CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Farzana Ansari; Anurag Sridharan

Project Number
S0201

Project Title
Got Traction?

Abstract

Objectives/Goals
The objective of the project is to determine whether the cost of a basketball shoe affects the co-efficient of static friction the sole of the shoe possesses.

Methods/Materials
In order to simulate a basketball court, polyurethane finish was applied to a wooden plank. Then, using a spring scale, the shoe was weighed. If the shoe weighed less than 500 grams, marbles were added until it weighed 500 grams. Then, the shoe was placed on the edge of the wooden plank and the plank was lifted so that it made an angle with the floor. When the shoe started to slip, the angle measurement (between the wooden plank and the floor) was taken. Then, using summation equations on the x and y axis and separating all the forces into x and y components, the co-efficient of static friction was solved for. This was repeated 5 times per shoe, and 50 shoes were tested in all.

Results
The results were that the TX traction shoe, which cost $50, had the greatest coefficient of friction, followed by the Iverson Off the Clock ($80) and the Spalding Dynasty ($50). However, the shoes with the lowest co- efficients of static friction were the Nike Cruise Force ($60), followed by the Nike Air Zoom Uptempo ($100). Finally, the shoe with the smallest co- efficient of static friction was the Nike Air Uptempo Player ($80).

Conclusions/Discussion
In conclusion, no definite correlation between the cost of the shoe and its coefficient of static friction was determined. The least expensive shoe and the most expensive shoe had virtually the same co-efficient of static friction. Also, the third least expensive shoe had the highest co- efficient of static friction. Though the coefficient of static friction is one of the main factors in determining the cost of a shoe, it is not the only factor. Comfort, durability, and sometimes even brand names all contribute to the overall price that the consumer pays. It was concluded from this experiment that the costlier shoe does not necessarily have the highest coefficient of static friction.

Summary Statement
The purpose of this project is to see whether the cost of a basketball shoe affects the co-efficient of static friction between the sole of the shoe and the court.

Help Received

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Ryan Caron; Dylann White

Project Number
S0202

Project Title
The Science of Snowboarding

Abstract

Objectives/Goals
Oun Goal was to determine how the length, width, and flexibility, of a snowboard, determine the speed.We tried to factor out as much experimental error as we could.

Methods/Materials
Procedure: Ryan Stood at he top of a selected area on a snowboard,he waited for Dylann to give him the signal and he rode as fast as he could from piont A to point B. She timed him and she recorder the time fo each of the three boards. We did the test three times per board tested. We used 3 differnet boards, a Silence 160cm, a Burton 155cm and a Mellenium 3 158cm.

Results
The Mellenium 3 158cm board was the fastes by at least 1m/sec and that correlates dirrectly to the fact that it was longer, narrow, and very stiff.
comming in second was the silence 160cm and it was also very long but very soft and was pretty narrow.
The burton 155cm was the slowest and it was also the shortest. The board was moderatly wide and was very flexible. we concluded that our hypothesis was correct.

Conclusions/Discussion
We found that a longer, Narrower, stff board was the fastest, and the shorter, fatter and softer the board the slower it would be but it would be much easier to turn and carve on.

Summary Statement
Testing the factors that affect the speed of a snowboardn

Help Received
Rip-N-Willies lake tahoe/Heavenly lake tahoe/

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Jason R. Castillo

Project Number
S0203

Project Title
Infrared Thermometers: How Accurate Are Infrared Ear Thermometers Relative to the Gold Standard Mercury Thermometers?

Abstract

Objectives/Goals
The objective of my project is to determine if the infrared ear thermometers are as accurate when compared to the gold standard oral temperature reading from a mercury thermometer as well as to determine the consistency between the two infrared temperature readings.

Methods/Materials
Informed consent was obtained from 53 randomly selected individuals. Each test subject was acclimated to room temperature for 10 minutes prior to any testing. Each person had their oral temperature taken for three minutes using the mercury oral thermometer (gold standard). During this three minute period, infrared aural temperatures were taken in both ears of the test subject. All temperatures were recorded as well as gender, age, ethnicity, and any ear surgeries/problems.

Results
The infrared readings matched the mercury oral reading only 3.8% of the time in the left ear and only 7.5% in the right ear. The two infrared aural readings matched each other only 3.8% of all readings. The range difference in the left ear was negative 2.1 to +1.5 degrees Fahrenheit variation from mercury reading. The range in the right ear was negative 1.6 to +2.1 degrees Fahrenheit. The difference between the two aural infrared readings was up to 0.1 to 1.8 degrees Fahrenheit difference. The infrared aural readings differing more than +/- 0.5 degrees Fahrenheit from the mercury readings were 55.0% in the left ear, 49.2% in the right ear, and 30.3% between the two aural infrared readings.

Conclusions/Discussion
Temperature readings are important in health and medical settings as it is one part in determining illness, infection, and an indicator to determine if ordering tests are appropriate. The project showed that infrared aural thermometers are inaccurate more than 90% of all tests (compared to the mercury reading) and have more than 0.5 degrees Fahrenheit variation 49% - 55% of all testing results. The data suggests that aural infrared thermometers, although convenient, are usually inaccurate and should be strongly reconsidered for use by health care professionals.

