ways to increase accuracy. This method of attribution achieved accuracy of 100% on fourteen novels from seven different authors, and accuracy between 64.3% and 100% on shorter texts. In addition, there was a relationship between the frequency of grouped word vectors and authors' style, and the frequency of grouped word vectors was second in accuracy only to the frequency of certain words, indicating that the use of word vectors could be a useful tool in authorship attribution.

Peter Wilson 1-08-012

Postal Pods

Some small businesses in Colorado Springs need a place to receive mail such as Postal Annex. When a customer receives a package, an employee sends the customer a text message informing them that a package is available for pick up. However, when normal mail arrives employees do not send a text message because it is too time intensive. Sending text messages for normal mail using current methods costs too much in additional labor. Customers are not aware when normal mail arrives in their postal box. This causes two problems: 1) Customers arrive at Postal Annex only to find an empty box, and 2) A customer delays checking their box while important mail has arrived. My solution is to provide a cost effective and less time intensive way for an employee to send a text message to the customer when normal mail arrives. I accomplish this by placing a wireless button in each mailbox that is pressed each time an employee places mail in the box. The button sends a message over a wireless network with a unique MAC address that is detected by a program running on a Raspberry Pi computer. My program processes the message, looks up the customer phone number, and sends an email to an email-to-text-message gateway based on the customer's mobile carrier. A text message is then received by the customer on their mobile device. My solution is worthwhile because it provides a way for postal businesses to deliver higher levels of customer satisfaction. Customers no longer must come to their mailbox only to find no mail, and important mail can be immediately collected. Postal businesses can also gain profit by charging additional fees for the service.

Junior Division Medicine & Health

Trista Barnett 1-09-001

Now you See Me . . . Now You Don't

The purpose of this project was to test Diabetic Retinopathy to determine how it affects the way a person moves around obstacles. I hypothesized that if that if I took different test subjects and had them run through the obstacle course with simulation glasses that it would decrease their time and accuracy. It was concluded that Diabetic Retinopathy affects a person's ability to move through obstacles. Diabetic Retinopathy damages the blood vessels in the back of the retina. Neovascularization is the formation of new blood vessels in the eye. These new blood vessels are fragile and will bleed resulting in dark spots, blurriness, and eventually blackness. This can be caused from high blood sugar levels. These blood sugar levels can be controlled through the use of insulin. The insulin needs to be placed directly into the bloodstream. A person will usually insert as much as needed to get the blood sugar back under control. This obstacle course tested everything that a person with diabetic retinopathy would struggle with every day. They struggled with the dot-to-dot. This is because a person with diabetic retinopathy will see black dots in their field of vision. It is really important for all diabetics to know this information because without proper care of their blood sugar levels, it could end in a disease such as diabetic retinopathy. They should check their blood sugar levels more than one time a day using a meter, which gives answers almost automatically. This only takes a prick on the finger.

Rochelle Casey 1-09-002

Coffee Buzz, Part 2

Did you know that people consuming over 60 pounds of added sugar per year and this does not include fruit juices. In 2008 the average intake was 76.7 grams per day, which equals 19 teaspoons or 306 calories. Sugar consumption is extremely high. Current intake levels are still way too high and are a key player in making people fat and sick. The maximum amount of added sugars you should eat in a day are 7. Men should have 150 calories per day (37.5 grams or 9 teaspoons). Women should have 100 calories per day (25 grams or 6 teaspoons). Eating too much sugar causes a barrage of symptoms known as classic metabolic syndrome. The heart rates of the Daphnia increased because the amount of liquid sugar was increased because sugar turns into glucose and your body needs to move glucose out of the bloodstream and into your cells for energy. The hypothesis was also correct about the liquid caffeine because when the amount of liquid caffeine was increased then the heart rate increased also.

Emily Ciecalone 1-09-003

Sleep Tight, But Not with Blue Light

The purpose of this investigation was to find out if blue light filtering glasses improved the amount of deep sleep a person can get. I hypothesized that if a light filter (blue light, natural light) was varied, then the amount of deep sleep (time-minutes) would increase with a blue light filter. The experiment involved the participants wearing a sleep tracker for five days. Their deep sleep (time-minutes) was recorded. Then, for another five days, they wore blue light filtering glasses from 6:00 p.m. until they fell asleep. Their sleep was tracked. Their deep sleep (time-minutes) was recorded. Both deep sleep times were compared. The data collected did support the original hypothesis. These findings lead to the conclusion that a light filter did affect the deep sleep time. The blue light filtering glasses improved the amount of deep sleep a person could get because, on average, the participants got 17.7% more deep sleep with the blue light filtering glasses. Based on the evidence, it is reasonable to conclude that when comparing deep sleep times with different light filters, the blue light filtering glasses will cause a person to get more deep sleep than with natural light.

Kelly Clingan 1-09-004

Can we Prevent Concussions in Sports and Chronic traumatic Encephalopathy in Later Life?

Research was conducted to determine the effectiveness of anti-concussion headbands in preventing either concussions or Chronic Traumatic Encephalopathy (CTE) in soccer. Phase one of this project explored the effectiveness of anti-concussion headgear. While there is no accepted concussion threshold, 50-95g's of brain acceleration is commonly used in research. After completion of the first phase, numerous studies were published on CTE's in athletes, particularly soccer players, as a result of cumulative sub-concussive impacts. During phase two, the 1,300 pages of data collected in 40 impacts in phase one were reexamined and additional best/worst case calculations performed for CTE prevention. As in vivo accelerometers cost thousands of dollars, in vitro research was conducted using equipment supplied by the CSU Department of Physics. Heading Simulation for CTE Prevention: 1. A competitive soccer player kicks a soccer ball at a force plate multiple times as the control. 2. Measurements were repeated with an anti-concussion headband attached to the force plate as the variable. Head to Head Simulation for Concussion Prevention: 1. Two soccer players strike force plates together at game speed as the control. 2. Collisions were repeated with one and two anti-concussion headbands as variables. Impulse and momentum calculations indicate heading with a headband would reduce brain acceleration between 6.35 and 29%, depending upon worst and best case assumptions. In neither case would the headband prevent CTE's or concussions. While significant in moderate collisions, headbands would not prevent concussions in extreme collisions.

Ava Connelly 1-09-005

Warmth Without the Womb

The purpose of this investigation was to test different combinations of materials to discover which one holds the heat to resemble an incubator for babies born in countries without electricity. The investigation is important because premature babies need to be kept at a certain temperature and not all babies are born in hospitals or places with electricity. In Third World countries or places that have been recently impacted by natural disasters, newborn babies are affected if there is no electricity and an incubator is needed. I hypothesized that the sodium acetate reusable hand warmer with mylar insulator wrapped around it would be the best. I tested to see which combination of heat concealing materials and heat producing materials could best resemble a makeshift incubator for areas without electricity. I used both mylar and goose down as insulators and physical and chemical hand warmers to generate heat. I found that the chemical hand warmer with no insulation had the best outcome because it stayed a steady temperature, without overheating the baby. All the other combinations were too warm to be safe for an infant. My results showed that a majority of the combinations of hand warmer and insulators stayed on average of 15 degrees Celsius warmer than the average body temperature of an infant. The data did not support my hypothesis. This study could be used by the Red Cross or other such relief agencies to help parents keep their newborns warm and safe in adverse conditions.

Henry Goodnow 1-09-006

Cool Mints or Mint Cools?

The reason that I did this experiment was because I always get hot in the middle of basketball games. Since peppermint makes your mouth feel cold, I thought that maybe some kind of mint could cool down your body temperature. To test this theory I ate mint candy and leaves; I also tried applying mint oil to my wrists and temples. The body temperature when I applied the mint drops rose an average of 0.1 degrees Fahrenheit. The temperature of my body rose an average of 0.3 degrees Fahrenheit when I ate the mint candy. The temperature of my body rose an average of 1.5 degrees Fahrenheit when I ate the mint leaves. My overall average body temperature went up 0.3 degrees Fahrenheit. I think that cellular respiration caused this rise in temperature. After doing my experiment, I found out that it doesn't cool you down, it only feels like it does. This is because of a protein in the mint called transient receptor potential cation subfamily M member 8 (TRPM8) which tricks your mind into thinking your mouth is cold when really it's not. Now when I am in the middle of basketball games, I know to use ice instead of cool mints!

Layne Green 1-09-009

Homeopathics: Do They Have Antibiotic Properties?

