

Junior Division Animal Sciences

Kimberly Pargin & Kandace Pargin

JR-AS-001T

"Tap the PAP"

PAP testing is very important to the cattle industry. There has been a lot of research and experimenting over the 82 years PAP testing has been underway. First we started researching how much PAP scores are used in high altitudes. We also researched what happens to cattle in high altitudes with a high PAP. We researched very carefully in hopes to find just what we were looking for and we did. We found that not many people have really researched and done experiments on our topic for our Science Fair project. We suspect that if the sister/brother's PAP score is low (lower than 40), the calf has a higher chance of having a low PAP score unless he/she has had pneumonia or lung sickness.

Tatum Duvall

JR-AS-002

A Study on Acquired Immunity to Canine Distemper Virus & Canine Parvovirus in Vizsla Dogs

Just because a vaccine is injected, how do we know it results in immunity? How do we know how long immunity lasts? Is it the same for all dogs? How do levels of immunity derived from Canine Distemper Virus and Canine Parvovirus antibody titers relate to the vaccination status of Vizslas? Antibody tests for Distemper and Parvovirus were ran on 45 Vizsla dogs with varying vaccination statuses. These titers showed that 96% of minimally vaccinated Vizslas and 79% of fully vaccinated Vizslas tested positive for adequately protective Parvovirus antibodies while 63% of minimally vaccinated Vizslas and 74% of fully vaccinated Vizslas tested positive for adequately protective Distemper antibodies. Immunity levels were similar between the minimally vaccinated Vizslas and fully vaccinated Vizslas. This research shows that the use of titers to develop individualized vaccine protocols for Vizslas could not only maximize their immunity to these life-threatening diseases, but also reduce the possible negative effects of over-vaccination.

Mandy Roth

JR-AS-003

Does Jumping Higher Result in a Dog Landing with More Force?

In agility competitions, jump height is determined by the dog's height at the withers. This project investigates the relationship between jump height and landing force on a dog. The intention of the project is to understand how increasing jump height changes landing force on the dog within American Kennel Club jump heights used in agility competitions. The goal of this project is to understand how to keep dogs happy, healthy, and active. The question this project answered is: Does jumping higher result in a dog landing with more force? To measure this, I attached an accelerometer to a dog and directed her through a 9 jump sequence at four different heights, four different times. I used my dog who I have been training in agility for 5 years. The test involved collecting over 47,000 acceleration data points. I used the formula mass times acceleration equals force to convert the acceleration to force. I found that the higher the jump height the more force the dog experiences on landing. Over the 4 jump heights I tested, the largest force increase was from 12" to 16" and the smallest force increase was from 20" to 24". The experiment I conducted helps us understand more about the physics of jumping and the likelihood for injuries in K-9's. In conclusion the higher a dog jumps the more force they land with. To keep K-9's safer you should limit how high they jump and make sure that they are healthy and fit.

Junior Division Animal Sciences

Piper Reitz

JR-AS-004

The Great Crawdad Caper

My project was conducted to determine which bait; whitefish/tuna cat-food, dry dog-food, cubed bait-fish, and sliced hot-dogs, would be the most effective in catching crayfish. My hypothesis was that cat-food would catch the most crayfish, because the cat food had a strong, fishy scent. To conduct my experiment, I filled a 14-foot diameter pool to a depth of 30". Next, I caught 100 freshwater crayfish from a local canal, and housed them in two 59-inch kiddie pools filled with water. Lastly, I put each bait in one of the five funnel-style traps, and then released the crayfish in the 14-foot pool with the traps. I conducted the experiment in 12-hour long night time trials. Over the course of my experiment, I conducted 10 trials. During those trials, I had a total of 242 crayfish captures. Overall, the bait fish caught the highest number of crayfish, catching 137 crayfish. The next most successful bait was the dog food, catching 38 crayfish. The cat-food caught 37 crayfish, nearly tie-ing with dog food. The hot dog caught 18 crayfish, barely higher than the control, which caught 17 crayfish. My research was clear and successfully identified the most effective bait to use to catch crayfish. My research has made me a better crayfish fishermen and may help fellow crayfish fishermen. It may also help wildlife biologists in their efforts to conduct crayfish surveys.

Catherine Deacon

JR-AS-005

Sensing A Storm

In this project I tested different horses to see if they could sense a storm. I did this by checking their heart rate and temperature. I checked 8 hours before and every hour for five hours after to conduct my research and make the graphs. It is stated in the Texas Agrilife that horses have a much cheerier disposition in sunnier weather. During the more stormy weather horses tend to get restless and anxious. I believe that horses can sense a storm because horses have a wider range of senses than some people like to think. I am doing this project because I am fascinated by animal science. I also think animals have a wider range of senses than we think. Animals tend to have a very differential reputation whereas people think they are not as smart as they actually are. Which is another reason for me to do this project to prove my knowledge about horses and to show they are smarter than people like to think.

Junior Division Behavioral & Social Sciences

Claire Farrell

JR-BSS-001

Are You Masking Your Emotions? Reading Emotions Through A Mask?

This project was to see if people could still read emotions, as well, when wearing a mask. In my hypothesis, I stated that if half of a person's face is covered (mask, gator, etc.), then the ability to interpret people's emotions will decrease, because half of the face that demonstrates our emotions will not be visible. I set up this experiment by making a survey. The survey was four multiple-choice questions. Each question had a picture of me making a facial expression. The subject had to circle the emotion they thought I was making. The choices were happy, sad, angry, scared, and none of the above. I printed 50 surveys and 50 consent forms. We handed out the survey to 50 people, and added their answers to the data table. I found that the majority of people can still read emotions easily. The #1 emotion that gets mixed up is scared and sad. Eighty-two percent of people got sad correct. That was the lowest percentage of correct answers. This can be dangerous because depression rates are rising and if you can't see when someone is sad, they will just get sadder. In this experiment my hypothesis was overall disproven. This is because even though some people struggled, the majority of their answers were correct. I found it interesting that there was no emotion that everyone got correct. Ninety-eight percent of people got happiness correct, which was the highest number of correct answers.

Grace Jones

JR-BSS-003

Dog Treat

Dogs have been known as man's best friends. Petting dogs has shown to relieve stress. My project is to find out if looking at a picture of a dog changes people's emotions. The hypothesis that I believe is that pictures of dogs would make people happier. The experiment involved creating a google form, it consisted of 6 different pictures of dogs, a picture of a random item, and a question asking how does this picture make you feel. The answers they could pick are sad, mad, happy, or neutral. After making the survey I posted it on a social media platform so that people could take it if they wanted to. The answer with the highest average would be the one that most people felt. The random picture was to show how much happier the dogs made them. The averages ended up to be mad 0.1% sad 6.75% neutral 20% and happy 74.5%. This information concludes that my hypothesis is correct: pictures of dogs do make people happier. The random picture was happy at 14.9%, sad at 7.4, mad at 9.6% and neutral at 68.1%. These findings lead me to believe that pictures of dogs usually make people happier. But, depending on the picture it might make someone sad, neutral, or mad. From the results that I received I have come to the conclusion that pictures of dogs do make people happier.

Junior Division Behavioral & Social Sciences

Kaycee G. Clark
Was It Really Green?

JR-BSS-004

People of all ages encounter peer pressure. Peer pressure can be good like getting good grades because others are getting good grades. It can also be bad like taking drugs because your friends think that it is cool. The purpose of my project is to determine what age students are most prone to peer pressure. The hypothesis I investigated was that middle school students will be most prone to peer pressure based on a study by Laurence Steinberg and Kathryn Monahan that found that susceptibility to peer pressure increases during early adolescence peaking around age 14. I tested my hypothesis by observing groups of five people from each grade K-12 that were asked to memorize the colors of objects on a series of cards. Before two of the people came into the room, three of the five were asked to say that the image of a green star was actually blue. After being shown the cards, all five were asked what color the image of the star was. The three people that were told to respond that the image was blue responded accordingly, and then the other two were asked to respond to determine if they would agree that the green star was blue. Responses and hesitation were observed for signs of peer pressure. My study found students in grades 10-12 exhibited the most signs of falling to peer pressure, so students in these grades should be more aware of peer pressure and what they agree with.

Kabir Srivastava

JR-BSS-005

Guess How Many?

How does age affect the Wisdom of the Crowd test? My hypothesis was that the older the age group the better the result. My hypothesis was supported. After analyzing all of my data I was able to see that there was an upward trend, the average guess got closer when the age range got older. I completed this test by having people of different age groups guess the number of jelly beans in a jar. I recorded their ages and guesses. After collecting all of the data I could I averaged the guesses based on their ages. The age ranges were 0-11, 12-21, and 22+. The average of the oldest age group was 1455.89, the real number of jelly beans was 1800. My test results were not up to the standards of other important tests such as Galtons. The average of the test by Galton was within 10 pounds whereas my tests were extremely off from my true number. There are a few possible reasons for this. The largest one possibly being that my test subjects had incredibly close backgrounds. Most of the guessers came from my school. This is a problem because it could cause people to think in similar ways. The results of my testing lead me to believe that the older an age group the better the results of the Wisdom of the Crowds test. That result makes me think that guessing is a skill we can develop and older people are better at doing it.

Bella Ilgner

JR-BSS-006

How Do Artists Coordinate Color with Mood

The purpose of this project was to see how artists use color to bring out moods in a person. I hypothesized that artists use different colors in their artwork to make the viewers feel different moods. The experiment involved me showing people the same drawing but in different colors. I used primary colors, secondary colors, and tertiary colors. In conclusion the data supported my hypothesis which stated that artists use certain colors to make a person feel certain emotions. For example ,when I used the color black, most people felt sad. When I used the color Red, most people felt happy. Another example is when I used the color yellow, the people were torn between happy and confused. One last example is when I used the color blue, most people felt angry. Most of these were my intended feelings, some of the data surprised me. These findings led me to conclude that artists do indeed use different colors to make people feel different emotions.

Junior Division Behavioral & Social Sciences

Penelope Baxter

JR-BSS-007

Mind Body Connection

PMDD, which is more professionally known as Premenstrual dysphoric disorder, affects over three million people in the United States yearly. Even with such severe symptoms, this disorder is often misdiagnosed as a similar, yet less serious condition known as Premenstrual syndrome (PMS). This poses the question, "What symptoms, relating to the physical and mental state of menstruating people, does PMDD cause, and how do they affect them? In this project, the symptoms of PMDD are surveyed in order to better understand how they affect the people located in the target age group. A survey was created, taking into account the physical, behavioral, and emotional symptoms that PMDD causes. Based on the symptoms linked to this disorder, questions relating to physical and mental changes were asked. Applicants, aged 30-40 (controlled variable) were surveyed. In the week prior to their period (independent variable), these participants were asked whether or not they experienced the symptoms mentioned (dependent variable). My hypothesis was that, if fluctuations in estrogen and progesterone occur, then they will cause behavioral, physical, and emotional problems in people who menstruate. This observation was proved correct, as of the people surveyed, the majority experienced a spike in physical, behavioral, and emotional traits related to PMDD. Additionally, it became apparent to me that this disorder is highly relevant in this age group and causes many harmful manifestations.

Anesh Ilango

JR-BSS-008

The Army Within Ourselves!

In our daily lives we might be curious to know and understand about something better that is interesting to us. This study aims to investigate how well people know about the immune system that protects us from illness. Also, evaluates how well the audiovisual model might help them to understand "The Army Within Ourselves!". In this context, the title represents the immune system and macrophage (the large eaters). To test the hypothesis that people might understand better when presented with an explanatory teaching model, Structured pre and post surveys were distributed among 16 participants of different age groups (from ages above 5 to 40 years old). Then, I asked them to watch the audiovisual model. After 20-30 minutes, a quiz was conducted to test their memory and understanding of the context. Responses from survey data were analyzed using a student's t test method. The average test scores of quiz results were noted. The results of survey responses showed a statistically significant difference. This suggests that participants were active in learning and the data analysis supports the hypothesis. This supports the teaching model as understandable among different age groups when presented in a creative fun way. Due to covid-19 surge and restrictions, it's difficult to get more sample size for this project. Thus, concluding that people might understand and adapt to a healthy lifestyle when they are well informed with an effective teaching model. In the future this may help us to study different teaching models and their implications among different groups.

Junior Division Behavioral & Social Sciences

Shayla Lewis & Layla Gress

JR-BSS-009T

How Smell Affects Taste

Olfactory nerves play a big part in how we interpret what we eat and how it tastes. Olfactory nerves take in the smell of our food and our taste buds take in the taste of the food, both of these connect to our brain and therefore makes our food taste how we normally think of it to taste. We wanted to test what would happen if we were to change what we smell as we eat ice cream. We chose chocolate and strawberry as the ice cream flavors that we were testing with the scent that we chose was vanilla. From our background research we know that vanilla could make something taste sweeter. We hypothesized that by smelling vanilla it would change the flavor of ice cream. For our experiment we fed all of our participants one ice cream flavor without smelling vanilla, then again while smelling vanilla, they would then fill out a form asking how the flavor changed. With those results we used a rate of change scale to determine the change in flavor. The results proved our hypothesis correct. A possible extension would be to add another flavor of ice cream. We could also add another scent. This could help us determine if a less pungent smell would have the same effect on food that a more pungent scent did. Thirdly we could add a new age group. We only tested eighth graders because we wanted to get the same age group.

Rhegan Sitzman & Rylee Kelly & Taylor Morris

JR-BSS-010T

Does Color Affect Taste?

In this experiment we will be testing to determine if the color of something affects the taste of a beverage or food. The purpose of this experiment is to find out if sight will change the way you taste apple juice. Like a blue color making it taste like a blueberry, or the color red making it taste like a cherry. We hypothesized that the colored beverages would persuade people's choices to make them think differently. We think that the color red will be favored the most because it is one of the sweetest tasting colors. For this experiment we used four ounces of apple juice, six clear plastic cups, and six different colored dyes and another clear plastic cup of water for cleansing a palate. We had each volunteer take a sip of each cup and order the cups from greatest to least six as their favorite all the way to one as their least favorite. After we had finished the experiment we finally determined that the subjects had favored red the most, because it tasted sweetest whereas yellow and green were disliked more because their brains told them that they were more tart/sour. In conclusion we supported our hypothesis because when we look at something we do judge it by its color.

Junior Division Behavioral & Social Sciences

Julia Ropp

JR-BSS-011

The Power of Positivity

Positive Psychology is the study of the conditions and processes that contribute to the flourishing or optimal functioning of people, groups, and institutions that facilitate a person's development in areas such as school, work, and everyday life. My project tested the outcome of teenage females that consistently wrote down 3 gratitudes for 21 days in a row to increase happiness levels and decrease stress levels. A group of 30 test subjects took a pre-survey to analyze how they felt and their reactions to certain situations. They were then split, so half would write three things they were grateful for and the other half would write three things that displease them for 21 days. Once a week they would take a survey the same as the pre-survey and at the end of the 21 days, they would take a post-survey same as the previous surveys. The t-test values for comparing 8th-grade pre-test and post-test were 0.003094086686, 6th grade 0.04364980, and 7th grade 0.04973556312. All these numbers are below 0.05, the value in which higher data points will be highly correlated. When each number is rounded to the nearest thousandth (8th 0.003, 6th 0.044, 7th 0.050) they are all statistically significant. Therefore, there is almost no relationship as expected. This shows that over the 22-day period the data changed in a positive way. If a female that is in the age range of 12-14 writes down three things they are grateful for over a 22-day period, will cause a reduction of stress and improvement of happiness. A female that is in the age range of 12-14 writes down three things that displease, irritate, or annoy them over a 22-day period will increase stress and decrease happiness.