Summary Statement
My project is to determine the accuracy of Infrared Aural (ear) Thermometers as compared to the Mercury Thermometer temperature in determining human body temperature.

Help Received
My sister assisted me in attaining test subjects.

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)

Joaquin A. Chavarria, Jr.; Tyler K.M. Fortney

Project Number

S0204

Project Title

Living on the Cutting Edge: Analysis of Different Power Sources Used to Run a Lawn Edger

Abstract

Objectives/Goals

Our experiment was to determine what power source, other than gasoline, would best run a lawn edger. We thought that the solar panels would be the best power source.

Methods/Materials

The only variable in our experiment was the type of power source. We used an electrical cord, solar panels, solar panels with magnifying glasses, wheelchair battery, and rechargeable battery. Each power source was tested four (4) times, for a total of twenty (20) experiments. We timed how long it took to edge my yard. We controlled: days between edging, outside temperature, and area to be edged. Each experiment was done under the same conditions and controls.

Results

The five (5) power sources that we used in our experiment, in the final ranking order were: (1st) Rechargeable battery, (2nd) Solar panels with Magnifying glasses, (3rd) Wheelchair battery, (4th) Electrical cord, and (5th) Solar panels. The solar panels didn't have a lot of power.

Conclusions/Discussion

Our hypothesis was that the solar panels would be the best power source for running a lawn edger. We were wrong, it was the worst. The rechargeable battery was the best power source to run a lawn edger. It did not have a power cord to drag around and get in the way. It was lighter and eaiser to push around then the others. It had a lot of power. We then, designed our own lawn edger with a NiCd rechargeable battery and have a patent pending.

Summary Statement

Our project was to find the best power source (not gasoline) to run a lawn edger.

Help Received

Our Mothers took us to the library and helped with the cost of our project. Mr. Ken Fortney made the final blueprints from our drawings. Mr. Broc Whitehead is our Patent Lawyer.

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Flavia I. de la Fuente

Project Number
S0205

Project Title
Do Different Types of Metal Alloys Vary in Their Resistance to Elevated Heat when Measuring Hardness?

Abstract

Objectives/Goals
The purpose of this project was to determine which types of metal alloys resisted elevated temperatures the most effectively when measuring hardness.

Methods/Materials
Materials :Rockwell Hardness Tester 3 samples of 4130 iron-based alloy about 700 grams each 3 samples of titanium-based alloy (6% aluminum, 4% vanadium) about 700 grams each 3 samples of Unitemp 718 nickel based alloy about 700 grams each High Temperature Oven Sandpaper
Procedure 1. Take the nine samples of metal alloys and mark their Rockwell Hardness on the #C# scale 2. Put nine samples in oven for 4 hours at 300 degrees Fahrenheit. 3. Let samples cool inside oven overnight (oven runs for four hours and then automatically shuts off) 4. Take samples and remove any oxidation by rubbing against sandpaper 5. remove samples and measure Rockwell Hardness 6. Take nine samples and repeat steps 2-5 at 600 degrees, then in increasing increments of 300 degrees until 1500 degrees

Results
The results indicated that the metal alloys all increased in hardness until they reached a peaking point, after which their hardness began to drop. The three alloys, as a whole, grew in hardness until they reached the vicinity of 1200 and 1500 degrees, where they started to drop sharply. If further tests with higher heat exposure were conducted, it is most probable that the hardness level would continue to decrease. The Steel alloy held a somewhat consistent hardness level until it was exposed to 1200 degrees, the temperature at which the hardness level dropped by about 5 units. The steel alloy also kept oxidizing, and the oxidation had to be rubbed off with sandpaper every time in order to measure the hardness. The titanium alloy was consistent in its hardness yet began to increase sharply in hardness at 900 and 1200 degrees. It then peaked and dropped severely at 1500 degrees. The nickel alloy grew steadily in hardness until it reached 1500 degrees and dropped off sharply.

Conclusions/Discussion
In conclusion, the nickel-based alloy Unitemp 718 should be used in the aerospace industry where high temperature resistance is necessary- however, it is only applicable where the highest temperature does not exceed 1200 degrees Fahrenheit. Steel should definitely not be used in an environment with elevated temperatures, because the heat is basically burning away at the metal, continually decreasing its size.

Summary Statement
My project is about the ability of industrial metals to withstand elevated temperatures when measuring hardness.

Help Received
My dad provided equipment.

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Andrea K. Flinn

Project Number
S0206

Project Title
Is the Corrective Accelerated Blister Testing of Orthophthalic Laminate Valid?

Abstract

Objectives/Goals
The objective is to test the validity of a more accurate method of measuring the resistance of orthophthalic laminate to degradation by water.