My project was all about seeing if homeopathic medicine had the power to work as antibiotics do. I found out that it does kill the bacteria but there was no Zone of Inhibition. My hypothesis was If you place one antibiotic disk soaked in Phytolacca Decandra 30c, one soaked in Hepar Sulph 30c, and one in Belladonna 6c on bacteria then Hepar Sulph will kill the most bacteria because it has the most calcium and it is used for uses relevant to strep throat, common cold, and the flu. First, I did research on the topic and found out many interesting facts. Then, I grew the bacteria on petri dishes. Then recorded the colonies. After I diluted the homeopathics in 60 ml of water each. I put that on the bacteria using homemade antibiotic disks because my kit failed to contain them. After I recorded the amount of colonies after. I found out that my hypothesis was correct in a way but also incorrect. There was no zone of inhibition but most of the colonies were dead. In conclusion, I believe most of the colonies died in the Hepar Sulph because Hepar Sulph is used to treat infections in the back of the throat. I swabbed the back of my throat. I'm very glad to have tested on these specific homeopathics because now I know that they are the most efficient but do not work like antibiotics.

Georgia Hartley 1-09-010

Mind the Gap: The Effect of Tension on the Gaping of Sutures

When sutures don't withstand this process they gape which can lead to infection. Infections caused by suture gaping are never good for the patient and can lead to further complications. This project aimed to see which of five different methods of sutures could best withstand the process of wound healing. The five suture types were placed in fetal pig dermal tissue samples, which were then exposed to two types of force; tension and shear. After the testing was conducted and results were collected, there was sufficient data to answer the question, which of five methods of suturing will show the least gaping when exposed to force? The vertical mattress suture showed the most gaping in both tests conducted. In the test with the first type of tension, the simple running shows the least gaping and with the second type of tension, the simple interrupted showed the least gaping. This data did not support the hypothesis posed which was that the simple interrupted would show the least gaping. Instead the opposite happened, as the vertical mattress was expected to show the least gaping by an expert. Knowledge on this topic could help doctors everywhere make safer decisions for their patients. So while this project did not support the hypothesis posed it did answer an important question and offered an opportunity to further the knowledge available on wound healing.

Madison Hening 1-09-011

The Effects of Social Media and Smartphone Use on Physiological and Psychological Health

The question guiding this science fair experiment is: How are cardiovascular health, mental health, and cellular health affected by social media viewing on smartphones in adult subjects between the ages of 18 and 60? The purpose of this experiment was to inform people about potential dangers and negative health effects of smartphones and devices requiring wifi; as well as provoke further research. The hypothesis guiding this experiment was: If people between the ages of 18 and 60 watch social media for twenty minutes, then radiation will cause unhealthy blood because that's what research shows will happen; heart rate and blood pressure levels will go up because stress levels will increase; and the surveys will show less happiness because social media causes jealousy and loneliness to occur. This experiment consisted of 18 subjects taking a survey regarding happiness and anxiety; the subject's fingers being pricked twice; subject's blood pressure being taken three times; and subjects viewing their Facebook account on an smartphone for twenty minutes. The results of this experiment were partially supported by the hypothesis. The results included a decrease in happiness, very little increase in anxiety, decrease in heart rate beats per minute, a fall and rise in systolic and diastolic blood pressure, and a significant change in blood cells resulting in rouleaux formation. In conclusion, results were significant; displaying the negative psychological and physiological health effects of social media and non-ionizing radiation.

Thea Lessar 1-09-012

Ultrasound Therapy and Its Ability to Diminish

Often times when people harm a joint, it will not heal correctly. When this happens, most will use physical therapy, medicine, or other treatments that may cause more harm or not fix the problem and could be risky. A good non-invasive alternative to these treatments is ultrasound therapy. Ultrasound therapy works by sending sound waves into your deep tissue which increases the blood flow, decrease pain, and help with the healing process. Ultrasound therapy has existed for decades but has only now begun to get significant recognition. The purpose of this study was to see if the treatment was effective in treating a variety of joints. Five subjects were identified with different joint problems (knee, foot, hand, shoulder). We measured each person's pain by using the Numeric Pain Rating Scale (NPRS), which uses a number line from one to ten with one being the least pain and ten being the most pain. We asked each participant their pain level before, after, and 24 hours later. Each participant received eight treatments. Treatment results were as follows; participant A felt an average of 88% decrease in pain, participant B felt an average of 12.5% decrease, participant C felt an average of 13% decrease, participant D felt an average of 12.5% decrease, participant E felt an average of 19% decrease. The total average of decrease in pain was 31.25%. I believe that ultrasound therapy may be a very good alternative to other treatments.

Brinda Malik 1-09-013

Sleep Architecture in a Teenager

Sleep serves several important restorative functions for human body. Sleep is divided into REM and non-REM sleep that is further divided into 3 stages: N1, N2 and N3. Rapid Eye Movement (REM) sleep improves memory retention/recall of information acquired throughout the day. Stress significantly disrupts sleep continuity resulting in more time spent in N1/N2. This can lead to drowsiness and poor performance the following day. I propose, if stress is greater during school nights from school related activities, then there will be less time in the deeper stages of sleep including N3 and REM. To test my hypothesis, I had done overnight polysomnography with EEG/EOG/EMG leads on a weekday and a weekend. In contrast to my expectations, I ended up having 31% more deep sleep (REM+N3) during the middle of the week, compared to more relaxed sleep during the weekend. Interestingly though, I ended up having 14% less REM sleep during the middle of the week compared to weekend testing. I believe that I had longer duration of deep sleep because I was tired from school activities during the weekday. On the other hand, I had less REM sleep that could potentially affect my memory recall of the lessons from school. I had better REM sleep when I was relaxed on the weekend, that could potentially be useful for students such as myself if we revised school work on the weekends and could help improve our grades.

Brooklyn Martinez 1-09-014

Autoimmune Disease

Do you know someone who has an Autoimmune disease? Autoimmune diseases are fairly common, affecting more than 23.5 million people in the United States. You may have heard of some of them, such as Type 1 diabetes, Lupus, Etc. Many Autoimmune diseases are hard to understand, but they all have one thing in common, they happen in the immune system which normally fights off germs to keep us healthy. An Autoimmune disease mistakenly attacks the person's own body. In my science project, I will use M&M's and a die to make a model of the immune system in the human body and discover how a person's genetics affect whether they get an autoimmune disease or not.

Marin Masters 1-09-015

Back Off Bacteria

The purpose of this investigation was to determine whether natural antibiotics were as effective when compared to Ciprofloxacin, a pharmaceutical antibiotic with a Black Box warning, when used to kill Escherichia Coli (zone of inhibition). I hypothesized that if the antibiotic (pharmaceutical, cranberry juice, oil of oregano, MCT oil) was varied, then cranberry juice, a natural antibiotic, would be the most effective compared to Ciprofloxacin, when killing Escherichia Coli (zone of inhibition). The experiment involved growing bacteria (E. coli) and administrating antibiotics to the bacteria (Ciprofloxacin, cranberries, oil of oregano, MCT oil) in a laboratory. After the bacteria had grown for a 24 hour period the zone of inhibition was measured in centimeters. The data collected did not support the original hypothesis. These findings led to the conclusion that natural cranberry juice did not result in any measurable zone of inhibition and was not effective in killing Escherichia Coli. Oil of oregano had a zone of inhibition 2.12 cm smaller when compared to the pharmaceutical antibiotic Ciprofloxacin, and a zone of inhibition 1.02 cm larger when compared to the control. None of the natural antibiotics were as effective as Ciprofloxacin when killing Escherichia Coli.

Nathan Quagliato 1-09-016

Inherited Fingerprint Patterns

The purpose of this project is to see if there are general fingerprint pattern types that are dominant. If so, could the basic pattern types be inherited? To perform this experiment I collected fingerprints from families with several generations nearby. I classified the prints into three basic categories to find out which is the most common. I also recorded the pattern types onto family trees to see if there was any connection from one generation to the next. I found that loops are the most common, occurring 70% of the time. The whorl finger prints seem to follow a recessive inheritance pattern. If both parents have whorls, the children are likely to have the whorl pattern. If one parent does not have any whorls and the other does, the children are unlikely to have any whorl fingerprints.

Cora Schrock 1-09-017

Peroxidase Reaction Rate

The purpose of this project was to determine if dehydration and pH influence peroxidase enzymatic activity in the decomposition of hydrogen peroxide. It was originally hypothesized that the investigation would reveal negative effects of dehydration and that peroxidase will be more efficient in a neutral environment rather than an acidic or basic one. Peroxidase reaction rate was determined using a spectrophotometer to measure percent absorbance which is proportionate to solution concentration. Guaiacol served as an indicator of the reaction, binding with the oxygen produced from the decomposition of hydrogen peroxide. The peroxidase reaction rate was most efficient in a neutral environment (pH 7). Results showed that extreme dehydration (50% and above) slowed reaction rate.