Berkley Ulibarri

JR-BSS-012

The Power of Suggestion

This project is testing the power of suggestion. This experiment is a perfect fit for the behavioral science category. The experiment tested different age groups and gender, to see whether they agreed to my suggestive questions. The questions were asked in a way to make them question their memory. The experiment was having the subject look at a picture for one minute. They then had to describe the picture in writing with the most detail possible. The written description was designed to help them remember the picture better than if they just looked at it. The next day is when the questions came into play. A series of questions were asked, some of the questions were normal questions about the picture. The rest of the questions were asked in a suggestive way. The hypothesis was proven correct, the power of suggestion was successfully used to change someone's memory of a picture. The subjects agreed with my suggestions more than they disagreed. It was observed that the women were easier to persuade than the men. The descriptions were also very interesting, the various subjects described the picture in very different ways. The experiment was proven to be used in the real world when the power of suggestion has been a questioning tactic for world-renown organizations. Interrogations leading to wrongful convictions is one example where this tactic is used wrongly and is a real problem in our world.

Junior Division Chemistry & Biochemistry

Charli Martinez

JR-CB-001

Wood vs. Humidity

Wood is unquestionably one of the most common types of building material, particularly for items such as furniture. Softwood is the most widely used of the two types of wood in the world, hardwood and softwood, because it is the cheapest. But which type of softwood, hemlock, pine, and white wood is the safest and wisest to utilize? Within this experiment, three varieties of softwood (hemlock, pine, and whitewood; independent variable) were examined in this study and found to be the most durable under certain conditions, such as humidity. Before and after each piece of wood was subjected to humidity, the length, width, and height (volume) were measured (dependent variable). Another observation taken was if the wood had any obvious deterioration. My hypothesis stated that whitewood would be the most impacted and least durable when exposed to humidity due to its habit of absorbing moisture easier than the other woods tested. The experimental results proved my educated guess correct by the whitewood suffering the most damage after being exposed to humidity, whereas the hemlock and pine wood suffered less. Furthermore, these results also demonstrated that pine wood is probably the safest and wisest wood to utilize in furniture construction.

Gaby Falter

JR-CB-002

Effect of pH on the Reaction Time of the Enzyme Amylase

Enzymes are proteins that help speed up metabolism. One of them is alpha amylase found in our saliva to help transform starch into simple sugars, to help with digestion. To find how fast complex sugars can be broken down by it, two experiments were conducted to determine the optimum pH for this to occur, and to confirm if the starch was converted into a simple sugar. Theoretically, alpha-amylase will reach its highest enzyme activity closer to pH 7. Initially, to determine the rate of reaction, a test was completed on solutions containing starch, amylase, and iodine at different pH values. The mix of starch and iodine generated a dark blue color, which cleared once amylase was introduced. The time for this change to occur was measured and compared. This was followed by the application of the Benedict's test, where the resulting precipitate helped confirm if the reaction occurred. The results show that pH 9 was optimal because of the fastest time to observe a color change. Even though alpha-amylase was used, the used powdered version was a type of alkaline (higher pH) amylase, where the optimum pH is between 9 and 10.5. The experiment and results are important and can be applied in the food industry, especially during the brewing and fermentation processes. The iodine test can be used to determine if the breakdown of starch occurs and how fast. In a future experiment, if trying to determine if pH 7 is the optimum, actual saliva should be used.

Junior Division Chemistry & Biochemistry

Arath Carrazco

JR-CB-003

Flaming Gummy Bears

The purpose of this project was to test what is the reaction when you mixed potassium chlorate and gummy bears. My hypothesis was that the Haribo gummy bear was going to have the biggest luminous reaction and the longest reaction. To make this experiment possible different items were needed. Potassium Chlorite and three different types of gummy bears were the main elements. Using the test tubes and heat will help the melting of the potassium chlorate. When melted add the gummy bear to make a reaction. Remove the test tube and right down results. To have more accurate results this procedure needs to be made multiple times in order to get better results and observe the luminous reaction. The data collected did not support my hypothesis. The Haribo lasted 40.41 seconds and was the 2nd brightest. The Albanese gummy bear had a time of 41.04 seconds and was the brightest out of the three. The black forest gummy bear lasted 52.17 seconds and was the 3rd brightest gummy bear. These things lead me to believe that sodium was the changing factor. I believe this because the Albanese gummy bear was the brightest gummy bear which had low sodium in it.

Ayla Coffey

JR-CB-004

Growing Epsom Crystals in Eggshells

In this experiment, I grew Epsom Salt crystals in eggshells. I decided to do this project because of my interest in the growth of crystals and minerals. I wondered if the crystal growth rate would be affected by the temperature. My project involves testing crystal's growth, by weight in grams, using water temperature as my variable. My results suggest warmer temperatures increase the rate of crystal growth.

Lexi Zimmerman

JR-CB-005

Extracting DNA

The title of this project is Extracting DNA. The purpose of this experiment was to test if I could see the difference in a strawberry with and without mold. I would also be learning more about how mold can affect DNA. I hypothesized that I would easily be able to tell the difference and was proven correct based on the difference in color and texture. This experiment involved moldy and ripe strawberries and observing the results. I mashed both strawberries into separate bags. Then I added a mixture that is made with dish soap, salt, and water. Next I strained both into separate bowls adding rubbing alcohol after straining the mixture. Finally, I observed what happened and wrote down the data. My data supports my hypothesis. By doing this experiment it proved that mold does have an impact on DNA. I found this out by extracting the DNA. Then I compared and contrasted many components. I looked at pictures that I had and compared the different textures. They had differences that you could easily examine. The results that I collected was that a moldy strawberry had a very thick texture but was runny. The color was white and clumped up into a tiny ball. The ripe strawberry did not look thick but it held its shape. The color was red and it spread like a cloud with lightning. The final result is by looking at the different strawberries in a plastic container, you can see the obvious and noticeable differences.

Junior Division Chemistry & Biochemistry

Brigid Morin

JR-CB-006

Nothing Is Black or White: How Chemicals Affect the Amount of Light that Paint Reflects

My project was about how chemicals affect the amount of light that paint reflects. My hypothesis was if four types of paint are compared that are made up of deferring pigments and fillers, then the paint with the least number of fillers and most high-quality pigments will be whitest. In my experiment, that was the advanced acrylic which has Titanium Dioxide and Zinc. I did this experiment by painting equal portions of each paint of a black canvas. There were three tests for each paint, advanced and beginner acrylic, oil, and latex paints. Then, I averaged the (red, green, blue) or RGB and hue, saturation, lightness levels of reflection or color. With HSL, percentages range from 0% (black) to 100% (white), so the goal was to get as close to 100 as possible. For RGB, colors are ranked from 0-255 in red, green, and blue. (255, 255, 255) is white and the aim was to get as close to white as well. The professional acrylic was 88% of light reflected, the basic acrylic was 86%, the oil paint was 82%, and the latex was 84% for the Lightness level. My hypothesis was supported by the results because professional acrylic performed the best. This is because the BASICS acrylic contained the most Titanium Dioxide and Zinc which is known to emit infrared and reflect ultraviolet light. This is useful because the chemicals cool areas more than standard air-conditioners.

Lucas Hickam & Ruben Hatcher

JR-CB-007T

Integrity of Water Bottles

The purpose of this project was to test which brand of water bottle holds up longer under pressure from dry ice. I hypothesized that If we test multiple types of bottles then I believe that higher priced brands will hold up longest under pressure because they might spend more on their containers. This experiment involved weighing dry ice on a small scale, crushing it up in a closed container, funneling it into a water bottle filled with 8oz of tap water, and closing the cap on a level surface. The data collected did support my hypothesis because the higher priced brands (Dasani and Aquafina) held up the longest. These findings lead me to believe that higher priced water bottle brands put more money into their bottles.

Taryn Wickham & Jocelynn Middlemist

JR-CB-008T

Quandary with Your Laundry

Stains show up in our everyday lives, at the most inconvenient times of course, so we decided to do a project that laid out the best way to get the annoying stains out. We tested four laundry detergents, some more common and others on the inexpensive side to compare. Our experiment consisted of “spilling” different food items onto T-shirts and throwing them in the wash to uncover which detergent did the job. While none of them removed the stains completely, some were effective in tackling most of the stain and making it less noticeable. We collected data and ranked the T-shirts to identify the most effective to least effective detergents. The last steps consisted of comparing cost and researching the science of stains removal to piece together a better understanding of our results.

Junior Division Chemistry & Biochemistry

Shirley West

JR-CB-009

Pipette Rockets

Hydrogen gas and acetylene gas are both highly combustible, yet hydrogen is more commonly found in rocket fuel and acetylene in welding and metal cutting. It was predicted that hydrogen would propel a pipette rocket farther than an acetylene gas rocket in a 2:4 oxygen to hydrogen gas ratio. However, after testing hydrogen gas and acetylene gas rockets, it was found that acetylene had an overall farther distance flown by the pipette rockets in a 4:2 oxygen to acetylene gas ratio.

John Butler

JR-CB-010

Smokin' Hot Native Timber

Which native wood will burn the hottest and cleanest, therefore cooking the best pizza in a wood fired pizza oven? I think the aspen will be the best to cook pizza, meaning it will have a high temperature and light intensity and low CO₂ levels. Collect local wood: pine, aspen, oak, and chokecherry. Cut 1kg of each type of wood. Put pine in a pizza oven and start a fire, after it is going add one of the test woods. Take an initial temperature, CO₂ and light reading. Let the wood stove warm up. Take a final temperature, CO₂ and light sensor reading. Use the labquest 3 for the CO₂ and light sensor readings and the laser thermometer for the temperature. Repeat for each wood type and complete three trials. Calculate the averages for the data. The best wood is the one with a high temperature, high light intensity and low CO₂ levels. The data I collected sported my hypothesis. Out of the native timber tested, aspen reached the highest temperature and had the second lowest CO₂ level. Aspen in the pizza oven reached an average temperature of 545°C. Aspen had 4850 ppm of CO₂ at the highest level. A wood fired pizza oven needs to be at 450°C to cook pizza perfectly and you want a wood with a low amount of CO₂ so the pizza doesn't turn black. My tests were done after dark, so the light intensity meter read zero the entire time.

Adaline Pedersen

JR-CB-011

The Charcoal Challenge

The purpose of this project was to determine which brand of charcoal gets the hottest. I hypothesized that Kingsford would get the hottest. My motivation for this project was that I am a chef/outdoor cooker and I wanted to see which charcoal really was the best. The experiment involved lighting 15 charcoal briquettes of each brand on fire and testing the temperature for thirty minutes, checking temperatures at 5, 10, 15 and 30 minutes after the start of the experiment. The data collected did support my original hypothesis. After checking the temperatures of the three brands of charcoal for 30 minutes I found that Kingsford Original Charcoal got the hottest. These findings help me conclude that if I wanted to cook something quickly but needed the fire to be very hot, I would use Kingsford.

Junior Division Chemistry & Biochemistry

Kyra Griffin

JR-CB-012

The Effectiveness of Over-the-Counter Lactase on Lactose Intolerance

Approximately 65% of the worldwide population experiences gastrointestinal symptoms including nausea, vomiting, diarrhea, bloating, gas, and abdominal pain. These symptoms may be attributed to a “reduced production of lactase after infancy”, commonly known as lactose intolerance. To improve tolerance to products containing lactose, this project sought to determine if lactase in a caplet or drop form would be more effective. After treating 1% cow’s milk with two different forms of lactase, a glucometer was used to measure the glucose content in each series after a twelve-hour refrigeration period. The results were inconclusive as to which product form is more advantageous to someone with lactose intolerance. However, less variability in glucose levels using a smaller dose in both caplets and drops was observed. Minimizing gastrointestinal symptoms can still be accomplished by using an over-the-counter product in combination with education about lactose levels in food.

Maggie Gorton

JR-CB-013

Vanishing Vapors

Water doesn’t actually disappear, it turns from a liquid into a gas which is called evaporation. This happens because the sun heats the liquid and that is how it turns into a gas. However, I think adding an air source to the heat will speed up this process of evaporation even more. Materials gathered: sponges (3), portable heater, portable fan, water, timer, measuring cup ($\frac{1}{4}$ cup), metal bowls (2), and cooling racks (2). I built platforms out of metal bowls and cooling racks for each of my sponges to sit on. I poured $\frac{1}{4}$ cup of water on each sponge and placed the sponge on the platform in front of the heater and in front of the fan. I set a timer and checked the sponges every five minutes. I used the process on the third sponge and placed it on a platform that was in the middle of both the fan and heater. I set a timer and checked it every five minutes. At the 60-minute mark for all sponges, I squeezed the excess water from all sponges. The results of my experiment proved my hypothesis correct. It was true that the combination of both the fan (air) and heat dried the sponge faster than just the fan or heat alone. These results mean that evaporation happens at a faster rate when both heat and air are involved. So in nature evaporation would happen faster with the sun and wind together than separate.

Junior Division Chemistry & Biochemistry

Rielyn Surma

JR-CB-014

What Does Hair Crave?

The Purpose of this experiment was to find out if human hair and Golden Doodle hair reacted differently. I wanted to find out if we can use shampoo on dogs, is it just for their skin? I will be testing different liquids (Chlorine Bleach, Hydrogen Peroxide, and Distilled White Vinegar) on the human hair and the Golden Doodle hair. I would like to find out if they reacted the same, or if they reacted differently. After Experimentation, I found out that the Golden Doodle hair, and the Human Hair reacted the same way. The Chlorine Bleach had disintegrated both the human hair, and the Golden Doodle hair. The Hydrogen peroxide had turned the Golden Doodle hair into a vanilla blonde color, while the human hair was left a little bit darker. The Vinegar had not done much to both types of hair, but it had moisturized it. The conclusion that I reached was that the goldendoodle hair, and the human hair had pretty much the same results. Special Dog Shampoo is made mainly for the dog's skin. If dogs had less sensitive skin, we would only have to buy 1 shampoo that would work on dog hair, and human hair. My research question was questioning what hair would be more sensitive to specific liquids. Both the human and the goldendoodle hair had pretty much the same reaction.

Bobby Kirby

JR-CB-015

What Makes Ice Melt the Fastest?

My experiment was to see what would melt ice more. I tested salt, citric acid, sugar, hot water, and dish soap. After pouring 1/2 tsp of each ingredient on an ice cube I set a timer for 10 minutes. After ten minutes I took my controlled ice cube and compared it visually to the tested ice cubes. After I compared each ice cube I retested my experiment to double check my results. My hypothesis was that citric acid would melt the ice cube more. My hypothesis was incorrect because table salt melted the ice cube more.

Junior Division Earth & Space Sciences

Tenzing Matt

JR-ESS-001

Detecting Solar Activity with a Homemade Magnetometer

This research is important for many reasons. Radiation can affect the safety of pilots and astronauts in space. Most aircraft and satellites have built in magnetic compasses that can be affected by solar disturbances. Power grids have also been taken down by solar activity in the past. Lots of things run on electronics, from cars to medical appliances, airplanes and all our technological infrastructure, which can be impacted by electromagnetic radiation from the sun. My research could help us study and learn more about solar activity and maybe could even be used to find patterns in when solar flares happen. My hypothesis was that if there was a strong solar flare toward earth then the magnetometer will detect it because it is interacting with earth's magnetic field. I built two magnetometers and shone the laser every day at the same times and recorded how far the laser dot traveled. I repeated this three times a day for five days during December 28th 2021 through the January 1st, 2022. The results matched up with the readings from satellites monitoring space weather and solar activity on the Space Weather Prediction Center website. These findings show that a homemade magnetometer may detect solar flares. My hypothesis was plausible. I had a significant change in my readings on December 30 through the 31, 2021 which did coincide with a significant solar event therefore supporting my hypothesis.

