

*Welcome to the*

# SCIENCE AND ENGINEERING FAIR



**St. John  
Paul II School**  
HIGH SCHOOL DIVISION

## **2023 Project Abstracts**

## **What Effect do Acidic, Basic, and Neutral Liquids Have on the Structure of Bones?**

Oliver Affonso

Bones are made of calcium and other minerals that degrade in acidic or basic conditions. The study that was conducted aimed to show how different solutions affect bone structure. Specifically, this experiment shows how bleach, vinegar, and milk altered the structure. To test the hypothesis that; the more drastically acidic or basic a liquid is, the more of an effect it will have on the bone, bones were placed in the liquids for 7 days. Bones were tested for 7 days and imaged using an x-ray machine to show an increase in or decrease in the calcium levels. The results showed that acidic removed the calcium leaving only collagen, the milk added calcium, and the bleach removed collagen leaving only calcium left on the bone. These results suggest that there are other factors that are responsible for the structure of bones, other than calcium. On this basis, when testing for depletion in calcium levels, other minerals such as collagen, phosphorous, and potassium should be considered.

## **Growth of Rapid Fescue vs. Fescue Grass Seed**

Harry Baroni

Scotts Rapid Fescue grass seed is supposed to grow twice as fast when compared to regular Scotts Fescue seed, but does it really grow faster? Research was conducted in this experiment to test if the rapid grass seed actually grows two times taller and longer roots when compared to regular fescue seeds in the same amount of time. To test the hypothesis that Scotts Rapid Fescue seed will grow longer roots and taller than Scotts Fescue seed, samples of each type of seed were grown to see which actually grows faster. The results of this experiment surprisingly rejected the hypothesis, and the Scotts Fescue seed's average height of the tallest blade of grass, and the average of the longest root from each sample outgrew the Scotts Rapid Fescue seed. These results suggest that Scotts Rapid Fescue seed does not actually grow twice as fast as Scotts Fescue seed. Every year, millions of money is spent on lawn care in the US. Scotts Rapid Fescue seed does not have more benefits than Scotts Fescue seed, other than that it's supposed to grow faster. So, it may not be worth the extra money to buy the rapid fescue seed.

## White Nose Syndrome Investigation

Mugsy Batchelder

Thousands of bats per year are being killed by the White Nose Syndrome. Bats are essential to the environment, and the White Nose Syndrome is causing bats to wake up during hibernation where they either freeze to death or starve to death. This study uses fungi that both contain similarities to the White Nose Syndrome, in order to test possible solutions that may kill or greatly decline the growth of the White Nose Syndrome. When the solution Serra Peptase is introduced, its ability to eat proteins may help to eat away the fungus. To test this hypothesis, Yeast and Rhizopus (Two fungi with similarities to WNS) were grown in petri dishes, and then either pretreated with 0.25 mL of Liquid Probiotics or Serra Peptase, or introduced to 0.25 or 0.5 mL of the same solutions. The results were interesting because the Serra Peptase cracked apart the Yeast growth, however did not visibly affect either of the two fungi when pretreated on the petri dish. However the Liquid Probiotics both ate through some of the Rhizopus growth, as well as warded off Rhizopus growth when pretreated on the petri dish. These results suggest that the Liquid Probiotics are useful when treated *before* the fungal growth appears, whereas the Serra Peptase is useful when treated *on* the fungal growth, because it breaks down the proteins of it.

## Air Pressure and Angles: Effects on a Ball's Distance

Cody Boghdan

When kicking a soccer ball, air pressure is one of the most important components in having a long and accurate kick. There is a large impact that air pressure can cause when a ball is being kicked. Another important factor that can sometimes be overlooked is the amount of force that is put onto the ball. This experiment aims to determine what is the optimal air pressure and force that allows the soccer ball to travel the farthest distance. To test the hypothesis that a soccer ball at 11.0 psi being kicked from 90 degrees will make it travel the farthest, a tool was designed then built to kick the ball with uniform force. The soccer ball was set at different air pressures throughout the experiment and "kicked" at different angles. The results showed the hypothesis to be correct, that the ball at 11.0 psi and being kicked from 90 degrees traveled the farthest. These results suggest that air pressure can greatly change the game and that a soccer ball should always stay around 11.0 psi for optimal gameplay. On this basis air pressure should be taken into account in making sure the game runs smoothly.