Elizabeth Tayane 1-09-018

Finding Treatment for Developed Antibiotic Resistance E. coli Using Amoxicillin and Coliphage T4

E. coli can be a life threatening illness. My experiment deals with a more effective way of killing E.coli than the leading medication, amoxicillin. that Inoculate four plates. Next pull three amoxicillin disks from their holder using sterile tweezers. Leave one disk alone, then cut the second disk in half. On the third disk cut it in half then quarter one of the halves using sterile scissors. Label each plate with percentages 25%, 50%, 75%, and 100%. Then draw a straight line down half of each disk. Label one side with the word “control”. When putting disks down DO NOT put them on the “control” side. Put the amount of disk that corresponds with the percentage on each four plates. Check the cultures every day for 3-4 days. Then use a P1000 micropipette on the highest setting to create a 50% phage and 50% NaCl .9% dilution. Use a p10 micropipette on the highest setting to administer phage. Drop two drops on the control side. Then administer three drops on the other half. repeat these steps on each plate. Let coliphage culture for 4-5 days before disposal. I had quite interesting findings in in my plates. Some plates developed large, yellow, circular, disks, which I believe are resistances to the Coliphage. Coliphage did kill less E. coli than anticipated, and amoxicillin was much harder to make E. coli resistant to it than expected. Overall, contradictory to my hypothesis, amoxicillin was a more effective treatment to Escherichia coli.

Nathaniel Vercammen 1-09-019

How Flatworms are Affected by Magnetic Fields

This experiment identifies how different magnetic strengths affect reproduction and healing in flatworms. The goal of this project is to identify if magnetic fields speed up healing or slow it down. I also monitored how reproduction rates were affected by the different magnetic field strengths. If healing time is reduced we can then understand how we could apply this knowledge it to human healing. If reproduction is affected we may be able to help families that are struggling with having children. Flatworms are soft bodied invertebrates that can be cut in half and regenerate as long as there head is not injured. By monitoring the healing process after a flatworm is cut in half, I was able to show that magnets speed up healing, but too much exposure over long periods of time can slow down the healing cycle. A medium level magnetic field (5 MgOe) increased reproduction the most. Extremely strong magnetic field exposure (48 MgOe) does not help with the reproduction of flatworms but is the best environment for healing.

Natalia Wright 1-09-020

Battling Bacteria: Testing the Effectiveness of Natural Remedies on Streptococcus

The purpose of this project was to test if natural remedies (1, 2, 3, 4, 5) could eliminate the bacteria streptococcus, which is associated with strep throat, as effectively as Amoxicillin. I hypothesized that the MCT oil would kill the most bacteria. This experiment involved dipping sterile filter disks into different natural remedies (1, 2, 3, 4, 5), placing them on bacterial plates of streptococcus, and incubating them. The resulting zones of inhibition were compared to the control, Amoxicillin. The results were measured with a ruler in millimeters. The data collected did not support the original hypothesis. These findings led to the conclusion that some of the natural remedies killed the streptococcus, but none as well as Amoxicillin. The eucalyptus oil killed the most bacteria when compared to the lemon essential oil (4.8 mm), the other natural remedies, and negative control (16.1 mm); however, when compared to the Amoxicillin, the Amoxicillin had a larger zone of inhibition of 35.8 mm; therefore, based on the data, it is reasonable to conclude that when testing natural remedies against Amoxicillin, Amoxicillin killed the most streptococcus bacteria.

Parker Steckel 1-09-021

How Fresh Is That Egg?

The purpose of this study was to determine if there are accurate methods available to identify whether an egg is fresh or old when "sell by" dates are not available. Characteristics of a fresh egg include less air inside the shell, a neutral odor, a viscous albumen, and a rounded yolk. I tested three methods of determining egg freshness: the float test, candling, and plate and sniff test. I tested nine eggs, three eggs were one day old, three eggs were 41 days old, and three eggs were 50 days old. My hypothesis was that the float test would be the most accurate. The float test was 100% accurate, the candling test was only partially accurate and the plate and sniff test did not produce consistent results and was deemed inconclusive.

Vianney Escobedo Herrer 1-09-022

Worm Food

If a worm gets fed organic vs non-organic food, then the worms that ate the organic food will have increased biomass. Many people question whether organic food is actually better than non-organic food. This project was done to determine if organic food is actually more nutritious than non-organic food. A total of 60 Night crawlers (worms) were used for this experiment, 30 were fed non-organic food and the other 30 were fed organic food. The results were that the worms fed organic food reproduced more and had more biomass. These result support the hypothesis that organic food is more nutritious than non-organic food based on the results of this experiment.

Maya Monks & Ella Sharp 1-09-301

Medical Cushioning Using Slime

In doing this project we were hoping to find some positive answers to an uncomfortable situation. The purpose of this project is to engineer a better method for cushioning medical devices. Crutches are useful for the injured, but they are designed to be functional, not comfortable. Crutch pads were made to help, none have done the job, let's try something new, slime. Slime: a polymer and a cross-linker that when mixed become a non-Newtonian fluid. We chose 3 slime recipes (Basic, Butter, & Fluffy) and engineered a new one that we called Marshmallow slime. Next we did our testing. When conducting our experiment, first we created 3 batches of each slime for physical testing. We tested viscosity, elasticity, compression and recovery for each slime, then we vacuum sealed them. We analyzed the data to find which batch of each slime was the closest to the average. Then we attached each one to a crutch and covered them. Participants used crutches for 1 minute then filled out a survey that rated the pain level under each arm and said which crutch they preferred. Then the data was recorded and analyzed. In the end we found that all of the slimes were preferred over a rubber crutch pad. The two best slimes were Marshmallow and Butter, with Marshmallow preferred 75% of the time and Butter preferred 64% of the time. With some optimization of containment and attachment methods, Marshmallow and/or Butter slime could be used create a better experience for patients.

Eli Weisensee & Ky Bandy 1-09-302

Are Soft Drinks Really Hard?

This project showed the common everyday person the detrimental side effects of soft drinks. In this experiment we tested how much decay would occur from leaving the teeth in the drinks for 12 days. Testing on carbonated and non-carbonated, diet and non-diet, sugar free and sugary, and caffeine free and caffeinated. In the results, Monster caused a 36.8% decrease in mass on hog teeth, and Coca-Cola caused a 16.8% decrease in mass on bison teeth. What the research showed is if the sugar content is higher the decrease in mass is higher. It also showed carbonation may have been a factor because it increases the acidity of the beverages.

Junior Division Microbiology & Molecular Biology

Mariah Addai-Opoku 1-10-001

Bacteria Growth on Different Types of Floor Material

This investigation was conducted to understand if socks or shoes have more bacteria growth depending on the type of floor material. We gathered the materials, as to step on both sides of the floor material which was sock and shoe side, and I swabbed the floor material onto the agar plates and let them incubate. It is important because it lets us know that even if we don't wear shoes in the house bacteria is still there. It also is important because it lets us know that bacteria is everywhere even more on socks then shoes. It is lastly important because for example carpet has more bacteria so somewhere out there your carpet has a lot of bacteria. My essay should be read because my essay gives everyone facts about bacteria and when it comes to floor material they are connected to sock and shoes as well.

Ellinor Davenport 1-10-002

Persistent & Resistant

The Healthcare environment consists of abnormal situations involving the cataclysmic enemy of a malfunctioning domain, bacteria. To reduce the element of antibiotic resistant bacteria we introduce cleaners to eliminate their existence. So to eradicate common viruses that may transit from bacteria we endorse cleaning products that should withstand their intensity. With common knowledge we understand that any manufactured merchandise would be the most effective as seen on the shelf. But could cleaners be more effective when its concentration is diluted? The measure of inhibition of each infused disc was acquired at the Fort Lewis BSL-1 lab. Subsequently, I matured the bacteria in a sterile environment. When exposed to the diluted cleaner (Bleach:25%=2.5 ml of Bleach and 7.5 ml of dH2O; and so forth with the Multi Surface Cleaner) the Bleach brought measurable results (Plates 1a-1b: averaged 50%= 3.0 cm/ 25%= 1.95 cm; and Plates 4a-4b: averaged 50%= 2.0 cm/ 25%= 1.35 cm) and (Plates 2a-2b: averaged 50%= 0.0 cm/ 25%= 0.0 cm; and Plates 3a-3b: averaged 50%= 0.0 cm/ 25%= 0.0 cm). When reviewing the above data, I found the most adequate cleaner when diluted to 50% was the Bleach with a high average of 3.0 cm. These results have the ability to enable schools worldwide to efficiently dilute cleaners for maximum benefit; particularly those using strong or amalgamated solutions.