Makai Chambers

JR-ESS-002

Discovering an Exoplanet

My goal for this project is to fully explain the state of an exoplanet. I was trying to figure out what information I could learn about an exoplanet from its star's light. First I used the Whipple Observatory near Tucson Arizona (sponsored by the Harvard Smithsonian Center for Astrophysics) to schedule images to be taken. Then I used those images to measure the relative brightness over time of the target star compared to nearby stars to find the dip in brightness over time. Using the dip in brightness I deduced that the planet has a tilted orbit, that it has a diameter of 30.575 EU's, that its distance from its star is 0.0696301 AU's, that its year is 7.3 Earth days long, and that it has a transit time of 3.1 hours. I was expecting to find a smaller gas giant far away from its star, instead I found a large gas giant close to its star.

Aidan Baar

JR-ESS-003

Does Soil Types Influence Fertilizer Availability To Plants?

The purpose of this project was to determine whether or not soil type such as silt, sand, and both silt and sand effect fertilizers availability to plants. The hypothesis was that sand would not be able to hold the nutrients as well as other soil types such as silt. To test this tubs of dirt were put into nine columns and then water was flushed through them and collected into catch cups. After the water dripped into the catch cups, the water was then put in to test tubes and put in a viewing box to see the levels of nitrate or phosphate. Powder would be added to test the levels of either nitrate or phosphate. The water was then tested right after it was added, 5 minutes, 10 minutes and readings would be taken after each one of them. The results after each testing was recorded on a sheet of paper. The data from this experiment does not support the hypothesis because the sand was able to hold on to the nutrients even though of the bigger particle size. The silt was surprisingly not able to hold on the nutrients as well as the hypothesis said.

Junior Division Earth & Space Sciences

Gabe Clark

JR-ESS-004

Paleo-Ornithology: Experimental Taphonomy & Bird Origins

It is likely that birds originated from dinosaurs. Taphonomy is the study of fossilization. Experimental taphonomy permits scientists to test how things may fossilize by recreating and analyzing the effects of certain environmental conditions. It might be possible to test ancient environmental conditions in such a way that explains why there are very few feathers in the fossil record. According to the hypothesis guiding this experiment, if environmental factors affect fossilization processes then feathers will decay more easily than bones when exposed to acidity, salinity, and heat/pressure because soft tissues such as feathers are more fragile. Colored chicken feathers were submerged in a 5% acetic acid solution at a pH of 2 and an instant ocean solution for three weeks. Feathers were also placed in an autoclave at 123 degrees Fahrenheit and 0.165 Megapascals for 2 hours. Treated feathers were then examined using a handheld microscope for any observed changes to the quill, shaft, and vane and compared with controls, which were chicken bones and untreated feathers. The results supported the hypothesis. Acidity, salinity and heat/pressure each resulted in changes to the structure and/or color of the feathers. Acidity and heat/pressure had the most effect on feather decay while heat/pressure had the greatest impact on changes in feather color. Initial environmental conditions could represent an important factor in the preservation of feathers in the fossil record. Understanding the effect of various environmental factors might help scientists in their search for preserved feathers in the fossil record.

Pace Wallace

JR-ESS-005

Wind Erosion

I wanted to see how plants affect wind erosion because around our farm I noticed the movement of soil was different in different fields and pastures during the drought. I hope the findings will help my family understand what happens when we are in a drought and the wind blows. I think there will be more erosion when there are no plants than when there are plants. Prepare tubs, 3 inches of dirt in each tub, collect trees and make some roots out of pipe cleaners. Glued pipe cleaner roots to trees and spread them out in the tub 0 in half of 1 tub, 2 in the other half, 4 in one half of the second tub and 6 in the second half of tub 2. Measure soil depth at the beginning. Turn the fan on high and let it run on each tub for 10 minutes. Measure soil depth and count the number of trees that are knocked over or tore out of soil. In the first box there was no change in trees or soil depth. In the second box there was no change in trees but it lost .5 cm of soil. The data tells us that there was more change where there were more trees than when there were less trees. My data did not support my hypothesis because there was less erosion in the box with more plants.

Junior Division Earth & Space Sciences

Noah Tice

JR-ESS-006

Does Elevation Affect the Amount of Alpha and Beta Radiation in the Air?

Alpha and beta decay is happening constantly in the air. Isotopes that release alpha and beta particles through alpha and beta decay are in the atmosphere. The atmospheric pressure will change at different elevations. A cloud chamber was built to see alpha and beta decay trails at two different locations with significantly different elevations (5,318 feet and 11,542 feet). Each test consisted of three trials with each being 15 minutes while counting the number of alpha and beta trails visible in the cloud chamber. There were 63% more alpha particles per minute and 37% more beta particles per minute at the lower elevation compared to at the higher elevation. The T-Test results from comparing the two data sets had P-values lower than 5%. This means that the two datasets are statistically significantly different. The results indicate that there is less particle decay in the air at higher elevations than lower elevations. This also means that people at a lower elevation are more at risk of lung cancer due to inhalation of more radon.

Junior Division Energy

Isabella Martinez

JR-ET-001

Bella's Ballerinas

When researching topics for my project, I decided that I wanted to choose an experiment where I could demonstrate electric energy. I researched looking for the best approach. I read about the Lorentz Force. I read how electric and magnet fields work, and how when together, they produce energy. I learned about homopolar motors and to how to build them and decided that this would be the best way to achieve my goal. If I place the copper wire on the positive end of the battery wrapping it loosely around the rest of the battery to the negative end where the magnets are attached, THEN the copper wire will conduct electricity from one end to the other, creating a force that causes the wire to spin. This is BECAUSE when you have an electric charge inside a magnetic field you create the " Lorentz Force." The placement of the copper wire was very important for the ballerinas to reach full spin capacity. You must ensure that the copper wire is touching the positive end of the battery, and that the remaining wire is loosely wrapped around the battery/magnets, allowing enough space to spin. I Illustrated a diagram with the correct placement and wrapping of the copper wire. Another variable would be the length of the copper wire. Using the correct materials and following the procedure correctly, anyone can have success. This experiment shows how we can use electricity in different ways and how we can expand our knowledge of it.

Fernanda Pastor Sepulveda

JR-ET-002

Heat in Hue

The purpose of this experiment was to determine which color absorbs the most heat, and which one absorbs the least amount of heat. The colors tested were black, dark blue, yellow, and light green. This project was chosen to determine if the hue absorbed the most heat, Research shows that black will absorb all wavelengths and reflect none. The lighter an object absorbs, the more heat absorbed since light is energy. Research also shows the only color that does not attract heat is white because white reflects all visible wavelengths of light. An object of a given dark color will absorb more photons. Based on this information, data should show that black absorbs the most heat, followed by dark blue, light green and yellow. Water was poured into 4 jars, which were then wrapped with the construction paper. The starting temperature was noted. To measure the starting temperature, drill a hole larger than the diameter of the thermometer into one of the lids. Using modeling clay to cover jar and keep the thermometer in place. Place the jar below the heating lamp, after 30 minutes, note the temperature. The jar with the black construction paper absorbed the most heat, raising up to 86 degrees Fahrenheit, the dark blue to 82 degrees Fahrenheit, the light green to 78 degrees Fahrenheit, and the yellow to 76 degrees Fahrenheit. These results confirmed the information from the research. The hypothesis was correct, black did absorb the most heat, and yellow absorbed the least.

Junior Division Energy

Saatwik Das

JR-ET-003

Magnetic Levitation

What is the effect of the type of magnet on the height at which it levitates? The hypothesis was that the type of magnet will affect the height that it levitates against an electromagnet when the magnet has a weight on it. The project tests if the height that a magnet levitates is affected by the type of the magnet. The magnets had weights duct taped to it, and then it was dropped into a tube, over an electromagnet with the poles of the electromagnet and the magnet facing each other. The resulting magnet+weight levitates over the electromagnet, and the height at which it levitates is measured. The hypothesis was supported by the results of the experiment because they show that the neodymium magnets had significantly levitated higher than the other samples.

Skyelyn Lefever

JR-ET-004

Homemade Battery

The purpose of this project was to see how you can make a battery with the most voltage and what battery can even get voltage. I hypothesized that only two out of the four batteries would get voltage, my hypothesis was incorrect because all of the batteries got voltage even if it was the slightest bit. This experiment involved stacking up pennies and nickels, pennies and washers, and pennies and foil. The reactions upon the stacks depended on what you had stacked up. Four batteries were made layering each differently every single time. All of the reactions were different because there was a varying voltage between the batteries. The data didn't support the original hypothesis because all of the data shows that the batteries got voltage and my hypothesis was that only two of the batteries would get voltage. Each of the voltages in order from least to greatest are 0.18, 0.64, 1.83, and 3.27. This caused the data chart to be spread out because none of the voltages were equal. The average voltage of all of the batteries was 2.18 which was a lot higher than I thought the average would be. Therefore, my data didn't support my hypothesis because all of my batteries got above 0 volts. These findings lead me to believe that when you layer things differently energy transfers through the materials in a different way. When you layer things it is most effective to not have the metals touching.

Julian Parker & Jaiden Hwang

JR-ET-005T

Ooze to Energy

We tested different types of mud and which would produce more electricity in a microbial fuel cell, to find what type would be the most efficient to fight against climate change. We use plastic containers, vinyl tubing, copper wire, agar, and aquarium pump tubing to build three microbial fuel cells. We put our three mud samples into the cells to let the bacteria break down organic material into energy. The South Platte River fuel cell had functionality issues, therefore, we focused on the other two fuel cells. The local pond microbial fuel cell initially generated more electricity, but within a week, the reservoir microbial fuel cell out-produced it. The reservoir produced an average voltage of 0.031V while the local pond produced an average voltage of about 0.025V, showing that the reservoir was a better source for energy production. The potential errors suggest that these results may not be reliable and further research is needed to support or refute these findings.

Junior Division Energy

Gemma Braza & Lilyanne Oldham

JR-ET-006T

Bright On! Illuminating the Solar Oven

Our project was an investigation into the most favorable shape of the inside of a solar oven for the fastest increase in temperature. Efficiency and rate of temperature increase are crucial for cooking because an appropriate temperature and pace for heating is necessary for the uses of solar ovens, such as baking and water pasteurization. Optimal ovens allow communities with poor energy infrastructure to take advantage of a powerful cooker using attainable resources (cardboard, etc.). The outcome of this experiment indicates the ideal solar oven shape. We took a box, covered the inside in aluminum foil, and put plastic wrap over the top for the control oven. Other shapes were made by taking the control box, shaping cardboard, covering it in foil, and inserting it in the box. A dowel with two marshmallows (which each had a four cm radius) was placed nine centimeters up from the base. We placed all four in direct sunlight for one hour and took the temperature of the marshmallows every five minutes to find the optimal design. The control increased by $0.6\text{ }^{\circ}\text{C}/\text{min}$. The parabolic shape increased by $0.7\text{ }^{\circ}\text{C}/\text{min}$. The trapezoid increased by $0.45\text{ }^{\circ}\text{C}/\text{min}$. The triangular increased by $0.4\text{ }^{\circ}\text{C}/\text{min}$. The parabolic interior performed the best, with the temperature increasing at the fastest rate ($0.7\text{ }^{\circ}\text{C}/\text{min}$). The control/rectangular was the second best oven, with the temperature increasing at about $0.6\text{ }^{\circ}\text{C}$ per minute. It is the best shape for a solar oven.

Junior Division Engineering

Cuinn Archer

JR-ENG-001

Automatic Water

My topic was making an automatic plant watering system. I chose that as my project because my plants always died because I forgot to water them. My goals were to have it automatically water based on the plant water level, cost under 35 dollars, be partly solar powered, make it aesthetically pleasing, make it compact, be remote controlled, have it tell you when water level is low, and be able to turn the watering system on and off. For my project, I designed and printed 3D parts, cut and screwed wood together, wiring the breadboard and arduino, coding the arduino, putting things in the appropriate place, and calibrating the sensor. My contraption worked, but had a few flaws, such as the water dish not popping back up, and not reaching my goals of making it remote controlled, making it solar powered, and making it under 35 dollars. I learned how to code and wire things for arduinos, and how to design things to be able to 3D print them.

Payton Zieske

JR-ENG-002

What Foundations Are Best for a House with Settling Problems?

People really don't know what materials are best for making a foundation good for an area with settling problems. For my science fair project, I will be testing 3 materials that are used to build foundations. Those materials are concrete, styrofoam blocks, wire bars, and reinforced wire. There are 3 types of foundations. One of them has a styrofoam barrier on the outside and the inside with concrete poured in the middle. The other foundations are slabs. The only thing different is the fact that one of them has a piece of wire in the middle. I am going to test the materials by building a 14" x 24" foundation made out of the materials and putting the foundation on a model of settling ground. I will make a model of settling ground using a thick board that will hold up the majority of the foundation but I will put a little bit of the foundation off of the board. Then I will add 5 pounds to the edge of the foundation till it cracks and breaks. I will do this so the foundation will settle faster. I was surprised when the solid slab of concrete held up the most weight. It held 45 pounds and then broke. The foundation that I thought would do the best but didn't was the reinforced wire. The foundation that did the worst was the styrofoam foundation.

Junior Division Engineering

Ayush Vispute

JR-ENG-003

DirtCheapFilters

Millions of people do not have access to clean water for personal use and there are few cheap and accessible alternatives. This project aims to create an easily accessible and cheap water filter that will produce water usable for cleaning and washing. The filters will be engineered when water bottles are cut from the bottom and top. Later, cloth is attached to the bottom for filtering. Additional filterers such as sand will be placed inside the water bottle to enhance and complete the filter. The project will test if increasing filtering layers increases efficacy, and which materials are most efficient at filtering water. Efficiency of filters will be determined by qualitative observations of color and odor and quantitatively through the evaporation test of filtered dirty water. Results demonstrated that the most effective filterers are sand and cloth, leaving the least odor and highest efficiency on the evaporation test. Increasing layers of filtering materials increases efficiency but decreases speed, however, the filter still works in a timely manner, capable of filtering large amounts of water in little time. These filters can be expanded globally as filtering materials are easily accessible around the world. These filters can be advanced by introducing clay into the project. Clay is not as accessible in many parts of the world, but is cheap and can be bought for widespread filter production. Clay is effective at removing pathogens from water and can produce water usable for drinking. Accessible substitutes for clay are still being researched by me.

Jakoby Ross

JR-ENG-004

Gear Down for What 2.0

The purpose of this experiment was to write the coding for an automatic transmission for a bicycle that shifts based on incline. Mountain biking can be a challenging sport and knowing how to shift gears and having to move your hands away from the handlebars to do so is difficult. I want to help make the shifting process easier and make sure riders can keep their hands in place. I used Arduino Create to write several codes that would control a gyroscope and servo motor. The combination of codes successfully made the LEDs and servo motor respond to a change in incline. As my project progresses, I will print a box to house the arduino equipment and design a way to mount it to the bike and connect the shifting cable to the servo motor.

Jacob Kossler

JR-ENG-005

Laminar or Turbulent Flow?

I am trying to find which shapes have more laminar or turbulent flow. This could be important because it can help us understand the physics of flight. I built a wind tunnel based on a design from the NASA Glenn Research Center. I tested 5 different shapes in the wind tunnel and took pictures of each piece to document which one I thought had the most laminar or turbulent flow based on the patterns in the smoke. I found that a smoother symmetrical design has the most laminar flow, and a more rough, bumpy design is the most turbulent. The symmetrical piece would be a good design for the nose of a plane because it has good laminar flow, but not enough turbulence for a wing, in other words it is aerodynamic. The block is not good for anything on a plane because it has all turbulent but no laminar flow, in other words it would cause only drag. The typical wing is a good design for a wing because it has a balance between laminar on the bottom of the wing, and turbulence on the top of the wing which provides lift for a wing.