## **Do Soil Nitrogen Levels Influence a Tomato's pH?**

Nora Bruinooge

Soil contains nitrogen. These nitrogen levels can affect many aspects of plants. Soil is an essential component of living life because it provides structure and stability. However it can also have effects on living things, especially when it comes to plants. This study investigated the effect nitrogen levels have on a tomato's pH level. During this research different soil mixtures were tested for nitrogen. The soil mixtures included a compost, earthworm, and fertilizer additives. The different mixtures will increase or decrease the tomato plants pH level. For example, soil with decomposers, such as earthworms might release higher nitrogen levels resulting in a more acidic tomato. Clearly these different soil mixtures will result in change, resulting in a more acidic or basic tomato.

## **Changes in Heart Rate and Carbon Dioxide in Exercise**

Sebastian Burke-Lukac

Heart rate goes up with exercise. A low level indicates a healthy heart. This experiment will show if low carbon dioxide correlates with low heart rates. How does the heart's rate and carbon dioxide change with exercise? Heart rate and carbon dioxide levels should go up with exercise. The results will be helpful to see how cardio will affect parts of your body while working out. Twenty-five people participated. The heart rate was measured from a pulse detector which was held by both hands. Carbon dioxide was measured from an exhale. The people then ran up and down one story of the stairs twice. The same thing was measured again. The result showed that most people's heart rate and carbon dioxide increase by almost double from exercise. People with asthma had higher carbon dioxide levels. The two exceptions whose carbon dioxide levels went down waited too long to breathe. These things show that carbon dioxide and heart rate levels are connected.

## **Additives effect on the speed at which ice melts**

Devin Crofford

Many have pondered on whether or not to put ice in their drinks, due to the quick speed at which the ice will melt. It has been shown that different additives can have a dramatic effect on the speed at which ice melts. Different solutes contain bonds which can break down the hydrogen bonds between water molecules, causing it to require less energy to change its state of matter. This study aims to determine which additive has the largest effect on the speed at which ice melts. To test the hypothesis that salt causes ice to melt the fastest, rather than sugar or carbonation, three ice cubes were soaked in different solutions over two, three minute intervals. The three different solutions each contained a different additive: salt, sugar, and carbonation. Before and after each interval, the ice's mass was recorded and accounted for. The results pointed in a direction opposite of the hypothesis: carbonation causes ice to melt the fastest and lose the most weight. These results show that putting ice in a carbonated beverage will cool the drink, but the ice will quickly melt.



## **Measuring Different Nutrients in the Different Ripening Stages of Peppers**

Mia Curley

Diets in regular food intake are essential to keeping bodies healthy. Measuring the levels of fats, starches, carbohydrates, and proteins in different ripening stages of peppers will show if peppers contain these nutrients. The ripeness of the pepper determines the flavor and color of each one. Bell peppers start green, then turn yellow, orange, and then turn red as they go through the ripening process. This experiment aims to test the different nutrients in peppers through four different tests including, Benedict's Reagent, Sudan Stain, Biurets Solution, and Lugol's Iodine tests. To test the hypothesis that red peppers are the healthiest of the different peppers in the different ripening stages. The results showed that peppers contain no fat or starch, although the peppers do contain little amount of protein. Also, the different ripening stages contain different amounts of carbohydrates, starting with green peppers having the least amount of sugar, followed by yellow and orange peppers with a bit more, and finally red peppers with the highest sugar. These results show how bell peppers are a healthy choice for our diets. In this context the results may apply to people trying to figure out a new healthy diet, or people that work in the food business. This information could also build upon other hypotheses about similar foods and plants to peppers.

## **Do Different Percentages of Milk Fat Affect Ice Cream Melting Rate?**

Angelina Cuthbert Manchuk

Different percentages of milk fat affects the melting rate of ice cream and its taste. The amount of fat differentiates in different ice cream and creates inconsistent melting rates. With a higher milk fat percentage, it could potentially melt faster than having less milk fat in it or vice versa. This research aims to conclude whether the amount of fat changes the ice cream's melting rate in any way. To test the hypothesis that has been stated different brands of ice cream and different fat percentages will be used in different ways to melt. Including homemade ice cream with a low milk fat percentage will be used. In researched studies the results should be constant and similar, however the results varied especially in different ways of melting the ice cream. The ice cream would change between how much it melted with the two different ways it was melted. These results conclude that no matter how much milk fat there is and what ways you melt it, the ice cream will vary and not be consistent in the amount that melts.

