CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY

Name(s)
Josiah D. Bartel; Jesse T. Houser

Project Number
J0201

Project Title
The Evaluation of Penetration Abilities of Various Slingshot Projectiles

Abstract

Objectives/Goals
The purpose of our experiment is to discover which size and material of spherical projectile delivers the optimal (deepest) penetration into a block of foam, when fired from a slingshot. Our research suggests that a fairly small, mid-weight, projectile made of material with the greatest sectional density will penetrate deepest.

Methods/Materials
We made braces for the slingshot and the foam block to stabilize them both, so that a number of variables were eliminated. We shot a range of materials, and sizes for each material (wood, glass, candy, steel & lead). Originally, we shot one of each projectile for four trials, but to further confirm our hypothesis we ran an additional ten trials, graphing and interpreting the new data.

Results
We found that a small projectile with a medium mass and a high sectional density (our smallest lead ball) penetrated the best.

Conclusions/Discussion
A mid weight projectile penetrated best because it received the most kinetic energy from the slingshot. Higher densities usually penetrated better because they have more mass focused on a smaller volume. But sectional density (how much mass is in a given area) was a better indicator than density alone.

Summary Statement
Our experiment evaluates the effects of mass, density and sectional density on the penetration abilities of various spherical slingshot projectiles.

Help Received
Mr. Bartel helped by explaining the physics to us, and by helping us to process our graphs. Mr. Houser helped us to construct the braces. Mrs. Houser helped with typing and editing.

CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY

Name(s)
Emily J. Biagini-Lee

Project Number
J0202

Project Title
It Doesn't Take a Rocket Scientist: Part 2

Abstract

Objectives/Goals
My goal was to learn about how far a rocket flies, depending on several variables. Do rocket trajectory angle, amount of weight, and distribution of weight affect how far a rocket flies? What happens to a rocket's flight distance when you change these components?

Methods/Materials
My materials included cardboard tubes, sheet plastic, foam tape, an air compressor, PVC pipe to make an air chamber and several other small items. First i had to make an air chamber out of PVC pipe to get a standard amount of air to launch each of my rockets. Then I made rockets out of cardboard tubes, and with plastic fins. I used foam tape to create rockets with high or low weight, and with the weight either at the top only, or distributed between the top and middle of the rocket. I launched the rockets at each of three launch angles.

Results
The rockets with the 45 angle flew the farthest. The Low / Distributed weight flew rockets flew farther than rockets with other settings of weight.

Conclusions/Discussion
In my background research, I found that thrust, drag and gravity have a lot to do with how far a rocket will fly. I was right about the 45 degree angle with the low weight being the one that flew the farthest, but i was wrong about the rocket with the weight split between the top and bottom flying the farthest.

Summary Statement
This project looks at the role of several variables in rocket launch distance.

Help Received
Dad helped to build the air chamber and supervised the launches.

CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY

Name(s)

Daniel A. Carrion

Project Number

J0203

Project Title

Comparison of Petroleum Based Diesel Fuel and an Alternative Diesel Fuel

Abstract

Objectives/Goals

I compared petroleum diesel to Diesel Secret Energy (DSE) in fuel consumption, motor oil cleanliness, exhaust emissions, power, and price.

Methods/Materials

To make DSE, I constructed a pumping and filtering apparatus. I used two engines to test the fuels: a Perkins four-cylinder stationary engine, and a Ford 6610 tractor. I changed the oil in both engines and put two gallons of diesel in both. I ran the Perkins engine at 1500 rpm for one hour. I tested the Ford 6610 by equipping it with a mower and ran it at 1500 rpm in fifth gear for one hour. I drained the remaining fuel and subtracted that amount from two gallons to determine the hourly fuel consumption rate. I did a total of five tests on both engines. I changed the oil on both and kept a sample of the old oil for further comparisons. I then started testing with DSE. I ran the same process for five tests. For the exhaust tests, I set an air conditioner filter about three inches from the stack for thirty seconds. I repeated that five times. I did a similar test where I gave each filter three revs of the engine. I repeated that five times, using both fuels. For the oil tests, I compared the used oil samples from the diesel tests and the DSE tests to new Delo 400.

Results

On the Ford 6610, DSE use averaged about .4 ounces less consumption than diesel. The Perkins engine on DSE consumed about 22 ounces less on average. DSE was more fuel efficient. After five hours of testing on DSE, the motor oil was still almost clear. After five hours of petroleum diesel testing, the motor oil was like black mud. The oil stayed much cleaner when running on DSE. The emission tests were inconclusive. The filters that came from the DSE idling tests looked a tiny bit darker than the diesel filters. While running on DSE, the exhaust stacks on both engines visually looked much cleaner and the exhaust smelled good. The exhaust that was emitted from the engine while running on diesel was black and nauseating. Both engines' power increased by at least 200 rpm while running on DSE. The price of petroleum diesel is about $2.87 per gallon. DSE costs about .85 cents per gallon. That is a $2.02 savings per gallon.

Conclusions/Discussion

DSE is an all around better fuel. Fuel economy is equal to or better than petroleum diesel, motor oil stays cleaner, power is improved, and it costs less than petroleum diesel. The exhaust looks cleaner and smells better.

Summary Statement

My comparison of DSE to petroleum diesel determined that a soybean oil based fuel can run more efficiently, has more power, operates cleaner, and is approximately 1/3 the cost of petroleum diesel.

Help Received

My dad supervised fuel mixing and monitored engine operation. He also proofread my writing and advised on my display construction.

CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY

Name(s)
Reid D. Cordry

Project Number
J0204

Project Title
How Far Can You Hurl? Hinged vs. Fixed Trebuchet Counterweight Design

Abstract

Objectives/Goals
Which trebuchet counterweight design performs most efficiently: fixed or hinged? A hinged counterweight utilizes gravity more effectively, and should outperform fixed designs.

Methods/Materials
One convertible counterweight trebuchet was built, tested, tuned. A firing range was built to control treb alignment and projectile impact. Four designs were tested: Hinged with wheels; Fixed with wheels; Hinged without wheels; Fixed without wheels. Each had ten firings. Adding 1.8ozs. to the fixed trebuchet's weight controlled for removing the hinge arm. Impact was labeled and measured for distance and angle. Indoor trials controlled air current. Criteria used to determine the most efficient design was the mechanism which produced the longest projectile distances and most consistent trajectory angle.

Results
Angle variances were similar for all designs: 1.5 - 2 degrees. "Hinged, wheels" and "Hinged without wheels" have the most consistent angles: .5 degrees variance, 70% firings. "Wheel less" designs experienced no "kickback", which could cause greater angle variances. "Hinged, wheels" outdistanced other designs 90%. "Fixed, wheels" hurled slightly farther than "Hinged, without wheels", 70%. "Fixed, without wheels" launched the shortest distances, 90%.

Conclusions/Discussion
Results indicate the "Hinged counterweight with wheels" is the most efficient design (.5 degrees angle accuracy, 70%; greatest distance 90%). "Hinged, without wheels" also shows the same angle accuracy/consistency (.5 degrees, 70%). Therefore, the hypothesis is correct. However, "Fixed with wheels" slightly outdistanced "Hinged without wheels", 70%. This suggests the importance of wheels to the overall design.

Summary Statement
The objective of this experiment is to determine which trebuchet counterweight design performs the most efficiently, fixed or hinged, by evaluating projectile distances and trajectory angle variances in a controlled environment.

Help Received
My father let me use the scales at the Corona Post Office for weighing parts. My mother helped with typing, and helped me figure out how to build my display.

CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY

Name(s)
Nathan Croutch; Zach Kalmbach

Project Number
J0205

Project Title
Wheels: Is Bigger Really Better?

Abstract

Objectives/Goals
To determine if the outside diameter of a longboard's wheel affects the speed of a longboard moving down a hill.

Methods/Materials
In our experiment we tested 70 mm, 65 mm, 62 mm, and 59 mm diameter longboard wheels down a 57 foot concrete slope. We recorded the time it took the longboard to reach the bottom of the slope, and then converted the time into speed.

Results
When using the largest wheels, 70 mm, the averge speed was 5.49 feet per second. The 65 mm wheels traveled 5.93 feet per second. When using the 62 mm wheels, the average speed was 5.58 feet per second. When we put on the smallest wheels, 59 mm, the average speed was 5.70 feet per second.

Conclusions/Discussion
In our hypothesis we stated that the largest diameter wheels (70 mm) would have the fastest speed. The 70 mm wheels moved the longboard at an average speed of 5.49 feet per second. On the other hand the 65 mm wheels moved at an average speed of 5.93 feet per second, therefore our hypothesis was not supported. One way to make this experiment better would be to test the wheels speed going down a long and short distance slope. This would enable us to find out which wheel is faster, all-around.

Summary Statement
We discovered that the outside diameter of the wheel on the longboard did not have a significant affect on the speed of the longboard.

Help Received
Mom helped to get all of the supplies, Dad helped put the board together, our advisor helped us with any questions and oversaw our project, our expert helped answer questions and supplied two sets of wheels, and we had two donations of wheels from two different retailers.

CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY

Name(s)
Tiffani M. Destine

Project Number
J0206

Project Title
Gas Blast

Abstract

Objectives/Goals
The problem seems to be that gas is very expensive, and Americans are having to get gasoline everyday. Could it be that Americans are driving to much or that the gas stations themselves are ripping us off and not giving us the right amount of gasoline. It is hypothesized that the more expensive the gasoline cost, the less gas a person will get. This is believed to be true because, the gas stations will get more money because, the gasoline itself is more expensive.

Methods/Materials
This problem will be solved by going to ten different gas stations, and paying the price for a gallon of gasoline displayed . Then, the price that was paid will be pumped into an authorized 1 gallon gas can. The gasoline pumped will be measured to see if people are getting ripped off. The controls in this project are, the gas stations(Arco, Shell, Chevron, 76, and Independently Owned) and the pumps (#1-10) chosen to be tested. Background knowledge shows that only 13% of the price payed for a gallon goes to the gas stations itself. Background knowledge also shows that gas station get tested by the State to see if people are getting a gallon of gas, if gas stations do not pass the State test it may result in major fine or forced to shut down.

Results
As it was hypothesized gas stations are ripping people off. Each gas stations tested had a least one pump that did not deliver a gallon of gas. 57% of the pumps did not deliver a full gallon of gas. Only 43% of pumps tested did indeed deliver a full gallon. This data only shows a 7% difference but, when it boils down to the end it make a BIG difference.

Summary Statement
Are people getting the gallon of gasoline the paid for?

Help Received
Mother overseen project

CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY

Name(s)
Noah W. Goldman

Project Number
J0207

Project Title
The Gravity Engine and Its Application in the Self-Propelled Garbage Can

Abstract

Objectives/Goals
The objective is to determine whether it is possible to harness wasted gravitational potential energy and convert it into easily accessed kinetic energy. My application of this principle is a garbage can that can bring itself out to the curb when full and back to the house when empty.