Methods/Materials
Three groups of 100 laminate samples were labeled, massed, and submerged in distilled water. The groups were cooked at 55°C, 65°C and 93°C for 47, 13.5, and 1.25 days, respectively, so that all groups should have degraded equally. The cooked groups were massed. The average mass of the water gained was calculated for each group. Implementing the new method, all samples were dried in an industrial oven at 71°C for 8 hours and under a vacuum for 30 hours. The samples were massed again, and the average differences between the original and dried masses were calculated. When added to the original masses of water absorbed, these values revolutionarily accounted for the mass lost when blisters on the laminates broke. The percent difference was found between the groups' uncorrected values, then corrected values, and finally between each group's corrected and uncorrected values.

Results
A 19.7% difference existed between the average mass of water absorbed by samples at 55°C and 65°C, while a 64.67% difference existed between those at 55°C and 93°C. These deviations indicate that accelerated testing is invalid. Data indicates that a mass (an average 0.018 grams per sample) was lost from blisters bursting only in the group at 65°C. The group's corrected and uncorrected values differed by 0.6%.

Conclusions/Discussion
s the amount of water absorbed differs by more than 15% between the groups, the data does not support accelerated testing. It cannot support the corrective test without supporting accelerated testing, and so does not support the hypothesis which states that if the groups absorb equal masses of water, then the corrective test is supported. However, the mass lost when blisters burst indicates that the new test measures a value which the old cannot. During longer periods of submersion, this value becomes more significant in the overestimation of laminates' stability. Such inaccuracies endanger the lives of those who rely on the stability of marine crafts made from orthophthalic polyester laminates.

Summary Statement
A more accurate method was engineered for determining the resistance of orthophthalic polyester laminate, a material used in marine crafts' hulls, to degradation by water, and that method's validity was tested.

Help Received
Survival Systems International donated 300 laminate samples, two thermometers, and a scale to the project. A qualified technician at SSI placed the samples in and removed them from the industrial oven and vacuum. A neighbor, Caroline Nelson, recorded the samples' temperatures for a week.

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Nicholas W. Frechou

Project Number
S0207

Project Title
Is Popular Always the Best?

Abstract

Objectives/Goals
After interviewing golfers, I wanted to find out if the preferred golf ball is best.

Methods/Materials
Procedures for Bounce Test. Step 1 Purchased eight brands of golf balls, three of each brand. I marked each brand with a sharpie. Step 2 I chose an area in my back yard over cement where there is a counter to drop the ball from. I taped a meter stick to the counter vertically so I could record the height the golf balls bounced. Step 3 I had someone drop the ball from the same position without any force. I recorded the bounce height in centimeters in my chart. Step 4 repeat for each ball three times and each brand. Step 5 I averaged the bounce height for each ball.
Procedure for Distance Traveled Test. Step 1 I weighted down the striking mechanism so it wouldn't move from the motion. Step 2 I measured the distance form the tee, past the measuring stick to insure accuracy. Step 3 I placed the golf ball on the tee, I had my helper pull back the arm of the striking mechanism to its maximum postion and released it. I recorded the distance in centimeters to where the ball first hit in my chart. Step 4 Repeat for each ball three times and each brand. Step 5 I then averaged the results.

Results
I found that Top Flite Infinity traveled the farthest and bounced the hightst. But it was the least expensive and not mentioned by anyone I interviewed.

Conclusions/Discussion
My results did not agree with my hypothesis, even though many golfers that I interviewed preferred Titleist Pro VI. Titleist pro VI did not bounce the heighest or travel the farthest. Top Flite Infinity had the biggest bounce of 89.2 cm. and Titlest Pro VI had 83.4 cm. for a difference of 5.8 cm. In the distance test, Max Fli Noodle had the greatest distance of 216 cm. and Titlest Pro VI only had 172 cm.,a difference of 44cm.

Summary Statement
Do all golf balls go the same distance, and do preferred brands go farther?

Help Received
Aunt helped read the meter stick for better accuracy, and my mom pulled back the stricking mechanism.

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Brendan Gavaller; Forest Terry

Project Number
S0208

Project Title
Solar Powered Hydrogen Electrolizer

Abstract

Objectives/Goals
Our objective was to construct a device which, using only solar energy, could produce hydrogen gas at a rate that we could measure.

Methods/Materials
M A T E R I A L S: 2 32cm X 128cm Siemens solar cell panels; 2 138cm X 5cm X 5cm steel supports; 1 wooden base unit; 3 10cmX 62cm clear acrylic tubes; 1 11.5cm X 1m ABS sewer pipe; 1 10.5cm ABS caps; 1 ABS tee; 2 ABS elbow tees; 2 meters of 1.25cm plastic tubing; 3 1.25cm hose connectors; 2 wire hookups; 2 socm X 30cm stainless steel mesh; 6 stainless steel rings; 2 stainless steel bolts; 1 ABS cement; 1 black silicone sealant; 1 500g bottle of sodium hydroxide; 40 liters of distilled water; 1 brass drain valve; 1 multi-function meter; 1 metric tape measure.

M E T H O D S: 1. Build the electrolizer power source; 2. Build the electrolizer device; 3. Add 500 grams of sodium hydroxide and forty liters of distilled water into the device; 4. Test and measure the results.

Results
The result of our project was that hydrogen gas was produced at rates correlating to solor panel efficiency.

