

## **The Effect of Step Length on the Exerted Forces and Velocity of the Body**

*Student Research By: Allyssia Ashman, Kathleen Fitzsimons, Megan Rawlins, and Brittany Watling*

Many physical pains can relate back to the way someone walks, which is dictated by the step length of the person. The force a person exerts on the ground is exerted back onto them; this is called the normal force. The purpose of this experiment was to analyze the effect of step length on force applied by and velocity of the subject. To determine the effect of step length on the force exerted, volunteers were filmed walking across three force plates, positioned at five different step lengths, 65cm, 70cm, 75cm, 80cm, and 85cm. As the subject walked across the force platforms, the force exerted by the body was measured and recorded. The velocity of the subject was measured by tracking the position of specified points on the subject using the motion analysis program, ViconPeak Motus. Two-sample T-tests showed that the data of each of the subjects was statistically different from data collected on the other subjects, so subject data was analyzed on an individual basis. The trends of each of the subjects displayed that as step length increased, so did the force exerted by the subject. On the other hand, the change in velocity was not significant. The difference between velocities at different step lengths was not a great change.

## **The Effect of Varying Primers on the Precision of the PCR Amplification Process as Applied to Crime Scene Suspect Identification**

*Student Research By: Jamie Dullea, Ellery Henley, Kristen Patchel, and Kathryn Van Ham*

In crime scene analysis, polymerase chain reaction is used to quickly and easily identify or eliminate possible suspects. The purpose of this experiment was to create a method of DNA extraction in a high school environment that would successfully reduce the suspect pool at a crime scene using multiple primers. Research was conducted at the Macomb Academy of Arts and Sciences in Armada, Michigan. Three varying primers, purchased from Operon Biotechnologies and Bio-Rad, were used in PCR amplification, in order to determine correlating banding patterns between trials. DNA was obtained from test subjects through saliva samples, then extracted, and amplified. Seven trials of both male and female DNA were paired with a designated primer and placed into an electrophoresis chamber to produce a banding pattern that was dependent on the length of each individual's DNA segment. Unfortunately, only one agarose gel produced a visible banding pattern following electrophoresis. No other data was obtained during testing due to inexplicable procedural errors. Primers purchased from Operon Biotechnologies were prepared on a nanomol scale. Since the DNA was highly temperature sensitive it had to be handled very carefully to ensure that it was not damaged.

## **The Effect of the Beats per Minute of a song on a Subject's Resultant Heart Rate.**

*Student Research By: Jack Calderone, Justin Roland, Beau Seigfreid, and Adam Suddon*

Music is part of our everyday lives and has been the subject of a great deal of research in the recent years. Music is growing in today's scientific environment, but the reality of music having the power to cause this type of neurostimulation and promote change within the body itself is still up for discussion. In order to test these studies, students volunteered to participate in a study measuring heart rate when different tempos of music were played. Once within a controlled environment, five different variations of a song were played through headphones to concentrate the music into the subject's ears. The student's heart rate was then taken initially and during the playing of a song. That student would be asked to come back to the room in a latter portion of the day should their name be randomly selected again. The experiment had shown no valid trend in a change in heart rate due to a change in beats per minute of a song. Change in beats per minute of a song being directly related to the change in heart beat of a human still could not be necessarily proven or disproven with the collected data.

## **The Effect of Increasing Frequency Levels On the Formation and Complexity of Fractals**

*Student Research By: Perry, R.J., Phillips, Ryan, Rusek, Andrew, Young, Eric.*

The purpose of this experiment was to determine if different frequency sweeps could produce a fractal of a higher complexity. There were five different sweeps used during the experiment: 150Hz to 200Hz, 200Hz to 250Hz, 250Hz to 300Hz, 300Hz to 350Hz, and 350 Hz, to 400Hz. To produce fractals using sound an amplifier was used. It was connected to a laptop in order to generate the frequency sweeps. The data was analyzed using a program called Benoit Fractal Analysis Program. In order for the program to analyze the data, a digital photo was taken of each fractal. The program produced the results rated on a scale from 0 to 2; 0 being the least complex and 2 being the most complex. The most complex fractal created was at the frequency sweep of 200Hz to 250Hz, with a complexity of 1.89. The least complex fractal was produced at 250Hz to 300Hz, with a complexity reading of 1.66.

# **The Effect of Various Paraffin-Beeswax Ratios on the Enthalpy Change of a Burning Candle**

*Student Research By: Sean Gillis, Chris Graham, and Stephen Peltier*

The two waxes that were used in the experiment were paraffin wax and beeswax. The mixtures were made in the following six ratios of paraffin wax to beeswax; 100:0, 80:20, 60:40, 40:60, 20:80, 0:100. The experiment was conducted using two procedures; one was with a bomb calorimeter and the other with a homemade calorimeter. Candles were made of the different mixtures to be used for testing of the homemade calorimeter. Certain masses of each type of wax were heated up to make the different mixtures. After each mixture was let to sit out for a week, they were then heated up again and poured into pre-assembled molds made of PVC pipe. A primed wick was also held in the center of the candle until the candle hardened. These were the candles that were burned using the homemade calorimeter. The candles were burned for five minutes each with the temperature of the water recorded before and after the test. This was done to accurately find the enthalpy or change in heat of the water.

In the procedure with the bomb calorimeter, different quantities of each wax were massed out that equaled up to 0.5 grams and matched the different ratios. These were the samples that were burned in the bomb calorimeter. The reason for this experiment was to determine if paraffin wax gave off more energy than beeswax when burned. The results for the bomb calorimeter showed a general upwards trend from beeswax to paraffin wax but the p-values from the 2 sample t-tests did not support the graph of the means.

# **The Effect of Number of Reflections on the Light Intensity and Divergence of the Beam of a Type II Semiconductor Laser**

*Student Research By: Braden Hayes, Joshua Kanke, Raymond Van Ham, Thomas Zinger*

Lasers are used in many different applications including measurement, engraving, and medical uses. In order to control the beam of light, lenses and mirrors must be used to direct and focus the light. The experiment was conducted to determine the effect of the number of mirrors the laser was reflected off of on the intensity and divergence of the beam. The results showed that the intensity was inversely related to the number of mirrors while the divergence was directly related. The effects of Snell's law and the properties of specular reflection are discussed. Finally, suggestions for improvement in the procedure of future, similar experiments are given.

## **The Effect of Varying Salinities of Water on Oil Absorption**

*Student Research By: AnnMarie Ede, Hannah Miller, Erica Pregano and Amanda Shields*

The experiment took place at the Macomb Academy of Arts and Science through the school year of 2008-2009. The purpose of this experiment was to see if the salinity of the water would have an effect on how much oil is cleaned up. Fish tanks were set up with 20,000mL of water and various amounts of crushed salt (0mL, 200mL, 400mL, 600mL, and 800mL) were added. Changing the salt concentrations represented different salinities of water, from freshwater to ocean water. Then 550mL of oil was added, and cotton balls were skimmed across the top of the oil with a total of sixty cotton balls per test. Cotton balls represented the sorbents, which absorb oil in large scale oil spills and are made of similar materials to the cotton balls. The cotton balls were massed before and after being skimmed over the oil, to find a mass gain. This was subtracted from the initial amount of oil, resulting in a measure of how much oil was picked up. The 400 mL test picked up the largest amount of oil, but the 600 mL was the best test, due to the fact that it had the most consistent absorption rate throughout the test.