Junior Division Engineering

Isaac Silvers

JR-ENG-005

The Power of Sail: The Effect of Sail Shape on Distance Traveled

The purpose of this experiment is to determine how the sail shape affects the speed of the sailboat. I researched this to determine which sail shapes used throughout history were the fastest. I built a boat and made several sail shapes: triangle, gaff, square, wing and oval. I attached the different sails to the boat and blew a fan on the boat. I timed how long the boat took to cross a bathtub. Some trials failed when the boat didn't reach the other side. The average time for the triangle sail was 30 seconds. The average time for the oval sail was 19 seconds. The average time for the square rig was 6 seconds. The gaff and the square rig were both under 2 seconds on average. My hypothesis was correct. The triangular sail was the fastest and always got to the other side of the tub. Sailors could use this to determine what sail shape is faster to win races or determine what sails allow for more control. Sail shapes have changed for thousands of years, and I believe there is still room for more improvements.

Andrew George

JR-ENG-006

Moving Water with the Archimedes Screw Pump

Prepare to be amazed! The researcher will be able to move water with just a few turns of his wrist. Some may think it is magic, but it is not. It is simply the Archimedes screw. In this project the researcher will build a very simple pump called an Archimedes screw, to move water from a lower place to a higher place. This project compares two different sizes of tubing wrapped around the same size of PVC pipe elevated the same height, to see which tubing moves water faster. In this project the researcher thought that the larger tubing would move more water faster than the smaller tubing. After running 3 trials with both sizes, the researcher found out that he was correct.

Alyson Buchanan & Lillie Cordova & Alliana Corchado

JR-ENG-008T

Clean Rivers: Freshwater Cleaning Design

Water pollution has been a serious problem for years regarding wildlife as well as the effect it has on the human species. Statistics say 40% of rivers in the U.S are polluted, and 45% of lakes are polluted causing an unsafe and unsanitary living environment for animals. Rivers contain an amount of sewage runoff that can severely affect the natural habitats of wildlife. As well as damage the supply of freshwater that us humans need. Our driving question for the Fulton Heights Charter Academy's STEM Fair was: "How can we as makers and community leaders design solutions to address challenges in the United States, using the three pillars of Sustainability: Earth Care, People Care and Fair Share?" We were motivated by the aspect of Earth Care to design many solutions to clean our beautiful rivers. IF we can clean rivers with our simple technology, then, we can prevent waste from getting to our oceans. We used the STEM Design process to get to our initial prototypes. We did research on the need for a product like this and found there is a high need. We met our design criteria of meeting the 3 Pillars of Sustainability in our prototypes. We designed a simple design with nets and moving motors to clean rivers before the trash gets to the oceans.

Junior Division Engineering

Aanshi Shah

JR-ENG-009

Wheel of Fortune: A Novel Approach to Prevent Wastage of Water

Showers are the third largest use of water (1.7 trillion gallons per year) in a typical American home. My project aims to identify and help prevent household wastage of water; an easy way to save water.

To identify the extent of this wastage, I used a fidget spinner to devise a water wheel. Using submersible pumps with different levels of power, simulations of different flows through showerheads were created. The speed of the water wheel was recorded under different flows. My independent variable was the flow rate of water in gallons per hour. My dependent variable was the speed of the water wheel in rotations per minute. The data collected was used to identify the relationship between the speed of the water wheel and the flow. The data analysis established a strong correlation coefficient (R^2) between the flow rate of water (x) and the speed of the water wheel (y). I was able to derive a formula ($y = 2.67x$) to describe this relationship. The amount of water used can thereby be accurately calculated for any duration from the speed of the water wheel under flowing water. This information when available may motivate an individual to practice reduced water consumption during showers as per the Theory of Planned Behavior; thereby preventing household wastage of water. My next goal is to test this behavioral change through a smaller water wheel that, when installed in the shower drain, will provide the water usage information in a digital format on the showerhead.

Parker Mitchell

JR-ENG-010

Spin That Wheel II

This year for science fair I am continuing my project from last year. Last year, I made a hydroelectric waterwheel for my grandparents off-grid cabin. They have solar but it does not generate enough electricity to keep their C-PAP's running all night. More than 99 percent of power in Norway is hydropower. Hydropower can save you lots of money. For example, it costs 0.85 cents per kilowatt hour. This is one quarter of using natural gas (Wisconsin Valley Improvement Company, 2022). I designed my waterwheel last year. This year, I built a bridge to hang my waterwheel from. I mounted my waterwheel from the bridge over the creek. I mounted my waterwheel with a trailer winch so I could change the submergence levels. Then, I tested it by connecting the DC motor to the solar panels. I found that it produced 4 watts (W) of electricity in the winter. Next, I attempted to modify my wheel by changing the channel to make more electricity; however, nothing was successful.

Junior Division Engineering

Thatcher Watkins-Brown

JR-ENG-011

Transmitting Data Via Light

This experiment was created to determine how data could be stolen off another “air gapped” computer. Air gapping is where a computer is not connected to the internet or any other network. This will prevent attackers from being able to take data off the computer. The question that the experiment was created to solve was: If there is a device to transfer data, will it be able to reach the speeds of transfer that other researchers were able to reach? The hypothesis was: If the lights on the device start to blink faster, then the data loss will increase because there is less time for the sensor to register the data. The variable that this experiment tested was data transfer rate, determined by how fast the light flashed. This experiment used an LED coded to blink quickly to transfer data via binary to a phone. To capture the data being sent there was a phone with the app “Phyphox” downloaded. At 20 bits per minute the data loss rate was less than 1%, however, at 240 bits per minute the data loss rate went up to more than 51% making the message unreadable. This experiment showed that as an LED flashed faster, the photoreceptor being used to capture it had more data loss. After the experiment had run, the conclusion was that as lights start to blink faster, the data loss does decrease because the sensor cannot register the data as well.

Isabella Sophia Delhierro

JR-ENG-012

How Can the Energy Created from a Solenoid Engine Be Used To Create Electricity To Power Things?

The purpose of my project was to find out; How can the energy created from a solenoid engine be used to create electricity to power things such as a light or a jump rope? When experimenting with the engine, it ran on a 9v battery for a designated time of 10 minutes. The electricity made by the piston was measured with a simple voltmeter every 30 seconds and recorded in a data table. After 7 minutes the engine slowed down then stopped due to energy loss. At time 0 there were 0 volts because the engine was not running, at minute 3.5 there was 1.6v, and at minute 7 the engine stopped running. The average from beginning to end was about 1.48v. From minute 1 to 3.5 there was a steady amount of volts from 1.58-1.6. Once the engine stopped, I attached a second battery to make sure the engine was able to run and that there wasn't a malfunction. I concluded the reason it created 0v and came to a stop was because it lost too much energy throughout the system and could no longer sustain itself. I also concluded that the engine didn't make much electricity because of inefficiency, friction, and the copper wires being the wrong thickness. If there was little to no resistance, all the correct materials were present, and nothing was out of place I believe it would improve the design.

Andrew Simmons

JR-ENG-013

RC Aerodynamics

My topic was RC aerodynamics. I chose it because I like to drive my RC cars and I thought aerodynamics would be a good idea. My hypothesis was that the flat body will make the car have the fastest time out of all of them. So what I did in my experiment was I built the bodies out of cardboard. Then I taped the bodies on the RC car, ran the test, then I did the same thing over and over until all the bodies have gone 3 times. I learned that a car with less of a structure will be the most aerodynamic and the fastest.

Junior Division Engineering

Chayton Feaux

JR-ENG-014

Ballistics Testing: The Effect of Temperature on Projectile Penetration into 10% Ballistics Gel

How does temperature affect the penetration rate of a projectile? In this experiment, temperature was used as an independent variable to test penetration of a .17 cylindrical projectile (bb) into 10% ballistics gel. The penetration depth was measured in four blocks at different temperatures. This test determined how deep the bb would penetrate into the ballistic gel at various temperatures. The test involved shooting a bb into the 10% ballistics gel at a distance of 10 feet with a constant projectile velocity. The experiment determined that the penetration rate of the projectile increased as the temperature went up. In the end, my hypothesis was supported because the depth rate continued to go up in every block of gel.

Junior Division Environmental Sciences

Sophia Zhang

JR-ENV-001

A Small Bond Breaking Breaks Boundaries Toward the Solution to Plastic Pollution

The wastewater industry reports that about 55 percent of contact lens waste is dumped into soils, --translating to 11,000 to 12,650 kilograms of contact lens fragments ending up in U.S. dirt annually. A large portion of the remaining 45 percent (accurate statistics unknown) ends up in bodies of water. However, contact lenses do not degrade in the natural environment until after 500 years, which poses a serious threat to our environment. In this project, I investigated the degradation process of contact lenses, which were placed in different solutions of household substances such as hydrogen peroxide, 70% isopropyl alcohol, nail polish remover, etc. as well as harsh chemicals including acids and bases, by monitoring their change in diameter over time. The results concluded that the following three conditions are capable of degrading the contact lenses into several minuscule pieces with residue sizes of 0.5 mm to 1.5 mm: (1) the use of triazabicyclodecene as a catalyst in ethanol, (2) the use of a combination of trimethyl orthoformate, methanol, and sulfuric acid, and (3) the use of tetrabutylammonium fluoride at 60 °C. By contrast, the various experiments conducted using household substances yielded no results. The knowledge gained from this study offers potential solutions to contact lens degradation in the future, which would reduce contact lens pollution and better protect the environment for animals and humans alike.

Priya Mayjoy

JR-ENV-002

Arkansas River Water Quality Study

This project is about the study of the Arkansas River. It is important to know if the water is clean or not. I think that the Dissolved Oxygen levels will be higher in Leadville. I believed that the Carbon Dioxide will be higher in Holly than it will be in Leadville. When started testing I thought that the Turbidity would be higher in Holly. I also thought the pH would be higher or more basic in Holly. I used Aquatic kit AQ-2 for the tests pH, Carbon Dioxide, and Dissolved Oxygen. I used the Turbidity kit. For the Hardness of the water I used a testing strip, I dipped it into the sample of water. The Turbidity increased as we tested the Arkansas River. The dissolved oxygen decreased as I went away from the source. The Hardness of the Water increased to 25 when we reached Holly, CO. The Carbon Dioxide decreased as the elevation decreased. My hypothesis on Hardness of the water, Carbon Dioxide, Dissolved Oxygen, and pH was incorrect. I was correct on the Turbidity experiment. The Arkansas River started to get very dirty in Pueblo. CO. The Turbidity increased about 40 JTU. When I tested the Hardness of the water in Pueblo it increased from fifteen to twenty-five. Carbon Dioxide gradually decreased in Pueblo.

Junior Division Environmental Sciences

Brianna Rueb

JR-ENV-003

Discovering Decomposition

For my science experiment, I wanted to find out what material would decompose the most in soil by burying various materials in our vegetable garden. I wanted to see how much the microbes and organisms in the garden would break the materials down in 60 days. The rate a material decomposes can also vary due to temperature, moisture, exposure to sunlight, and the presence or lack of microorganisms. (stacker.com) In my experiment I buried the materials in the winter, so the soil temperature was cooler than it would have been in the other seasons. I also buried them in our vegetable garden so there were lots of microorganisms. The materials I used in this experiment included a cotton t-shirt, toilet paper, a paper towel, a notebook page, a magazine page, a pencil, newspaper, a disinfectant wipe, a plastic bag, dirt, and a shovel. My hypothesis was that if I bury these items for the 60 days, the toilet paper would decompose the most. My experiment would show what materials are the worst for the environment. My results showed the toilet paper decomposed the most followed by the paper towel and notebook page. Also, the newspaper and magazine mostly decomposed while the shirt, wipe and pencil showed very little signs of decomposition. The plastic bag didn't decompose at all. From my experiment, I discovered that paper decomposes more quickly than plastic. Therefore, I can conclude that plastic is a lot worse for the environment than paper.

Rachel Rademacher

JR-ENV-004

Effects of Fertilizer on Algae Growth

The problem is that too much algae in lakes is growing due to too much fertilizer leaking into lakes. The purpose of this experiment is to find the effects of fertilizers to see which kind grows the least amount of algae and is the least harmful to the environment. My hypothesis is that Grow Fertilizer will grow the least amount of algae because it has the least amount of phosphorus. To do this experiment, I took water from Milavec Lake and poured it into fifteen different aluminum pans. I then made the different fertilizer types, Ferti-Lome, Miracle-Gro, Bloom and Grow. I then added the fertilizer to the pans, three pans per one brand of fertilizer. I also didn't add any fertilizer to three of the pans. Then, I recorded the changes daily for twenty-two days. This resulted in Grow growing the least amount of algae. However, Ferti-Lome killed everything in the pan and Bloom grew the most algae. This concluded in Grow growing the least amount of algae being the best for the environment. Ferti-Lome killed everything in the pan, including the natural algae. Grow grew the most amount of algae. This is because they both had the most amount of phosphorus. This concluded in my hypothesis being correct. These results can apply to the real world because people can use Grow more than other brands of fertilizer since it doesn't grow as much algae as other fertilizers.

Junior Division Environmental Sciences

Anneke Ausema

JR-ENV-005

Marsh vs. Mower: A Study in How Human Disturbance Affects Biodiversity

The purpose of this project was to observe the effects of human activities, such as cutting grass, on the biodiversity of the short grass plains ecosystem. In June 2021 the grass behind the houses that backed Pelican Marsh was cut down by a new mowing company. This experiment explored how this affected the biodiversity of the area. The independent variable that was tested was level of human disturbance (grass mowed by the city) in the areas being observed. The dependent variable was the number of species seen. The data was collected through 30-minute observations of the disturbed area and the adjacent undisturbed (non-mowed) area. The natural area had 3 more unique species and 57 more unique organisms than the disturbed area. Most of the time the data from observations contained more of a species in the natural area than the disturbed area. Through these trends and the overall data, it can be concluded that cutting down grass does change the biodiversity of the short grass plains ecosystem.

Autumn Schulz

JR-ENV-006

Insulating with Recycled Materials

Plastic waste is a problem plaguing our society, filling our landfills and oceans. Affordable housing is greatly impacted by the cost of building materials. Can an individual utilize common household waste to replicate the properties of fiberglass insulation for eco-friendly construction? To test the effectiveness, I placed three different readily accessible mediums (sand, plastic bags, cardboard) inside 16.9 oz plastic water bottles to compare insulating value to R-6 fiberglass insulation. A 2-liter bottle with room temperature water was placed in the center of each of 4 buckets. Then 18 water bottles filled with each medium were layered around the 2-liter bottle and sealed. An infrared thermometer was used to take the temperature of the water before and after being placed outside. Temperature change was recorded at 8 and 24 hours. Data showed that over an eight-hour period the control (R-6) held more heat than the experimental materials; but, over a 24-hour period of time, all of the testing materials equalized. Results were similar after repeated experimentation. Alternative materials readily available performed as well as standard fiberglass insulation over a 24-hour period and were able to keep water from freezing despite exposure to overnight temperatures below freezing. Use of common household waste such as plastic water bottles, plastic bags, and cardboard could reduce building costs associated with affordable housing and be used to address immediate needs in the homeless community while simultaneously reducing waste going into landfills and the ocean.

Junior Division Environmental Sciences

Chayse Rawsky

JR-ENV-007

Ponder This - How Wildfire Affects the Growth and Health of Ponderosa Pine Trees

Effects from climate change have been increasing wildfire intensity and duration in western states. Last summer, poor air quality from wildfires caused Boulder County officials to recommend limiting outdoor activities for residents. If these outdoor conditions are unhealthy for humans, I wonder what effect it could have on the growth and health of our local forests. To test the effect of wildfire smoke on trees, I acquired Ponderosa Pine tree seedlings from the Colorado State Forest Service Nursery. I built two airtight chambers out of plexiglass and the seedlings were placed inside. Smoke from burning pine needles was introduced daily for 7 days into one of these chambers, while the other chamber remained smoke-free. The size of specific parts of each seedling including full height, biggest bud and top bud height and width, were measured on day 0, 7, and 14. Color observations for overall tree health were also recorded. Needle length measurements of the full tree height showed that all of the smoked seedlings shortened by 1cm, while the control samples either stayed the same size or grew taller by 1cm. Measurements of the top, biggest bud, or number of buds indicated a declining growth trend for the smoked samples compared to the control samples. Color observations reflected declining health in the smoke samples since some of their needles changed from green to brown. I believe these results occurred because particulate matter collected on the needles of the smoke-exposed samples, blocking their stomatal pores and light needed for photosynthesis.

