CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)

Aaron J. Adriance

Project Number

J0201

Project Title

Which Shape Is the Most Truss-worthy?

Abstract

Objectives/Goals

The objective was to determine which shape - a triangle, arch, or vertical beam - could create the strongest bridge truss.

Methods/Materials

10 identical bridge segments were constructed for each shape using 2-ply chip board and contact cement. Each segment was taped to a five gallon bucket on both sides for stability, and each bucket had a counter weight taped to its sides. Iron weights ranging from one - ten pounds were placed (one pound at a time) on each segment until failure between two five-gallon buckets.

Results

The triangle consistently held more weight than the other shapes. The arch came close to the triangle a few times, but never held more than the triangle, which won out every time. The triangle held an average of 42 pounds, the arch an average of 30.5 pounds, and the vertical beam held an average of 12.1 pounds.

Conclusions/Discussion

The triangle is one of the most important shapes in engineering and is used on most current bridge trusses. For this reason, the triangle took considerably more weight to destroy than the other two shapes. A triangle cannot be deformed unless a side's length is changed or a joint is broken.

Summary Statement

The purpose was to determine which shape - a triangle, arch, or vertical beam - could create the strongest bridge truss.

Help Received

My dad held the material while gluing.

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)

Stephen T. Ai

Project Number

J0202

Project Title

Quantifying the Effects of Temperature and Relative Humidity on Violin Pitch

Abstract

Objectives/Goals

I play violin. I noticed my violin sounded somewhat different and became out of tune more easily when the weather was warm and dry. I decided to try to verify this effect. My project attempted to study the effects of temperature and relative humidity on the pitch of a violin.

Methods/Materials

A built-in microphone on a laptop and a spectrum analysis program OscilloMeter were used to record spectra of violin sound and measure peak positions of the fundamental and harmonic frequencies of the violin. A heater and a humidifier were used to change the temperature and humidity under which the violin was tested. I measured the fundamental frequencies of all four strings in both control and manipulated environments. I recorded results. To reduce error, I repeated the same measurements several times and calculated the mean values. I performed 160 tests in four test environments. I changed the experimental environments by turning on a heater or a humidifier in both a large and a small room for 60 minutes. Each time, I moved the violin into the experimental environment and left it there for 30 minutes before testing. I then repeated the measurement procedures. I compared the results of each string#s fundamental frequency in the control room to the results recorded in the various experimental environments. I repeated my entire procedures using another violin to see if it exhibited similar changes in pitch.

Results

My results suggested that the pitch of a violin does change according to the temperature and humidity and that violins exhibit greater sensitivity to the temperature than humidity.

Conclusions/Discussion

When the temperature increased, the violin pitch shifted to lower frequencies. As the humidity decreased, the frequency of most strings also decreased. A thin string was more sensitive to the environment than a thicker string. In addition, strings played under conditions of high relative humidity produced less undesirable noise than strings played under the condition of low relative humidity.

Summary Statement

This project studied the effects of temperature and relative humidity on violin pitch.

Help Received

Thanks to my parents for their help and support. Thanks to my science teacher for her guidance.

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)

Ali E. Champness

Project Number

J0203

Project Title

The Effect of Slope Angle and Foundation Depth on Building Stability

Abstract

Objectives/Goals

The purpose of my project was to discover how foundation depth and angle of slope affect a building's stability.

Methods/Materials

The bottom quarter of a rain gutter was filled with landscaping rocks and the remaining space filled with potting soil. To simulate a slope the rain gutter was elevated with bricks at one end. The tower was built with 10 Lego Duplos. Four angles of slope were tested. Three foundation depths were tested at each slope angle (three times). A rubber ball was released up slope at each depth to test the tower's stability. The ball was released three times for each depth, creating a gap between the soil and the tower. Then the gap between the soil and tower was measured.

Results

On the slope of 10 degrees the tower moved the least overall. Slopes of 17 degrees and 15 degrees resulted in more movement in the tower. The tower on the slope of 13 degrees moved the most. The tower was not stable at one Lego Duplo block deep. While at three blocks deep the tower had little movement regardless of the slope. Since the data was inconsistent more trials will be conducted.