Aydin Gocemen 1-10-003

Bacterial Growth Rates vs. Magnetic Field Strength

Medical experts are investigating to see whether magnetism can be beneficial to one’s health, but can magnetic fields affect the growth rate of bacteria? This experiment tests for how magnetic field strengths at 1000, 666, 333, and 0 Gauss affect the bacterial growth rates for Escherichia Coli (E-Coli) and Saccharomyces Cerevisiae (baker’s yeast). These bacterial growth rates were measured by recording the bacterial colony diameter in centimeters and inserting the data into an equation to find the growth rate in percent. The hypothesis was that the bacterial growth rate wouldn’t be affected by magnetic fields acting upon it. The experimental results do not support the hypothesis, for there is a strong positive trend between magnetic field strength and bacterial growth rate during the first 24 hours. The experiment also showed that after 48 hours, the growth rate slows down dramatically such that there isn’t a trend at all between magnetic field strength and bacterial growth.

Gracey Hening 1-10-004

Antibiotic Resistance: The World's Most Dangerous Threat to Effective Healthcare

Antibiotic resistance is a very dangerous threat to healthcare today. Bacteria and infections are becoming resistant or adapting to antibiotics. Some antibiotics have lost all of their effectiveness against bacteria. Antibiotic resistance is caused by misuse or overuse of antibiotics. It also occurs naturally, but there are ways to prevent antibiotic resistance from developing. My hypothesis was if antibiotics are repeatedly used on the same bacteria then the effectiveness of the antibiotic will decrease. To test antibiotic resistance, I swabbed bacteria on a petri plate, and placed an antibiotic disk on the petri plate. Then, I waited 24 hours to measure the inhibition zone. After measuring, I swabbed the bacteria around the inhibition zone and took that same bacteria and swabbed it on to a new petri dish. I repeated this four times. The results were very exciting to see. All of the inhibition zones decreased by the fourth generation, supporting the hypothesis. Some antibiotics did not work at all after the second generation which was super cool and interesting. Antibiotics are supposed to lose their effectiveness over time. I was surprised that there was a difference in such a short period of time. Overall, I learned a lot doing this project. I learned not only a lot about antibiotic resistance, but I learned things for future microbiology projects. I had a hard time the first two times I tried this experiment. Nothing worked until the third time after I changed some materials and other things. It was frustrating at first, but I am glad that I chose antibiotic resistance for my project.

Esha Sury 1-10-005

Synergizing Antibiotics with Phage K and Prophylactic Nanosilver: Manipulating Resistance

I investigated if synergizing bactericidal additives in an antibiotic optimizes treatment, or even triumphs antibiotic resistance. I consolidated Phage K and/or Prophylactic Silver Nanoparticles with antibiotic to battle bacteria with inserted resistance genes. I cultured Staph. Aureus, Staph. Epidermidis, and E. Coli - 2 strains for each bacteria, resistant or susceptible to the chosen drug. From there I conducted several tests with a log10 dilution series to dilute a concentration of antibiotic, additive, bacteria, and growth medium. To measure the bacteria in my dilutions I used a Tecan spectrophotometer, measuring bacterial turbidity at an Optical-Density of 600nm particle dispensary wavelength. Using 4-parametric logarithmic regression I found Erythromycin is 4.5 fold (74.8%) more effective with Nanosilver in Staphylococcus Aureus. Along with this, I spotted both an increase in sensitivity with both additives (bacteria killed with smaller concentration of mixture) and a quiver in resistance. I was surprised with my significant findings, though they were a slight tangent to the main focus of my hypothesis. Unfortunately, certain results were thwarted with the reflective nanosilver in the spectrophotometer and with the Phages (in need of PFU analysis) that were too host specific to meet our requirements. Overall, communication between each organism is always a big variable- this meaning a "cure" to resistance is impossible when bacteria are too quick to adapt new genes. Prevention is our best bet to avoid a broad range of bacterial infections, and combination therapy is a possible route for long-term prevention.

Faith Roberts 1-10-006

Mold Massacre

The purpose of this investigation was to determine whether essential oils (eucalyptus, cinnamon, clove) can destroy mold. I hypothesized that if the essential oil type varies, then the diameter of the ring of inhibition will be largest for clove oil. This experiment involved spreading mold onto agar, placing sterile filter disks with the solution on them, and then recording the zone of inhibition after 24 hours in a 30℃ incubator. Bleach was used as the control. The data collected did support the original hypothesis. Based on evidence, it is reasonable to conclude that the clove oil killed the mold the best because, on average, clove oil had a ring of inhibition diameter 19.4 mm greater than eucalyptus, 9.18 mm greater than cinnamon, and 25.94 mm greater than the control.

Kennedy Frank 1-10-007

Do the Growing Conditions of Tomatoes Influence pH and Potential Bacterial Colonization?

This project determines how well bacteria grow in different levels of acidity in tomatoes. Two different tests were done in this experiment. The first test focused on how well bacteria would grow in four different types of tomatoes (organic, vine ripened, hydroponic, and green-house). The pHs were tested on each of these tomatoes before mashing them into a tomato slurry. After mashing them into a tomato slurry the pH of each type of tomato was tested. After testing the pH of each tomato, 1ml of the tomato was added to a test tube followed by sterile inoculation of the bacteria. The second test focused on how the tomato would influence an established bacterial colony. The pH levels of were recorded on each of the four tomatoes again. Tubes of nutrient broth were inoculated with bacteria and incubated to establish a growing culture. After 24 hours, 1ml of the tomato slurry was aseptically added to each appropriate tube. Serial dilutions were done on each culture so that optical density could be read on each of the cultures. The data collected in this experiment did not support the hypothesis. The hypothesis states that most bacteria cannot tolerate acidic environments, therefore the more acidic the fruit the lower the bacterial growth will be. The data in this experiment showed that the higher the pH the less bacteria growth, and when in the lower pH environments, greater bacteria growth was shown. The vine ripened tomatoes had the highest growth and the lowest pH.

Lucian Grinnan 1-10-008

Best Thing Since Sliced Bread!

The purpose of my experiment was to find out if certain substances affect the growth of yeast. Since yeast is a living microorganism I suspected that different substances will shorten the rising height. To test my theory I added beer, garlic and cinnamon to the yeast. The average growth of the yeast with the added ingredients was 3 cm. This was a decrease in the growth of the yeast by 5cm as the average growth of the yeast with no added ingredients was 8 cm. My experiment showed that beer, garlic and cinnamon decrease the growth of yeast. However the beer, garlic, and yeast make the bread less dense, like I suspected. The beer and cinnamon had a bland taste, but the garlic was very tart. The added ingredients decreased the growth of the yeast and the density, but increased the taste. As a baker I have decided that just using yeast and no added ingredients is the fasted way to get more bread in less time!

W. Hall Matthews 1-10-009

Algistatic Effects of Retail Barley Products on the Cyanobacteria, Anabaena in Fresh Water

There is an ecological crisis in Florida. Pollution rich water is being dumped from Lake Okeechobee into the Indian River Lagoon overfeeding blue-green algae and causing disastrous blooms. The purpose of this project was to test algistatic claims of retail barley products as an environmentally safe solution. I hypothesized that all of the products would more greatly decrease the growth of Anabaena, a cyanobacteria present in Lake Okeechobee, over 21 days than the control. The extract as the most processed product would reduce growth the most and the straw the least. Controlled conditions for duplicate samples of Anabaena tested barley straw, pellets, and extract in concentrations as usage labels directed. Using a Carolina® Spectroscopy Chamber and a cellular phone color analyzer app, data for red, green, and blue was recorded every 7 days. The average numerical color data collected confirmed the visual results which did partially support my original hypothesis. The extract prohibited the growth of Anabaena the most, 64% less growth compared to the control. The straw was second at 19% and the pellets were third at 18%. This project successfully tested the algistatic claims of 3 environmentally safe barley products. There was a troubling difference between growth in all of the duplicate samples. These differences may be from unequally distributed cyanobacteria at the beginning of the experiment. In conclusion, all retail barley products on average did decrease the growth of Anabaena as compared to the average control. Barley extract had the greatest algistatic affect compared to the control.

Kristen Frasco & Emily Barrera 1-10-301

What Doorknob Is the Dirtiest?

The goal of this study was to find out what door knob was the dirtiest in the community. We did this experiment to show people that even if you think something is clean, it more than likely dirty and is filled with thousands of millions of microscopic germs and bacteria. It was hypothesized that out of the ten door knobs in which we took samples, the McDonald's front door would be the dirtiest because of how many people use it daily and due to the lack of how many times they clean the door knobs. The ten door knobs we swabbed were located in Fort Morgan. Our hypothesis was correct; the McDonald's front door was the dirtiest door knob. One surprising thing was that the Morgan Community College was a close second and very dirty. Some observations that we made was there was a red colony on the Fort Morgan Middle School front door Petri Dish. We also noticed coral-looking colonies in several of the dishes and we also noticed dark blotches in some of the dishes. A common looking bacteria was little yellow dots that appeared on the dishes. From the 717 Ute Street front door, one of the bacteria colonies had a "tail," which allows the bacteria to move around. Bacteria is everywhere. Some of it is good bacteria, but a lot of it is bad. This study showed us even if you think that something is clean, it is more than likely still very dirty.