Mathangi Kurup

JR-ENV-008

Phytoremediation of Lead Contaminated Soil Using Brassica Juncea

Heavy metal toxicity has become increasingly concerning for humans, animals, and environments alike. Although there are several remediation methodologies regarding metalloid removal, most are expensive, can be injurious to health, and some even cause secondary pollution. Phytoremediation is a relatively new plant-based approach to remediating hazardous contaminants in the environment using plant species called hyperaccumulators. The objective of this experiment is to prove the efficiency of phytoremediation using the hyperaccumulating plant, brassica juncea (indian mustard), as a method of removing Pb (lead) from soil. Brassica juncea seeds were grown in 4 soil treatments of Pb; 400 ppm (parts per million), 800 ppm, 1200 ppm, and 0 ppm (control). This study was observed for 5 weeks under a controlled environment with light and 35 ml of water twice a day. At the end of the 5 weeks, 5-gram soil samples of Pb-treatments were sent to an external lab for testing. The lab results confirmed that the brassica juncea plant, whilst maintaining good health, had the ability to phytoremediate efficiently and could be used in restoring soil polluted with Pb. The plants had accumulated about 91.08% of Pb in the 400 ppm treatment and 59.6% in the 800 ppm treatment. While 1200 ppm treatment had data irregularities, the results displayed a positive accumulation trend. Overall, the resultant trend clearly indicated that phytoremediation using brassica juncea is effective in remediating Pb-contaminated soil. In conclusion, phytoremediation is an economically viable, sustainable, and environment-friendly solution to remediate metalloid contamination.

Junior Division Environmental Sciences

Juakin Sawatzky

JR-ENV-009

The Effects of Pollution on Freshwater Invertebrates

The purpose of this project is to see the effect of pollution from wildfires on freshwater invertebrates. The hypothesis stated that smoke would decrease the dissolved oxygen concentration and lower the pH levels of the water, causing a decline in the number of freshwater invertebrates. To test this, two cultures each of three different types of invertebrates were established (planaria, deros annelids, and copepods). One of each of the cultures served as the control, while the other was subjected to wood smoke for 30 minutes. The pH and DO levels for all the cultures was recorded before, immediately, 24 hours and 48 hours after treatment. For all three species (copepods, Dero and planaria) the pH levels dropped dramatically following the smoke treatment. The pH of each culture improved over the next 48 hours, but never regained its original level. The dissolved oxygen level for all three species also dropped following the smoke treatment, and never re-established the original value. Following the smoke treatments, there was severe decline in the activity level and health of the invertebrates. All the planaria and Dero appeared to have died. Very few copepods were seen moving around in the cultures. This data does support the hypothesis, and illustrates the potential of deeper environmental problems following wildfires.

Cole Potter

JR-ENV-010

The Affects of Laundry Greywater on Plant Growth

Imagine being in a drought with very little water and your water is rationed each day. You would need to think about how to use the limited amount of water for drinking, cooking, flushing the toilet, washing clothes and bathing, to name a few. This doesn't leave much or anything for watering your plants or yard. What if I told you I have a solution to this problem! The solution is greywater. Greywater is water that has been used for washing laundry, bathing or showering, and from bathroom sinks. This greywater could be put to good use in your yard because it is more affordable. In my experiment, I wanted to find out if laundry greywater using different types of laundry detergent affected plant growth. I predicted that the plant based laundry detergent would affect the plants less because it didn't have as many chemicals. I watered trays of wheatgrass and green bean seeds with three different types of greywater and kept track of plant growth for two weeks. My results did not support my hypothesis because the plants watered with plant-based detergent didn't grow as fast and were the same color as plants watered with the other detergents. I determined that it doesn't matter what type of laundry detergent is used to make greywater for watering plants. Greywater is being thrown out and not being put to good use. It's a good way to reuse or recycle water.

Junior Division Environmental Sciences

Saahithi Kasa

JR-ENV-011

The Heat of the Matter: Increasing Relative Humidity with Soil Additives

Wildfires have taken a toll on the environment, burning through approximately 5.6 million acres of land across the United States. The largest factor in kindling these fires is atmospheric humidity, so this experiment sought to find a way to retain moisture in the atmosphere by reversing the processes of dew harvesting (i.e., sucking moisture out of the air). Working from the ground up, three different soil additives, perlite, hydrogels, and worm castings, were tested to determine which, if any, would increase the soil moisture and the relative humidity of the air around a Norfolk Island Evergreen. The perlite outperformed both the worm castings and hydrogels; it raised the relative humidity by 2% and soil moisture by approximately 3.3%. Although the results show the perlite's overall increase was greater than the hydrogels and worm castings, there was also an increase in relative humidity for the hydrogels and worm castings. These findings suggest soil additives do have a positive effect on retaining moisture in dry environments.

Ernest Kolesnikov & Toshiro Nagafuji

JR-ENV-012T

How Different Substrates Affect Bioplastics

In our project we compared polymers to each other, we did this to find which bioplastics would be a better alternative to petroleum based plastic. The main way we compared polymers was by comparing their degradation rates. The way we took the rates of degradation was through a novel process. The rate of degradation in our experiment was based on the amount of yellow dye (which was in our polymer) being released over time; we had degraded our polymers in sodium hydroxide. We measured the amount of yellow dye in concentration (drops per ml). In order to find the concentration, we used the Beer-Lambert Law which states a linear relationship between concentration and absorbance and lets you calculate the concentration of a solution by measuring the absorbance. We did not have a spectrophotometer so we used a camera and ImageJ (image processing software) to get RGB (Red Green Blue) values of our yellow dye solutions. RGB values can be converted to absorbance values and then using a standard curve, we were able to get concentration values. We also got IR (infrared spectroscopy) data to see what was in our polymers.

Junior Division Environmental Sciences

Cameron Wolkow

JR-ENV-013

Mycelium Degraded Paper Products Faster Than Compost

I was reading a New Yorker article and found it interesting how South Korea adds mycelium to its compost. Mycelium is thought to help compost because it has a special adaptation that produces enzymes that break down matter. Last year for science fair, I tested if mycelium breaks down common household items better than compost. After one 7-month period, compost and mycelium degraded these items equally as well. Science fair judges suggested that mycelium could have degraded the items faster than compost, but I had no way of knowing because at the end of 7 months the compost may have caught up with the mycelium. So, I conducted the same experiment this time with timepoints. I assembled a total of 20 bags, 5 for each month. The bags that I made consisted of mycelium, compost, substrate (as a control), and compost with fungicide to keep the natural mycelium that already exists in the compost out. All the bags contained the following materials: cardboard, latex gloves, paper bowls, and compostable plastic cups. In the end, I observed that mycelium degraded paper products (paper bowls and cardboard) faster than compost. I also found that mycelium and compost degraded latex gloves equally well, but both were better than compost plus fungicide. This demonstrates that the mycelium component of compost was responsible for degrading the latex gloves. In the end, I can conclude that mycelium is the special component in degrading these materials.

Addison Roepke

JR-ENV-014

Swimming in Pharmaceuticals: The Effect of Different Over-the-Counter Medications on Daphnia.

Pharmaceuticals have been found in the brain tissue of fish tested in rivers in our country. Our wastewater treatment facilities are not capable of filtering out these harmful substances before they flow into our river systems. I investigated the effect of over-the-counter medications on Daphnia Magna. Daphnia Magna are used to test water toxicity. The purpose of this experiment was to determine the effect of Pseudoephedrine (Sudafed), Benadryl, and Ibuprofen on the heart rate of Daphnia Magna. In my experiment, I had a control group and three groups of Daphnia Magna that were exposed to three different medications. After the Daphnia were exposed to the medication for the same amount of time, I placed them under the microscope and measured their heart rates. After conducting my experiment, I learned that all three medications lowered the heart rate of the Daphnia Magna. Benadryl lowered the heart rate the most, followed by Ibuprofen. Pseudoephedrine lowered the heart rate the least of the three medications when compared to the control group. The information that I gained from this experiment will help people understand the effects of over-the-counter medications on aquatic life. It is important to properly dispose of over-the-counter drugs so they do not adversely affect living organisms.

Junior Division Math & Computer Sciences

Helen Wan

JR-MCS-001

Color in a Bird's World

Color vision is essential for birds finding food, avoiding predators, and navigating through environments. Compared to human trichromatic vision, avians are tetra-chromatic. Birds have four types of cone cells, the photoreceptors, to receive and process color. Each cone cell has an oil droplet that filters the color: red, green, blue, and UV. Through the interaction of these four colors, birds have much broader color space than humans. The purpose of this project was to find out how birds see color by developing a Python code to convert an image into a bird's view. The software imports a picture, extracts the pixels' RGB values, calculate HSV (Hue, Saturation, Lightness), and converts the hue value to wavelengths. The software calculates the wavelength transmission through the oil droplets of bird's cone cells. The transmitted wavelength is then further converted to RGB values to reconstruct the new image. It shows that the bird's color view can be drastically different from humans. However, it may not always be true that birds' color view is superior to humans in some scenarios. In this tool, only color transition and spectral sensitivity are considered. The view angle, clarity, object shape, and brightness effects are not included. These may vary the conclusion of the current study. However, these aspects open more avenues to study the bird's vision capabilities. The software can also be used for other animals, once the animal's wave transmittance models are available.

Michael Killingsworth

JR-MCS-002

Debt, I Think Yes

The purpose of this experiment was to see how the element of winning ties was incorporated into the card game Blackjack to give the player an advantage or a disadvantage. I wanted to see if the player could win money from the casino if the player won ties. I did it by coding the game to have the dealer win ties, then changing it to have the player win ties. The data showed that typically the player would lose less money when winning ties, but the player would still lose money. Still after 1000 games they would be in debt to the casino from about \$1000 to \$3000. Most of the time, the player winning ties did not make much difference. For a player starting with \$1000, the average ending player amount when drawing to 17 with the dealer winning ties is \$957.50 whereas with the player winning ties it's \$965. The data showed that the best number for the player to draw to is 16. A player drawing to 16 and winning ties still lost money. The conclusion is that people should not play Blackjack at a casino since they will always lose money after several games.

David "Bear" Kent V

JR-MCS-003

The Rapid Retriever: Coding a Program To Automate Scraping for Lost or Stolen Items

My project is the Rapid Retriever, and its purpose is to make a website to help people recover lost or stolen items. My bike was stolen last year, and so were 188,500 other bikes. I made a project to make searching for your lost or stolen item on Craigslist efficient and easy. This website will save hours of time for every user, as they won't have to check Craigslist for upwards of 15 minutes a day and waste mental energy searching for their item. It works as follows. You first go to the landing page and submit the required information on your item. You are then redirected to a page where items from Craigslist are displayed. You check through until you find your item or don't. This website was implemented in Python using Flask, SQLite, python-craigslist, Urllib, and lxml.

Junior Division Math & Computer Sciences

Eli Krause

JR-MCS-004

Learn Better with Games

For this project I created a game to help people learn math. It will make learning fun by balancing challenges and skill level, and will provide opportunities to practice the multiplication table. People recall 90% of what they learned if they learned it in an engaging video game. To make this game engaging I incorporated the flow state. The flow state is when a person is completely engaged in a game. To make this happen, the challenges in the game and the skill level of the player have to perfectly match. As the player's skill level increases, the challenges need to increase at the same rate. When challenges and skills are out of balance, the game can be overwhelming which results in anxiety and stress, or it can be underwhelming and the player becomes bored and unsatisfied. This project is a simple two dimensional game with a ball that rolls over hills and jumps in the air. I programmed this game using JavaScript. I needed to program complicated physics to create this game. To do this I calculated the magnitude and direction of the normal force acting on the ball when the ball is touching the ground. Then I added gravity to find the resultant force. To calculate the magnitude of the normal force, I needed to take into account the velocity of the ball when it hit the hill and what angle the hill was at. This project worked very well and many people were engaged in it.

Hank Guiles

JR-MCS-005

Windows 7 Pro To Gaming Laptop

My topic was an ancient computer upgrade. I chose it because I was about to throw my laptop away instead I upgraded it. Based on my background research I think I will be able to make a Dell Laptop that is currently running Windows 7 into a gaming laptop. I believe that upgrading and replacing parts of a Windows 7 laptop will result in gaming laptop performance. My procedure was to find an old laptop (make sure it is ok if you take it apart). The next step was to take it apart (unplug the battery first). Then I had to find the hard drive, ram, and battery and take them out of the laptop. I had to find and order a compatible hard drive, ram, and battery. When the new parts got delivered, all I had to do was install the hard drive, ram, and battery and put the laptop back together. The mean of the bootup time after the upgrades was 23 seconds. The mean for the gaming computer is 22 seconds. Before the upgrades it was 35 seconds. My laptop got 12 seconds faster after upgrades. It performed like a gaming laptop. And I spent \$230 on parts and used a \$100 laptop. I saved \$770 on the gaming laptop by buying and upgrading. It was a huge success.

Junior Division Math & Computer Sciences

Terra McClure

JR-MCS-006

Plinko Fun

Plinko Fun is about seeing where the plinko tiles go when dropped. According to Ultimate Guide to Plinko, plinko is a gambling game where when a tile is dropped it goes through a field of pegs to a slot at the bottom. The goal for this project is to find a successful method of winning plinko by dropping the chip from a specific point. What to do for this project is drop the plinko chip 100 times graph the data and to math including factorials. The project resulted in the plinko tiles landing more to the left. This slightly disrupted the way the plinko chip went. The plinko board was slightly unlevel so next time this project is done use a level before testing. The result was different than planned. After doing the math something that was found was the math for point D did not match because of the tilt. I learned that there are many places to drop the plinko chip but only point A made it in the 4th slot the most. The information that I collected was to help people score higher in plinko. It could also help the people running plinko. The way it could help the people running plinko is they could tell the people where to drop the chip.

Dietrich Smith

JR-MCS-007

Powering Up Graphics Cards

This project was centered around the concept of overclocking a computer. Overclocking is a method of forcing your computer to run faster than it's intended to go. Graphics cards will either slow glitches or the computer will overheat and crash, but there is small chance that the graphics card will provide the best performance. Research completed confirms that overclocking can cause a computer to begin to crash during a game or benchmark you should dial back overclocking. In the past, a lot of overclocking was done when computer chips first came out because they were not very powerful. Methods utilized included downloading software to collect data and running multiple tests to compare the performance of the computer with the amount of overclocking. Some of the major findings that I found during my research is that not all graphics cards can be overclocked, and some are already at their maximum performance. I was lucky enough to have two graphics cards that I could easily overclock to improve the data collected. I predict that this study will help people to learn more about computers and how overclocking works.

Hudson Watkins-Brown

JR-MCS-008

Feeding the Sprites

The experiment was done to find how long it would take for organisms to go extinct from lack of food with the food spawning at different rates. The approach to solve this was to create a program simulating organisms with an 8 second life span eating food that spawned at varying rates. The Construct program was used because it can simulate how things eat. The program works by: The organisms search for food, as soon as they eat their first piece of food an 8 second timer starts that kills the organism if it does not eat before the timer is done. The data showed that with a 4 second food spawn rate around 100 organisms died every 5 seconds, and with longer food spawn rates the organisms died faster. The data showed that the organisms died in chunks instead of one by one. For example, in the 6 second spawn time, a large number of organisms died between the 10 and 15 second run times. Overall, the hypothesis that organisms would die faster if the food spawned at a slower rate was true. Next time data could be collected at shorter intervals to show when they die better. This experiment could be extended in the future to include: more food, predators, poisons, and terrain.