## **What common, everyday medium can best grow alfalfa sprouts?**

Ava Czech

Alfalfa sprouts grow differently in different substances, and some places have more of some resources than others. The tested mediums were garden soil, ash, and rocks, all of which were found around a house. This study aims to determine the best growing conditions for these kinds of sprouts. To test the hypothesis, sprouts were grown with the same amount of sunlight, water, and amount of material they were planted in. It was found that alfalfa sprouts grew best in ash. Therefore, areas with larger percentages of ash will be able to grow these sprouts the best, due to the fact that they grew significantly better to those grown in soil and rocks.

## **The Effect of Light on Plants**

Saoirse Diver

All plants perform photosynthesis to survive. Plants in the natural environment use sunlight for food and energy during photosynthesis. At times, indoor plants cannot use natural sunlight so they use artificial light. Plants use the energy of the sun to change water and carbon dioxide into sugar and glucose. This experiment tests if using artificial light has an effect on the plants' growth and development. To test the hypothesis that pea plants will grow equally, they were sorted into four different groups and put under different types of light. The four types of light were halogen, LED, incandescent and sunlight. For two weeks, the plants were given the same amount of fertilizer and water. Over this time period, the plants grew at all different ranges. In order of growth, the natural sunlight grew the most, then LED, halogen, and incandescent. This research proves the kind of light used does have an effect on the plants. People like farmers and florists would benefit from knowing how different kinds of lights can affect the growth of plants because they could grow their crops and plants in different places.

## **The Saponification Process: The effect of different fragrance oils on setting time**

Michaela Enright

Saponification is an extensive process that requires apt attention to detail and the utmost precision. It is well established that soap needs 2-3 weeks to set and 4-6 weeks to cure. This experiment aims to test whether different fragrance oils affect the soaps during the setting phase. To test the hypothesis that both synthetic oil soap and essential oil soap will be involved in different ways, an experiment was conducted by making two batches of soap. In one of the batches, essential oils were mixed in, and in the other batch, synthetic oils were mixed in. The results that both soaps showed no trouble setting supported the hypothesis, however, the soap containing essential oils set faster. These results suggest that when making soap, it is quicker to use essential oils because it's the fastest way with scenting to still get the same results. The control experiment with no scent takes 2-4 weeks, the essential oil takes 4 weeks, and the synthetic oils take 5 weeks. This helps speed up the soap-making process.

## **Stabilizer's Effect on Chlorinated Pool Water**

Olivia Evans

Today, pools across the world face a major problem: chlorine levels in these pools are rapidly declining due to harsh UV rays from the sun. Without stabilizer, the sun quickly dissipates the chlorine present in the water. This experiment aims to determine just how much stabilizer affects chlorine levels. Specifically, it investigates different levels of stabilizer and how they affect chlorine's dissipation rate. To test the hypothesis that more stabilizer slows down the dissipation process, different water samples with various stabilizer levels were created. These samples all contained different levels of stabilizer and the same amount of chlorine. These samples were then tested daily for the remaining ppm of chlorine in the water. The results showed a decrease in dissipation rate in the samples with higher levels of stabilizer. These results suggest that when stabilizer is added to pool water, it dramatically affects how fast the chlorine goes away. On this basis, stabilizer should be used in order to preserve the amount of chlorine in pool water.

## **How Temperature Affects the Growth of Mold**

By: Elyse Giannakoulis

The environment determines how long food can last in a location after purchasing it. Not only can food grow mold, but it can also spoil and rot. It is important to know where to store food in order for it to last longer and prevent the growth of mold and bacteria. This study aims to determine whether or not the temperature and environment the bread is in affects the growth of mold. To test the hypothesis that the temperature affects the mold growth on bread, an experiment was practiced. Each location consisted of two pieces of bread in which the humidity and temperature was measured. The results showed that the hypothesis was true and that the temperature does affect the growth of mold. These results show that it is important to know the environment of the locations of bread because the temperature determines how long it will last.

## **How Magnetic Fields Affect Ants' Behavior**

Quincy Hietsch

How do magnets affect the behaviors of animals? Magnets work by using fields and these fields could affect animal's behaviors. This study will use magnets, ants and orange slices to figure out if they do. Magnets were put in different positions and the ants would have to go through the fields or around them to find the orange. The results were that the ants were not affected by the magnetic fields and will go any way to get to the orange. These results show that magnets do not affect the behaviors of ants.