Methods/Materials
A model was built using styrene plastic and various other materials. The axle mounts were oiled and the device set on a model train track with a yardstick along side it. The device was set so the mechanism#s counter weight was down and the garbage-pulley-and-hook-system up. Various amounts of weight were put in the bucket and then attached to the pulley. When the weight was released, the device was to move along the track. Measurements were recorded of the distance the device moved, the amount of time that it moved, and its average velocity. After the weight had dropped to the platform of the device, it was removed, letting the device roll back into the starting position.

Results
The device did indeed move forward when weight was put in and back when the weight was taken off. The more mass that was put into the trash container, the faster and farther the device moved.

Conclusions/Discussion
The explanation of these results was that the greater mass in the container, the greater the force with which gravity pulled it back towards the earth. With a heavier weight, the friction was overcome faster and therefore the object dropped faster, moving the whole device faster and farther. Specifically my device converted the gravitational potential energy produced by lifting the trash into the container into kinetic energy that was captured and used when it fell. This energy was then used to power the vehicle. This invention is used to demonstrate a single example of the possibility of harvesting unused potential energy. The principle could be applied in mines, dumps, and construction sites. It can be used almost anywhere that a mass is lifted or transported.

Summary Statement
My project proposes and tests the capturing of unused gravitational potential energy, and its conversion into usable kinetic energy

Help Received
Mother helped determine model making materials and techniques, gave instruction in basic model building

CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY

Name(s)
Conor P. Hawblitzel

Project Number
J0208

Project Title
Get Your Head in the Game

Abstract

Objectives/Goals
To determine if protective padding, known as headgear,could absorb the level of g force impacts in soccer which commonly result in concussions.

Methods/Materials
90 tests were conducted.30 separate tests were performed on a mannequin head with out any headgear,30 tests were performed on mannequin B wearing Full90# headgear and 30 additional tests were performed on mannequin C wearing Headblast headgear. To stimulate a force of 78 gs, a baseball pitching machine was used to propel a ball directly at the mannequin head. A single baseball was used for all tests. Both the front forehead and the right side of the head were tested. The level of g force was measured by an accelerometer. The parameters of the accelermeter were set at 75 gs as 78 gs are considered strong enough to cause a concussion by the American Academy of Neurology. Both side and front impacts were measured at three separate speeds.

Results
One brand of headgear failed to reduce impact by the expected 30% but the other brand exceeded the expectation of 30%.The tests showed that the level of impact to the front forehead was reduced by Headblast headgear at 1% at the highest speed of impact and 13% on the lowest speed for front impact. Full90 reduced the level of impact 43% at the highest speed and 62% at the lowest speed. For side impact, Headblast reduced the level of impact 13% on the lowest speed and 36% on the highest speed. Full90 reduced the level of impact 23% on the lowest speed and 44% on the highest speed.

Conclusions/Discussion
The hypothesis that headgear would reduce impact on the head by at least 30% when a 78g force impacted the head, was partially correct. One brand of headgear failed to reduce impact by 30% but the other brand exceeded the expectation of 30%.The tests showed that impact to the front forehead was reduced by Headblast headgear at 1% at the highest speed of impact and 13% on the lowest speed for front impact.Full90 reduced the impact 43% at the highest speed and 62% at the lowest speed.For side impact, Headblast reduced the impact 13% on the lowest speed and 36% on the highest speed. Full90 reduced the impact 23% on the lowest speed and 44% on the highest speed. Headblast was more efficient in reducing impact on the side of the head than it was the front, but Full90 was more efficient the Headblast in both side and front impact tests. Full90 exceeded the expected 30% reduction of g force for front impacts.

Summary Statement
Does soccer headgear absorb force on a head enough to prevent a player from sustainting a concussion.

Help Received
Mother helped type and locate test accelormeter.

CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY

Name(s)
Madeline M. Hearst

Project Number
J0209

Project Title
Going the Extra Mile: Tire Pressure and Gasoline Consumption

Abstract

Objectives/Goals
The objective was to determine the effect of tire pressure on gasoline consumption.

Methods/Materials
35cc gas powered scooter, gas cap modified with 25 mL pipette, pump with tire pressure gauge, gasoline, safety helmet, elbow and knee pads, digital calipers

Procedures: The gas tank cap was modified by drilling for the insertion of the 25mL pipette then carefully calked and sealed. The tires were inflated to the maximum recommended pressure of 50 psi and confirmed with the tire gauge. The fuel tank and pipette were filled to the top mark. The experimenter drove 20 2-lap trials, recording the fuel consumption and refilling the pipette. Another 20 trials were run and observed at each pressure, 20 psi and 35 psi. The experimenter constructed a tire stand slotted to allow the measurement of tire sidewall bulge at each pressure using digital micrometer calipers.

Results
The 20 2-lap (.55km) trials averaged 19.3 mL at 20psi, 17.99 mL at 35 psi,and 17.64 mL at 50 psi. Tire sidewall distortion was measured multiple times at each pressure with calipers on the tires maximum buldge at ground contact. The tire width averaged 87.36mm at 50 psi, 87.38mm at 35 psi and 89.32mm at 20 psi.