## **The Effects of Temperature and Time Exposure on the Alcohol Production Rate in Apple Cider**

*Student Research By: Shana Knake, Crystal Knust, Shelby Motoligin, Casey Murray*

When apple cider is left in certain environments over an extended period of time it may undergo a change in composition called fermentation. This process occurs when natural yeasts in cider convert sugars to alcohol. The purpose of this research was to determine how temperature and time affected the alcohol production rate in apple cider. The experiment was conducted at the Macomb Academy of Arts and Sciences in Armada, Michigan from October to December 2008 using an infrared spectrophotometer. Four half gallons of cider were assigned different temperatures and were kept in controlled environments for the duration of the seven week experiment. The 5°C cider was kept in the refrigerator, the 20°C in the senior research room, 40°C in a box heated by one 60 watt light bulb, and 50°C in a constructed box heated with two 60 watt light bulbs. Each week, a sample was taken from each temperature group, tested in the infrared spectrophotometer, and compared to a background. The alcohol production rate was analyzed by finding the area underneath each alcohol peak given by the infrared spectrophotometer graphs, located between 3500-3200cm<sup>-1</sup>, and comparing them to an insignificant peak in order to make a ratio. There was a significant increase in alcohol production found in the 5°C cider from the first week to the fourth, and continued to increase to the seventh week, though at a slower rate. The 20°C cider's alcohol production increased rapidly from the first to the fourth week as well, but then began to decrease to the seventh week. The 40°C and the 50°C cider did not show a significant increase in alcohol over the seven weeks of testing. Therefore, the optimal temperature for alcohol fermentation to occur ranged from 5°C to 20°C. When exceeding 20°C, the yeasts began to die off from the heat, so sugars could not be converted to alcohol.

## **The Effects of Blade Length and Pitch on the Power Output of a Wind Turbine**

*Student Research By: Matt Karl, Bret Kirchner, Cody Tousignant, and Cole Waterstraat*

The following experiment was conducted in order to provide the most efficient blade length and pitch combination to a real world wind turbine application. The harnessing of wind energy itself has become one of the most effective methods in striving for a cleaner, more renewable future. Currently, the world's population is reliant on non-renewable energy sources such as fossil fuels and, if not dealt with, will quickly run out. A 10:1 scale wind turbine was constructed and blade lengths of 8, 10, 12, 14 and 16in were cut and positioned at a blade pitch angle of 15, 25, 35, 45 and 55 degrees. To synthesize wind energy, a box fan was positioned to create a steady flow of wind parallel to the turbine. As the blades spun, the attached DC motor would convert the energy from the wind into electrical power. As the data was analyzed, it was concluded that as both the blade length and blade pitch angle increased, the resultant outputted milliwatts decreased. This trend was due to the blade length's mass increasing. With each consecutive length increase, it required more energy to spin the assembly. The more energy required to spin the assembly resulted in less energy being transferred to the DC motor. The blade pitch angle outputted the most power when it was at the lowest angle because, at this angle, it allowed the most surface area to be parallel with the fan, harnessing the most energy. All experimentation was conducted in the Mac Lab of the Macomb Academy of Arts and Sciences between the dates of October 18, 2008 and December 21, 2008.

## **The Effects of Ethanol and Octane Added to Gasoline on the Amount of Energy Produced**

*Student Research By: Chris Haller and Matt Martin*

The purpose of the experiment was to see if the addition of ethanol (as in E85 fuels) and the octane rating of the fuel affected the amount of energy produced from the fuels. To observe the effect of ethanol on gasoline, six different mixtures of a gasoline to ethanol ratio were created. Six ratios were tested: 100% gasoline, 80% gasoline/20% ethanol, 60% gasoline/40% ethanol, 40% gasoline/60% ethanol, 20% gasoline/80% ethanol and 100% gasoline. The 20% gasoline/80% ethanol trials were as close to actual E85 fuel and used to receive a similar trend in the energy that E85 might produce. In addition to testing the ethanol content in the gasoline, the octane rating of gasoline was also tested using the gasoline with an octane rating of 87, 89 and 93 in each trial. All trials were run using the IKA C200 Bomb Calorimeter which would ignite the fuel mixtures and measure the amount of energy that was produced by the fuel. It was concluded from the data collected that as the amount of ethanol added to the gasoline increased the amount of energy produced by the fuel decreased. It was also concluded that the octane levels did not make a significant difference in the energy produced. Even though the amount of the energy produced increased as the octane level grew, it was by such a small margin that the difference was not influential. Experimentation was conducted in the staff meeting room m of the Macomb Academy of Arts and Sciences in Armada, Michigan.

## **The Effect of Soap Amount and Washing Time on the Number of Bacteria Killed on Human Hands**

*Student Research By: Kyrene Teipel and Katie Wylin*

The objective of this experiment was to determine the best combination of washing time and soap amount to kill the greatest amount of bacteria on human hands. Testing began on October 8, 2008 and concluded on December 17, 2008 and was conducted at the Macomb Academy of Arts and Sciences. Random soap amounts and washing times were paired together and assigned a computer. There were seven different amounts of soap that the hands were washed with: 0mL, .5mL, 1mL, 1.5mL, 2mL, 2.5mL, and 3mL. Six different times were tested from 5 to 30 seconds in increments of five. A full page was typed on the computer keyboard to obtain bacteria and then four fingertips were swabbed. After the hands were washed and dried, the same four fingers were swabbed again. Both bacteria samples were diluted serially. The final dilution of each, which had a ratio of 1:100,000, was incubated on nutrient agar for one week. The resulting colonies were counted and compared.

The data was analyzed and several conclusions were made. The amount of soap used did not seem to have an effect on the amount of bacteria that was killed. This could have been due to that the soap was spread evenly over the hands, so the same amount was still in contact with the skin regardless of the overall soap amount. However, it was found that the longer the hands were rubbed together, the more bacteria were killed.

## **The Effect of a Vehicle's Velocity on the Impact Force When Entering Standing Water**

*Student Research By: Kevin Kline, Zach Nawrot, Aaron Solomon, and Chris Tobey*

An experiment was conducted from October 8, 2008 to December 17, 2008 at the Macomb Academy of Arts and Sciences in Armada, Michigan to determine the effect of a vehicle's velocity when entering a body of standing water on the impact force experienced. The purpose of the project was to simulate what happens to a car when driving through a section of flooded roadway, and to determine how the speeds corresponded to the force experienced when transferring between the road and water. In order to conduct the testing, a model section of a roadway was constructed, and three 1:18 scale Chrysler 300s were tested at various velocities ranging from 0.62m/s to 1.86m/s. Each trial was recorded and analyzed using Vicon Peak Motus. The cars were tracked as they completed the transition from the road surface into water, and the speed and time were used to calculate the force exerted on the car. It was found that as the velocity increased, the impact force exerted on the car increased at an exponential rate as well. This was thought to have occurred because of Newton's second law of motion; force is equal to the acceleration multiplied by the time the force is applied. The amount of time it took for the car to be slowed to a stop was constant and the acceleration increased. This means that as the acceleration increased so would the force measured.

## **The Effect of Reflecting Sound off Various Surfaces On Decibel Level Change**

*Student Research By: Joe Kilpatrick, Tyler Kinch, Jeff Medley, and Matt Soulliere*

An experiment was conducted to see whether loud sounds or quiet sounds would lose more intensity when traveling through various mediums. Sound was played in a sound proof box out of an iPod speaker and reflected at a 45° angle off two different surfaces: carpet and water. The decibel level was then recorded using a sound level meter. (Pasco Scientific Digital Sound Level Meter, Roseville, CA) This process was repeated for five different decibel levels. When the testing was completed, it was found that carpet reflected less sound than water and that the initial decibel level being played did not make a difference to the change in the reflected sound. This was believed to have happened because of constructive interference caused by sound waves bouncing off the walls of the box. Another reason this happened is because lessening of space due to addition of a surface. Even though the project did not result in any substantial findings, all of the data collected was proved to be scientifically sound data using p-values.