Conclusions/Discussion
We found that we could produce measurable ammounts of hydrogen gas in an electrolizer powered by the sun. We found that the peak hours of hydrogen production corresponded to the peak hours of current production. During peak hours of production, we could produce 1100 cubic cm of hydrogen gas. The ammount of power produced by the solar cells corresponds directly with the ammount of gas produced.

Summary Statement
We constructed a self-contained hydrogen electrolizer, which is powered by solar cells.

Help Received
used Mr. Fleck's machine shop; Mother helped type the information

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Raven D. Gray

Project Number
S0209

Project Title
How Waterproof Is Fabric with or without Scotch-Gard?

Abstract

Objectives/Goals
Fabrics are made up natural and man-made fibers. Those fibers are woven,knitted, or felted together to make a cloth. Depending on how taut the fibers are put together determines how water resistant that fabric is.The purpose of this experiment was to clarify how water repellent the common fabrics used in everyday lifestyle really is,opposed to scotch-guarded fabrics.

Methods/Materials
The experiment consisted of 12 different fabrics; Berber Polyester, Silk, Linen, Crepon Sheer Nylon, Stop Nylon, Cotton, Acetate, Waterproof Nylon, Polyester, Polyester #Fleece#, Wool, and Leather. The experimental group had scotch-gard added to each fabric, while the control group had nothing added. First, each fabric was weighed by grams,then each fabric was placed on a 45 degree slant. 6 inches above the slant, a funnel with a spray nozzle were suspended. 250 ml of water was then poured onto each fabric. After spraying the fabrics with the water, absorption was measured on a scale and rated according to a #standard spray test rating#. This was done to each scotch-guarded fabric as well.

Results
First, each fabric being tested was weighed at its original weight. When the water was added to the control group, each fabric weighed only 2 or 3 grams more than the original weight, except for Berber Polyester and Polyester Fleece. Berber Polyester and Polyester Fleece weighted almost 5x their original weight. The experimental group weighed the same as the control group, un-wet. After being wet, the fabrics weighed 1 gram more than their original weight except for Berber Polyester and Polyester fleece. Their weights were almost 3x their original weight. For the standard spray rating for scotch-guard, leather and the waterproof Nylon were a 100. The closest fabrics to being waterproof was Acetate and Wool, with 90. Polyester Fleece, Cotton, and Rip Stop Nylon, were rated at an 80. Linen and Silk were a rating of 70. And Polyester, Berber Polyester, and Crepon Sheer Nylon, were rated at a 50.

Conclusions/Discussion
Overall, the data did support the hypothesis. The scotch-gard did prevent water absorption onto the fabrics. The data shows that for almost every fabric tested with scotch-gard, the water did not penetrate the opposite side. Each fabric was woven together differently, so each fabric absorbs different amounts of water. The more water repellent a fabric is, the tighter the fibers are woven in that fabric.

Summary Statement
This project is testing the water resistability, or how waterproof different fabrics are with or without Scotch-Gard.

Help Received
Dr. Diane Lewis of FIDM (Fashion Institute of Design and Merchandise) and Northridge University

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Anthony J. Khougaz

Project Number
S0210

Project Title
Shake, Rattle, and Roll 2: Possible Earthquake Stress on Building Structure

Abstract

Objectives/Goals
To see which building structure might hold up best in an earthquake.

Methods/Materials
Four basic materials were used to simulate building structures: K'nex, Legos, sugar cubes and Lincoln logs. K'nex were used to simulate steel girder construction, Legos were used to simulate reinforced block wall construction. Sugar cubes were used with frosting mortar to simulate unreinforeced block wall/brick construction and Lincoln logs were used to construct a log cabin. Structures were built with approximately the same base. Structures were shaken with an "earthquake maker" designed and built last year for a soil liquifaction experiment. The structures were tested at least twice, time to failure was recorded and photos before and after were taken.

Results
The Lincoln log construction was the most unstable, followed by the sugar cube construction (after foundation adjustment). The Lego construction followed and the best structure was the K'nex structure.

Conclusions/Discussion
Prior to research, I believed the heavier construction (block wall/brick) would hold up best. My initial research indicated that the steel girder buildings would hold up best. The test results appear to bear this out. I did not attempt to test structures on different soils where liquifaction could be a factor, nor did I attempt to simulate a specific magnitude earthquake, but merely subjected all models to the same degree of stress.

Summary Statement
My project was to test simulated building structures reaction to earthquake stress.

Help Received
My science teacher reviewed my completed project/report and offered suggestions. My father helped reassemble my "earthquake maker" and and helped operate it while I observed and logged results.

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Kelsey E. Laity-D'Agostino

Project Number
S0211

Project Title
Keeping the Rover Rolling

Abstract

Objectives/Goals
Planetary rovers utilize machined metal wheels with treads called grousers. The drive wheels must provide traction and resist side-slip on loose soils such as sand. The objective of this experiment was to answer the question: With a chevron-shaped grouser, what is the optimum internal chevron angle to provide both the required traction and to resist slipping while traversing a sand slope?