Aryan Gandhi & Peyton Streu 1-10-302

Blooming Algae

The purpose of our project, Blooming Algae, is to see whether algae grows faster in more acidic or alkaline water versus natural water with no added ingredients. We made this possible by adding different amounts of bleach to make the water more alkaline and different amounts of vinegar to make the water more acidic. The reason behind this project is that we wanted to see how different chemicals in fresh water around the world affect the growth of algae. Our natural water came from the North Pond in Silverthorne, Colorado. This location was chosen because it has a natural water source. The water was separated into five containers of equal volume. One of the containers was kept natural as a control. Two of the other containers had added bleach in varying amounts. The last two contained added vinegar in varying amounts. The pH of each was recorded along with the amount of algae growth. We found that the pH that grew algae the best was alkaline. These results can be tied to human impact because algae and humans are both living organisms. This means that if algae can grow better in a specific type of water, we would expect this to be more beneficial to humans as well.

Junior Division Physics

Novalee Ah Yo 1-11-001

Tin Foil Strength

My project is seeing how strong tin foil is by making two boats out of tin foil. Boat #1 has 1 piece of tin foil. Boat #2 has 2 pieces of tin foil. Next, I place boat #1 on the water and drop pennies onto it until it sinks. Lastly, I place boat #2 on the water and drop pennies onto it until it sinks. My hypothesis is, if I make two boats with different amounts of tinfoil and put them on water, dropping pennies into each boat from the same height, then the boat with the least amount of tinfoil will sink first because it is not as sturdy as the boat with more tinfoil. My procedures are: Make two different amount of tin foil boats; Fill up a bucket full of water; Place boat #1 on water; Drop pennies one by one from the same height until it sinks; Repeat steps 3&4 for the 2nd boat. Lastly, my results are boat #1 sank first because the mass from the water made it heavier and weigh more than the water. Boat #2 sank last because it has more air than boat #1. My hypothesis is correct.

Matthew Anderson 1-11-002

Redesigning Ventilation to Minimize Airborne Pathogen Transmission in Multiple-Bed Hospital Wards

We investigated how to minimize infection in multiple-bed hospital ward patients from airborne pathogens while maintaining patient thermal comfort and cost-effectiveness. We tried to find the optimal configuration of four ventilation control factors (humidity, airspeed, air change rate, and ventilation regime) that minimize the mean age of air in ward patients' breathing zones using computational fluid dynamics and Taguchi design. We discovered that the optimal configuration of ventilation control factors was: 45% humidity, 1 m/s inlet airspeed, 12 air changes per hour, a supply vent above the patients' bed on the wall, and a return vent to the lower right of the bed/ The mean age of air in this configuration was 93.4% better than the current standard in hospital wards and was 86.8% better than the mean configuration of ventilation control factors. This configuration was also able to maintain cost efficiency and patient thermal comfort.

Kooper Grinstead 1-11-003

Veggie Tales

My mom refuses to feed my sister and I canned vegetables; she is convinced that they "just aren't the same" as frozen veggies, so I wanted to see if I could prove her wrong. My mom works, and doesn't often have a lot of time to get dinner ready, and I know that when she cooks frozen veggies it takes longer than it would if she were just heating up a can of the same thing. I tested frozen peas versus canned peas to see which contained more stored energy. I did this by making my own calorimeter to burn the food in and check temperature change between the frozen pea and the canned pea. I hypothesized that the canned peas would have more stored energy, but after completing three separate trials, my data told me that the frozen vegetables contain more stored energy than the canned vegetables. This information was very important to me, not only because I had to tell my mom she was right, but because I can pass along my findings to others, and hope that they will make the switch from canned to frozen.

Zachary Isley 1-11-004

*Quantum Entanglement of Photons Via Spontaneous Parametric Down Conversion in a KD*P Crystal*

Modern communication networks used for financial data, medical records, and election voting are not secure. Stealth technology reduces the effectiveness of our RADAR systems used in national defense. Quantum entanglement applications in communication networks can provide complete security. RADAR using quantum entanglement can detect all stealth technology. My project demonstrated the creation of photon pairs that were quantum entangled. The purpose of this experiment is to observe Quantum Entanglement (QE) via Spontaneous Parametric Down Conversion (SPDC) in a Potassium Dideuterium Phosphate (KD*P) crystal. The hypothesis for this experiment is that due to the conservation of energy and momentum: 1) Entangled photons generated by SPDC will have twice the wavelength of the pump laser. 2) The entangled photons will result in a ring image. Also, the image captured by a camera will get brighter the longer the camera is exposed. The independent variables are 1) the amount of time the camera is exposed and 2) if the KDP crystal is in place. The dependent variable is the wavelength of light that exits the crystal. The results show that quantum entanglement via SPDC did occur. 1) Down converted photons of twice the laser wavelength were detected, showing conservation of energy. 2) Images showed a ring of captured photons showing conservation of momentum. 3) Longer exposures resulted in brighter images. This project shows that quantum entangled photons can be generated using minimal equipment and cost. This has direct applications in secure communication and national defense.

LilyRae Martinez 1-11-005

Rocketology: Lift Off

I did our science fair project because I wanted to do a project involved in the physics category. Also I am very interested in the study of rockets. I did this to learn more about chemical reactions, which I was a little confused on and why they react the way they do. I worked with baking soda and vinegar. I found out that because baking soda is a sodium bicarbonate, and that each molecule contains a sodium atom, a hydrogen atom, oxygen atoms, and carbon dioxide molecules. Vinegar is an acetic acid. Each molecule contains a hydrogen atom. The problem I investigated was, “Will the rocket fly higher if we add more baking soda or vinegar?” For the procedure, I used a small canister, and in each trial, I added a different amount of baking soda or vinegar. Then I measured the height that the rocket shot up, and in the end I averaged up all of my totals. My results were that when we decreased the amount of vinegar, the rocket went higher. This happens because the baking soda dissolves and reacts with the acetic acid in the vinegar to produce CO2 bubbles. I met my hypothesis because when I decreased the amount of vinegar, the rocket shot up higher. This can be used in the future to use it as a cleaning supply, because of the ingredients in the baking soda and vinegar, or if you get a college degree, you can design new experiments or to examine what else the two can be used for.

Kjersti Moritz 1-11-006

Up Up and Away

The purpose of my experiment was to find out how a Monarch butterfly wing angle would affect the quality of its glide. I hypothesized that if the angle of attack is set at 45 degrees then it will have the most lift force because the air can get underneath the wing and lift it up well. To perform this experiment I set butterfly wings at different angles and used a fan to measure the lift in grams. My experiment led me to believe that somewhere between 40 degrees and 45 degrees was the ideal angle for butterfly gliding.

Hoa (Jenny) Nguyen 11-11-007

The Science Behind Tsunami: Study the Effect of Water Depth on Wave Velocity

The purpose of my project is to investigate the wave of a tsunami and investigate how the waves travel to the other side with a single wooden block from different heights. People should care about the work I did because the stronger a tsunami is the faster the wave travels and the more damage they cause. I tested how fast waves traveled by dropping a wooden block at different heights. I also recorded how many seconds it took for the waves to reach to the other side. The problem that I solved was to find how the velocity was affected by the water depth in the Tsunami. The result I got was the higher the wooden blocked was dropped the faster the wave traveled due to the pressure of the block. In conclusion, the height of the block modeled the intensity of a tsunami.

Cael Nordyke 1-11-008

Shotgun Spread

The purpose of this project was to find the brand of shotgun shell with the widest spread. Many people love to hunt, and I am one of them. In bird hunting, the shot has to move fast and spread wide. Any hunter would want to use the type of shell that has the widest spread to have the best chance at getting the kill. I measured the spreads of three different brands of shotgun shells to find which produced the widest spread. I hypothesized that if different brands of 20 gauge shells are used, the brand Federal will cause the spread to be wider because, Federal is considered to be the best non lead shot ammunition for upland birds. The experiment involved shooting 15 rounds of each brand of shell at targets and measuring the spread of the shot shell. The data I collected did not support the original hypothesis. The average spread of Federal 20 gauge shells was 9.125 inches. The average spread of Remington brand was 9.35 inches. The average spread of Winchester brand was 7.79 inches. These findings lead me to believe that out of the brands I tested, the one with the widest spread is Remington.