## **The Effect of Varying Amounts of Oil and Naturally Occurring Bacteria in Soil on Oil Degradation**

*Student Research By: Torrin McDonald, Sean Steinberg, and Melissa Wawrzyniak*

Oil spills are a common problem in fresh and salt water ecosystems throughout the world. When an oil spill occurs, it can greatly harm the wildlife and ecosystem of that region. To protect these ecosystems, it would be beneficial to find an efficient, natural process to quickly clear the oil from the environment. Previous research had been done to suggest that bacteria naturally occurring in soil breaks down oil in a process called oil biodegradation. The naturally occurring bacteria have been suspected to break the hydrocarbon bonds in the oil, creating a less harmful substance. Research was conducted at the Macomb Academy of Arts and Sciences between the dates of October 8<sup>th</sup>, 2008 and December 17<sup>th</sup>, 2008, to test this theory. One gram of soil, 20 milliliters of water, and varying amounts of oil were placed into multiple test tubes, and overall mass loss was observed. After analyzing the results, no trends were found that proved that oil degrading bacteria were present in the soil. The mass differences had a high variability, therefore, no trends were found in the data. The p-values proved that the variability in the data was not a result of the changing oil amounts. It was determined that all mass loss was due to evaporation rates. Therefore, future research should be done without using water, so that evaporation would not be a factor when determining mass loss.

## **The Effect of Hydrogen Peroxide on the Immunity of Escherichia Coli**

*Student Research By: Chelsea Antilla, Kelly Copley, Jamie Green, Jacob Payne*

The purpose of this experiment was to see how long it took for Escherichia coli, a bacterium present in all humans, to become immune to hydrogen peroxide, a weak antiseptic. This experiment was chosen because of the increasing concern about antiseptic resistant bacterial strains such as MRSA. At the beginning of each day, tryptic soy agar was made with 40g of agar mix and 100 ml of boiling water. This mixture was then poured into 100 Petri dishes, which were placed in an autoclave and sterilized. After the dishes were sterilized, they were plated with a hydrogen peroxide and Escherichia coli solution. The four different solutions were 0.03% hydrogen peroxide, 0.3%, 0.5%, and 1.0%. The remaining percent of each solution was distilled water. After the dishes were sterilized, each dish was allowed to solidify for one week and any dishes showing growth were then disposed of. Once plated, each dish was placed in an incubator set at 37°C for one week. Upon removal, each dish was photographed for later analysis. The data obtained varied greatly and was irregular; therefore, the hypothesis was only partially supported. For future research, better testing methods will need to be used in order to eliminate variance and improve the strength of the trends. It is also recommended that the exposure of the hydrogen peroxide to any form of light be as limited as possible, so as to retard the decomposition of the hydrogen peroxide.

## **The Change in Heat from a Lighting Strike at Varying Distances**

*Student Research By: Mike Copley, Jake Serilla, and Preston Treend*

This study was conducted to observe the heat from lightning-generated electricity as it passed through a sandy medium. This was done by measuring the temperature spike in the sand at four points; each was a separate distance from the lightning strike. The environment used was set up to replicate a beach. It was made up of a large fishtank, containing 18.92L of sand. The sand temperature, before and after the lightning strike, was recorded on two X-plorer GLX's, using four surface temperature probes. The probes were placed 7.62 cm apart. A 250,000 watt Tesla Coil served as the source of electricity. A metal rod, one meter long, was placed in the center of the fishtank, three centimeters down into the sand, and served as a lightning rod to divert the electricity into the sand.

The results obtained supported the hypothesis. The sensor placed 7.62cm away from the lightning rod recorded the highest mean temperature spikes. The sensor placed 30.48cm from the lightning rod recorded the smallest mean temperature spikes. In order for the electricity to travel farther through the sand, it must travel through more sand. This allowed more heat to be absorbed by the specific heat of the sand.

## **The Effect of Air Pressure on the Height the Volleyball's Bump Height**

*Student Research By: Evan Baumann, Eli Becht, Michael Frost, and Shannon Klee*

The purpose of this experiment was to observe how air pressure affected the bounce height of the volleyball. There are many different ways a ball can be returned to the opposing side in volleyball. One of the main techniques is called a bump. Depending on the speed of the ball, sometimes the player has to apply an upward force to the ball so the ball will travel back over the net. To find the best way to get the ball to go farther without applying any upward force, a research group thought increasing the pressure of the ball would do the job. All research was completed at the Macomb Academy of Arts and Sciences in Armada, Michigan. A stand was made to imitate a volleyball player in the bump position. A track for the ball to roll down allowing the ball to achieve the proper height and speed needed to bump was also constructed and attached to a ladder. The data gathered from testing showed that the difference in pressure of 3 PSI and 7 PSI made a large impact on the height the ball was bumped. However, there was no significant difference for variables 4 PSI, 5 PSI, and 6 PSI.

## **The Effect of Voltage on the Strength of a Magnetic Field**

*Student Research By: Ted Binkowski, Jacob Caporuscio, and Kevin Jutila*

Many researchers around the world have been trying for years to produce a weapon that would accelerate a projectile beyond velocities obtained through conventional gunpowder methods. Using current run through parallel rails to create a magnetic field, a method was produced which used this technology to accelerate projectiles well beyond conventional velocities. This new weapon became known as a railgun. To further explore this new technology, disposable camera capacitors were used to provide power for a miniature set of rails. A gauss meter was then used to measure the electromagnetic field produced, and the voltage was changed to see how the magnetic field would be affected. The various voltage settings were 27.4 V, 24 V, 18.4 V, 12.6 V, and 6.1 volts, using 0 volts to measure the background magnetic field as a control. The weakest magnetic field was produced using 6.1 volts, while the strongest magnetic field was produced using 27.4 volts. This is because voltage is essentially a measure of electrical pressure, and mathematically, increasing the pressure will make the magnetic field stronger. However, the effect of changing the amperage of the current run through the wires would affect the strength of the magnetic field. Further experimentation with railgun technology would be needed to determine the effect of amperage.

## **The Effect of a Slingshot's Draw Length on the Size of the Projectile's Impact Crater**

*Student Research By: Nathan Antilla*

Over a course of ten weeks, research was conducted to see whether the draw length of a slingshot had any major effect on the size of a crater produced with a projectile fired from said slingshot. A slingshot was mounted to a stand and a box of sand was constructed for testing. After many trials were performed, it was concluded that the draw length did have a noticeable effect on all fields of measurement for the crater other than the crater depth. 2-sample T-tests supported this result.

## **The Effects of Light Wavelength and Tilt Angle On Electrical Output of a Solar Panel**

*Student Research By: Gary Ezzo*

To test factors that cause a solar panel to produce electricity most efficiently, various angles of the solar panel, combined with a variety of light colors shining on the solar panel were tested to determine what combination produced the highest voltage. The colors that were tested were white, red, green, and blue. These colors, except white, were produced using light filters (Lee Filters, Andover Hampshire, England). The solar panel that was used was a 15.8cm x 17.4cm 12-volt solar panel. A 120 volt lamp containing a 650 watt light bulb shining white light was placed with the bottom of the lamp 97 cm above the top of the cardboard box. This lamp was used to produce white light. The color of light to be tested was randomly selected, while one solar panel angle was tested for the entire day. The combination of solar panel angle and light color that produced the greatest average voltage was 20 degrees combined with white light. The combination that produced the least great mean voltage was 80 degrees combined with green light. The smaller degree measures caused the light to hit the solar panel with a greater intensity, causing more electrons to flow through the solar panel over a given period of time. However, there seemed to be no trend between light wavelength and voltage output. This was likely because the solar panels were calibrated for the use of sunlight, which contains more red light than light produced by a light bulb.

## **The Effect of Electrolyte Ph Level on Max Power of Liquid State Batteries**

*Student Research By: Daniel Finn, Donald Goulette, Joshua Lewis, and James Schneider*

Power is a measurement of the work in an object. In the case of electricity, voltage is how much push is needed to complete a circuit, and current is how much is going through a circuit, are used to calculate power. Power was calculated for the experiment by measuring voltage and current for a liquid state battery, which was comprised of copper (for the positive terminal) aluminum (for the negative terminal) and acetic acid for the electrolyte. It was found that if the Ph level was not at 1.5 there was a sharp drop in voltage and current; in terms of max power, there is a quadratic trend that peaks at a Ph level of 2. These can be explained by the surface area ratio of the anode and the cathode. The surface area of the anode was 2.7 times larger than the cathode's. This caused too many negatively charged ions to be created and not enough positively charged ions to accept them.