Methods/Materials
The materials needed for the project were a wheel test vehicle, wheels with chevron-shaped grousers with internal angles varying by 30 degrees, clean dry sand, and a spring scale. The rover wheel test vehicle with interchangeable front wheels was driven across smooth dry play sand. While the vehicle is moving, measure the traction load in grams to the point of wheel slip and measure the load in grams needed to pull the vehicle off a straight line while driving forward (side-slip measurement).

Results
A range of rover wheels with chevron grouser treads (chevron angle 0º-180º in 30º increments) was tested for its ability to provide driving traction and side-slip resistance in dry sand. Clearly a flat paddle-like tread would pull forward best and a ridge all around the wheel would resist side-slip best. This experiment was designed to determine the shape which would both reliably climb and traverse dunes. The results showed a 90º chevron grouser performed best.

Conclusions/Discussion
A mathematical relationship between traction and slip resistance was determined experimentally. This result can be incorporated into computer models of rover wheels to develop new designs that are efficient for planetary exploration. It was found that both traction and side-slip resistance were related to the projected length of the grouser blade. This relationship was a cosine or sine function respectively. From analysis of the sine and cosine relationship plots, it is clear that the optimum angle is 90º for the chevron grouser. The cosine plot for traction load showed a traction of 159 g, which was greater than the median. The sine plot showed a side-slip resistance of 47 g, which is close to the maximum. In profile, the 90º chevron grouser pattern forms a closed disc, thus acting like a ridge around the wheel.
Future work should explore the relationships between grouser spacing and depth to traction and side-slip resistance.

Summary Statement
An experiment to optimize the tread design (maximizing traction and minimizing side slip) for a planetary rover navigating on sand.

Help Received
Father helped build and test wheels; JPL Engineers Donald Bickler and Chris Vorhees helped define measurement technique.

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
David M. Lee

Project Number
S0212

Project Title
Trebuchet

Abstract

Objectives/Goals

-Can trial and error testing of different projectile weights, counterweights and throwing arm lengths establish simple relationships that can determine throwing distance?

-Can modern physics and mathematics accurately predict throwing distances?

Methods/Materials

douglas fir drill rod collets masonite screws plywood wheels eye hooks particle board nuts scales golf balls pennies weights measuring tape chain bolts washers

Construct trebuchet
Test : Launch 15 golf balls at the different settings of variables. Use rolls of pennies as your counterweightRecord the distance each ball was launched.

Results

The trebuchet launched the golf ball the furthest distance when it was free rolling, had a release angle at 60 degrees, had the longest setting of the throwing arm, had a counter weight that fell at the greatest distance, did not have a restricted throwing arm, and had the greatest amount of weight in the counterweight basket.

Conclusions/Discussion

My conclusions are that the golf ball was thrown the furthest at the settings stated above due to the following reasons; In theory a release angle of 45 degrees should allow the projectile to be thrown the furthest, however when the angle was set at 45 degrees the golf ball slipped out of the basket it was held in. Any angle less than 60 degrees caused the arc of the golf ball to be too flat and any angle greater than 60 degrees caused the ball to slip. The longer arm setting allowed for the maximum size of the arc of the golf ball. The greater distance traveled by the fallen counterweight allowed it to gain my speed through the constant acceleration. Thus, creating a greater force and launching the ball further. The greater amount of weight in the counterweight basket allowed more force to be had. When the trebuchet was allowed to be free rolling the counterweight fell in a straighter path perpendicular to the ground. When the cocked arm is released the counterweight comes down in a circular path causing the constant acceleration due to gravity to be not completely pure. If a trebuchet with wheels is fired, it will rock forward allowing the weight to fall in a straighter path.

Summary Statement

My project is about experimeting with a model trebuchet to find if modern mathematics and physics can predict throwing distances.

Help Received

Father helped with the potentially dangerous parts of making the trebuchet; Two Uncles helped with the calculations; Sister and Mother helped with collecting the data

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Christopher P. Leyva

Project Number
S0213

Project Title
Launching into Physics: A Study of Projectile Motion

Abstract

Objectives/Goals
My objective in this experiment was to find which angle of trajectory will fire a projectile the farthest?

Methods/Materials
Materials: Tennis Ball Cannon, Pen and Paper, Orange Cones, Tennis Balls, W-D40 Lubricant, Tape Measure, Tennis Ball Cannon Stand, Prestone Starting Fluid (fuel)
Procedure:
A. Load the cannon
B. Fire the cannon at each of the following degrees: 80, 70, 60, 55, 50, 45, 40, 35, 30, 20, 10
C. Measure and record the distance traveled from the point of impact of the tennis ball
D. Repeat steps 1-3 until you have fired the cannon at all of the angles
E. Compare your measurements

Results
The tennis ball traveled the farthest when fired at a 45 degree angle.