## **Does the temperature of the air affect the air pressure of a basketball?**

Marlo Jumper

When playing basketball, the air pressure that makes the ball bounce a certain height can change with low or high temperatures. This can affect how the game is played because the ball's air pressure could change due to the gym temperature. This study aims to determine how the different temperatures will affect air pressure and bounce height. To test the hypothesis, the hotter the air temperature, the higher the bounce and the lower the air temperature, the lower the bounce, basketballs were put in different temperature areas to change their air pressure and bounce. The result supported the hypotheses, and suggested that keeping the basketball in cold or hot temperatures changes the basketball's bounce. The results can help with air pressure in many sports balls, not just basketballs.



## **How Does Fertilizer Affect Bean Plants**

Ellie Kowal

Fertilizer was invented to help plants grow, but it is known to kill plants if there is too much. Farmers and plant owners use fertilizer all the time to help their plants grow. When using fertilizer, they want to know what is the right amount to give the plants to ensure they don't die. The experiment in this project was made to figure what amount would make the plants grow at the faster rate. The hypothesis was that the plant that had the recommended amount of fertilizer would grow at the fastest rate. This experiment was designed to test plants without fertilizer, plants with the recommended amount, and plants with too much. The results showed that the fertilizers' effect on the beans was that the plant with no fertilizer grew at the fastest rate, which was 19.7. This information going forward can help people find out how much of the amount of fertilizer used affects what they are growing. People like farmers and plant owners can really benefit from knowing the information found in this experiment.

## **Can superworms survive on a diet with polystyrene?**

Aleksander M-Borkowski

Plastic pollution is increasingly causing issues in the environment, and compounds such as polystyrene are some of the most damaging pollutants, which may take millions of years to decompose. Scientists have discovered that superworms, the larvae of darkling beetles, are able to consume polystyrene, better known as styrofoam. The basis of this investigation sought to find whether superworms can survive on a diet with polystyrene. In order to determine this, weights and populations were measured in three separate groups of superworms with varying foods. In these three populations of superworms, one group was given a normal diet, another was given a mixed diet, and the last group was given a diet of only polystyrene. Results showed that the most deaths and the largest loss of weight occurred in the superworm group containing only polystyrene. Indicated in these results is that superworms cannot sustainably survive on a diet of solely polystyrene, but that a mixed diet may be a better alternative if degrading polystyrene is the goal. Superworms may one day become a solution to pollution caused by styrofoam.

## **Plants in Space**

Brian Mancinelli

Scientists are in need of a way to grow food to support the potential future human life on Mars. This experiment aims to test how gravity affects the germination of plants. This experiment specifically shows the correlation between gravity and weight, which will also be shown in the project. To test the hypothesis that weight will negatively affect the germination of plants, weights will be put on top of germinating seeds ziploc bags, which contain germinating peas wrapped in a wet paper towel. The results from the experiment suggest that a heavier weight negatively affects germination.

## **Does the Color of Honey Affect its Sugar levels?**

Leah McManus

When purchased in American grocery stores, honey is often processed using filtration methods and heat. This is to make it more visually appealing to the consumer. However, filtration changes honey's chemical composition and its glucose levels. It has been established that filtration can affect the glucose level of honey, but does its color affect the level of glucose too? If so, how drastically? This study aims to test the amount of glucose present in the honey using a refractometer. To test the hypothesis that the darker the honey the higher the glucose level, three honeys were taken one light in color, one medium in color and one dark in color and tested using a refractometer. I used heated and unheated samples of each honey. The results showed that darker colored honey has a higher glucose level. These results suggest that filtration also raises the glucose levels. The testing of these questions is beneficial for people with diabetes. This is because it is a good tool to raise your insulin levels and keep your blood sugar regulated. This could also be an important experiment to prove that the color of food has a significant impact on how much sugar is inside of it.

## **The distance the ball travels on different surfaces**

Lily McNamara

Depending on how smooth the surface is, a soccer ball will travel a specific distance. When a ball is kicked with the same force, different surfaces affect how far it travels. This study aims to show how the distance traveled is impacted by the friction of various surfaces. The ball is kicked on various surfaces while maintaining the same force and air pressure in an effort to test the hypothesis that the level of friction affects the distance traveled. The results demonstrate that the ball travels differently depending on the surface, due to the fact that the tar had the greatest distance traveled and coarse grass had the slowest distance. According to these studies, a harder surface makes the ball roll farther. This knowledge is helpful to know what to expect playing soccer on different surfaces.