## **The Effect of Antimicrobial Content in Polyethylene on the Prevention of Bacterial Growth**

*Student Research By: Emily Fleming, Stephanie Herbert and Sarah Jurzysta*

The purpose of this study was to see if the antimicrobial product Microban would be able to live up to its expectations and constantly fight off bacteria, such as Escherichia coli (E. coli). Microban is incorporated into many objects that people use every day to prevent bacterial growth: hospital equipment, tiling, infant play toys and school products. An experiment was conducted to determine if the percentage of Microban in polyethylene effected how well bacterial growth was prevented over an extended period of time. The percentages of Microban were 0%, 0.6%, 0.89%, 1.48%, 2.07% and 2.37%. After Petri dish samples were made, E. coli was dispersed onto all of the samples. The samples colonized for seven days, after which the area without colonization was calculated. This was done using simple geometric shapes to determine the area in millimeters squared. After data collection was completed, it was found, on average, that as the percentage of antimicrobial increased in polyethylene, the area without colonization on the dish, surrounding the plastic, increased as well.

## **The Effect of Mass on the Kinetic Energy Experienced through a Rollercoaster**

*Student Research By: Rebecca Durbin, Sean Mulvey, and David Sheridan*

A rollercoaster was constructed out of K'nex to simulate the same velocities that occur on a real life rollercoaster. The purpose of the experiment was to find whether mass has a direct impact on the kinetic energy experienced during the ride. The experiment was conducted October 8th 2008 through December 17th 2008 at the Macomb Academy of Arts and Sciences. Weights were set as 102g to 152g in increments of 5g. After the rollercoaster was constructed the testing could begin. Eight photogates were set along the rollercoaster in different spots to simulate real rollercoaster motions. Two were located around the loop, one before and one after a loop. One was placed at the top of a hill. Two were placed after a right turning hill, and a left turning hill. The remaining three were set at the bottom of hills. An index card was attached on the top of the carts so the photogates could measure the velocity. Two GLX's recorded the times of the cars as they passed through the photogates. It was found that the average masses of the tests did increase the kinetic energy when mass increased. This only happened for photogates 2, 4 and 5 though. Photogate 5 can be explained because the cars were moving at the same speed through this photogate. The increase in mass would directly increase the amount of kinetic energy present in the car. Photogates 3, 6, and 7 seemed to show a quadratic curve, where the middle weight of 127g performed the best. It did not travel extremely fast to cause the car fly off, nor was it held down by its own mass, which decreased speed tremendously. Two sample t-tests supported that the data was parallel.

## **The Effect of Impact Position upon the Force Produced Within a Helmet**

*Student Research by: Alex Blake, Fred Flaim, Mitchell Kallek and Jake Moegle*

The purpose of this experiment was to determine if the angle of impact on a football helmet affected the amount of force produced inside the helmet. This research was conducted in the junior/senior research room at the Macomb Academy of Arts and Sciences. Research has shown that most concussions in a football game were caused by an impact on the side or directly behind the head. A sledgehammer was used as a pendulum to hit the helmet to simulate a collision. A Styrofoam mannequin head was cut in half and an accelerometer was placed inside of the head after it was hollowed out. The data showed that 45 and 0 degrees were highly different from other gradients. 45 degrees had a significant amount of variation compared to the other trials. This was thought to have been caused from the facemask and where the hammer struck the helmet. The facemask stuck out from the helmet and on occasions, the hammer would deflect off of the helmet, which caused the data to vary. It was found that the angle of impact from the sledgehammer to the helmet did not effect the amount of force produced inside the helmet.

## **The Effect of Shampoo and Conditioner on the Tensile Strength of Hair**

*Student Research by: Nicollette Brown and Alyssa Goike*

The purpose of this research was to determine if the strength of hair increased when washed with Redkin, a salon brand restoring shampoo, and when washed with the generic brand Dove. These results were used to decide whether an expensive shampoo and conditioner would be more effective than its generic counterpart. Testing was conducted at the Macomb Academy of Arts and Sciences from October to December 2008. The hair was divided into sections; one half was dyed with permanent hair dye, while the other half remained natural. These sections were then accordingly washed with both Redkin and Dove shampoo/conditioner. The number of washes tested in the experiment were one, three, seven, ten, and fifteen. Afterwards, ten strands of hair were tested for tensile strength. The results showed that as the number of washes increased, the hair's strength would also increase. However, throughout the experiment non-dyed hair remained noticeably stronger than dyed hair. This is because dyeing the hair would further weaken it, while the non-dyed hair remained at its optimal strength. The largest increase in strength for all variables occurred between the control and the first wash. This could be because the original hair came from a weave that was treated with chemicals to ensure sanitation; therefore, the first wash would have restored the most strength to the hair. Lastly, the results showed that Dove improved the hair's strength slightly more than Redkin. However, when standard deviations were accounted for, both shampoos performed at approximately the same rate. This is because both Redkin and Dove shampoo and conditioner have the same intended purpose, so the products contain similar ingredients.

## **The Effect of Sulfuric Acid on Stain protected by PET**

*Student Research by: Sarah Doering, Cecelia Goulette, Emily Herbert, and Elizabeth Ulinski*

The purpose of this experiment was to determine a possible solution to the damaging effects of acid rain on everyday surfaces. Not only is acid rain the cause of harmful skin conditions on human beings, but it also wears away many substances, such as deck stain. This is because the acid rain causes the composition of the substance it comes in contact with to break down. However, it is found that acid rain has little effect on substances such as polyethylene terephthalate (PET). To conduct this experiment, blocks of wood were layered with a plastic-stain mixture. Each trial consisted of different amounts of PET plastic ranging from 0.1g to 0.5g in increments of 0.1g. The coated blocks were soaked in sulfuric acid for one week to allow the effects of the acid rain to take place. The percent visibilities of each trial were then tested using a UV-Vis to determine how much stain and plastic were removed from each of the blocks. These percentages were then recorded and analyzed to determine if the PET plastic had assisted the stain to withstand the effects of acid rain. It was thought that the 0.5 grams of PET would have the best result. Instead, it was found that the 0.1 grams did the best when referring to the means.

## **The Effect of Vegetable Oil on the Efficiency of Biodiesel**

*Student Research By: Nicole Ewert, Grace Gregory, and Alyssa Williams*

Biodiesel is made of many oils and fats but through a chemical process it is transformed into two products. These are methyl esters and glycerin, methyl esters is the chemical name for biodiesel. The biodiesel experiment was done to see if adding vegetable oil to biodiesel would increase its efficiency. Six different percent ratios were tested in the experiment. The ratios were mixed to add up to a 0.5 milliliter mixture of biodiesel and vegetable oil. The percents included zero, five, ten, fifteen, twenty and twenty five percent vegetable oil. The control of the experiment was the one hundred percent biodiesel. The control was predicted to have the smallest amount of energy released, so it was tested for comparing purposes. The data was very similar throughout the results, but a small trend can be identified. This can be shown by looking at the difference in the largest mean from the smallest mean and realizing that it is only a little more than three degrees difference. The largest mean came from the control and the energy released decreased as the percent of vegetable oil increased.

## **The Effect of the Acid Rain on the pH of Soil and the Mass of Plants**

*Student Research By: Caylyn Boadway, Kristie Harms, Kate Shellenbarger, and April Wesolowski*

An experiment was conducted in the biology lab at the Macomb Academy of Arts and Sciences. The purpose of this experiment was to find out if different pHs of water (acid rain) would effect the growth of radish plants. The researchers wanted to see if the acid rain affected the pH of the soil or the mass of the plant. Six different pHs were tested: 6.5, 6.1, 5.6, 5.1, 4.6, and 4.1, with 5.6 being the control. To start the experiment, the researchers had to mix up all of the acid water, with the varying pHs. Once the seeds were planted, a set procedure was followed each week. Once a week the plants would be individually massed and the soil's pH would be tested. Also, the physical appearance of the plants were written down each week. On an average of three days a week the plants would be watered with pre-measured amounts. This was done to keep the soil "... evenly moist (not wet) to prevent roots from becoming cracked..." (Brown). Once the first five weeks were over, a new set of plants were tested. After analyzing the data the researchers concluded that the pH of the water had little or no effect on the mass of the plant or the pH of the soil. The only big effect noticed was the appearance of the plants. However, the appearance did not differ for different pHs of water. Overall, there was no pattern or trend that had to do with the amount of acid found in the water.