Junior Division Medicine & Health

Reece Mundell

JR-MH-001

Blood Types on the Symptoms of COVID-19

In the last two years, people around the globe have suffered from a new virus and its multiple variants. COVID-19 has been unpredictable since day one and each case has been unique. Initially this virus seemed to have the most devastating effects on older adults as well as those with pre-existing medical conditions. I believe that participants with type O (positive or negative) blood will have less severe symptoms of COVID-19 than participants with types A, B, or AB. After studying my data, I discovered that almost all of the participants (regardless of their blood type) experienced the loss of taste and smell, fatigue, and headache, even if their symptoms were mild. 75% of severe cases were contracted by participants with type O+ blood. (50% of participants) while a majority of participants who described mild or no symptoms had type A, B, and AB blood types. Only 1/3 of participants with type O blood reported mild symptoms. The theory that individuals with type O (positive or negative) blood had less severe symptoms of COVID-19 than individuals with types A, B, or AB was incorrect. To confirm these results and learn more about the relationship between COVID-19 and blood type, individuals with more post-COVID symptoms should be tested. Also to add to this study, variables such as weight and age could be added for a continuation.

Grady Wilson

JR-MH-002

Electrifying Electrolytes

The purpose of Electrifying Electrolytes was to find which drink had the most electrolytes out of Gatorade, Powerade, Body Armor, distilled water, orange juice, and apple juice. I hypothesized that Gatorade would have the most electrolytes. I thought this because all the sports teams use it to refuel their athletes. This project involved pouring all the drinks (Gatorade, Powerade, Body Armor, distilled water, orange juice, and apple juice) into individual cups. Then I made the straw with wire wrapped around it. When you dipped it in the liquid, the multimeter would give numbers in milliamps. Then I had to convert milliamps to amps, then amps to siemens. The siemens was the conductivity measurement that figured out the amount of electrolytes. The higher the amps, the more electrolytes. The data collected did not support my hypothesis. For example, the average of Gatorade in milliamps was 30.73. Body Armor, which was the highest, had an average of 48.96 milliamps. Gatorade was 2nd to last. These findings lead me to believe that Body Armor has the most electrolytes out of Gatorade, Powerade, Body Armor, distilled water, orange juice, and apple juice. This is good for me to know, because I sweat a lot after sports, so I can refuel faster with Body Armor.

Jaylenn Gonzales

JR-MH-003

Get Moving, Lazy

People need to exercise to stay healthy. The American Health Association tells you that it is important to raise your heart rate when exercising to help keep your heart healthy. The results of my experiment show you that a cardio workout raises heart rate the most. A yoga workout does also help raise your heart rate, but not as high. I thought that cardio would raise it the most because it involved more exercise and movement. To test my hypothesis, I had 6 volunteers complete 20 minutes of yoga, walking, and cardio, on separate days. I check their pulse before working out and immediately after. More and more people are having heart issues, so it is vital to know what you can do to help your heart the healthiest it can be.

Junior Division Medicine & Health

Lila Mosberger

JR-MH-004

How Ethanol Affects U-87 Glioblastoma cells

Prenatal alcoholism can have devastating effects on a child's brain. Other experiments have tested how ethanol affects neurons but not many have tested how it affects glial-like cells. U87 Glioblastoma cells were treated with varying concentrations of ethanol for varying amounts of time. The wells treated with ethanol had a decreased number of surviving cells, and the surviving cells were less healthy. The higher concentrations made the health of the cells worse but the longer times didn't - most likely due to an experimental error. This means that in prenatal alcoholism not only do the neurons die and get unhealthier, the glial cells are also affected.

Broderick Kite

JR-MH-005

How To Eliminate Concussions

After testing, I found that my hypothesis was, in fact, correct and supported. I realized that to get accurate results for each trial, you must hold the helmet in the same position, drop the helmet from the same height, and onto the same spot on the ground. I did three tests of each: 18 eggs (1.36 kg) in a helmet with external padding and 18 eggs (1.36 kg) in a helmet without the external padding. When I dropped the helmet with the external padding, an average of the three attempts were 6.33 of 18 hardboiled eggs were 100% cracked. When I tested the helmet without the external padding, an average of 10 of 18 hardboiled eggs were 100% cracked. With my results, I would like to talk to the coaches and administration in our school about practicing with the external padding on our helmets.

Sophia Dainty-Guilfoyle

JR-MH-006

Most Hydration Given By Water

My topic was surface tension and the most hydration water gives you. I chose this topic because I really wanted to know what water from my house and a few stores would have the most hydration if I was really thirsty. In my hypothesis I thought that the water from my sink, which has the best filtered water, would be the most hydrating. In my experiment I used the measure of surface tension with different purities of water to determine the amount of hydration. In my Hydration experiment the mineral water had the most surface tension. In my experiment I learned that surface tension does really change based on the purity of water and you can see it as it changes.

Junior Division Medicine & Health

Chloe Pennington

JR-MH-007

TATAA Celiac! A Proposed Model of Celiac DNA Isolation, Intervention and Cure

Is it possible to “cancel out”, using a theoretical CRISPR model, the TATAA box code that determines Celiac by causing the mRNA polymerase to scan over it? My hypothesis is that test one (with HLA-DQ2 and CRISPRi) will be more effective than any other tests; test two (HLA-DQ2 and CRISPR), test three (HLA-DQ8 and CRISPRi), or test four (HLA-DQ8 and CRISPR). I believe that because HLA-DQ2 has the most direct influence over pronouncing more severe Celiac symptoms. HLA-DQ2 is also the more common Celiac gene (it's seen in 90% of people with Celiac Disease), and therefore seen in patients more commonly that are experiencing the aforementioned symptoms. CRISPRi is a novel version of CRISPR that uses genetic perturbation to repress gene expression and therefore the symptoms associated with it. I believe that combining CRISPRi and HLA-DQ2 will create the strongest and most promising method of removal. I hope to discover possible ways for Celiac treatment through a novel gene-editing solution. My prediction is that by changing the promoter sequence of the exon, I will be able to pause the production of the Celiac inducing gene sequence. As you can see from my results, the CRISPRi and HLA-DQ2 had the highest efficacy score of .7397 compared to CRISPRko and HLA-DQ2 (.5911), CRISPRi and HLA-DQ8 (.6374) and CRISPRko and HLA-DQ8 (.6351). My hypothesis was correct, the sgRNA sequence extracted from the HLA-DQ2 combination with CRISPRi creates the most effective method of removal. I will use computer model software (Mac Vector) to analyze DNA and protein sequences to understand the influence CRISPR has over the HLA-DQ2 and HLA-DQ8 gene when inserted properly. My discoveries help people because of the critical issue Celiac presents. Celiac is extremely important and a rising relevant issue since more of the population is becoming more informed about it. By finding cures to Celiac diseases, we can help everyone who is affected by this.

Junior Division Medicine & Health

Naomi Kruse

JR-MH-008

The Magic in the Milk: Determining Whether Milk Protein Plays a Role in Antiviral Protection

An elaborate innate immune system protects nursing infants from harmful microbes, but it remains unclear as to whether the protein in milk protects a nursing infant against viruses. To determine whether TMV can be passed on in the presence of milk, I inoculated each of 51 geranium leaves with TMV plus water dilution as a control, TMV cow milk dilution, human breast milk dilution, whey dilution, denatured milk dilution, or denatured whey dilution. I applied similar variables to *Saccharomyces cerevisiae* (yeast). I stained and examined the cells under a light microscope under 500x power after 4 hours. I looked for evidence of infection by comparing cell density and cell structure. After noticing multiple slides with larger cells and small round particles, I decided to take the average size of the living cells. I noticed that the density of dead cells was similar throughout the tests at an average of 37% stained cells. There were 2 experiments that showed a significantly lower density of stained cells at 15% for cow milk + TMV and the other for mother's milk at 24%. Most of the tests for milk and milk with TMV contained cells that averaged between 1.1- 2.0 micrometers. The most interesting factor I found was that the yeast from the TMV + water contained an average cell size of 2.95 micrometers. The denatured protein tests also contained larger cells. The test for whey + TMV was too cloudy to report. Geranium results are still pending. The results of the yeast experiments were the most conclusive at this time. I found that cell density in both cow and mother's milk may provide some protection as indicated by two of the tests by a measure of 15% and 6% increase in living cells respectively but were more likely outliers. For a qualitative assessment, I found that the yeast from the denatured milks plus the addition of TMV measured on average, one micrometer larger than the cells protected by milk with intact protein. This could have been yeast-producing spores rather than the usual budding, possibly indicating that the cells were under stress when the protective protein was denatured. This work provides preliminary evidence that milk protein could be of some antiviral benefit. Work should be continued and compared to the plant model in *Phaseolus*.

Mykaela Fury

JR-MH-009

Factors Affecting Lung Capacity

What factor has the largest effect on lung capacity? My hypothesis that adult males would have a greater lung capacity balloon. I measured the balloon with a fabric tape measure. They answered questions about current colds, gender, age, asthma, smoking, and positive COVID tests. I grouped was somewhat supported. During my experiment to measure lung capacity, I tested 33 people. I asked each participant to take one breath as large as they can and blow it into a families' together to see if genetics effected the balloon circumference. The top 4 balloon circumferences were adult males. Also, all the adult males that were tested were in the top 10. Smoking did not seem to influence the circumference of the balloon. Gender and age did seem to have a small effect on the circumference of the balloon because the fifth largest balloon was a female and her daughter who is only 14 years old had the sixth largest balloon circumference. I think that family genetics influenced it because there was a whole family that was in the top 10. The 70-year-old participants did not have as great of lung capacity as younger adults. However, they both tested positive for Covid, so it is difficult to tell if it was their age or the positive test for Covid. Current colds did seem to influence balloon circumference looking at the 2 adults that currently have colds. Asthma could possibly influence your lung capacity, but it is hard to tell from my test subjects.

Junior Division Medicine & Health

Garrison Hostiuick-Kennedy

JR-MH-010

Virtual Reality Science

I want to learn why virtual reality makes some people sick and how it effects the brain, I tested different people from different age in a virtual reality introduction game in order to learn more.

Phoebe Donovan & Lola Green

JR-MH-011T

Headway or Headache? The Relationship Between the Biologic Reaction to Learning: Online vs In-Person

We hope to discover the biologic response to learning; online versus in-person. If format is related to biologic engagement of students, then learning online will cause a decrease in biologic engagement. Objective 1: Learning in-person will cause participants' brain activity to increase, because it's easier to be distant and detached while online. Objective 2: Learning in-person will cause a decrease in blood pressure, because blood pressure increases as a result of stress. Objective 3: Learning in-person will cause an increase in heart rate. Focusing causes your heart rate to increase, and we think that since there is a teacher present, participants will be more compelled to focus. Objective 1 was incorrect. On average, participants' brains were 7% less active when in-person. Objective 2 was correct. On average, participants' systolic blood pressure decreased by 1.88, and participants' diastolic blood pressure decreased by 0.25, when in-person. Objective 3 was correct. On average, participants' pulse rates increased by 1 bpm when in-person. This experiment, and other research, offers insight into the most effective way to teach and learn.

Avienda Schatz-Devine & Tadan Helm & Phoenix Borten

JR-MH-012T

Go with the Flow - The Relationship Between Frequency and Brainwaves

How do different frequencies affect brain waves? Our goal is to find the best way to help people relax using binaural beats. Our hypothesis is that an increase in frequency will result in an increase in the level of brainwaves. We thought our hypothesis would be correct because the higher frequency stimulates the brain to be more alert- which results in higher levels of brain waves. Higher frequencies reportedly boost your brain waves into a gamma state which may make you more alert or focused. There were also previous studies that supported our hypothesis- stating that low-frequency waves are linked to delta and theta states which can boost relaxation and improve sleep.

Junior Division Medicine & Health

Abby Avila & Jay-Me Avila

JR-MH-013T

Which Pills Really Dissolve in Your Body

Doctors and scientists are always trying to figure out what pills provide more pain relief and sleep aid more quickly, but which over the counter pills really dissolve in your body, and which pill may provide pain relief or sleep aid more quickly for a human? In this experiment we will be testing three pills (Ibuprofen, Tylenol, Melatonin) to determine which pill dissolves the quickest in hydrochloric acid. In this project based on our data it states the melatonin dissolves the quickest. Each pill was tested in one 25 ml graduated cylinder with the same amount of hydrochloric acid. To determine which pill dissolves the quickest we measured with a stopwatch and tested each pill in two trials. If the following pills (Ibuprofen, Tylenol, Melatonin) were to be put in hydrochloric acid, then melatonin would dissolve the quickest because they instantly dissolve as soon as you take them. The experiment showed that Melatonin dissolved the quickest because as soon as a Melatonin pill is placed on your tongue it immediately reacts with your saliva causing it to dissolve.

Junior Division Microbiology & Molecular Biology

Joshua Wells

JR-MMB-001

"UV Spotlight!": What is Really on Your Toothbrush?

Our mouth is filled with many different microorganisms that can affect our health. The latest fad for cleaning toothbrushes is using UV light. I evaluated bacterial content on toothbrushes to determine if UV lights truly killed the bacteria and if cost of the UV light affected the effectiveness of the product. 12 new toothbrushes were brushed on the floor in my bathroom. 3 toothbrushes were sanitized for 5 minutes each in 3 different UV light cleaners. All petri dishes were labeled, taped and stored in a science incubator at 85 degrees. Every day the petri dishes were monitored for the number of colonies size, colors, and types of bacteria were measured and documented. The result of my project showed that all toothbrushes used in the White UV light had the least amount of bacterial growth with an average of 36 colonies. The blue UV light had average growth of 54 colonies. The control group was third with an average of 80 colonies and the green UV light had average growth of 147.3 colonies. I concluded that my hypothesis was not correct. I discovered that the more expensive a UV light is the chances are that it will kill more bacteria. Other studies have shown that Hydrogen Peroxide, vinegar and Listerine have a higher success rate for killing bacteria on toothbrushes and would be a lot cheaper way to kill bacteria off of a toothbrush. I feel sterilizing your toothbrush is important and could improve oral health and physical health.

Dannica Ward

JR-MMB-002

A Study of Yeast Strains and Sourdough Properties

In my experiment, a study of yeast strains and sourdough properties. The question I experimented with was: How is the chemistry of the sourdough starter affected by the type of yeast and bacteria that form and collects in the bread? I created three jars for each type of yeast, and got results and recorded for each of the jars. I measured the rise with a ruler on the outside of the jar, I tested the pH with a pH strip, and an air quality sensor was used to get the CO₂ results. I found mostly that on average the wild yeast had a more acidic outcome, a lower rise, and CO₂ than the baker's yeast levels, as well as that typically the jars with baker's yeast had a more appealing smell and look. I concluded that due to the results I gathered typically Baker's yeast is a better type of yeast if you are going to be baking sourdough if you would like a more appealing and active yeast colony that produces a higher rise and less acidic level. All in all, I learned a lot from my experiment and acquired a lot of interesting and informative data.

Junior Division Microbiology & Molecular Biology

Mae Shelton

JR-MMB-003

Clean, Cleaner, Cleanest

People are surrounded by germs, which are constantly making you sick. I decided to test different cleaning products to see which one eliminated the most germs, specifically Salmonella. The result of my experiment was that Clorox wipes and a homemade solution of lemon juice and vinegar eliminated the most bacteria. Killing bacteria helps you eliminate the chances of getting sick. My results will save you money by not purchasing cleaners that don't work and helping you get cleaners that actually help kill germs. My hypothesis is that Clorox wipes and a homemade mixture with lemon juice and vinegar will work the best, growing the least colonies of bacteria. First I poured the agar into petri dishes and then I swabbed each surface and sealed each petri dish. Then I let them grow. After they grew for a week I measured the bacteria growth and compared which grew the least. This year a lot of people are getting sick with COVID as well as other typical illnesses. It seems many more people are sick than normal. Killing germs in your school and home can help prevent illness.