Conclusions/Discussion

The results did not support my hypothesis, because of inconsistent soil compaction and tower height. Inconsistent soil compaction led to poor data. The tower height changed when the foundation depth was increased, because the tower's height above the surface decreased. A 10 Lego Duplo tower was used throughout the experiment. By not adding a block as the depth increased the tower height and center of gravity was not held constant. In the new trials I will control both soil compaction and tower height.

Based on the data, increasing the foundation depth will result in a more stable building.

Summary Statement

My project is about how foundation depth and slope angle affect a building's stability.

Help Received

Mother helped cut red background pieces and proof read summary; Father helped cut rain gutter and taught me how to do math for my data.

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)
Nicole Chernavsky

Project Number
J0204

Project Title
Howe vs. Pratt

Abstract

Objectives/Goals
The objective is to determine which truss bridge design is more effective at dissipating the force of a load, the Howe truss or the Pratt truss.

Methods/Materials
Three models of each bridge type were constructed from Balsa wood. Three beam bridges, without and additional truss, were used as the control group. Each bridge's mass was recorded. Then, a bucket was suspended from the bridge. The bucket was slowly loaded with weights and the deflection of the bridge was also measured. Once the bridge collapsed, the mass of the load was recorded and the final deflection was also recorded. A load-to-mass ratio of each bridge was conducted, along with the amount of deflection, to determine which bridge was stronger on average.

Results
The beam bridge had an average load-to-mass ratio of 194.92 and deflected 27.52 mm on average. The Howe truss had an average load-to-mass ratio of 512.61 and deflected 13.23 mm on average. The Pratt truss had an average load-to-mass ratio of 528.93 and deflected 9.53 mm on average. The Pratt truss deflected the least and had the highest load-to-mass ratio.

Conclusions/Discussion
The Pratt truss disspipated the load more efficiently than the Howe truss, although both truss bridges dissipated the force significatnly more effectively than the beam bridge. In addition, the Pratt truss deflected the least and held the most, on average, while the beam bridge deflected the most and held the least. This brings one to the conclusion that the more rigid the structure is, the stonger it is and the more load it can hold. Therefore, the Pratt truss dissipated the force of the load the most effectively, due to its rigid design.

Summary Statement
Determine how structure of the truss bridge affects its ability to dissipate the force of a load

Help Received
Dad helped to build bridges, Mom helped to prepare the poster board

Name(s)

Amal I. Duriseti

Project Number

J0205

Project Title

Beware Ye Minifigures

Abstract

Objectives/Goals

I wanted to find out how changes in projectile mass, counterweight mass, and throwing arm length affect the range and trajectory of a projectile launched by a trebuchet.

Methods/Materials

I built a trebuchet using Legos and launched projectiles weighing 3/8 oz, 1/2 oz, 3/4 oz, and 1 oz for each of 6 possible combinations of two arm lengths (21 inches and 23 inches) and three counterweight masses (500, 1000, and 1500 grams). I observed the shape of the trajectory and recorded the range for three trials of each case. I graphed the average of the three trials for each case.

Results

My results show that the range of a trebuchet increases as projectile mass decreases, counterweight mass increases, or the throwing arm length decreases, and that the trajectory of the projectile becomes flatter as the projectile mass decreases, the counterweight mass increases, or the throwing arm length increases. The converses of all the findings are true.

Conclusions/Discussion

My results confirm the hypotheses about projectile and counterweight mass, but disconfirm the hypotheses about throwing arm length. The evidence indicates that a longer throwing arm decreases the range of a projectile and makes the trajectory more curved.

Summary Statement

I tested how changes in projectile mass, counterweight mass, and throwing arm length affect the range and trajectory of a projectile launched by a trebuchet.

Help Received

Mom helped sew sling and spot landings; Dad helped with sling design modifications

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)
Lena K. Egbert

Project Number
J0206

Project Title
Leveraging Light: A Method for Measuring Minute Masses

Abstract

Objectives/Goals
My project combines the principle of the lever and interference of light to measure very tiny weights. I hoped to measure small weights and compare them to known weights to see how accurate it was.

Methods/Materials
First, I built a balance with a rigid rod and knife edge. Tiny weights added to one end of the lever caused it to move down by very small distances. I measured these tiny movements of the lever using a Michelson interferometer that I built with a laser pointer and small mirrors. One of the mirrors of the interferometer is attached to one end of the lever to measure its movement. This device is able to measure movements of the mirror close to the wavelength of the laser used (650 nm). I can even measure weights less than a microgram.