Zack Rankin 1-11-009

Turn on the Octane

My experiment's purpose was to determine which octane rating would allow an engine to run the longest. The results of this experiment would allow consumers the choice to use the longest lasting fuel in their vehicles. The higher the octane, the higher the price. I hypothesized that the 100-octane fuel would allow the engine to run longer. My dad and I started by removing the blade off our mower. After reviewing OSHA's safety procedures, we started by measuring out 120 mL of fuel. We added the fuel to an empty tank and started the engine. The throttle was secured. I simply observed the engine and kept track of the time. After the engine stopped, I recorded the time, checked the oil levels and repeated the steps after it cooled down. I recorded the amount of time that the engine ran. The data showed that 91 octane ran the longest. The motor ran for an average 12 minutes 55 seconds. The 91 octane ran 12 minutes 19 seconds, and the 85 octane ran for 12 minutes 10 seconds. These seconds seem insignificant, however most people put over 15,000 miles on their vehicles. Once converting my 120 mL to the average amount of fuel needed to travel 15,000 miles. The simple difference of 36 seconds converts to nearly 36 hour difference between the first and second place fuel. In conclusion, transportation companies, commuters, and daily drivers should heed the results of this experiment.

Caleb Siegling 1-11-010

Antibubbles and Surface Tension

I created antibubbles in three household items: soap, maple syrup, and olive oil to see which one has the most surface tension. You can use this information to understand why certain substances are used for cleaning dishes and other things. My question was what household substance has the most surface tension? The way I approached my experiments was to do 9 antibubbles in each substance to get accurate results. I added all of the times for each substance and turned them into an average time. I also did observations using slow motion on my phone to see the size and the time of the antibubble to get the most accurate answer for my question and hypothesis. My results were that olive oil's average antibubble time was 744 milliseconds. Maple syrup's average time was 763 mili seconds. Soaps average time was 378 milliseconds. This means that maple syrup has the most surface tension and soap has the least. My project contributes information about surface tension in house hold objects. It shows how science connects with things like olive oil, maple syrup, and soap and why soap is effective in cleaning dishes. It also helps you understand why Dawn dish soap is used to help clean birds affected from oil spills. I believe that I met my objectives, answered my question, and understand why dish soap is effective in cutting the surface tension of syrup and oil.

Zakery Snider 1-11-011

Your Rubbish – My Joules

The purpose of this investigation is to determine if paper, cardboard, charcoal or a combination produce more energy. If different fuel types (paper, cardboard, charcoal, combination) varied, then the heat released will be greatest with the combination of the materials. This experiment involved putting different fuels (paper, cardboard, charcoal, and combination) under a filled pot to measure the energy produced (joules). Charcoal was used as the control. The energy produced was measured by placing the fuels under a pot of water, then to measure the change in water temperature. After that, the information was plugged into the equation $q=m\times C\times \Delta T$ to find the energy produced. The data collected did support the original hypothesis. These findings lead to the conclusion that different fuel types did change how much energy was released. The combination of materials had the highest joules produced. Based on the evidence, it is reasonable to conclude that the combination of materials has the greatest joules produced because on average the control produces more joules of 8549.31 when compared to the control average of 1541.11. There is a statistical difference between the combination and the rest of the materials. The data rages of the combination exceeded the data ranged of the other materials.

Joshua Snyder 1-11-012

Ready, Aim, Fire!

The purpose of this investigation was to determine which airsoft barrel improves the ballistics when an airsoft bb was fired. I hypothesized that if the barrels (smooth bore, rifled bore) were varied, then the ballistics of a rifled barrel would have increased performance in accuracy but would have comparable results with force. This experiment involved shooting airsoft bb's through barrels (rifled, smooth). The smooth bore barrel was the control. The bb's firing power came from an air compressor, firing at 120 psi. The two criteria for comparing the barrels was accuracy (observed on a paper target with a bullseye) and force (observed in ballistic gel). Based on the evidence, it is reasonable to conclude that the rifled barrel did have better ballistics because on average the rifled barrel was 8 mm more accurate than the smooth, and had more force (8.2 more mm penetrated).

Kiersten Super-Hill 1-11-013

Refraction Action

The purpose for this experiment is to find out how different temperature (10°C, 20°C, 30°C, 35°C) affects light refraction (degrees) off glass. My hypothesis is if the temperature of the glass (10°C, 20°C, 30°C, 35°C) is colder, then the light refraction (degrees) will be greater (10°C) because the atoms are closer together. My hypothesis is based on the theory that if the glass is colder, the light will refract a more because the atoms in the glass are closer together. The light should refract more every time the temperature gets colder. The light once directed at the glass would then refract in another direction. This may help all those who wear any type of lens because they defect light. Also since there are many types of glasses and lens, the different refraction might decide the strength of the shades. This idea is based on my experience wearing glasses and goggles. The experiment involved changing the temperature of the glass and pointing a laser at it. Then the laser would be measured to see how much it refracted. The data collected did support the original hypothesis part . The average for the glass temperature 10°C was 1.2 deg. The average for the glass temperature of 20°C was 2 deg. The average for of refraction for the glass temperature of 30°C was -0.2. The last average for the glass temperature of 35°C was -0.8 deg. As the temperature increased, the amount of refraction started decrease and actually showed refraction in the opposite direction. The data stated that the glass temperature of 20°C had the most refraction.

Nathan Woo 1-11-014

Magnetic Linear Acceleration

The purpose of this science fair project was to see how many magnets it takes to launch the final ball at the fastest velocity. If the test increases the number of magnets in between each jump, then the velocity of the end ball will be higher when it goes off. This is because there will be more magnetic attraction bringing the previous steel ball from the last jump to it, and the next ball will launch at a faster velocity. The independent variable is how many magnets are in between each jump. More magnets will be added to change this. The dependent variable is the velocity of the last steel ball bearing. It will be measured with a slow motion camera and a timer. Some control variables are the length of the ramp (4 inches), the angle of the ramp, and the distance between each of the magnet jumps (4 inches). In the middle was 4 magnets in each jump, and the average velocity was 153.965 cms per second. The fastest was the 3 magnets and the average velocity was 161.31 seconds, and the slowest was 2 magnets with an average time of 145.2676 cms per second. The hypothesis was rejected because 4 magnets did not get the fastest time, but three magnets did. The average for 4 magnets was slower than the three magnets. This can benefit scientists if they wanted to launch something to space.

Nathaniel Ellis 1-11-015

Electromagnetic Pulses (EMPs): Solar Flares, Radioactive Waves and the End to Our Digital World!

Recently in the news I have been hearing a lot about the possibility of an electromagnetic pulse attack (EMP) against the US. It got me thinking - what is an EMP attack, and how dangerous are they? I began my investigation on the internet, and found a wide variety of conflicting information. I learned that EMPs can knock out electronics on a small scale, and also on a large scale (nuclear). But on a large scale an EMP attack would carry significant practical and political complications. I believe this research is important because there appears to be much misinformation about EMPs. I wanted to demonstrate the mechanics of an EMP, and how an individual, institution, or government might guard against it. My research goal was to discover what an EMP is, and how it might affect typical household electrical equipment (both AC and DC) using two different DIY EM Pulse generators. To investigate this, I built both a low- and high-power EMP device and tested their effect at different distances and recorded the results. Lastly, I researched the possibility of a large scale (nuclear) EMP attack. My expected outcome was that a small EMP will take out small electronics from a limited distance - this was proven through experimentation. A larger scale EMP might be effective, but impractical. And there are low chances of a large scale (nuclear) EMP attack due to political implications.

Connor Provencher 1-11-016

Field of Dreams

The purpose of the experiment was to determine if the turf age affected the energy absorption of the turf. A lacrosse ball was dropped onto a field from 171.4 cm off of the ground and then measured after one bounce for three fields in Eagle County. The, that data was converted into percent energy absorbed. The data showed that the oldest field absorbed the most energy and the newest field the least. My conclusion was that the fields could have had different infills which would have made the energy absorption different for each field regardless of how old it was.

Reginald Huff 1-11-017

Testing Electrical Conductivity

My project tests the electrical conductivity of a variety of materials. I tested materials I found around my house including metal paper clips, snow, water, food items and cloth. My circuit had a 6 V battery, insulated wires, and a light bulb. I attached my materials to the circuit and determined whether each material could conduct electricity well enough to light the bulb. I also measured the amps of the circuit and resistance for each material I tested. I found that some materials would not turn the light on even though they conducted electricity, like the water and tomatoes, while only materials with free electrons, like metal or salty water, would turn the light on.