Conclusions/Discussion
The average gasoline consumption with tires inflated to 50 psi (the manufacturers maximum recommended pressure) was 17.64 mL. The average gasoline consumption at the intermediate pressure (35 psi)was a similar 17.99mL. The average gasoline consumption at 20 psi was a signifigantly higher 19.13 mL. The average for the 20 psi trials showed an 8.5% increase over the 50 psi trials. The 35 psi trials were 6.3% higher than the 20 psi trials and only 2.0% lower than the 50 psi trials. This may be because there was relatively less tire distortion between 50 and 35 psi (87.36mm vs. 87.38mm) than between 35 psi and 20 psi (87.38mm vs. 89.32mm). A greater degree of tire sidewall distortion, and thus greater effect on fuel efficiency, may be observed with a load closer to the vehicles top rating (270 lbs/123 kg) rather than the experimenter (99 lbs/45 kg).

Summary Statement
This experiment measured and compared fuel consumption of a gasoline powered vehicle under varying tire inflation pressures.

Help Received
My dad supervised the testing and the modification of the gas cap. My mom took the photographs and helped arrange the display board.

CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY

Name(s)
Peter S. Hernandez

Project Number
J0210

Project Title
What Makes a Hitter's Park? Do Certain Atmospheric Conditions Affect the Home Run Statistics of Major League Ballparks?

Abstract

Objectives/Goals
To find out if altitude, temperature, and average humidity have an effect on the number of home runs hit at Major League Baseball parks. My hypotheses were that:
a) ballparks located at higher altitudes would have more home runs because thin air means less drag on the ball,
b) ballparks in warmer areas would have more home runs than those in colder areas, because hot air rises and the ball would stay up longer,
c) ballparks with less humidity would have more home runs, because water in the air makes it denser and would keep the ball down not let it go as far.

Methods/Materials
I chose certain Major League ballparks based on where they were located, to get a variety of conditions. I eliminated parks that were not open-air, because I wouldn't have any way of knowing what the air conditioning was like. I got statistics from the internet about the home run averages, altitude, average temperature, and relative humidity for each park. I narrowed down the parks based on how many of the same years I could find home run statistics for, and used Microsoft Excel to compare the data.

Results
I found that relative humidity and altitude do seem to have a significant effect on home run statistics. Parks at higher elevations and parks with drier air had more home runs. Temperature didn't seem to be a major factor.

Conclusions/Discussion
I had to use the information I could get easily in the three weeks my school allowed for my project. Those weeks were not during the baseball season. I could probably get more accurate information and results if I could get information from each city's paper for actual game days over the baseball season, and base my conclusions on actual game day data.

There are other things that affect home runs, like the physical dimensions of the ballpark, and how good the pitchers and batters are, but sometimes even when the pitcher isn't doing well and there are really good batters, there are lots of hits, but no home runs, so it makes sense that atmospheric conditions make some kind of difference.

Summary Statement
My project is about the effects of altitude, temperature, and relative humidity on the home run statistics of Major League Baseball parks.

Help Received
I am just learning to use the internet and don't type too well, so my mom helped me do the searches and type my report. My mom and my dad taught me how to set up the Excel worksheets and formulas. Mom helped me glue everything to my display after I got it laid out.

CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY

Name(s)
Austin J. Hiatt

Project Number
J0211

Project Title
Determining the Fastest Gear Set-Up on a Single Speed BMX Bike Around a Designated Course

Abstract

Objectives/Goals
The objective of my project is to determine what gear set-up will be the fastest around a 1,176 foot race track. I will be using six different gear set-ups with two crank arm lengths. Each set-up will be tested ten times.

Methods/Materials
In my project, I used a 2003 customized Cheetah race bike, a stop watch and a measuring wheel. After each gear set-up was tested, I regained my energy by resting so that each test was as accurate as possible.

Results
The results of my project were that a 40:14/160 gear set-up with an average time of 43.03 seconds was the fastest time. The slowest gear however, was a 42:15/165 with an average time of 46.05 seconds.

Conclusions/Discussion
My conclusion is that a 40:14/160 was the fastest gear set-up by almost one second. This information should help me in the future of my career as a BMX racer.

Example: 40 (pedal gear):14 (rear gear)/160 (crank arm length)

Summary Statement
My project is about testing different gear set-ups to see which one was the fastest.

Help Received
I used the BMX track in Tulare, Ca run and operated by Ron Jones. My parents helped me with the testing (timing and dropping the starting gate). My Dad helped my with the graph on the computer and the project design.

CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY

Name(s)
Robert W. Nelson

Project Number
J0212

Project Title
Paintball Pandemonium

Abstract

Objectives/Goals
The objective is to determine if temperature affects the accuracy of a paintball shot. I hypothesized that the room temperature paintballs will be the most accurate.

Methods/Materials
Seventy five paintballs were divided into three groups. One third was cooled, one-third was heated and one-third was kept at room temperature. After fifteen hours, twenty five paintballs were shot from each temperature environment using a VL Triton 2 paintball gun. The paintball gun was aimed at the target and clamped into position to eliminate aiming variations. The distance from the center of the target was measured and recorded for each shot to determine shot accuracy.

Results
Room temperature paintballs were the most accurate, with an average miss distance of 12.5 cm. Heated paintballs were the least accurate, with an average miss distance of 17.7 cm. Cooled paintballs were only slightly more accurate than heated ones, with average miss distances of 17.1 cm.

Conclusions/Discussion
I concluded that the paintballs kept at room temperature shoot more accurately than paintballs that are heated or cooled. I further determined that a possible explaination for the results was that the paintballs, when fired, expanded across the barrel. The cooled and heated paintballs expanded to where they would have contacted the barrel, while the room temperature paintballs would not contact the barrel. I believe this contact may be the cause of the inaccuracy.