In my device, the laser beam is split in two by the half-silvered mirror (beam splitter). The beam is reflected back so the two beams end up on the screen. These combine to make interference patterns. By measuring the change in the pattern, I can measure how much the end of the lever moves.

Results
I tested my device with various small objects such as a grain of salt and a mustard seed. I compared my results to known values. They were fairly accurate. I measured grains of salt, sugar, and sand and various cooking ingredients such as cream of wheat. I measured the change in the interference pattern by counting the number of rings that moved over. If one ring moved and a new one formed in the middle, that meant the lever moved one wavelength.

Conclusions/Discussion
This is a very inexpensive, easy way to measure small masses accurately without expensive equipment. If I had a more accurate way of measuring changes in the interference pattern, my results would have been even more accurate.

Summary Statement
Measuring minute masses using the principle of the lever and interference of light.

Help Received
Dad helped cut wood and metal with table saw.

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)

Skylar T. Frantz

Project Number

J0207

Project Title

Wood or Aluminum: Which Baseball Bat Hits the Ball the Furthest?

Abstract

Objectives/Goals

Which baseball bat, wooden or aluminum, will hit the baseball the farthest when hit from the sweet spot of the baseball bat?

Methods/Materials

The purpose of my project is to determine whether an aluminum baseball bat will hit the baseball further than a wooden baseball bat. The sweet spot of the baseball bat is defined as the exact spot that will cause the ball to go the farthest. The sweet spot will already be determined. Next, I made the pendulum that will be used to test the baseball bats for consistency in hitting. Twenty-five trials were performed on each baseball bat. After my testing, I will learn which baseball bat hits the baseball the farthest.

Results

The results, after 25 trials, were that the aluminum baseball bat hit the baseballs further than the wooden baseball bat. Aluminum baseball bat results: Shortest distance hit = 4.64 meters. Farthest distance hit = 7.59 meters. Average distance hit = 6.55 meters. The aluminum baseball bat, on average, would hit 1.71 meters farther than the wooden bat. Wooden baseball bat results: Shortest distance hit = 3.67 meters. Farthest distance hit = 6.98 meters. Average distance hit = 4.84 meters. The wooden baseball bat, on average, hit 1.91 meters less than the aluminum bat.

Conclusions/Discussion

After completing my investigation, I found that my hypothesis was correct. The aluminum bat hit farther than the wooden bat because it is a harder surface and it will go further.

Summary Statement

Which baseball bat will hit the baseball the furthest...wood or aluminum?

Help Received

Dad assisted with the pendulum. Mom with typing. My teacher supervised the entire project.

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)

Cameron S. Geiger

Project Number

J0208

Project Title

Shake, Rattle, and Fold

Abstract

Objectives/Goals

My objective is to determine what type of structure will hold the most weight during the static and seismic experiments. My hypothesis is that structure C, with the two diagonal cross beams, will hold the most weight

Methods/Materials

Five structure types with identical size and varying supports were constructed. I built an earthquake table and tested the various structures to discover the maximum weight that each structure could hold during the static and seismic experiments. I tested each structure 8 times.

Results

Structure C (the structure with two cross beams) held the most weight in both the static and the seismic tests. Structure D (the structure with one cross beam) almost held as much weight as structure C. All of the structures held more weight during the static test than they did during the seismic test.

Conclusions/Discussion

The results of my experiment supported my hypothesis. Structure C did hold the most weight. I learned that forming triangles in structures is very important because triangles are extremely strong shapes and can greatly improve the strength of the structure.

Summary Statement

My project determines what type of structure can hold the most weight during static and seismic experiments.

Help Received

My dad helped me build the earthquake table by using the tools that were too dangerous for me to use. My mom recorded data while I tested the structures. My mom edited my research report, and my sister helped me with the Bibliography.

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)

Aidan R. Hogge

Project Number

J0209

Project Title

Effect of Trebuchet Arm Length or Counterweight Mass on Projectile Distance

Abstract

Objectives/Goals

The Purpose of my experiment is to determine how changing the length of the throwing arm and mass of the counterweight will affect the distance that a projectile can be thrown by a trebuchet.