James Tindle & Zoe Wagner 1-11-301

Under Pressure

Last year, we studied gravitational wave detectors together, and we thought that it was interesting how the gravitational wave detectors found such small differences using a laser to make the measurements. We wanted to do something similar and use a machine to measure minuscule differences in the results. We then talked about things that we could do and came up with the question: 'How does air pressure affect the speed of sound?' We built an apparatus out of PVC pipe that uses an oscilloscope to measure the speed of sound at different air pressures. We used a bicycle pump to increase the air pressure inside the pipe. We tested the air pressure in increments of 10 pounds per square inch (psi) from 0 to 100. We used the oscilloscope to send a signal to the speaker which converts the signal to a sound that travels to the microphone at the other end of the pipe. The oscilloscope measured the amount of time it took for the sound to travel through the pipe. At 0 psi, it took 1.7 milliseconds to travel the 23 inches from the speaker to the microphone. At 100 psi, it took 1.67 milliseconds to travel the length of the pipe. We learned that the higher the air pressure, the faster the sound.

Parker Stone & Myer Wickham 1-11-302

Why No WiFi?

We wanted to find out why we did not get strong WiFi signals in our basement bedrooms. We thought that materials in walls were blocking the signal. We decided to test six common building materials to see how obstructive each material would be to WiFi signal transmission. The materials tested were wood, metal, drywall, concrete, glass and plastic. Our hypothesis was that wood would be the most obstructive. We constructed boxes to fit over a router made of wood, metal, drywall, concrete, glass and plastic. Using software on a laptop computer located 50 feet away from a router; we recorded measurements of the signal strength with the router in open space. We used this same procedure to measure WiFi signal transmission with the router under each box. Concrete, metal and plastic were the most obstructive materials. Next, we examined the placement of the WiFi router in the home. The router was located behind a large screen TV made of mostly plastic and metal, two of the most obstructive materials we tested. We took WiFi signal strength readings in each room of the house with the router located in front of and behind the TV. Our results showed a better signal with the router in front of the TV. Our hypothesis was incorrect. We found that metal, concrete and plastic were the most obstructive materials to WiFi signal transmissions, not wood. We also found that moving a router to a position in front of a TV improved WiFi reception.

Junior Division Plant Sciences

Victoria Arellano 1-12-001

It's Lit

I had to figure out what different colors of light could do to a lima bean, and a chia seed. During this experiment I found out that the lima beans grew more under the red light because of the wave length. The chia seeds grew more under the black light better. Both the chia seeds and the lima beans grew under the white light but not as much as the black and red light. I turned on the lights at night and I kept the plants under high until I was ready to go to school. They were under the light for nine hours and I kept this experiment going for 5 days.

Blake Bowshot 1-12-002

Nature's Magnificent Medicine: Aloe Vera

The purpose of this investigation was to determine if different types of soil affect the regeneration of an Aloe Vera plant. I hypothesized that if the soil type (sandy, potting, top, garden) was varied, then the Aloe Vera growth height will be the highest with sandy soil. The experiment involved adding three callused Aloe Vera leaves to each type of soil (sandy, potting, top, garden) and measuring their growth heights. The Sandy soil was used as the control. The Aloe Vera growth height was measured in centimeters, and the growth height was averaged for each soil type. The data collected did not support the original hypothesis. Based on the evidence, it is reasonable to conclude that the top soil had the highest growth height because top soil, on average, had a higher percent change of 4.6% when compared to the control, 7.5 % when compared to potting soil, and 3.9% when compared to garden soil.

Ainsley Crist 1-12-003

How Acidic Mine Drainage Affects Plant Growth

Mining is an essential part of American society, however, when heavy metals left in mines combine with rain water, acidic toxic water forms. In 2015, this water was accidentally released from the Gold King Mine in Colorado causing heavy metals to become present in farm irrigation water. If plant health is visibly impacted by such toxins, crops may be disposed of; if not they may be consumed by humans. What is the effect of toxic mine water on plant growth? It was hypothesized that the growth of pea plants will be visibly, negatively affected by toxins found in acidic mine drainage. This experiment was tested by growing six groups of six plants each for two weeks after germination. Distilled water was used as a control in one group, and concentrations of one, three, five, eight, and ten percent acidic mine drainage was used to water the other groups. Plant heights were measured and compared at the start and end of the treatment period. The averages of the change of heights for each group varied but were very similar; the control group grew the most (average of 8.80 centimeters) and the ten percent concentration grew the least (average 8.12 centimeters). The remaining experimental groups' average growth between 8.80 and 8.12 centimeters was not related to treatment concentrations. Based on the results, the data represents no relationship between the variables. To conclude, the growth of pea plants was not visibly negatively affected by acidic mine drainage, therefore, the hypothesis was not supported.

Christopher Custer 1-12-004

Roots of Steel: Nutrient Absorption in Soil vs. Hydroponic Plants

This project, Roots of Steel, was conducted to determine which growth medium, soil or hydroponics, would allow for better iron absorption in basil plants. Thirty-two grams of iron chelate were added each to the environments of 14 soil-grown plants and 14 hydroponically-grown plants. After sufficient time for the plants to absorb the iron had passed, a lysing buffer was used on leaf samples from the 10 fittest hydroponically-grown plants and a control, non-supplemented plant. This lysing allowed for the extraction and measurement of the iron using a test kit designed to measure iron in water. The soil plants died of over watering due to the dilution necessary for the iron supplement to be safe. This was because all the iron was added at once in each environment. The hydroponically-grown and supplemented plants had an average of .028 parts per million of iron more than the non-supplemented plant tested. The non-supplemented tap water used for the hydroponics had less iron than the plants, therefore they absorbed the additional iron. This supports my hypothesis that the hydroponically-grown plants would absorb more nutrients than the soil-grown plants.

Alexander Dhupar 1-12-005

Water Solution Effect on Hydroponically Grown Basil

The purpose of the researcher's experiment was to determine which type of nutrient-rich water grew basil the best when utilizing the hydroponics deep water culture method. Finding the optimal nutrient-rich solution for basil growth is applicable to the real world because hydroponics requires less space and water for plant growth. Additionally, hydroponics reduces the amount of pollution and waste. Pollution is caused by soil runoff because toxic runoff can get into bodies of water and pollute the surface water or the runoff can fall into underground water supplies. Optimizing plant growth in limited space for future crop growth needs inspired this project. The researcher performed this experiment by inserting basil seedlings into a deep water culture hydroponic system, and measuring the basil height once a week for three weeks. The results of this experiment were that the plants grown in tap water grew the most and produced the most leaves other than cotyledon. The plants in the half strength Dyna-Gro solution grew the least. This means that the balanced nutrients of the tap water were more beneficial to plant seedlings than Dyna-gro water solution. Optimization of solutions utilized in hydroponic gardens can increase the yield of plants, thus increasing the benefits of hydroponics which include growing plants faster, utilizing limited space and producing plants more conveniently over the different seasons.

Noelle Edelmann 1-12-006

WiFi Radiation Affecting Plants' Growth

The purpose of this project was to find out if WiFi radiation affects the growing of plants. I was interested in finding out the result since I knew it affects some things. I heard a lot of the time that different types of radiation is even bad for us humans. So I decided to test WiFi Radiation on plants to see if it affects them. What I had to do in this experiment was simple, I went to the store and got six of the same type of plant. Next I put them all in a spot of different WiFi amount, some had two in the same place. I watered them once every two days and measured them once a week. After six weeks I gathered my data. It turns out, the less WiFi there is the better the plants grow. The plants closer to the WiFi, it is harder for them to sprout more leaves. I always gave the plants the same amount of water. The thing is that the plants closer to the WiFi, their soil dried out so much faster than the plants farther away. It was interesting how the leaves by the WiFi were turning brown. Yes, my experiment turned out well. In this experiment I was testing to see if WiFi radiation affects the growth of plants. I had six plants spread out throughout my house where there are different amounts of WiFi waves.

Kamryn Holland 1-12-007

All of a Spudden . . .

Dormancy in potatoes is a healthy and natural thing, where the potato "hibernates." However, sometimes seed needs to be planted before tubers have sprouted. My project was an experiment to see if I could shorten the dormancy period, and if so, which method works the best. Working with the Colorado State University San Luis Valley Research Center, I tested two varieties of potatoes, Canela Russets and Rio Grande Russests. My main treatment was a chemical known to be used to stimulate sprouting called ProGibb, or Gibberellic Acid. I also used CapSil, a surfactant, and a coring tool to open up the tuber. I hypothesized that ProGibb+CapSil would be the most effective, as my background research taught me that those chemicals are highly recommended by experts in crop stimulation. After soaking the potatoes in the chemicals, and applying the coring treatments, I set the potatoes in a cooler, where I took weekly data. In the end, I found that the treatments were mostly the same for the varieties, and in Canela, both ProGibb+ CapSil and ProGibb+CapSil+Wounding were equally effective, and had the shortest dormancy lengths. Rio Grande's most effective treatment was the combination treatment, ProGibb+CapSil+Wounding. My hypothesis would be considered somewhat correct, even though I was right in thinking that ProGibb+CapSil are the most effective. However, I didn't include wounding in my hypothesis. This project can definitely inform potato growers on how they can plant seed potatoes sooner.