Summary Statement
Does the temperature of a paintball affect it's accuracy when shot?

Help Received
My mother helped me design my display board. My father supervised me as I conducted the experiment.

CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY

Name(s)
Jacob M. Noblett

Project Number
J0213

Project Title
What Type of Motor Oil Will Cause the Least Amount of Friction?

Abstract

Objectives/Goals
This project is being done to test which engines oils cause the least amount of friction. The reason I chose this project is to learn which oils are better for cars. Is synthetic really the best or is high mileage better for older cars as well as new cars.

Methods/Materials
The oils being used are all 20W-50-multi grade motor oil. One each of synthetic, standard and high mileage. To test the drag caused by friction we built a sheet metal slide, reinforced it with 48 inches aluminum flat stock, and held it up with a few 14 inches long threaded rods. A hinged landing on the top is where we will place the 3 brass freeze plugs, which weigh 33.6 grams. So to start them I just lift the lever on top and record the results.

Results
To get the most accurate results I did two kinds of tests. One was cold, just apply the oil and let go, the other was a warm test. I put a heat lamp under the track and waited 30 minutes for it to heat the track. Once it is fully heated I continued the normal procedure. The results were: Warm tests - Synthetic 36 inches, High Mileage 36 inches, Standard 34inches. Cold test - Synthetic 36 inches, Standard 35 inches, High Mileage 34 inches.

Conclusions/Discussion
The averages in both (warm & cold test) were: Synthetic 36 inches, High Mileage 35 inches, Standard 34 1/2 inches. So my conclusion is that Synthetic is over all the best, after that is High Mileage, and last is Standard.

Summary Statement
My project is meant to determine which motor oil will cause the least amount of friction.

Help Received
Granpdpa drilled holes for slide. Grandma picked up parts and supplies.

CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY

Name(s)
Ryan J. Nowicki

Project Number
J0214

Project Title
Justice Cup Viscometer: Can a 10th Century Chinese Cup Measure Viscosity?

Abstract

Objectives/Goals
The 10th Century Chinese Justice Cup is a simple drinking device with a twist: it dumps all of its liquid through a hole in the bottom after reaching a certain fill level. My hypothesis is that the Justice Cup can also be used as a simple viscometer, a device used to measure viscosity or the amount of resistance to fluid flow.

Methods/Materials
27 different liquids were tested in both a Justice Cup Viscometer and a Simple Funnel Viscometer and the results were compared. The mean drainage times for each liquid were then plotted against viscosity to obtain a calibration chart for each viscometer.

Results
The Justice Cup was used as a simple viscometer and produced measurements far more accurate than other Simple Viscometers. Liquids with different viscosities flowed through the Justice Cup over a greater range of times than the Simple Viscometer. The viscosity of an unknown liquid was then accurately predicted by examining the proper position on the calibration line.

Conclusions/Discussion
Viscosity is a very important property of a fluid that is used not only in the production of many industrial and household goods (e.g. oil, drilling fluids, pumps and food), but also in medicine to better understand fluid flow in humans and other living things. This experiment showed that a device created over 1000 years ago for trickery and amusement can in fact accurately measure viscosity over a wide range of common liquids. These data suggest that the design of the Justice Cup should be considered in the future production of simple, low-cost viscometers.

Summary Statement
This project studies an ancient Chinese tea cup to determine if it can be used to measure viscosity.

Help Received
Dad/Mom helped pour the liquids in the cups while I measured drainage times; Teacher gave me advice on how to display data; Dr. Ratcliff helped understand the complex relationship between drainage time and viscosity

CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY

Name(s)
Daniel E. OLeary, III

Project Number
J0215

Project Title
How Does the Length of the Arm of a Trebuchet Affect the Distance an Object Can Be Launched?

Abstract

Objectives/Goals
There has been limited research on the relationship between a trebuchet's arm length and the vertical and horizontal distance an object can be launched. Virtually all authors consider the arm length "fixed." However, one research study discussed the results of a computer simulation, indicating (1) decreasing vertical distance associated with increasing arm length and (2) increasing and then decreasing horizontal distance an object would be launched, associated with arm length, suggesting an "optimal" arm length for a trebuchet. Unfortunately, that study did not substantiate the theoretic computer simulation results or provide a reason for the optimal distance.
As a result, the purpose of this research is to empirically investigate the impact of the length of the arm on distance an object can be launched.

Methods/Materials
My trebuchet was made from wood which had two side holders for support. Then I made five arms with the lengths of 2 ft, 2.5ft, 3 ft, 3.5ft, and 4 ft and 20 pounds in weight for the counter weight. The object I launched was a tennis ball.

Using each of the five arms, I found the horizontal distance, velocity, angle of the launched object, time in the air, and starting height. I set the cocking angle for each of the arms at 45 degrees. The longest arm touched the ground when set this way, establishing the "touch point."

Results
Using five different arms, I found that, as the length of the arm increases the vertical distance traveled from the point of release decreases. I also found that, for horizontal distance, the results were like a mountain, with increasing and then decreasing distance associated with arm length. Accordingly, there is an "optimal" arm length, based on what you want to accomplish.
When I compared the arm length that generated the longest horizontal distance, I found it was related to the underlying triangle that the trebuchet defines. It appears that an arm length equal to the distance between the touch point and the base point may provide an #optimal# arm length for generating horizontal distance.