Sophie May-Ostendorp

JR-MMB-004

E. Coli Elimination

My project, "E.Coli Elimination", was focused on how well E. Coli survives in soil in natural conditions. The reasons for this project are simple. We do not know how long this bacteria can live outside the human body. If we knew how long E. Coli can live, we would know how long it can be in nature before it infects humans. This could help agriculture, livestock, and impoverished communities—particularly in the developing world—to know how to treat this bacteria. My hypothesis was: if E. Coli is exposed to different temperatures, sunlight, water levels, and humidity, then the E. Coli in the warm climate will thrive, in the cold climate it will struggle, and the other variables will have little effect on E. Coli. This is because E. Coli typically thrives in the summer in the most humid climates. The way I did this experiment was to introduce the bacteria to soil samples with 10 different climate conditions. Every three days I cultured a sample from each climate condition, continuing for three weeks. What I found was that E. Coli is a very resilient bacteria. None of the climates fully killed the bacteria. Most samples thrived in all conditions and grew many colonies. Now we know that it isn't as easy as suspected to fully eliminate bacteria. If I were to continue the experiment, I would make the climates more extreme to get more limited results.

Junior Division Microbiology & Molecular Biology

Augustus Gdanitz

JR-MMB-005

The Effect of Microbial Populations on Soil Conductivity

This research will benefit agricultural research and production. The project will aid in the growth and production of crops and plants by determining another factor to find the fertility of a soil sample. The research investigated if a correlation exists between bacterial population and soil conductivity. This research was conducted with a microbial fuel cell, which converted the bacteria activity in soil to electricity. Three different types of soil were used which allowed the relationship to be found. Electrical output was recorded three times daily with a voltmeter. The garden soil used in testing was very fertile, with electrical readings that topped out at 200 mV. This was followed by the feedlot soil, which recorded 120. The sandy soil had the least bacteria, and recorded a high at 78.6mV. Therefore, the project was successful, as correlations can be found using different soil types. With this information, farmers can test their soil microbial population levels and plant their crops accordingly to ensure the most successful harvest possible. With this information, agricultural workers can adapt their soil management, making more efficient harvests. This can be achieved by adding organic matter, keeping the soil moist, avoiding pesticides, and maintaining soil pH levels.

Noah Higinbotham

JR-MMB-006

The Spread of Germs

My topic was The Spread of Germs. I chose this topic because I wanted to see how germs spread. My hypothesis was that my 3rd grade class would spread the most germs. During my experiment I put Glo Germ (replicates bacteria) on the hands of a 7th and 3rd grade class. I then left the class for 1 hour. After that hour I examined where the Glo Germ had spread. In my experiment I learned that 7th graders spread 54 square inches of Glo Germ. And the 3rd graders only spread 37 square inches of Glo Germ. I learned that 7th graders spread more germs than 3rd graders.

Gryffin Lawrence

JR-MMB-007

Toothpaste Trauma: The Relationship Between Toothpaste and Change in Amount of Bacteria on Teeth

My question is, how does a toothpaste affect bacterial growth I hope to discover what toothpaste is best for getting rid of the bacteria in your mouth, so we know what chemicals help your teeth the most. My hypothesis is if the type of toothpaste is related to bacterial growth, then the arm and hammer peroxide care toothpaste will have the least growth of bacteria on the teeth because the arm and hammer peroxide care toothpaste has both sodium fluoride and sodium bicarbonate, which reduce acids slowing down tooth decay. The others don't use sodium bicarbonate. 1) Take participants into the room and swab their teeth; 2) Explain how to brush teeth; 3) Have them brush their teeth and then swab teeth again; 4) Record data; 5) Repeat with next participant. The amount of toothpaste was always one milliliter. The same way to brush teeth was to touch the back bottom & top for three minutes. The same swab places the back bottom and top for five seconds each. The same toothbrush brand which was Quite Clean Toothbrushes Full Soft, the same amount of time culturing bacteria, a day. The percentage of bacterial growth was staggered for each toothpaste, with some ranging between -100.00% to 466.67% and others from -25.00 to 266.67. This disproves my hypothesis. This experiment helps people by showing which toothpaste is best to use because it reduces the most bacteria.

Junior Division Microbiology & Molecular Biology

Scarlett Paulson & Jaden Depue

JR-MMB-008T

Germ Busters: Evaluating the Effect of Disinfectant Methods

The researchers' purpose for doing this project was to ensure that the janitors and the custodians are using the best cleaning supplies. This will ensure that the students or whomever is using the product that was cleaned, is healthy. Our problem statement is Germ Busters: Evaluating the effectiveness of disinfectant methods. Our results found the Electromagnetic sprayer had the most bacteria, with the On-Gaurd producing the second most. The control test resulted the third most bacteria, and the UVC light had the least amount of bacteria. We think that there had to be some contamination in some of the plates and that is why we had the cleaning product testing higher than the control. The On-Gaurd had a high result because it had pinpoint bacteria. We can conclude that the UVC light is the most effective. In the first test had no results. This is likely due to the culture loop being over heated and killing all of the bacteria. In a second test we got results, but as many as expected. We think that this is due to all of the COVID-19 precautions. We have started cleaning excessively, and it has killed most of the bacteria.

Alyssa Rueb & Trista Hartman

JR-MMB-009T

Our School's Bacteria

The purpose of this project was to see what surface in our school had the most bacteria. We swabbed six different surfaces; a drinking fountain push plate, a toilet seat, a soap dispenser, a student's computer, the front door push plate, and a hand sanitizer bottle. Alyssa's hypothesis was that the drinking fountain push plate would have the most bacteria. She assumed this since so many people use the drinking fountain daily. Trista's hypothesis was that the toilet seat would have the most bacteria for the same reason. To do our experiment, we started by putting on gloves. Next we labeled the agar plates with the surface we swabbed. After that we swabbed the surface using a cotton swab and then wiped it onto the agar plate. We then repeated these steps for all the other surfaces. Lastly, we taped the agar plates shut and put them in a hood for five days. After five days, we took them out and the soap dispenser had the most bacteria. Following that was the toilet seat. The one with the least bacteria was the front door push plate. This means that the results supported neither Trista nor Alyssa's hypothesis. These results show that we need to clean the bathroom more. This is because the toilet seat and the soap dispenser had the most bacteria on them. If we do this, our school may have less cases of sickness. Overall, we had a great time doing this experiment.

Catlin Bonicelli

JR-MMB-010

What Part of the School Is the Grossest

Public schools are intended to be sanitary, safe environments for students to obtain an education; but how sanitary are they really? More specifically, what is the grossest part of my school? In this project, I swabbed five surfaces in my school (a kindergarten doorknob, a 1st grader's desk, a computer lab computer, a water fountain, and a toilet lid,) in order to determine which would produce the most bacterial growth. The swabs were then transferred to agar dishes and incubated for five days. I hypothesized that the doorknob would produce the most bacteria, as it is a frequently touched surface. The experimental results disproved my hypothesis, with the computer and the water fountain producing the most bacterial growth. I cannot determine which was "grosser", as the water fountain produced more bacteria (365 colonies), but the computer produced more diverse bacteria (202 colonies.)

Junior Division Physics

Levi Priestley

JR-PH-001

Bullet Accuracy

I chose bullet accuracy because I've always wanted to know what bullet is the best for hunting and target shooting. Based on my internet background research, my hypothesis is that out of five different bullet companies such as CCI, Remington, Winchester, Federal, and Norma T-22, CCI's company will have the best 22 LR accuracy. This bullet has an amount of 32 grains that is the weight of the bullet. Second, will be the Winchester 22 LR round. Next, will be Remington's 22 LR rounds. Second from last, will be Federals 22 LR rounds with a weight of 40 grains. Lastly, I believe, will be Norma T-22 bullets which are good bullets but according to my internet research they will have the worst quality of bullets out of these companies. I tested the accuracy of these five different bullet companies. I found out that Norma T-22 was actually the best bullet company for 22 LR bullets. I learned which bullet to use in hunting and target shooting and which one to recommend to friends.

Carson Stone & Drake Hass

JR-PH-002T

Don't Drag Me Down - The Effect of Flap Position on Paper Airplane Flight

How do you fold a great paper airplane? We researched how airplanes fly to get ideas. We learned that there are three forces that contribute to flight; lift, drag, and thrust. We also discovered Bernoulli's principle. We used this information to hypothesize that our paper airplanes would fly further, longer and more accurately if flaps on the wings are positioned down. We used 3 airplanes in our experiments. A launcher, placed on a tripod, was used to shoot each plane to control for thrust, launch angle and height at take-off. Each plane was launched 5 times. The distance the plane traveled, the landing distance from the target line and the amount of time planes spent in the air was measured for each flight. Flaps were cut into the wings of each plane. We launched and took measurements with flaps $\frac{1}{3}$ the wing length in the up position and then down position for five flights. We launched and took measurements with flaps $\frac{2}{3}$ of the wing length in the up position and then down position for five flights. We found that the distance traveled and time in air were longer when the flaps were up for all planes. Planes landed closer to the target line when the flaps were down. We have concluded that, with flaps up, paper airplanes fly further and stay in the air longer. With flaps down, they fly straighter.

Jacob Vasquez & Tanner Baker

JR-PH-003T

Wingin' It

The purpose of this experiment was to determine which paper plane design would fly the farthest. The planes tested were glider, world record, jet plane, fighter, dart, and regular. The project was chosen to determine which paper plane would be the best at flight. Based on research, the plane that should fly the farthest is the paper airplane called the world record. The reason is that it is the world record but we still tested it out and figured out that that is the correct fact. Though we found that is true we still needed to double check it so we did one more test and it was still correct.

Junior Division Physics

Sage Ketels

JR-PH-004

Does Shot Size Matter?

Knowing which lead shot to use while hunting is important. This helps you to see which lead shot to use to kill the animal in the most humane way while hunting. You don't want an animal to suffer, so it is important to kill it on the first shot. Having the shot penetrate further will help guarantee this. I think the 2s and the 4s will penetrate farther into the cardboard than the 6 and 7 1/2. I had an expert shoot different gauges of lead shots into pieces of cardboard. I then measured the depth of the penetration. Many people still rely on hunting to provide for their families. If you are going to be a responsible hunter or huntress you are going to use all of the animal possible, and treat it with the most respect. One way of doing this is by killing it as quickly as possible. This is the best way to hunt responsibly, whether for sport or a food source.

William Larkin

JR-PH-005

Hitting the Bounce Out of the Ball

This project is about defining what happens to the height a tennis ball bounces with repeatedly hitting the tennis ball. My hypothesis stated that if I hit a tennis ball in increments of one hundred hits, then the height the ball will bounce after each one hundred hits will decrease in a linear fashion. I set up my experiment by measuring the height a tennis ball bounces when dropping the ball from 1.83 meters. I repeated this after hitting the tennis ball in increments of one hundred hits, up to one thousand times. I then repeated this for a total of three tennis balls. I found that the average height a new tennis ball bounced was 1.147 meters. After a tennis ball had been struck one thousand times, the average height the ball bounced when dropped from 1.83 meters was 1.113 meters. While there was a decrease in the height the ball bounced with more strikes of the tennis ball, the decrease was not in a linear fashion. My hypothesis was partially correct, because with additional strikes of the tennis ball, the height which a ball bounces decreased. But this decrease was not a linear decrease as I had hypothesized. This experiment provides information to tennis players about how often amateur players should consider changing out tennis balls while playing to maintain a consistent level of bounce in the tennis balls.

Mary Fernandez

JR-PH-006

No More Noise!: How Cotton Density Affects Sound Level in Earmuffs

Earmuffs are hearing protection devices that shield the inner ear from intense sound energy. When I used earmuffs with foam in them to block out every-day sounds at home, I noticed that noise was still getting through! I wondered if a common household material like cotton would block out sound effectively in earmuffs, so I tested different cotton densities. My hypothesis was that if I use cotton balls (10 grams), a washcloth (15 grams), and a flour sack dish towel (20 grams) to decrease sound in a pair of earmuffs, then the flour sack dish towel will block out the most sound because its greater mass will absorb more noise. I set up this experiment by attaching an ear cup to a bubble-wrapped acrylic tube holding a smartphone with a sound meter app. I played a tone from a speaker outside of the ear cup and recorded the maximum decibel level for each cotton density. The data showed that the less densely packed cotton reduced sound more effectively than the more densely packed cotton. My hypothesis was not supported, because the less densely packed cotton worked the best.

Junior Division Physics

Casey Pearson

JR-PH-007

Parachute Pandemonium

When you are thinking of a parachute, you may think of just one shape, but the fact is there are many different shapes that may be used. This experiment was run to test which shapes on a parachute have the least drop velocity. The shape parachutes used in this experiment were a circular parachute, a triangular parachute, and a square parachute, and all were the same size. The dependent variable in this project was the velocity, and the independent variable was the different shapes. My hypothesis was that the square parachute would have the least velocity, but it turned out to be proven incorrect, and the circular parachute ended up having the least drop velocity. I also concluded that the triangular parachute ended up having the greatest velocity, falling faster than both the square and the circular parachutes.

Will Walker

JR-PH-008

Pitch Perfect

Music has brought enjoyment and fun to the world for ages. I became interested in this project because I wanted to learn how to play the trumpet. My problem is how does temperature, altitude and humidity affect the pitch of brass instruments. I hypothesized that low altitude and high temperature will cause them to play flat. After I did the experiment's I found that my high temp and altitude caused them to play flat. Also that cold temperature and more humidity caused them to play sharp. With this information my temperature hypothesis was supported. Although not my humidity and altitude.

Haydan Drullinger

JR-PH-009

The Effects of Droplets Size from Irrigation Sprinklers on Evaporation Rates

The purpose of this project is to investigate the evaporation rates caused by different types of irrigation sprinkler nozzles. The hypothesis was that a smaller nozzle resulted in smaller droplets which should cause more evaporation. The process of measuring relative humidity was by using a LabQuest. The LabQuest was set to run for 2 minutes when play is pressed. The readings were taken every 30 seconds. Before relative humidity was measured the sprinkler ran for 2 minutes. After the two minutes were up the humidity tester was put in the drum and for the 0 second reading humidity was very low. For every nozzle size (20, 30, 40) five tests were performed. Before moving on to the next trial the depth of the water was measured to see how much water was being used. Nozzle size 20 had the most evaporation measuring around the 62 for the highest reading. For the 30 nozzle the highest the humidity got was 57. Last for nozzle 40 the highest reading was 40. Like the hypothesis stated the results showed that with a smaller nozzle that more evaporation was generated.

Junior Division Physics

Cooper Markley

JR-PH-010

What Grade of Arc is Best on a Free Throw?

My goal for this experiment was to find the best arc possible to shoot a free throw. With the data collected, I could then optimize not only my free throws but also the free throws of many other people. My process for the project was relatively simple. I used an app to find the arc of my shots and then combined that data with my records of shots I had made or missed. What I found was that the best arc for me is 50-52 degrees. Almost 7 degrees higher than what websites said was the best arc. From this info, I concluded that the best arc varied from person to person and height to height.