## **The Effect of Various Percentages of Diesel and Biodiesel on the Energy Released During Combustion**

*Student Research By: Cole McCloskey, Tyler Nichols, Mathew Van Ham, and Sean Woods*

The purpose of the experiment was to find which fuel, biodiesel or regular diesel, would release the most amount of energy when burned and which type would be more sensible to use factoring the eco-friendly benefits of biodiesel. With the same burning properties, biodiesel and regular diesel would produce the same fuel economy. In order to find which of the fuels would produce the most energy, a bomb calorimeter was acquired. Different fuels were mixed, into different percentage combinations, and then tested by burning under a bomb calorimeter, which was filled with water, to measure the heat produced. The different mixtures used were standard diesel, B9, B20, B49, and B99. After the testing was complete, the specific heat formula was used to calculate the amount of energy released, in kilojoules, from the burning of the fuels using heat, mass of the water, the specific heat capacity, and the change in temperature. After data collection, it was found that there was no difference between the amount of energy released by biodiesel or regular diesel. Many of the means were similar and the P values were high, meaning that the data was very similar as well. The only difference between the two was that biodiesel took longer to light but once lit, burned for longer. Also, the emissions from the diesel were a darker color than the biodiesels, which were clear. Overall, biodiesel proves to be more efficient than the regular diesel and is better for the environment.

## **The Effect of Various Rinse Times of Mouthwash on the Remaining Bacteria in the Human Mouth**

*Student Research By: Caitlin Bouchey, Amanda Douglas, and Allan Husketh*

In order to kill as much bacteria in the mouth as possible, an ideal time would have to be found for rinsing with mouthwash. Different times can greatly change how much bacteria is remaining. Bacteria was collected from someone's mouth before and after rinsing with 20mL of mouthwash. The percent of remaining bacteria was found for four different time trials of 7.5 seconds, 15 seconds, 30 seconds, and 60 seconds. After analyzing the data, it was found that 15 seconds had the best decrease in remaining bacteria. After rinsing, there was only 75.3% ( $\pm 44.7\%$ ) of bacteria remaining. This had the best results. The least positive was 60 seconds, which had a remaining bacteria amount of 177.6% ( $\pm 137\%$ ). This had a rise of 77.6% of bacteria. These changes in bacteria were formed because of the time the mouthwash was in the mouth. Different times had a different effect on the mouth. The different time trials changed the amounts of remaining bacteria.

## **The Effect of Different Amounts of a Substance on the Melting Rate of Dihydrogen Monoxide**

*Student Research By: Lauren Fitzsimons, Kelly Goolsby, Kourtne Kurtz, and Raschelle Sheinost*

An experiment was conducted at the Macomb Academy of Arts and Science in Armada, Michigan. Testing was conducted weekly from October 29, 2008 to January 15, 2009. In the experiment, different substances were added into water. The purpose of the experiment was to find out which substance; gelatin, propylene glycol, dimethyl sulfoxide, or sugar would decrease the frozen water's melting rate. To test this, the chemicals were added to the water in the amounts of 1 gram, 2 grams, 3 grams, 4 grams, and 5 grams. Bottled Déjà Blue water, was bought from the store in town and brought to the academy, and then whichever substance was being mixed with the water was brought out. The mixes were then put into bags and put in the freezer. Every Wednesday, the ice was brought out and melted in a heat box, for one minute intervals. The masses were recorded in excel as the experiment progressed. The substances were expected, that at least one of the substances would have a major effect on the melting rate. None of the chemicals had a major effect, but there was a small effect. The control for the experiment was just plain bottled water that was frozen.

## **The Effect of Heat on the Performance of Insulation Combinations**

*Student Research By: Singen Chang, Michael Pollari, David Schornak, and Derek Schornak*

Insulation has been placed in nearly every type of building throughout the world. The right type of insulation is an important choice towards the cost of heating and cooling. The cost could be reduced if the right combination of insulation is used. The idea was based on what combination would work the best and save money at the same time. Therefore, an experiment was conducted to determine an ideal combination of different types of insulation. Before the experiment could be conducted, a box was created to replicate a building with an insulation holder in the middle of the heating box to simulate a wall of a building. Light bulbs were placed on one side to simulate heat with the box split in half, one to represent the outside of the building with heat and one to represent the inside. The different insulation combinations that were used were: no insulation, 20%, 40%, 50%, 60%, 80%, and 100% fiberglass, and 100% cellulose. The no insulation combination was the control for the data. From the data that was collected, the most successful mixture found was 50% fiberglass and 50% cellulose. The researchers believed this because the mixture had the most constant temperature difference. Overall, all the statistics for each of the combinations were very similar. The lone outlier of the data was the no insulation combination. This would confirm that inserting any combination of fiberglass and cellulose would help insulate any building.

## **The Effect of Different Material Swatches at Different Distances on a Marble Rolling Through a PVC Piping Roller Coaster**

*Student Research By: Jessica Barjaktarovich, Ashley Ewert, Carlie Harms, and Isabella Kesler*

The purpose of this research was to test the speed of a marble rolling down PVC piping roller coaster with different material swatches placed on the roller coaster at different repeating distances. Sandpaper, pre-wrap, and cotton were the materials that were placed on the roller coaster. The control for the experiment was a PVC piping roller coaster with no materials covering the surface. To perform the experiment, a roller coaster was built out of PVC piping. The material swatches were then placed on the roller coaster. A marble was dropped at the beginning of the roller coaster and timed as the marble rolled through the roller coaster. The results of the experiment showed that the control produced the fastest times. The fastest times out of the three materials appeared when cotton was being tested. The slowest times occurred when sandpaper was being tested. The sandpaper was the slowest material due to the rough surface of the material, which caused more friction on the marble. The pre-wrap was the next slowest material due to the sponginess of the material, which also caused some friction on the marble. The cotton was the fastest material because it is a smooth material, and caused very little friction on the marble. Cotton had times that were similar to the control.

## **The Effect of Burning Sawdust Made from Combinations of Wood on Temperature Production**

*Student Research By: Brad Fistler, Vince Ragap, and Josh Tschiggfrey*

This research was done to show the heat outputs for different combinations of sawdust. The experiment was done to test which types of sawdust burn hotter or if the combined percentages burn hotter. Results show the different types of sawdust burned hotter alone. Fires used were inconsistent with heat output and were put out at different times with many outliers. This experiment used grams to measure the different percentages of sawdust. Every ten percent was measured as half of a gram. The total amount of sawdust added up to five grams as 100% sawdust. Sawdust used had to be measured on a balance to get the correct amount of sawdust necessary. The sawdust heat was measured in degrees Celsius. A maximum temperature of each trial was used for the data. The research used poplar and oak sawdust. It was finely ground to produce accurate burning methods. Previous tests showed that the wood had to be pure and finely ground. If not, this could have changed the project to wood chunks instead of sawdust. The burning of the sawdust was constant, except for a few outliers with a lower temperature. The temperature was higher when the sawdust was not mixed with another type of sawdust. This happened since the sawdust combination created a competition for heat.

## **The Effect of Monster on Worms**

*Student Research By: Kaitlyn Bushbaker, Christine Chorney, Jessie Hyatt, and Ashten Lindeman*

The purpose of this experiment was to show the effects of Monster energy drink has on living creatures, such as worms. For this experiment, six different concentrations of Monster and water were created and tested. The Monster and water mixtures were soaked into the worms' dirt and food. In each concentration fifteen worms were tested. The worms were randomly selected to be put into each concentration, where they lived for one week. After the week, their speed was tested by timing their travel away from light through a paper towel tube. It was found that the Monster did not increase the worms speed, it actually made the worms move slower. It was discovered that the Monster was killing the worms. If there was little or no water in the concentration the worms had a high chance of dying. When there was no Monster in the mixture, the worms' speed would increase. This is thought to be because the Monster was slowly killing the worms due to the ingredients it contained. These ingredients include citric acid and caffeine. The Monster did not provide enough nutrients for the worms to live on. Also it was believed that the Monster was causing the worms to lose their senses because they became unresponsive to light and touch.