Conclusions/Discussion
My primary findings were
#Shorter arm lengths result in higher vertical distance
#Arm length increases and then decreases the distance an object can be launched

Summary Statement
I studied how the length of the arm of a trebuchet affects the distance an object can be launched.

Help Received
Mother helped me build portions of the trebuchet that required drilling. Friends helped me gather data. Mother and Father proof read paper.

CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY

Name(s)
William L. Pedrotti

Project Number
J0216

Project Title
Backyard Ballistics

Abstract

Objectives/Goals
Paintball guns have held my interest for a long time. Accuracy and distance are crucial ballistics questions in these games. This project investigated the effect of pressure and barrel lengths on the variables distance and accuracy in the flight of common foam NERF darts.

Methods/Materials
A custom pneumatic gun was built with interchangeable barrels from PVC pipe. It can be pressurized to a 120 psig with a bicycle pump. Two tests were performed, one of distance, another of accuracy. For the distance measurement, a 45-degree shooting bench was used on a 200-ft outdoor range. Seven pressures from 5 to 80 psig of four trials each were shot for both the 12-inch and 30-inch barrels. In the accuracy measurement, a horizontal bench was used on an indoor 20-ft range, shooting at 6-in diameter targets. Five different pressures between 5 and 30 psig were shot for four darts each with both barrels.

Results
In the distance measurements, NERF darts traveled from 40 ft to over 200 ft; and varied quite a bit, but showed increasing average distance with pressure and barrel length. The average accuracy was improved from 8.5 inches to 2.5 inches by increasing pressure and barrel length.

Conclusions/Discussion
On average, longer barrels and higher pressures send a dart further and more accurately, verifying the initial hypotheses. There is a diminishing return to increasing pressure beyond 10-20 psig. The increases in accuracy were small but consistent and were limited by the test method. If you want to be more successful in paintball wars, use high pressure and longer barrels.

Summary Statement
It is a study of the variation of accuracy and distance in the flight of common NERF darts with both barrel pressure and length using a custom built pneumatic gun.

Help Received
The idea for the custom gun came from Mr. Brian Felker. My dad helped me with the taking of the data. My mom and dad helped type sections of the report and poster. My sister helped with poster design.

CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY

Name(s)
Logan M. Pike

Project Number
J0217

Project Title
The Art and Science of a Trebuchet

Abstract

Objectives/Goals
My gole was to determine how a trebuchet worked and what goes into making the trebuchet one of the most deadly weapons of its time.

Methods/Materials
wood, screws, nails, rope, canvas, tennis balls

Results
In the first experiment, in which the sling lengths were varied, the launches with the shortest sling traveled the shortest distance-- roughly 10 feet. However, as predicted, as the sling length increased so did the distance the projectile traveled to a maximum of about 43 feet. While the sling length tripled, the distance quadrupled. The data did seem to flatten out at the end with the longest sling, so the prediction is that if the size of the trebuchet had not limited the length of the sling, the data would have eventually shown a dip.

The second experiment in which the weights of balls changed did not go as expected, in fact it went the complete opposite direction of the hypothesis. As the heavier balls were tested, they went shorter distances. By the time the heaviest ball was tested, it was going an average of only 28 feet vs. about 34 feet for the lightest ball. This experiment illustrated the impact of inertia on distance. The heavier the projectile (mass), the greater the inertia, which decreases velocity and shortens distance.

Conclusions/Discussion
I think my data could help explain to historians how the ancient trebuchets were used in combat. For instance, my data indicates the optimal distance a trebuchet should be located from its target to have the best effect. It also showed why the trebuchets were more effective than the catapults that preceded them, because of their longer range.

However even after trying to keep constant as many variables as possible in the testing there were certain things that affected the launch like the shafts rubbing against the hinge and the movement of the counter weight. Also, I was limited in the size of my trebuchet. I believe building a larger frame for the trebuchet would clearly show that increasing the sling length would result in shorter launch distances after a point. So, in wrapping up this experiment, it is apparent that there are certain things that could be improved with more equipment and more supplies.

If I could further test the trebuchet and study more about its mysteries I could answer more of history#s questions on this great siege weapon.

Summary Statement
Experimentation on an ancient seige weapon and investigating how it propells projectiles over distances by varying the sling lenghths and the ball weights.

Help Received
Mom bought supplies and sewed sling gloves.

CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY

Name(s)
Cody D. Preis

Project Number
J0218

Project Title
Comparing the Effects of Vaporized Gasoline to Liquid Gasoline in an Engine

Abstract

Objectives/Goals
My objective is to determine if a four-cylinder engine will run efficiently off of vaporized gasoline rather than liquid gasoline.

Methods/Materials
Using a four-cylinder engine, I connected a hose from the carburetor to a sealed canister which contained one quart of liquid gasoline. From the sealed lid on the canister, I also ran a 2 ½ inch pipe down to the bottom of the canister which allowed air to come in and create fumes by bubbling the fuel. The airflow of the fumes was controlled by a valve and the airflow for the fresh air was also controlled by a separate valve on the hose going to the carburetor. By regulating these valves, I was able to start the engine and run it on fumes to conduct my experiment. I ran a total of 30 tests, 15 for liquid gasoline and 15 for vaporized gas. Gauges to monitor water temperature and oil pressure were also used.

Results
Liquid gasoline ran for an average time of 28 minutes and 8 seconds. Vaporized gasoline ran for an average of 88 minutes and 20 seconds.