Conclusions/Discussion
I have learned that firing a tennis ball at a 45^o angle achieved the greatest distance. I noted that the tennis ball would occasionally deviate from the expected path and land off to the right of its intended straight path. I noticed that the higher the projectile was fired, the farther off to the right it landed. I believe that the infrequent occasions that this happened are due to wind. I chose to do the experiment on a day that had very little wind. However, intermittent breeze would pass by and alter the path of the tennis balls. It is not practical to expect that there was no wind at all during the experiment. This explains why the projectiles that were fired at a higher altitude had a shorter overall distance. Due to being in the air for a longer amount of time, the wind had a greater effect on these tennis balls. If wind could be completely factored out of this experiment, the averages of 10^o and 80^o, for example, would have been very close to the same. Yet my results show that tennis balls fired at lower altitudes (10^o), achieved a greater distance than those of higher altitudes (80^o).
I think that fuel is another important factor in this experiment. The starting fluid must be sprayed directly into the chamber. If one is not careful, the aerosol stream can be sprayed onto the inside wall of the chamber. When this occurs, the fuel moves from a aerosol to liquid state. This in turn causes a misfire because the fuel does not mix with the air in the combustion chamber. In addition, as little as possible starting fluid needs to be sprayed. If too much fuel is sprayed into the cannon, the fuel-air ratio becomes too rich to ignite.

Summary Statement
This experiment involves the study of projectile motion by launching a tennis ball at different angles.

Help Received
My father gave me advice as I performed the experiment. He also helped record measurements as I fired the cannon.

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Noel L. Lopez

Project Number
S0214

Project Title
A Revolution in Electrostatic Motors

Abstract

Objectives/Goals
I used Plexiglas sheets and aluminum to make these motors. Due to previous problems with building motors, I designed new systems for cutting parts that improve precision and adjustability, including a circle cutter that exhibits superior precision to previous methods. The most sophisticated cutting device I made was a Computer Numeric Controlled Router, which would be capable of accurately cutting and shaping the various complex parts necessary for some of my designs. I had to quickly become an expert #C# programmer from scratch to learn how to make the control software for my device. Although I was not able to complete the CNC Router in time to construct some of my more complex designs, I was able to construct the most advanced motors I#ve ever made.

Methods/Materials
I performed tests on each design, calculating its power output. Of the designs tested, the model with a plastic rotor produced the most power output, but was one of the heaviest rotors. I was surprised by the poor performance of the rotor with thick aluminum plates, while the rotor with a circular arrangement of aluminum tubes performed well compared to its light weight. From this experiment, I have found that plastic and thin aluminum plates can hold the most charge.

Results
I determined that heavy plastics can hold a surprisingly large amount of charge on their surfaces. An unexpected result with the aluminum rotors was that the thick rotors did not perform well. This may suggest that aluminum also collects most of its charge on the surface; therefore surface area, not volume, decides the amount of charge a plate can hold. This project is the first stage for achieving my goal. The objective was met by finding the most effective design elements from those evaluated. I plan to complete my CNC Router and perform additional, more extensive testing of further designs.

Conclusions/Discussion
My project determined that new copper banding, copper with patina, and irrigated copper banding can be used to prevent brown garden snails from reaching their food sources.

Summary Statement
I found community sponsors to donate funds or materials; my younger brother did minor tasks to assist in cutting parts; I borrowed a smart pulley and computer interface from school.

Help Received
This project will test electrostatic motor designs I created or improved to find which produce the most power. I will use this information when designing motors in the future to compare against today#s electromagnetic motors.

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Page H. Monji

Project Number
S0215

Project Title
How Does a Circular Deformation in Rubber Affect Its Mechanical Stress and Strain?

Abstract

Objectives/Goals
How does a circular deformation in rubber affect its mechanical stress and strain? I observed patterns in mechanical stress and strain, locally, nominally, longitudinally, and transversely. I hypothesized that all the stress and strain would be greater than nominally when affected by a disconintuity. Also, the discontinuities and added tensile force (the weights) will only affect the longitudinal strain. I predicted that the transverse distances would not increase nor decrease because the material was being pulled vertically or longitudinally by weights.

Methods/Materials
Materials:
Seven sheets of 15 cm. by 37 cm. by ½ cm; Foam rubber; Metric ruler; white pen; Exacto-knife; Compass; Hand drill with 1/8 inch drill bit (0.3175 cm. drill bit); Four 15 cm. by 3 cm. by ½ cm. pieces of wood; 4 small wood clamps; 1 yard of copper wire; pole (from which to hang apparatus); Gram weights in 5000 g and 1kg increments
Procedure:
A. suspend sheets of rubber with 5 cm. diameter circular disconintuity from pole and add weights to stretch rubber. B. Each trail is affected by different tensile force or weight C. All seven trails have same apparatus: same 15 cm. by 37 cm. by ½ cm foam rubber, same 5 cm. circular discontinuity, 5 minutes allowed for each trail. D. I measured distance between pins, located transversely locally, transversely nominally, longitudinally nominally, longitudinally, locally. With these distances, I calculated stress, strain, and stress concentration.

Results
Because the discontinuity intensifies stress locally surrounding it, the local strain was greater than the nominal strain. The stress concentrations, the ratios of the longitudinal local strain to the longitudinal nominal strain, remain constant negative strain is associated with transverse strain, while positive strain is associated with longitudinal strain. This means that as the material elongates, the discontinuity causes it to decrease in width.