## **The Effect of Barrel Length on the Precision of a Pneumatic Canon**

*Student Research By: Alex Asbury, Dan Binder, Eric Kosek, Robbie Okray*

The purpose of this experiment was to see if there was a relation between the length of a barrel on a projectile and the precision of the shot. This was done by creating a pneumatic cannon. There were 5 different barrel lengths used in this experiment; 30 cm, 45 cm, 60 cm, 75 cm and 90 cm. In pneumatic cannons, air pressure builds up in the chamber of the cannon and the chamber is sealed with a valve. Once the pressure in the chamber was built up to the desired pressure, the valve is opened and the pressure pushes out the object that was in the barrel. For this experiment the barrel was loaded with a wad, because the marshmallow was smaller than the barrel therefore air could get around it. Before the marshmallow was put in the barrel, flour was applied so that when it hit the target it left a mark. The results that were concluded at the end of the experiment showed a significant relation between barrel length and precision. As the barrel length increased, the precision also increased.

## **The Effects of Foam Ridges on Decibel Absorption**

*Student Research by: Kaitlyn Clough, Rachel Goubert, Katrina Prohaszka, and Desirae Tibaud*

All research was conducted at the Macomb Academy of Arts and Sciences. The purpose of this experiment was to test different mixtures of soundproofing materials to determine which was the most efficient at absorbing sound waves. Sound waves begin to damage hearing around 85 decibels, so it is necessary to block loud noises. Two types of foam were used to create the mixtures: eggshell foam, which had rounded ridges, and commercial soundproofing foam, which had straight, triangular edges as ridges. To perform the experiment, a box was built and lined with eggshell foam. The mixtures of foam were built into cartridges and placed across the middle of the box. On one side of the cartridge was a radio and on the other side was a GLX sound sensor. A second independent variable was used, being the pitch of the sound. High, medium, and low pitches were tested using all seven foam mixtures. The data concluded that the decibel levels were almost the same for every variable of foam. The only noticeable change was the differences between pitches. All readings for the high pitch were close, but drastically different from the similar data for the low pitch. The scientific reasoning is that the sound diffracted the same way for each type of foam ridge. It is also possible that sound does not travel well in small spaces, and therefore was not allowed opportunity to spread out and be absorbed evenly.

## **The Effect of Blade Width and Angle on the Voltage Produced by a Wind Turbine**

*Student Research By: Ashley Brodacki, Elizabeth Crawford, Taylor Krause, and Haley Waterstraat*

The purpose of this experiment was to discover the most efficient way to produce alternative energy through wind turbines. This was done by manipulating the angles and widths of blades in an attempt to increase the voltage produced. To begin testing, a wind turbine model was created. Seventy-two blades were constructed using a template; twenty-four blades with a width of 1 inch, twenty-four of 2 inch, and twenty-four of 3 inch. Dowels were inserted into the base of the blades to connect them to a rubber stopper. The blades were twisted to the desired angle, using an angle measuring mechanism. The rubber stopper was then connected to the shaft of the motor in the wind turbine. Using alligator clips, a multi-meter was connected to the motor so the voltage could be visibly read. The appropriate angles and widths were tested and each voltage produced was recorded. As the angle decreased and the width increased, the voltage that was produced increased. The smaller angles could cut easily through the air (having a minimal amount of air resistance), and the larger widths were able to “catch” the greatest amount of wind due to their vast amount of surface area. Since 10 degrees was the smallest angle and 3 inch was the largest width, these variables produced the greatest voltages. Testing was done between October and December of 2008, at the Macomb Academy of Arts and Sciences.

## **The Relation Between Carbonation and CO<sub>2</sub> Released From ice Cubes**

*Student Research By: David Duncan, Austin Penzien, Vince Seefried, and Chris Sledz*

The purpose of this experiment was to create an ice cube that could cool and re-carbonate a beverage. For this experiment, the amount of carbonation added to the water was compared to the amount released from the ice cubes. Water was carbonated at different time intervals using a CO<sub>2</sub> tank with a regulator. The water was carbonated in an Erlenmeyer flask, and then separated into individually sealed containers. Each container was frozen for later testing. The frozen ice cubes were melted to see how much CO<sub>2</sub> was in the ice cubes. This was done by placing each ice cube into a sealed plastic bowl. This bowl was placed in a hot water bath to quicken the melting process. A CO<sub>2</sub> sensor was put through the top of the plastic container to record the amount of CO<sub>2</sub> released from the ice cube. These CO<sub>2</sub> measurements were later compared to other trials. It was observed from the results that the more CO<sub>2</sub> dissolved into the water, the more released from the ice cubes. This was true for all the trials except for the ninety second and one hundred twenty second trials. These two trials had the most carbonation. Through analysis, it was concluded that these two trials were indeed the same. This caused the trend of the project to plane out at a certain amount of carbonation.

## **The Effect of the Angle of a Mallet Swinging in a Pendulum Motion on the Force that it Exerts and the effects on Yarn, Polyester Fiber, and Paper**

*Student Research By: Natalie Bytner, Krystal Diel, Lauren Grobbel, Sabrina Tibauda*

The project was based on whether an increased angle of a swinging mallet would affect the force, and was conducted October 22, 2008 through December 10, 2008 at the Macomb Academy of Arts and Sciences (MA<sup>2</sup>S). A mallet swinging with pendulum motion was swung into a force plate. A mitten was put on the mallet to protect the force plate. The hinge was used so the mallet could be pulled back at different angles to get different levels of force. To do the data collection, the mallet was pulled back at different angles (10° to 70°, in 10° increments) to find a difference in force. Various materials (yarn, paper, and polyester fiber) were put over the force plate and tested, and then the force generated was compared to nothing covering the force plate. Polyester fiber covering the force plate created a lesser force than our control group and was thus an insulator. Paper, however, created a greater force than our control group and was thus a conductor. Yarn had little difference as opposed to nothing covering the force plate. There was an increased force as the angle of the mallet increased.

## **The Effect of Mass on the Size of Craters Formed**

*Student Research By: Gabriella Dabain and Maija Manninen*

The purpose of the research conducted was to determine how the mass of a meteor or airplane would affect the impact left in the Earth's surface. Having this information would help pilots choose where to land airplanes in case of an emergency. The research, conducted at the Macomb Academy of Arts and Sciences (MA2S) in Armada, Michigan, required a sandbox filled with pool filter sand, seven plastic eggs filled with different amounts of sand, two-meter sticks, a ruler, and toothpicks. The eggs all had a different mass. They were randomly selected using a random number generator and dropped into the sandbox from two meters above. The depth, width, and length of the craters were measured in centimeters using a ruler and toothpicks. The data showed that as mass increased, depth increased at a constant rate. The length and width also continued to increase until the egg massed 84 grams. The eggs above 84 grams had a decreasing length and width. It is theorized that this was found because once the egg was 112 grams, the force was such that the mass contributed mostly towards depth. It did not affect the width or length. The results suggest that if an airplane had a lighter mass, it would have to avoid areas around buildings and people, because the width and depth would be larger. A plane with a larger mass would be better off crashing in an area with a deep range of solid ground to prevent hitting water or a mining area underneath the Earth's surface.