(Note, the results and conclusions have been typed into their boxes but are not showing up in the project summary when I check it via the following page online.)

Methods/Materials

Materials: Tools (hammer, saw, etc.); Wood glue; Scissors; Drill and bits; Sandpaper; Metal cutters; Heavy objects (penny roles); Screws; Nails; Eyehooks; Wire; Tape; 3 feet of string; 6 inch piece of cloth; Card paper; Different sizes of wood; Projectile (ping pong ball).

Procedure: Construct trebuchet; Get three weights of different masses. One with 275g or so, one with 548g or so, one with 816g or so. Measure the distances that the projectile goes with different weights and arm lengths. One at 13", one at 12", one at 11".

Results

The longest arm and the heaviest weight both made the projectile go further then the others. A trebuchet with a heavy weight and a long arm will throw projectiles the farthest.

Conclusions/Discussion

The heavier counterweight makes the projectile go further because a larger counterweight mass will make a larger mechanical advantage. A larger counterweight mass makes the projectile#s end go faster, therefore throwing the projectile further, the average distance was 4.4 meters. The smaller counterweight mass makes the projectile#s end go slower, therefore throwing the projectile not as far, only 1.7 meters.

The longer arm length makes the projectile go further because being longer, it multiplies the mechanical force of the counter weight dropping a longer distance, the average was 3.2 meters, then a shorter arm, the average was 2.8 meters. A short arm would multiply the mechanical force less then a longer arm, making the projectile go not as far as a long arm would.

So a trebuchet with a long arm and a heavy counter weight will throw a projectile further then a trebuchet with a short arm and a light counter weight. This is exactly as I predicted.

Summary Statement

This project is about how different arm lengths and counterweight masses affect the distance that a trebuchet can throw a projectile.

Help Received

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)

Chase R. Hughes

Project Number

J0210

Project Title

You Should Have Seen the One that Got Away

Abstract

Objectives/Goals

The purpose of my project is to see what combination of knot and fishing line will hold the most mass so that you have the best chance of the fishing line not breaking, thus allowing the fish to NOT get away. I wanted to determine this because I like fishing and would like to know the best combination so that I do not have one that "gets away."

Methods/Materials

I tested my project by measuring 50cm of monofilament fishing line. I did this because if I just cut it anywhere, the fishing line would strech at different lengths and could affect how much mass the line would hold. Then with the Tribe Beam Balance, I measured 500grams of rice in a 10 cups that each weighed 35 grams. I would then tie the same knot to both ends of the line to a hook, thus giving me a hook on each end of the line. I then attached one hook to a cabinet and the other to a bag. I slowly poured the rice into the cup, watching the string as tension was applied to it. I kept a tally mark of the total number of cups added to the bag, and once the line snapped, I measured the rice that was left over in the cup and subtracted its' mass from a full cup. I added my tallied numbers and this last number together in order to determine the amount of mass that the line could hold.

Results

During testing, the Clinch Knot highest amount held on the eight pound test was 2,466.5 grams, the least amount was 498 grams, and the average was 1,570 grams. The six pound test high was 2,167.5 grams, the low was 500 grams, and the average was 1,373 grams. With the Uni-Knot, the most amount held on the eight pound test was 5,500 grams, the least held was 1,500 grams, and the average held was 2,606 grams. The six pound test high was 3,500 grams, the low was 2200 grams, and the average was 2606.

Conclusions/Discussion

I learned that using different combinations of fishing line and knots does affect the amount of mass that the line can hold. After completing my trials, I saw that the Uni-Knot was able to hold more mass than the Clinch Knot. These results showed me that the combination of the eight pound (8 lb) line and the Uni-Knot is the most effective for holding a large amount of mass, yet the six pound (6 lb) line with the Uni-Knot consistently held the highest average and is the more reliable line and knot combination.

Summary Statement

Determining the best combination of pound-test fishing line and knots in order to hold the most amount of mass.

Help Received

Mom - board, supplies, driving; Dad - supplies; Teacher - supervision; Sister - board supplies

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)

Elizabeth J. Kennedy

Project Number

J0211

Project Title

What Bridge Design Is Strongest?