Conclusions/Discussion
In engineering, it is extremely important to consider the effects of flaws upon the overall strength of a material. They cause the most stress directly surrounding the flaw. as the discontinuity increases, the strain also increases.

Summary Statement
Testing the patterns in mechanical stress and strain in rubber effected by a circular deformation.

Help Received
Dad taught me how to drill holes in apparatus

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Andrew D. Shrum

Project Number
S0216

Project Title
Petite or Prodigious? Is Bigger Really Better?

Abstract

Objectives/Goals
We decided to find out how the length of the barrel in a simple combustion based potato gun affects the guns range.

Methods/Materials
A potato gun is basically two pipes and reduction pieces glued together. It consists of a large combustion chamber, a barrel, a potato, an ignition system, and some sort of flammable aerosol. There is a cap on the end of the combustion chamber where the fuel is sprayed in, and a bolt through the barrel right where it meets the chamber to stop the potatoes from being pushed down too far. Each gun has some sort of fuel igniter. This can be either a flint lighter or a long ended lighter or a barbeque starter or even a taser. The lighters are inserted into the chamber and then sealed with silicone gel. The taser is connected to two bolts that span the inside of the chamber. The spark from the taser jumps the gap between them and ignites the fuel.

We made 4 separate potato guns out of ABS piping, all with identical combustion chambers and ignition systems, but varied barrel sizes, to see how much the length of the barrel affected the range that they could fire. The barrels were sized at 1 foot, 3 feet, 6 feet, and 9 feet.

Results
The 9 foot gun fired the farthest, followed by the 6 foot gun. The 1 footer and the 3 footer were both about equal.

The scientific explanation of why the biggest gun fired the farthest lies in the balance between the amount of propulsion produced in the chamber and the length of the barrel. If the barrel is too small (in the case of the one and three foot guns), then most of the propulsion is not used in accelerating the potato, but instead gets blown out of the end of the barrel and into the air. This is the reason that the smallest gun was the loudest. If the barrel is too big, the potato will receive all of the energy from the explosion, but it will not be enough to propel it past the internal friction of the barrel.

Conclusions/Discussion
The largest gun worked the best and our tests tell us that a longer barrel length is most effective.

Summary Statement
We decided to find out how the length of the barrel in a simple combustion based potato gun affects the guns range.

Help Received
Mentor helped with safety aspects, Physics teacher helped with the math equations.

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Amanda R. Suzuki

Project Number
S0217

Project Title
Pull Out Strength of Various Suture Anchors in Bone

Abstract

Objectives/Goals
The objective was to test the overall strength of four types of suture anchors. The hypothesis was that the Fastin RC anchor would be the strongest, followed by the super anchor, the rotator cuff anchor, and the GII anchor. The hypothesis was made based on the design and size of the anchors tested.

Methods/Materials
The repetitive stress apparatus was constructed with wood, k'nex pieces, and a k'nex motor. A suture anchor was attached by a suture loop to the apparatus. The apparatus was turned on and the stopwatch measured the time until failure, which is defined as the suture anchor pulling out from the styrofoam or until two minutes (the allotted time limit) have passed. A conversion factor was used to convert seconds to cycles to failure. All four anchors were tested on the apparatus ten trials each. For the maximum tension test, an anchor was inserted into balsa wood. Using a manual fishing weight scale, the anchor was pulled out of the balsa wood and the kilograms exerted upon pullout were recorded. Each anchor were subjected to this test for ten trials each.

Results
The Fastin RC anchor tested in both the repetitive stress test and the maximum tension test. The super anchor outperformed the rotator cuff anchor in the repetitive stress test, but the super anchor and the rotator cuff anchor had similar results in the maximum tension test. The GII anchor had the weakest performance in both tests.

Conclusions/Discussion
The Fastin RC is the best anchor for use in areas of repetitive movement or when sudden high tension might occur. The GII anchor, despite its poor results, is still useful because of its small size.

Summary Statement
My project tests the overall strength of four types of suture anchors in both a repetitive stress test and a maximum tension test.

Help Received
The Mitek Company donated the suture anchors; Dr. Stephen Suzuki knotted suture loops for repetitive stress test.

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Erik R. Van Esselstyn

Project Number
S0218

Project Title
Performance Cycling: Factors of Efficiency

Abstract

Objectives/Goals
This project is an insight into the world of bicycle performance and variability. Bicycles are the most efficient and common self-propelled vehicle, and can be seen in innumerable applications around the world for travel, work, recreation, and sport. In all of these applications, efficiency plays a major role in defining the extent of a bicycle#s utilization. A bicycle#s efficiency is determined by the amount of resistance that is present against the direction of its movement. This resistance is caused by many factors: surface area (wind resistance), fixed weight, spinning weight, and tire pressure (rolling resistance). The goal of this project is to determine which of these factors has the greatest effect on a bicycle#s performance and efficiency under varying conditions of speed and terrain.