## **The Effect of Liquid Density and Approach Angle on the Movement of a Water Wheel**

*Student Research By: Mitchell Bobcean*

The purpose of the experiment was to find out what was the ideal density of a liquid to rotate a water wheel as well as the ideal angle that a liquid hits a water wheel for the maximum amount of rotations. The results of the experiment showed that the least dense liquid (water) created the most rotations of the water wheel. The results also showed that as the angle the liquid hits the water wheel increases, the total rotations the water wheel makes also increases. Although the total rotations increased as density of the water and angle of the pipe increased, the total time the water wheel rotated was completely random for each variation of the liquid's density and the angle the liquid hit the water wheel.

## **The Effect of Different Angles and Surfaces on Time**

*Student Research By: Ashley Ede, Holly Hutcheson, and Sarah Maro*

For the experiment there were three different surfaces and six different angles. To conduct the experiment, two Photo gates were connected to a GLX machine to take the time of each trial. To change the Surface, either two grams of grass were placed on the ramp, a regular surface, or four strips of sandpaper. A car was rolled down on the different surfaces. It was found that regular surface did have the fastest times, then the grass surface, then sandpaper. Each angle did not differ greatly, but in comparing angle one and six, there was a greater difference. The results were believed to be caused by the different amounts of friction and motion, the incline of the angles, and the affects of increasing or decreasing them. By increasing the incline of the ramp, the car was able to move faster.

## **A Study of the Pressure Created by Various Mixtures of Coke and Pop Rocks**

*Student Research By: Jake Beaudin, Robin Bliss, and Drake McArthur*

The myth about Pop Rocks and Coke and their reaction is very well known. Little Mikey of life cereal commercials was reported to have died after eating a Pop Rocks and Cola combination due to his stomach exploding. The problem that is trying to be solved is to see the maximum amount of pressure Coke and Pop Rocks mixed can give off. Varied mixtures of Coke and Pop Rocks were combined into a jar connected to a pressure sensor, where they stayed for a period of time before the pressure was examined by using the gas pressure sensor. All of the materials were provided by the Armada Academy of Arts and Sciences. Results gained from the experiment prove that the highest amount of pressure released only amounted to 101 kilopascals, which were then converted into pounds per square inch, which equaled 14 PSI. A stomach would not expand at 14 PSI.

## **The Effect of Different Toothpastes on the Rate of Tooth Decay When Soaked in Mountain Dew for Various Amounts of Time**

*Student Research By: John Gaffney, Nick Nixon, Cody Schmidt, and Brandon Townsend*

This experiment was run in order to discover the effects Mountain Dew has on teeth after being brushed by different toothpastes. This experiment was performed at the Macomb Academy of Arts and Sciences between October 8th 2008 and December 18th 2008. The teeth were brushed by three different types of toothpastes. These toothpastes were Total Advanced Clean, Tartar Protection, and Cavity Protection. All were Colgate brand. Each tooth was thoroughly brushed and then soaked for various times. The times were: 60 minutes, 50 minutes, 40 minutes, 20 minutes, 10 minutes, and zero minutes, or the control. The teeth were then massed and the new data was recorded. After all of the data was collected, a number of different tests were run on the computer and they had shown which toothpaste held up the best against tooth decay. That toothpaste was the Colgate Cavity Protection. The tests had shown that the Colgate Cavity Protection toothpaste had the least amount of mass lost overall. This experiment was significant to real life because it shows people which toothpaste can help stop developing tooth decay. It also shows people all over the world that consuming too many sweets, like too much soda for example, can cause tooth decay to develop in their mouths and can severely affect their lives in the future.

## **The Effect of Mass on the Velocity of an RC Car on Various Surfaces**

*Student Research By: Alyssa Baker, Michael Graham, Garrett Hutcheson, and Jessica Payne*

The purpose of the experiment was to determine how mass added onto an RC car affects its speed, and how different surfaces affect the speed. Meter sticks were used to construct a track on three different surfaces: linoleum, gym floor, and carpet. Different amounts of play dough masses were placed on the RC car, which was driven from one end of the track to the other. The time from start to finish was recorded. The results showed that as more mass was added, the speed of the car decreased. The car drove the slowest on the carpet surface, and there was no significant difference between the speed of the car on the linoleum and gym floor. Because there is more friction on the carpet and an equal amount of friction on gym floor and linoleum (which were made of very similar material), the carpet was slowest and gym floor and linoleum had very similar results. Also, if more mass is added on to the car, the car needs more force to move the same speed. Because the batteries do not provide extra energy every time the mass is increased to make up for this, the car slows down. This can be applied to real life because the RC car could represent a real car or truck, and the different masses could represent different amounts of people or materials (wood, oil, etc.) in the vehicle. The different surfaces could represent different road types (pavement, dirt roads, etc.) This experiment could be expanded by using different battery types as an independent variable, or changing the angle of the surface being driven on.

## **The Effect of High Density Polyethylene and Sand Seeds on the Growth of Copper Sulfate Crystals**

*Student Research By: Trevor Goolsby, Eric Mustaffa, Austin Shultz, and Kurt Wieber*

Research was conducted at the Macomb Academy of Arts and Sciences in Armada, Michigan, from October 8th, 2008 to December 18th, 2008. The purpose of the experiment was to compare the area of copper sulfate crystals grown using different seeding techniques. Both High Density Polyethylene pellets and sand particles were used as crystal seeds during the experiment. Putting the crystal seeds into a Petri dish of copper sulfate solution produced copper sulfate crystals around the seeds when left undisturbed for seven days. Through this procedure, it was found that the type of crystal seed was not a determining factor in the final crystal area. Copper sulfate crystals were found to have grown larger with a crystal seed compared to the control due to assisted nucleation. In the field of copper sulfate crystal growth, few studies have been done. For future studies, a suggestion was made to have more independent variables, such as more types of crystal seeds, variations in air temperature, and periodic motion be included.

## **The Effect of Calcium on the Growth of Radish Plants**

*Student Research By: Marisa Green, Katherine Isaacs, Courtney Kurkules, and Jennifer Suddon*

A project was done to test the growth of radish plants that were watered with different concentrations of calcium. The calcium was measured by parts per million (ppm) and converted to grams (g). It was found that from 25 ppm to 50 ppm the calcium solution helped the radish plants grow. However from 75 ppm to 125 ppm the calcium started to lose effect or kill the radish plants. 50 ppm of calcium water helped the radish plants grow the best overall; height and number of leaves. The radish plants were measured by height and the amount of leaves per radish plants.

## **The Effect of the Percentage of Clay Added to Moist Sand on the Stability of a Mountain Formation, During and Earthquake**

*Student Research By: Dallas Bonkowski, Alexandria Kesk, Jeremy Martyniak, and Tiffini Valuet*

The project was done to see how the density of a material affects the stability of another when an earthquake occurs. The project would show the increase or decrease in stability when an earthquake occurs. A plastic bin was used to put the mountain formation in. The sand and clay were mixed and then placed into the cylinder container to mold the mountain it was then placed into the plastic bin. The plastic bin was then placed on the shake table and was shook for 5 seconds. It was then removed from the shake table to be measured by using a rule to measure the height of the sand. The formation was measured based on the highest point of the mountain formation. The results that were gathered showed that when a high density material is mixed with a low density material the formation becomes denser and sturdier. The higher the percentages of clay were added to moist sand, the more the formation stayed intact. This supports that a sand mountain is sturdier when it is mixed with clay.

## **The Effect of the Angle of Entrance and Size of the Meteorite on the Height of the Splash of the Water**

*Student Research By: Sarah Haller, Alyson Kline, Kelsey Job, Dallas Shafer*

The purpose of the research project was to find at what angle of entrance a meteorite would cause the largest tsunami. This was conducted at Macomb Academy of Arts and Sciences (MA<sup>2</sup>S) in Armada, Michigan. Also, it was tested to see if the size of the meteorite affected the wave height. Plaster of Paris was used to create the meteorites that were shot into the water. Fifteen gallons of water were poured into a tank. A sling shot was built to simulate a meteorite crashing into the ocean. Launch angles of 10°- 90° (at 10° increments) were tested 30 times each with a large and small meteorite. It was found that the larger the meteorite and the higher the angle, the larger the wave height. The means of the data for the large meteorite were larger and had a smaller standard deviation than the means of the small meteorite. The data had shown that the 10° small meteorite displaced more water than the 10° large meteorite. The rest of the angles had shown the opposite. The large meteorite displaced more water than the smaller meteorite concluding in the rest of the data.