Cooper Manganaro

JR-PH-011

Was Isaac Newton Correct? Testing the Classic equation ($F=Ma$) on a Pool Table

I wondered whether Newton's famous law could be tested using the familiar rather than doing a formal science lab experiment. I chose to test Newton's Law ($F = Mass \times Acceleration$) on a pool table, using seven 5-cm diameter plastic balls, all exactly the same size, therefore with identical volume. I filled each with different substances so each had different masses/densities. Each ball was rolled down a ramp on a pool table using a constant distance from the top (to create the same acceleration). All but one bounced against the end rail, causing them to rebound, traveling different distances. I repeated with each ball 10 times, carefully measuring distance traveled. I wanted to test whether balls with the greatest mass would travel farther than those with the least mass because of the difference in force against the end rail. Results were that balls with different masses traveled different distances ($F=M \times A$). I hypothesized that I'd prove Newton's Law correct and I (mostly) did! I say mostly because there were small variables that I couldn't control, possibly affecting results. After recording all data, like any good scientist, I decided to eat the chocolate that filled the chocolate ball; I found an air bubble inside, which possibly made the ball roll lopsided, possibly affecting results - where density *should* have aligned with distance. Overall though, my results were consistent in that the balls with the greatest mass (and therefore had the greatest force) rebounded the farthest, thereby proving that Newton's Law works - not just in a laboratory but also on a local pool table.

Charlotte Pegram

JR-PH-012

Singing Piano

This science project is about sympathetic vibrations, what they are, and how they are made. For the experiment my hypothesis was that, if I hold down the variables and hit C4 it will make the other notes ring. For my experiment I used a piano, a quiet room, my phone, and a chromebook. I used my phone for a recording app called phyphox. I pushed down the note C3, I pushed it down slowly so it did not make a sound. Then I forcefully pushed down C4, and then immediately let go of middle C. When I did this the sympathetic vibrations from C4 caused C3 to ring. I then proceeded to test several notes and got an average of 3.7 seconds that a note will ring after being struck with a sympathetic vibration from C4. I also got an average of 3.7 decibels from the start to finish of the sympathetic vibrations. After completing the experiment, I resolved that my hypothesis was correct. In that I held down all four variables and hit C4, it made every test note ring. With the data I collected I discovered that when a variable is higher than C4 the decibels are likely to be louder. These findings lead me to believe that if I use the piano to make sympathetic vibrations. It will accurately represent the physics of sound and enable me to be able to accurately record the time and decibel units of the sympathetic vibrations.

Junior Division Physics

Sky Richards

JR-PH-013

Candy Wars

When Mentos are placed in Diet Coke an interesting reaction occurs. I was curious why this reaction occurred and if I could use another type of candy and create an even larger geyser. The purpose of this experiment is to use the scientific method, practice statistical techniques and to determine which candy will create the highest eruption. My hypothesis is that Altoids will cause the highest eruption due to the number of surfactants in the candy. My hypothesis was incorrect. The Mentos erupted the highest and the Altoids hardly erupted. Other data such as eruption times and remaining volumes were also compared. To conduct this experiment, six different candies were measured to a weight within a gram. Then each candy was placed into a Diet Coke bottle. A video recording was taken of each candy/soda eruption. Finally, after each eruption, remaining liquid volumes were measured and recorded in mL. This same set of six candy/soda eruptions was repeated three separate times to collect sufficient data. The eruption is a physical reaction. The candy has many microscopic pores which work as nucleation sites when dropped in soda. The nucleation sites allow CO₂ bubbles to form and release. There are millions of bubbles forming as the candy sinks. The ingredients in the candy such as potassium benzoate, aspartame, sugar, gum arabic, and gelatin work as surfactants. The surfactants lower surface tension. When the surface tension is low and the pressure is building rapidly the bubbles erupt out of the bottle.

Lakshmi Thanikasalam

JR-PH-014

Capillary Action - Investigation and Empirical Modeling

This project will explore, define, and demonstrate Capillary Action using various liquids and thin glass tubes of varying diameters and try to experimentally model curve using the curve fitting technique. The principles of capillary rise, concave and convex meniscus formation were found and measured for data collecting purposes. This project found a way to demonstrate and measure capillary rise in multiple liquids. Then the data was taken and put into a graph and curve fitted to demonstrate empirical modeling. The project would then move on to validate the model, by testing the given graphing equation against the data collecting methods on glass tubes with smaller and larger inner diameters than tested before. This project will showcase the everyday occurrence of capillary action in many applications commercial and practical.

Junior Division Plant Sciences

Zach Schreurs

JR-PS-001

Bean Growth on the Red Planet: Yay or Nay?

If humans decide to colonize Mars, growing our own food would be critically important. My hypothesis was that bean seeds would: 1) germinate and grow in 100% Earth soil, and also in a mixture of Earth and Mars soil; and 2) not germinate or grow in 100% Mars soil due to its toxic chemicals. I planted two Blue Lake Bush Bean seeds in each of six pots: two pots with 100% Earth soil (ES), one with 100% Mars soil simulant (MS), one with 75% ES and 25% MS, one with 50% of each soil type, and one with 75% MS and 25% ES. I watered each pot to maintain moist soil, and gave all pots 12 hours of light daily at 500 W/m², slightly below Mars' light intensity, with temperature maintained at 15.5-26.6°C. Seeds planted in 100% ES germinated, but none germinated in any pot containing MS. After 20 days of watering the pots containing MS without germination, I planted two additional bean seeds in each pot, hoping toxic chemicals had leached out. None of these germinated. I also transplanted a plant grown in 100% ES to a pot containing 100% MS. The plant survived for two weeks but did not grow, unlike the remaining bean plant in 100% ES, which grew five additional centimeters. Bean plants likely did not germinate or grow due to the toxic chemicals present in the MS. However, the experiment revealed that bean plants can be successfully grown at Mars' light intensity.

Hudson Gryskiewicz

JR-PS-002

Great Grass Growth

In this experiment I planted grass seeds with different materials mixed in with the soil and measured them over time to see which grew the best. This information could be used to plant large fields of grass, such as golf or football fields, that needed to grow cleanly and quickly, while also saving water. I was wondering, what materials and watering levels are best for planting grass? I had 9 identical cups that I filled with 150 mL of dirt each, 2 with sponge pieces mixed in, 2 with perlite, 2 with sphagnum peat moss, and 2 with marbles. I also had one with regular soil as my control. I watered them all the same until they were all over 1/2 inch tall, then I started watering half (not including the control, which I continued watering as normal) of the plastic cups with half the amount of water, and half of the cups with double the amount of water. I measured all of the grass cups every 2-4 days and recorded the results. After observing the grass every 5-6 days for about a month, I found that the grass with more water grew much better than the ones with less water, and the cup with perlite mixed into the soil grew the best out of all. I think I did meet my criteria, as the grass grew, and I was also able to identify which cup of grass seeds grew the best and could go the longest without water.

Junior Division Plant Sciences

Joellianna Rohde

JR-PS-003

Grow with the Flow

For this project, I was experimenting with a hydroponic system and the pH levels. I grew lettuce sprouts at different pH levels. I first had to set up my hydroponic system (see diagram 1). Then I had to make sure each one of the 4 buckets was at a specific pH level (7.0, 6.0, 5.5, 5.0). To do this I had to add pH up and pH down, (see pH pictures). I then added my plants to each one of the buckets, (4 units) once I did this it was time to start the experiment. Over time I had to measure the plants and record that data, (see bar graph) to get a result. My results concluded that having the plant live at a higher pH level will allow them to grow at a better rate then they do at a lower pH level. This information and science experiment will become useful in the real world for the people who live in big cities or a place where it is harder to grow plants in the soil, hydroponics is a great way to grow plants.

Tenleigh Lorenzini

JR-PS-004

Growing through the Elements

The purpose of this project was to test what liquid would benefit the seeds growth the most. I also chose this project to see which liquid would help benefit my garden. I predicted that the milk would benefit the seed's growth the most because of all the vitamin D and proteins. I started this project by making sure I had all of my materials. I laid out three rows with two cups in each row. Then, I measured $\frac{1}{3}$ cup of soil into each cup, using my measuring cup. Next, using the ruler I measured a $\frac{1}{2}$ an inch into the soil. After measuring $\frac{1}{2}$ inch I placed one seed in each hole in each cup. After planting the seeds, I measured out $\frac{1}{2}$ a cup of each liquid. After measuring out each liquid I poured the same amount of liquid into their designated row. The data I collected did not support my hypothesis, which was that milk would work best. Tea ended up helping the plants grow the most overall. The data I collected stated that the plant watered with tea on average was two inches taller than the rest of the plants. The rest of the plants did not grow at all. These findings led me to believe that tea would benefit the plants in my garden the most. This data also helped me learn that tea would be the best thing to water my seeds with it if they had a hard time beginning to

Peyton Meyer

JR-PS-005

Hydroponic Plant Growth

The purpose of this experiment was to test and find out what plant grows the best in a hydroponic system. I hypothesized that the strawberries and lettuce would grow the best in a hydroponic system. I thought this because the leafy greens grow fast and easy so I figured that would be the case in my experiment. This data was collected everyday for five weeks. Changing the nutrients added water out every weekend. The plants grew rapidly for the first 3 weeks and then they started to slow down in weeks 4-5. This experiment involved setting up my six, 2 liter bottles and making them into a hydroponic system. Also planting your choice of seeds. This experiment was tested for five weeks and measured every day in centimetres. Refilling the water every week the plants began to use the water up a lot faster after they started growing rapidly. The data collected did not support my hypothesis. The kale grew the best out of all six of my plants. The kale grew about a total of twenty-two centimetres. These findings lead me to believe that the leafy green grew the best in a hydroponic system.

Junior Division Plant Sciences

Karson Harbison

JR-PS-006

Magnets Maximize Plant Growth

This project tested the effect of magnets on plants to determine if there was a better, more eco-friendly way to grow plants. Magnetism could lead to faster growing crops and help reduce the use of toxic chemical fertilizers and other chemicals used for growing plants. Plants were exposed to three different treatments (South pole magnetic exposure, North pole magnetic exposure, and North pole exposed water) and a control without magnets. The hypothesis predicted that the NPE plants would germinate faster and grow better because the direct magnetic field will have a stronger effect on the ions of the plant and that the other treatments would have a smaller positive effect on the plants. Results for radish and pea plants were measured every two days for approximately one month. For radish the magnetized water treatment (NPEW) had amazing results, the plants germinated faster and grew larger. Unfortunately, the radish plants in the control and SPE treatments did not germinate. The pea plants had similar results with the fastest germination and tallest overall plants in the NPEW treatment. Overall, my hypothesis was only partially supported and I was surprised that the beneficial effect of the North pole exposed water (NPEW) was greater than that of the direct exposure of the magnets (NPE). The good news is that the successful treatment of North pole exposed water would be even easier and cheaper to apply on a large scale because you would only need to expose the water to magnetism rather than having to expose all of the individual plants.

Miles Steven Snow

JR-PS-007

Magnificent Musical Plants

The purpose of this experiment is to find alternatives to toxic chemicals that increase plant growth. This research will prove nature sounds or music can help plant growth. This will help with food shortages. As food growth increases, we can feed more people while protecting the environment from toxic chemicals. My hypothesis is that music and nature sounds will stimulate and increase plant growth. The music group will most likely grow more than the others. In finding the answer to my question, I had three different groups. Each group had the same three varieties of lettuce plants- Marvel of the Four Seasons, Deer's Tongue and Paris Island. I had a control group, a nature sounds group and a music group. I played the sound or music every night. I did this at night so that the plants could be separated but get the same sunlight in the daytime. In my results, I measured the height of my plants every three days and weighed them at the end. The control group was taller and weighed more than any other group. Although I did not get the results I wanted, I think this will help farmers and scientists to not be tricked by rumors of plant growth increasing with sound. I did meet my objective but not in the way I thought I would. I had hoped the music or sound group would grow taller but I was mistaken.

Junior Division Plant Sciences

Makenzie Consaul

JR-PS-008

Ready. Set. Grow

The main focus of this project is to test the efficacy of Biovate at different rates. Biovate is used in potatoes as a seed treatment to help increase the number of tubers per plant therefore increasing the overall yield potential. I chose the variety Yukon Gold because it has a lower tuber set which in turn decreases its yield and is ultimately pushing the variety out of the market. In a small greenhouse trial I started with a control which is untreated and then applied equivalent rates of 16oz, 32oz, and 48oz per acre. We grew the plants out over a two-month period. Prior to harvest we eliminated the plants that either were affected by PVY or had seed piece decay. We harvested the plants and counted the number of tubers per plant. The tubers were sized and measured. All tubers bigger than $\frac{3}{8}$ inch were separated that ultimately would grow to market size tubers. At a glance the most effective rate seemed to be 32oz to the acre. If one was to only look at the 32oz rate and correlate the use of Biovate to a farm setting; the increase due to additional tubers was very significant at a \$360 net per acre. The only problem was there was no linear consistency from the 16oz and 48oz rates to support the conclusion. These rates showed a decrease in set. Therefore, additional experiment trials will need to be done to duplicate the experiment and ultimately prove the efficacy of Biovate.

Teagan Bruchez

JR-PS-009

Soil Matters!

The purpose of my Science Fair project was to test the different types of potting soil to see which was best for plant growth. The data collected did not partially support the original hypothesis. My hypothesis was that the Black Gold organic was going to be the best for plant growth. This project involved buying grass and dirt to grow the plant. I had to plant grass in different types of soil for my project. I also had to experiment on my project twice a day for two weeks. I tested the potting soils on height, pH, temperature, how much grass grew, and how fast each plant grew. My hypothesis was incorrect. The Miracle Grow potting soil worked the best throughout my project. These findings lead me to believe that using Miracle Grow Potting soil is more efficient to use for plant growth. However, if you want an organic garden using the Black Gold organic potting soil is more beneficial.

Kallie Green

JR-PS-010

Sugar Rush

The purpose of Sugar Rush was to see if different types of sugar affect bean plant growth. I hypothesized that granulated sugar will affect plant growth the best because it will add more sugars and increase growth of roots and stem. This experiment involved putting soil in stands and planting the bean seeds one inch deep. Measuring one tablespoon of sugar in a five hundred ml water bottle, shaking it every day. Watering these plants each day and observing the plants each day, plus recording root and stem growth. The data I collected did not support my original hypothesis. Granulated sugar did not affect the stem growth, although granulated sugar did help stabilize root growth. The granulated sugar made the roots grow at least five centimeters longer than the other water types. The brown sugar seeds had the least amount of root and stem growth because of the reverse osmosis caused by the extra molasses. This data leads me to believe that sugar does affect the plant's growth as much as people would think it does. Too much sugar will cause reverse osmosis if the bean seed has too much sugar that the bean seed is trying to get rid of.

Junior Division Plant Sciences

Tyler Wise

JR-PS-011

The Effect of Soil Compaction on Crop Germination

The purpose of this project was to determine how much soil compaction affects the germination of wheat seed. The hypothesis of this experiment was as the compaction increased the wheat germination decreased. To test this experiment there were 4 tubs full of sandy loam soil. Three weights (10, 15 and 25 pounds) were used, and a control. The weights sat on the compactions for 24 hours. There was a slight change in all of the compactions in the beginning with the germination. There was about a 17% decrease in germination between the 25-pound weight and the control. Also the plants in the higher compactions had smaller roots. The data from this experiment does support the hypothesis.

Adam Ouattara & Drake Coffield-Bamber

JR-PS-012T

Avocados So Ripe They'll Guac Your World

We wanted to know which environment is the best for ripening avocados. Our hypothesis is that number 3 in the bag with the banana will ripen first. First we tested the average of three ripe avocados by putting force on them until the skin broke. We used a Vernier Force Sensor. That is how we got the average force it took to break a ripe avocado. We are going to use one bar graph for each avocado's time to break the skin with the average force. To check if the avocado is ripe we will compare the unripe avocados color and force to a "ripe" one every day. We will place six unripe avocados in different environments: the six are in a fridge, in a plastic baggie, in a paper bag with a banana, underwater, sitting on the counter, and in a paper bag by itself. The environments that ripened the avocados the fastest were on the counter, in a brown bag, and in a brown bag with a banana. The banana didn't change the ripening speed. They all took 4 days to ripen. The worst was the avocado in a plastic bag with little air in it. It took 18 days. Another avocado that did badly was the avocado in the fridge.