Methods/Materials
The experiment was set up using a bicycle trailer as the test body, to be towed behind a car using a sliding hitch, which connects the trailer to a scale (for reading resistance) while stabilizing it and keeping it from side-to-side and vertical movement. Each of the afore mentioned variables, surface area, fixed weight, spinning weight, and tire pressure, was tested at 5 and 15 mph on a level and inclined surface for a distance of ¼ of a mile, with a variation of 300% from the value that was used for the control.

Conclusions/Discussion
According to my results, I concluded that that increased surface area has the greatest overall effect on the efficiency of and work required for a bicycle#s movement at higher speeds; but on an incline, or at low speeds, fixed weight has the greatest effect. Fixed weight has a greater effect with lower tire pressure and is significantly affected by movement on an incline. Spinning weight does not have as great of a direct effect as fixed weight because of its drastically smaller quantity, but, proportionally, it has a greater effect on the efficiency of a bicycle#s movement.

Summary Statement
This project is an insight into the world of bicycle performance and efficiency.

Help Received
Father helped in physical aspects of testing: moving heavy trailer load, driving vehicle, etc.

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Mark A. Webb

Project Number
S0219

Project Title
Increasing the Deflection of Concrete

Abstract

Objectives/Goals
My primary focus in this experiment was to see if I could increase the deflective properties of concrete by strengthening the crystaline stucture of concrete through the addition of chemicals with higher molar fractions of hydrogen than water. This is because concrete gets its strength from silicon and hydrogen bonding.

Methods/Materials
portland cement, fine sand, 28% ammonium hydroxide, denatured alcohol, hexane, water, wax, plastic wrap, 1000ml graduated cylinder, triple beam balance, laser, resperator, gloves, power supply, improvised deflection testing base, measuring board, gogles, concrete molds, notebook.

Results
Addition of a 3.5% concentration of Ammonium hydroxide solution to a dry concrete mixture increased the amount of deflection by at least 30% compared to the control (normal concrete w/water).

Conclusions/Discussion
It can be concluded that the addition of ammonium hydroxide solution increases the strength of concrete a only specific concentrations and that certain concentrations of ammonia can actually decrease the concretes deflective properties. It cannot be concluded however whether or not this increase in deflection is due to catalytic processes or the concentration of hydrogen in the system. Nonpolar solvents decrease the strength of the concrete significantly. Increasing the flexibility of concrete is very important in securing key structures during an earthquake.

Summary Statement
This project focuses on increasing the deflective strength of concrete.

Help Received
I had my mentor Stephen Hubbard supervise my use of the chemicals and wood crafting machinery.

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Dana E. Wooten

Project Number
S0220

Project Title
How Missing the "Sweet Spot" Affects the Outcome of a Putter's Performance

Abstract

Objectives/Goals
The purpose of this experiment was to determine how much the distance and accuracy of a putt was affected by the position of the ball on the clubface. Three putters were tested. There were four distances: 91.5 cm (3 feet), 183 cm (6 feet), 366 cm (12 feet), and 549 cm (18 feet).

Methods/Materials
Wood, Screws, Washers, 4 metal brackets, 2 metal clasps, 1 metal rod, 1 ruler, roll of masking tape, 1 pair of scissors, 1 permanent marker, 1 Wilson True golf ball, 4 paper circles with diameter of 10.8 cm (4 ¼ in),1 blade putter, 1 mallet putter, 1 face-balanced, toe-heel weighted putter.
1. The materials were gathered and the pendulum was put into place; 2. Seven marks were placed and each club: 1,2,3 cm to the heel and 1,2,3 cm to the toe and the "sweet spot"; 3. Each putter was placed into the pendulum and adjusted to fit; 4. Each putter was tested for each of the seven marks and for the four distances; 5. The results were recorded.

Results
In reference to the charts:
-Putter number one is the blade putter.
-Putter number two is the mallet putter.
-Putter number three is the face-balanced, toe-heel weighted putter.
-O.C. stands for Off Center. In other words, O.C. shows how far in centimeters the center of the ball finished from the center line. The + means anything to the right of the center line and the # means anything to the left of the center line.
-O.D. stands for Off Distance. This simply shows how far in centimeters the center of the ball finished from the ideal distance line. The + means anything beyond the line, and the # means anything short of the line.
-The red lines on the O.C graphs represent the width of the hole. Putts outside the red lines would miss the hole. The red line on the O.D. graph represents the distance to the hold from the ideal distance line. The closer that the plots are to the center means the closer that the ball was to the hole.

Conclusions/Discussion
In fact, the "sweet spot" is definitely the most consistent place to hit the ball on the club. The face-balanced, toe-heel weighted putter came out the winner. It was the best and most forgiving putter of the three. Just as most of the golfing world would agree, taking the club straight back and straight through, hitting the ball solidly (hitting it in the "sweet spot"), and using a face-balanced putter will give

Summary Statement
Thre purpose of my project was to determine how much the distance and accuracy of a putt is affected by the position of the ball on the clubface.

Help Received
My grandfather designed the pendulum used in the experiment. Once designed, my father and my grandfather helped to assemble the pendulum. My father aided me in the actual performing of the experiment.