## **What solution melts ice the fastest?**

Alex Morin

Ice on the road can be a very serious and dangerous problem. Nearly 2000 people die and over 135,000 people are injured each year due to car accidents on icy and snowy roads. This study aims to try and prevent those accidents from happening by finding the best way to clean the roads. To test the hypothesis of what solution works the best to melt ice, an experiment was placed. In the experiment each solution was placed on a sheet of ice and timed to see what melted the ice the fastest. The materials that were used were rock salt, magnesium chloride (liquid), brine (liquid), sand (solid) and pre-mixed salt (liquid). The results showed that rock salt melts ice the fastest. This is because salt lowers the freezing point of water, leading to the ice melting. This happens as a result of the salts (ionic compounds) disrupt hydrogen bonding to decrease melting temperature. These results suggest that to make the roads safer during a time where there is a possibility of having ice on the road, you should definitely apply salt.

## **Lung Capacity and Heart Rate of Conditioned vs Unconditioned Athletes**

Sophie Philbrick

Lung capacity and heart rate play a major role in athletes performance on and off the field, court, track, pool, ect.. Athletes who are unconditioned, and do not exercise or participate in sports, tend to have a weaker lung capacity than conditioned athletes who are active and regularly compete in sports. This experiment aims to determine whether the heart rate and lung capacity of an unconditioned athlete versus a conditioned athlete changes more or less before and after exercising and which is stronger. To test the hypothesis that a conditioned athlete's heart rate and lung capacity is stronger and changes less before and after exercise, 20 athletes were asked to complete a task. Ten conditioned athletes blew into a spirometer, wore an apple watch while running up and down four flights of stairs, and blew into a spirometer again after the run. The same test was completed again with ten unconditioned athletes to compare and contrast results. The results showed that both conditioned and unconditioned athletes' heart rates rose during and after the exercise. It also showed that the unconditioned athletes lung capacity had a greater drop after exercising than the conditioned athletes. These results show that playing sports and staying active helps to strengthen the respiratory and cardiovascular system (lung capacity and heart rate).

## **Nitrogen, Phosphate and Potassium in Fertilizers How Different Percentages Affect the Growth of Bean Plants.**

By: Anna Schlegel

The different amounts of nitrogen, phosphate and potassium vary in a range of fertilizers. All are key elements in the growth of plants. Nitrogen provides structure and helps with the DNA of plants. Phosphate stimulates a plant's metabolism, the process of photosynthesis and cellular respiration. This experiment aims to show that a fertilizer with a higher amount of nitrogen in it will yield more growth in a bean plant. To test the hypothesis, a group of fertilizers with different amounts of the nutrients will be surveyed, along with a control group that will contain no fertilizer. Over a three-week process, with two weeks' prior for germination, the plants started to grow. However, the results received from the procedure were unclear. Throughout the growth process, some materials used affected the plant's ability to grow. There was improper sunlight, extreme cold and sprinkles of snow, and soil that was not nutritional to stabilize growth. The result was that only  $\frac{1}{6}$  of the plants grew, which was not enough to get any clear data. This experiment, while it did not yield results to answer the original question, does indicate that in order to grow proper plants, conditions must be carefully monitored and considered.



## **What building material best protects insulation from fire?**

Gabe Spadaro

This project is addressing the problem of house fires and trying to figure out which building material best protects the insulation on the other side of the wall when a flame is right on the wall. boxes were built of the different materials and then stuffed with insulation. To test the hypothesis that the 2x4 would do the best a flame was put up to the box for 3 minutes. Then the insulation was checked by lifting the top of the box that was not screwed on then checked. the insulation for charring along with how the inside of the box was doing in terms of structural integrity. The results suggested that the drywall was the best performing material when protecting the insulation. So with the information of this experiment the material that best protects insulation from fire that was tested was the drywall.

## **How temperature affects battery life**

Ava Todd

When a battery is not lasting the amount of time it should then it may be because of the temperature it is being stored in. Temperature can affect the rate of a chemical reaction. Inside a battery there are many chemical reactions happening at the same time. When the rate of chemical reactions changes, that will cause the battery life to change. This experiment aims to find out if temperature affects the time a battery lasts and if it will affect different types of batteries differently. To test the hypothesis that the battery being frozen will last a shorter amount of time then the battery that is being heated, the batteries will be stored in different temperatures. Then the voltage of the batteries will be tested and put into a flashlight until it runs out of power. The results show that the temperature affects the battery life differently depending on the type of battery. The alkaline batteries lasted the longest overall no matter the temperature. On average, the room temperature batteries have lasted the longest. These results show that extreme heat or extreme cold make batteries last a shorter amount of time. This could help people in the future find the optimal condition to store a variety of batteries including household and technology uses. As well as car and industrial batteries.