Conclusions/Discussion
After completing my tests, I have found that my hypothesis for the engine was correct. My hypothesis stated that the engine changed to run off of vaporized gasoline will run longer than the engine unchaged to run on liquid gasoline. This data led me to the conclusion that vaporized gasoline can be a much more fuel efficent way to run an engine. It also seemed much easier to do then using an alternate fuel source. You never know, this could be the future of automobiles.

Summary Statement
Comparing the Effects of Vaporized Gasoline to Liquid Gasoline in an Engine

Help Received
Father helped supervise testing; Mother helped submit this application.

CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY

Name(s)
Erik R.V. Schoenborn

Project Number
J0219

Project Title
Fishing with the Pros

Abstract

Objectives/Goals
The goal in my project is to find which, out of three poles will cast a weight the farthest.

Methods/Materials
We used: 1.Three fishing poles of different flexibillities; 2. 25 zip-ties; 3. A standard sized sledge hammer; 4. One piece of blue chalk; 5. The experimenters driveway; 6. A spincasting fishing reel; 7. Making tape; 8. A pencil; 9. A pad of paper; 10. A 1 ounce circle weight; 11. Pole holder.
A brief run-down of the procedure is as follows:
1. First the experimenter measures the flexibillity of each fishing pole,in turn, by clipping the 1 ounce weight on to the end of each pole and measuring how far down the fishing pole bends. 2. After the experimenter determines the flexibillity of each fishing pole he or she labels each fishing pole, pole #1, pole#2, and pole #3. 3. The experimenter then lines up the poles with the tips together. 4. The experimenter then puts a blue peace of tape right above the top of the foam grip on pole #1. 5. Then the experiment puts the smallest pole up to each other two poles and puts a piece of tape where the first blue tape measures up to the others. 6. Then the experimenter tapes a fishing pole holder on to the end of a sledgehammer. 7. The experimenter zip ties the pole in place on the pole holder with the blue piece of tape at the front part of the fishing pole holder. 8. The experimenter then , using a fishing knot ties the 1/4 ounce walking weight to the end of the fishing line, and brings it out twenty-feet and marks that out on the sidewalk with the chalk. 9. The experimenter stops the line from coming out any farther and pulls the weight out another 1 1/2 feet and marks it again. 10. The experimenter then lets go of the line and measures how far it flies. 11. Record the data and repeat the experiment five times with each pole.

Results
The stiffist of the poles, pole number three, cast the weight the farthest.

Conclusions/Discussion
In conclusion the stiffer the pole is the farther it can cast a weight.

Summary Statement
My project is about the flexibillity of a fishing pole. I am testing whether the flexibillity of a fishing pole affects how far it can cast a (1/4) ounce walking fishing weight.

Help Received
My dad helped me set up the project.

CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY

Name(s)
Lindsey N. Schrock

Project Number
J0220

Project Title
Methods of Reducing Exposure When Filling an Anesthetic Vaporizer

Abstract

Objectives/Goals
The objective is to determine which method of pouring agent into an anesthetic vaporizer will cause the least amount of personal exposure to the agent.

Methods/Materials
I used three methods of pouring agent into a vaporizer. I poured directly into a Funnel-filled vaporizer. Next, an Anti-spill Adaptor was used to pour agent into a Funnel-filled vaporizer. Last, I used a Key-fill device and a Key-filled vaporizer. Acetone was used as an alternative liquid to an anesthetic agent. A chemical detector was placed ten to twelve inches above the vaporizer during filling. (All measurements taken in parts per million,(ppm)). Each method of filling was tested five times to obtain average results. This experiment was conducted in a well ventilated area.

Results
The Key-fill device plus vaporizer caused the least amount of personal exposure. During the Funnel-fill and Anti-spill techniques, spilling sometimes occured, causing exposure rates to increase.

Conclusions/Discussion
With the Key-filled vaporizer and device, the least amount of exposure occured. This proved my hypothesis to be correct. These results can help doctors, nurses, and veterinarians keep themselves safe when working with the equipment they use.

Summary Statement
I am trying to determine which method of filling an anesthetic vaporizer will cause the least amount of exposure to the operator.

Help Received
My dad helped by supervisng me during the experiment, and providing the equipment.

CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY

Name(s)
Gina D. Scott

Project Number
J0221

Project Title
Knock Down NOx: Can Urea Reduce Small Engine Pollution?

Abstract

Objectives/Goals
The objective is to determine if urea can reduce small engine pollution.

Methods/Materials
A catalytic device was constructed using a soda can half filled with zinc-plated BBs. Granulated urea was dissolved in distilled water. A 2-stroke 100cc Go-Kart engine was smog inspected at a certified California smog station (control trial). The engine exhaust pipe was replaced with the catalytic device. The engine was again smog inspected while simultaneously spraying the urea solution into a small hole drilled on the side of the catalytic device (urea trial).

Results
At the most typical operating engine speed of 6000 RPMs, there was a 41.8% reduction in exhaust NOx concentration in the urea trial compared to the control trial.

Conclusions/Discussion
There was a significant reduction in the small engine exhaust NOx levels with urea. This proved my hypothesis that urea can effectively reduce small engine pollution. Small engines are a large source of environmental air pollution. Further development of this device could lead to a simple and effective way to reduce air pollution.

Summary Statement
The purpose of this project is to discover if urea can reduce small engine pollution.

Help Received
Mother bought urea granules; Father helped me use tools in making catalytic device; Brother took pictures; Ahmad from In-n-Out Smog in San Juan Capistrano, CA performed the smog tests at a reduced rate.

CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY

Name(s)
Amy L. Shoemaker

Project Number
J0222

Project Title
Exploring Torque Using Pilot Holes in Wood

Abstract

Objectives/Goals
This experiment tested how different size pilot holes affect torque required to advance screws into wood. The effect of screws versus bolts, and maple (hard wood) versus pine (soft wood) on torque was also tested.

Methods/Materials
Different variables were tested to see what affects torque needed to advance a bolt or a screw into wood. The variables were bolts versus screws, hard wood versus soft wood, and eight different size pilot holes. The experiment was tested by advancing first a screw, then a bolt into the eight different size pilot holes in the first wood (pine soft wood) five times. Then the same steps were performed in the second wood (maple hard wood). This resulted in 20 tests for each pilot hole size, totaling in 160 tests.

Results
The results showed that torque required to advance screws and bolts depends on both pilot hole size and the type of wood, but not on a screw versus bolt. The results had a very linear relationship, ranging from about 0.17-1.80 Newton-meters in pine, and about 1.00-6.10 Newton-meters in maple. The largest amount of torque in maple was extrapolated (because it exceeded the torque wrench limit).

Conclusions/Discussion
It was hypothesized that the pilot hole size would affect the torque in that the larger the hole the less torque required. This was true, but the part of the hypothesis that stated that the wood type would have no effect as incorrect.

Summary Statement
This project tested how different size pilot holes affected torque required to advance screws and bolts into maple and pine.

Help Received
Father helped supervise for safety

CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY

Name(s)
Nathan J. Strain

Project Number
J0223

Project Title
The Cost Efficiency of Solar Power

Abstract

Objectives/Goals
To compare solar-powered lighter-than-air technology to rechargeable electric battery and gasoline power systems for cost efficiency and calculate potential utility in the real world.

Methods/Materials
A framed airship with interchangeable engines was constructed. A detachable module was made with rechargeable batteries, a light-weight airplane gasoline engine, and a customized solar array. The amount of energy/fuel being used (electric or gas), and the velocity of the testing blimp was measured. The cost to recharge the batteries was made from estimates of the amperes used by the battery charger. The cost of the gasoline used was measured as well. Calculations were then used to find the overall cost for the vehicle to travel a kilometer. In extrapolation to real life, calculations were made of the cost for each of the engine types to transport a real person and the cost for creating a real vehicle to do so.

Results
Ten time trials showed on average a 2cc gas engine lasted 1.99 minutes, the rechargeable battery lasted 56.29 minutes, and the solar panels powered while light was available. Ten distance trials over 20 feet (6.096 meters) demonstrated the gas-powered module took 7.31 seconds, the battery took 13.29 seconds, and the solar apparatus took 13.44 seconds. The cost per kilometer for gasoline power was 0.013 $/km, the battery was less expensive at 0.00097 $/km, and solar had no additional cost. After 6,000 kilometers, gasoline was more expensive than solar, and after 97,000 kilometers solar passes battery technology in efficiency. Further calculations estimated the cost of a solar vehicle for a student-sized person at $90,700 while the cost of a gasoline vehicle approached $76,000; however, the cost per kilometer of gasoline approximated $4.29 and quickly exceeded the cost of solar power.

Conclusions/Discussion
Solar energy provides an adequate alternative to gasoline and rechargeable batteries in this model. Extrapolation showed that although the cost of a solar-powered vehicle is initially more expensive, the cost of gasoline and recharging batteries (using fossil fuels) eventually become less cost efficient. The lighter-than-air craft with solar technology eliminates the need for roads and road maintenance, provides an alternative power source to fossil fuels, and, as extrapolated in the calculations, may eventually provide a workable alternative to the standard automobile.

Summary Statement
A solar-powered lighter-than-air vehicle may be more cost efficient than using gasoline or rechargeable battery technologies.

Help Received
My science teacher, Mr. Snell, showed me about electricity and wiring, and helped with editing; my Dad helped show me how to solder the solar panels and electrics, assisted with getting the supplies, and checked my calculations; my Mom was my assistant in running the trials, and helped me with editing.

CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY

Name(s)
Ryan J. Vig

Project Number
J0299

Project Title
What Material for an Acoustic Instrument Soundboard Has the Widest Range of Response?

Abstract

Objectives/Goals
The objective is to determine which material for an acoustic instrument soundboard has the widest range of response as defined by duration of vibrations and amplitude.

Methods/Materials
A stringed test instrument was built with the ability to interchange different soundboard samples to be tested. Ten different materials were cut into circles to be placed and secured above the sound chamber. The tested materials were acrylic, plastic, aluminum, birch plywood, brass, raw cowhide, engelmann spruce, high pressure laminate, red cedar, steel, and sub-alpine fir. A contact microphone was mounted on top of each material to capture the sound. A string picking device was used to strike the string. A computer was used to record and analyze the sound.

Results
The tested materials produced an initial voltage in a range of 168 mV to 895 mV. The sustained voltage at 2 seconds was from 29 mV to 221 mV and at 4 seconds, it was from 8.33 mV to 72 mV. The sub-alpine fir had the widest range of response, produced the longest sustain, and one of the highest voltages.

Conclusions/Discussion
My conclusion is that my hypothesis was incorrect. The red cedar did not have the widest range of response. The sub-alpine fir outperformed all other materials in sustained volume and high voltage, thereby producing a wider range of response compared to the other materials I tested.

Summary Statement
My project demonstrates and compares the ability of different materials to produce sound vibrations in an acoustical stringed instrument.

Help Received
My father gave me advice on the design and supervised my use of power tools during construction. My mother helped me with typing and proofreading.