Chance Jurkiewicz 1-12-008

To Pot or Not

The purpose of this project was to test if the growth method was differed if plants grew better with aquaponics or soil. I hypothesized that the aquaponics would do better because of the constant nutrients from the fish feeding the plants. This experiment involved planting twenty-seven seeds in each of the systems (aquaponics and soil) to see the growth yield (height, weight, and, leaf count). Soil was used as a control. The growth yield was measured by the height (cm), plant weight (g), leaf weight (g), and leaf count of each plant. The data collected did not support the original hypothesis. These finding lead to the conclusion that different growing methods (aquaponics and soil) did cause a change in growth yield. Soil, had the plants with the most average plant weight at 8.68g, leaf weight at 5.72g, and leaf count at 22.9 leaves. Aquaponics did have the greatest height average at 19.14cm. Therefore it is reasonable to conclude that soil does grow better and stronger than aquaponics.

Joselyn King 1-12-009

Cornstalk Feed Value: Triple Stacked vs. Single Stacked

The purpose is, "To see the difference in feed values of cornstalk varieties with different traits." It is hypothesized that the single traited cornstalks will have a better feed value than the cornstalks that have multiple traits. A brief procedure of the experiment is that you collect cornstalks from different fields that have different genetic traits. Once you have all of the cornstalks that you need grind and weigh each sample so that they are comparable. After that send them to a forage lab so that their nutrient levels can be tested. Once you get the test results back analyze the data and find out which one had the best feed value. The results did not support my hypothesis.

Payton Patrick 1-12-010

To Grow or Not to Grow

This will be a quick summary of my science project. The question I tested was, how will various amounts of caffeine affect plant growth? The procedure I used to perform this experiment is as follows: 1 Put 10 mung beans each into 3 separate containers and label them “water”, “coffee” and “caffeine”. 2. Dissolve caffeine tablets and coffee powder into water in their respective bottle. 3. Label each bottle according to its contents. 4. Water each plant with 100 ml of its assigned solution each day for 5 days. 5. Measure the height of the plants each day to see the differences in growth. 6. After all 5 days measure all plants and calculate the average height of each group. I found that the plants being watered with only water had the best growth with an average of 9 centimeters. The plants watered with the coffee solution came second with an average of 7 centimeters. The plants watered with the caffeine solution did the worst by far, they were so small we couldn’t measure them. In conclusion, I learned a lot from this experiment including how caffeine releases nitrogen into the soil, adding acidity and negatively impacting the plant’s ability to grow.

Lena Rohn 1-12-011

Beneficial Blues & Roborant Reds - Anthocyanins in Action

Anthocyanins are pigments found in certain varieties of plants. These pigments are very beneficial to human health. The purpose of this research project was to evaluate the effect of growing conditions on anthocyanin levels in plants. This is mainly for growers to implement these conditions so that their produce has higher levels of anthocyanins. In the experiment, the Japanese maples and beet microgreens were grown under variable temperatures, warm, cold and room temperature and watered with added compounds, acetic acid, magnesium, and nitrogen. Samples were analyzed using a spectrophotometer. It was found that magnesium and nitrogen raised the levels of anthocyanins and that the warm and cold groups had lower levels of the pigment. Acetic acid also raised the anthocyanin levels in beet microgreens. With these results, the production of anthocyanins in these plants can be improved by growing at room temperature (67˚F) with the addition of magnesium and nitrogen.

Chloe Rojas 1-12-012

How Do Different Nutrients in Water Affect the Growth Rate of a Pea Plant?

The purpose of this investigation was to see how nutrients affect the growth rate of plants. I hypothesized that if I water plants with different waters, plants watered with compost tea will grow at a faster rate because there are more micronutrients in compost than in fertilizer or tap water. The experiment involved planting peas in clear cups and watering them with different liquids; compost tea, fertilizer water, and tap water. I observed them every day and wrote down my observations. The data collected did support my hypothesis. The total average per day for tap water, which served as my control group, was 1.28 inches per day. This was the lowest average out of the three types of water. The second lowest average was for the fertilizer watered plants with 1.56 inches of growth per day. The highest growth rate was for the compost tea watered plants with a growth rate per day of 1.63 inches per day. These findings lead me to believe that if we use more natural fertilizers like compost tea or compost, then plants will grow faster. This may later lead to helping farmers when growing crops. This also shows us that the use of fertilizer and just plain water when growing plants is not as effective.

Sophie Scholl 1-12-013

The Oleophilic Ability of Botanicals in Cleaning Oil from Water

A plant's ability to absorb oil from water is known as its oleophilic capacity. This study compared the oleophilic capacity of five different plants when cleaning oil from water and looked at which characteristics of a plant may impact their oleophilic ability. Golden Pothos, Lady's Mantle, cattails, dried Spanish Moss, and Jerusalem Sage were tested to see which could absorb the most oil from a body of water. Each trial had a beginning weight of 200 grams of canola oil, 2000 grams of water, and 20 grams of plant foliage. The plants were placed in the water/oil mix for one hour. Then the foliage was removed and weighed to determine oil absorption. The results indicated that the leaf of the Jerusalem Sage soaked up the most oil, followed by Lady's Mantle and cattails. Dried Spanish Moss and Pothos Golden soaked up the least amount of oil. Jerusalem Sage was found to be the most oleophilic. It has hair-like structures (trichomes) on the surface of the plant that likely make the plant better able to trap oil. Meanwhile, Golden Pothos, which had no hairs, soaked up the least oil. Cattails were not he most oleophilic, but they were able to soak up a reasonable amount of oil and a very small amount of water. They were the most hydrophobic specimen studied. This ability to repel water while absorbing oil may make it a good choice for cleaning an oil spill out of a water source.

Austin Thacker 1-12-014

There Goes the Algae

Every freshwater ecosystem must have a food source for consumers. My experiment determined pH levels has an effect on algae growth. This benefits the balance of algae in our environment. Research proves algae can be both beneficial and harmful to a water ecosystem. Balanced pH levels in ponds are critical for organisms. My hypothesis was algae would grow best in basic pH when compared to neutral or acidic pH. This is because, I thought having less acid would help algae growth. First, I bought pH and algae from online. I combined equal amounts of algae culture salt and algae culture nutrients in three containers, containing water with 10, 7, and 5 pH levels. I observed their growth daily for 12 days. I learned algae grows better in 10 pH. The outer ring of the container with high pH was 85 percent covered and 1 to 2 millimeters thick. The outer ring of the container with low pH was 80 percent covered and 1 millimeter thick. The outer ring of the container with neutral pH was 77 percent covered and 1 millimeter thick. In conclusion, algae growth is most active in high pH. The results can contribute to the area of biology by helping biologists understand the impact pH has on algae. This can help in pools, landscape, and wetland areas. Research shows that some algae are harmful and some are not. This should be considered when fluctuating pH.

Clare Wiersma 1-12-015

The Night Time to Water?

The purpose of this investigation was to test if the watering time of plants (evening; morning) caused a change in the growth height. I hypothesized that the amount of hours of sunlight in a day would cause the evening watering time to be higher. This experiment involved watering plants at different times (morning; evening) and measuring the growth height (centimeters). The plant growth height was measured against a ruler from the top of the soil to the top of the stem. The data collected did not support the original hypothesis. These findings lead to the conclusion that watering time did affect the growth height of Wisconsin Fast Plants. The morning watering time (6:30) had an average growth height of 4.86 cm. The evening watering time (8:30) had an average growth height of 4.17 cm; therefore, based on the evidence, it is reasonable to conclude that when comparing morning and evening watering times, the morning watering time will cause the plant to grow taller by 0.69 cm.

Trista Marx & Kylie Freiman 1-12-301

Alfalfa: Nitrogen Fixing Bacteria vs. Nitrogen Fertilizer

The purpose of this project was to assist farmers who grow alfalfa. The problem being addressed is whether or not the nitrogen fixing bacteria will help germination and growth of the alfalfa more so than the nitrogen fertilizer. Alfalfa was grown in potted soil and germinated in petri dishes. Nitrogen items that were used include a concentration of nitrogen fertilizer and nitrogen-fixing bacteria inoculated seeds. The end results showed that the seeds did not germinate well in the petri dishes if too much fertilizer concentration was exposed to them. The application that had the greatest growth increase in the potted soil was the nitrogen fertilizer; however, in the petri dishes the common (no fertilizer or inoculant) managed to have the biggest effect on the alfalfa, followed by the nitrogen-fixing bacteria inoculated seeds. Additional research and tests may include researching further about how to grow alfalfa in the lab, as well as testing with a lower concentration of fertilizer in the petri dishes. This research shows that in the long run it may be cheapest to use only the regular alfalfa, but the fertilizer would be more beneficial for farmers' crops.