## **The Effect of the Hand Angle and Force on the Distance a Volleyball Travels**

*Student Research By: Janiece Dominek, Caitlyn Sheridan, and Angela Sztaba*

The purpose of this project was to find the best possible hand angle and force to use when serving a volleyball. A catapult was built that could accurately serve a ball and allow for hand angle and force to vary. The different angles tested were 90°, 110°, 130°, 160°, and 180°. There were also four different forces tested. Distance was measured as the dependant variable. All combinations of forces and angles were each tested thirty times. It was found that the hand angles were not a factor to the distance the ball traveled. The only variable that affected the distance the ball traveled was the force applied. The results showed that the greatest force performed the best, traveling the greatest distance.

## **The Effect of the Soap to Water Ratio on the Height of a Bubble**

*Student Research by: Sarah Herbert, Megan LaCavera, Chase Rhein, Brett Zebelian*

The purpose of the experiment was to find which ratio of bubbles to water would create the highest bubble. The ratios that made the solutions were measured in 10% increments from 10% bubbles to 100% bubbles; the 100% bubble solution having 250 mL of solution. The difference in the size of the ring was also tested using a 12 cm and 18 cm in diameter ring to find which ring would also create the highest bubble. The bubbles were measured by connecting the bubble ring to a fishing pole that was attached to the ceiling. After the ring soaked in the solution for 30 seconds, the ring was reeled up at a constant speed using a metronome to keep time. The top of the ring was watched to see how high it was when it broke from the bottom. This was how the experiment was tested and recorded. Each solution was tested 30 times. The solution of 100% bubbles made the largest bubble for both ring sizes. The small ring bubbles were about 40% smaller than the bubbles made by the bigger ring. When comparing the two ring sizes, the 12 cm ring had a maximum height of  $27.967 \text{ cm} \pm 1.991$  while the 18 cm ring had a maximum height of  $59.067 \text{ cm} \pm 1.660$ . People are always wondering how to get the biggest bubble possible. The testing that was conducted answered that question.

## **The Effect of the Angle a Foot Strikes a Football on the Distance the Football Travels**

*Student Research By: Mike Granata, Stephen Ireland, Zach Kilpatrick, and Jason Moegle*

The researchers tested which angle of a foot is most consistent and shows the best results for the distance a football is kicked. The group was responsible for finding the materials to build the contraption that consisted of many different parts. When the leg was held up in the air, it had potential energy. When the leg struck the ball, there was elasticity on the ball. When the football was kicked at the 90 degree angle, the average distance was 311.55 centimeters. When the ball was kicked at the 180 degree angle, the average distance was 172 centimeters. After 100 trials were completed for each of the six angles, the data was analyzed and inserted into Minitab. Trials were run for several weeks and the results showed that the 90 degree angle is the most effective. The ball went the farthest each time because all of the force from the leg was exerted on one point of the ball. The 180 degree angle was the least successful. All of the force coming from the leg was absorbed by the ball because it hit the ball evenly. From the 90 degree angle to 180 degree angle, there was a gradual decrease with the average distance the ball traveled for each angle.

## **The Effect of Added Mass to Speed on a Car**

*Student Research By: Ian Clark, Ryan Sawitzky, Tyler Switchulis, and Christian Tollis*

Mass helps to increase friction, so it would make sense if the mass were increased there would be more friction, helping the car to move. It was found that if there were more weight in the front, the car would go faster. It was also found that if the car had too much weight in the back, the car would have significantly lower acceleration. For example, on the gym, most of the tests were significantly slower than the tests done on the carpet. Our research project consisted of adding six different masses to six different set positions.

## **The Effect of Fabric Thickness on the Impact Force Exerted on a Force Plate**

*Student Research By: Trevor Fistler, Jesse Spalding, Mike Stewart, Aaron Walkowski*

Over the years, choosing catchers equipment for the game of baseball has always been pondered. The overall purpose of this experiment was to take these studies to the next level with state of the art technology. The effectiveness of force exerted on the catchers gear of a baseball player is widely known, however little is known about what type of foam can lower the greatest amount of force. Protection is needed if playing baseball, especially for the catcher. This is why the project was in general, an interesting experiment. The overall goal was to find how much foam a catcher would need to be safe if a baseball hit the chest or other areas that require padding. Two different types of foam were used, poly foam and Lux-r foam. Lux-r is more firm foam while Poly foam is softer foam. The two different foams were tested separately and also combined. The foam was placed in front of a force plate that rested against a wall. A pitching machine that was 13.72 meters away from the force plate launched the ball into the foam that was resting on the force plate. The pitching machine remained at the same speed of 15.65 m/s, being sure that it was not changed. The force from the force plate was read by a GLX reader, which then gave the maximum force in Newton's. This helped figure out how much foam was needed to keep the catcher safe. Different types of foam, Lux-r and Poly foam, and different thicknesses, 1.27, 2.54, 3.81, 5.08, 6.35, 7.62, and 8.89 cm, were used to determine the best foam to use. The final results showed that the variety of foams used did not make much of a difference. P-value tests compared two different types of foam and proved that they were actually not that different from each other. The findings were inconsistent, which showed that something that happened was incorrect. The results showed that either the green or white foam would produce the same effect, which did not make them different from each other. The tests mean that both foams are almost the same and either one can be bought and would work just as well as the other one. It was discovered that as the foam thickness was increased, then the force did not always necessarily decrease.

## **The Effect of a Fan Blade Thickness, Shape and Angle on Revolution Rate**

*Student Research By: Holly Ernst, Alyssa Hartsig, Danielle Kehrig, and Jade Woodruff*

The research conducted was based on wind turbines and which fan blade angle, thickness, and shape design would produce the greatest number of rotations per minute (RPM). The research was conducted at the Macomb Academy of Arts and Sciences (MA<sup>2</sup>S) in Armada, MI from September to December of 2008. The different shapes consisted of a rounded design and a rectangular design. The different thicknesses used were one millimeter and two millimeters. The different angles used were 0, 10, 20, 30, 40, 50, 60, 70, 80, and 90 degrees for each design. It was found that the ten degree angle was the best angle with the most RPM. The zero degree angles were the worst performing angle with the least amount of RPM because it was unable to catch any wind to help rotate the turbine blades.

It was also determined that neither the shape nor the thickness of each fan blade, affected the amount of RPM that were produced. The only thing that took effect on the blade rotations were the angles of the fan blades.

# **The Effect of the Angle and Surface Material on the Size of a Blood Spatter**

*Student Research By: Brian Batayeh, Vince DiGiorgio, Mike Medley, and Matt Michalewicz*

In this experiment, blood spatter patterns were analyzed. Four surfaces plywood, ceramic tile, cardboard, and Styrofoam were placed at six different angles, 0°, 15°, 30°, 45°, 60°, and 75°. Simulated blood was dropped onto the surfaces and the length, width, and length-width distance of the droplet was recorded. A stand was built to hold the medicine dropper so that it would always drop from the same height. The dropper was filled with simulated blood that had similar consistency to real blood. Wooden blocks were cut at the testing angles to hold the surfaces in place. The surfaces were set on the angled blocks and the simulated blood was dropped onto the surfaces. A milliliter of blood was dropped onto the surface and the blood spatter was measured in millimeters. The last step was repeated for each surface and each angle. Overall, the surface that created the biggest blood spatter was the surface of wood at 75° with a mean of  $32.9 \pm 11.5$  mm. The smallest blood spatters were from Styrofoam at 0°. This was because Styrofoam absorbed most of the blood when it hit, so the blood did not spread out. The length and length-width distance increased as the angle increased, but the width decreased as the angle increased. This happened because at an increased angle, the push due to gravity will increase proportionally, increasing its length and length-width measurements. The lower angles do not allow the spatter to increase in length, so the spatter widens.