Abstract

Objectives/Goals

My project determines which bridge design, Warren, Pratt or K, would be the strongest. I think the warren-truss design will be the strongest because it is the simplest design and spreads the weight of the load evenly over the bridge.

Methods/Materials

Popsicle sticks and glue were used to build 3 different bridge designs: Pratt truss, Warren truss, and K truss. 5 identical models of each design were built. All 15 bridge were the same length. Each bridge was then tested to the breaking point. These tests were done by placing the bridge between 2 bricks, a bucket was placed on the bridge and I slowly added weights, one pound at a time, until the bridge broke.

Results

Of the three bridge designs I tested (warren-truss, pratt-truss, k-truss) the warren-truss held the most weight. I tested each design 5 times and the average for the warren was 43.6 pounds. The k average was 31 pounds and the pratt design was the weakest and averaged 13.6 pounds. I noticed that the breakage on most of the bridges was near the ends of the sections. I checked the types of breakage, as well, determining whether it was a snap, splinter, or bad glue bonds. The warren mainly snapped, but also had some splinters, The pratt design, was likely not built as well, and fell mostly because of bad glue bonds. The k-truss design had a lot of splintering.

Conclusions/Discussion

The warren-truss design worked best. It held a high of 66 pounds and the average weight held was 43.6 pounds. The k-truss design held an average of 31 pounds, the pratt design had an average of 13.6 pounds. I think the warren-truss design worked best because the design spread out the areas of compression and the areas of tension almost evenly throughout the bridge. This caused the load to be distributed evenly.

Summary Statement

I tested 3 different bridge designs (Warren-truss, Pratt-truss, K-truss) by building 15 popsiicle stick models and testing them to the breaking point.

Help Received

Mother helped by taking photos of tests for my report; Mother helped by working with me on putting together some of the bridges; Science teacher, Ms. Zeringue, reviewd and edited my report.

Name(s)

Griffin M. Kraemer

Project Number

J0212

Project Title

How Deep vs. How Steep: Experiment on Soil Stability of Steep Slopes for Building Foundations

Abstract

Objectives/Goals

The objective was to determine the depth of a foundation required to maintain stability when a structure is built on a slope. The goal was to find out how deep a tower's foundation needs to be on a 30 degree slope.

Methods/Materials

A model of a building was constructed on a slope using a rain gutter, bricks, potting soil, a tower of Lego building blocks and other items readily available. The building block tower used was 18 layers tall and the foundation was up to 5 layers deep at 30 degrees. This is very close to the same ratio as a 10-story building with a 3-story foundation.

Results

After conducting the tests, the analysis showed that there was too much movement of the 18 layer tower with only a 5 layer foundation when built on a 30 degree slope.

Conclusions/Discussion

A building must have strong foundation to stay standing and survive earthquakes, wind, rain and everyday use. One of the key factors in designing a foundation is the slope of the ground. This science experiment shows that a building's foundation must get deeper as the slope increases. The goal was to find out how deep a tower's foundation needs to be on a 30 degree slope. The results showed that the foundation must be greater than 30% of the exposed height.

Summary Statement

This project tests a theory regarding soil stability and foundation depth when a structure is built on a steep slope.

Help Received

My father helped me build the experiment in our garage and helped with the spreadsheet for the analysis.

Name(s)

Calvin Le; Dylan Zhang

Project Number

J0213

Project Title

Volcanic Particle's Effect on Airplane Engines: Ash vs. Engine

Abstract

Objectives/Goals

Our goal is to see how much volcanic ash is needed to stall an airplane engine and which engine is most vulnerable. Our Hypothesis: The fighter jet will take an average of 10 tablespoons to break down, the commercial jet will take 18 tablespoons, and the propeller plane will take 25 tablespoons.

Methods/Materials

blow-dryers with protection: commercial jet engine; blow-dryers without protection: military jet engine; 1 RC propeller engine: propeller plane; 1 Fan capable of turning to High; 1 stable platform; Tape; Sand; Tube to regulate air particle input (for jet engine); Cardboard to block particles.

We simulated what would happen if three different types of airplane engines flew through a volcanic ash cloud: a commercial jet engine, a fighter jet, and a propeller plane. We used hair dryers for the jet planes (with some protection for the commercial jet, to simulate the brush seal, and no protection on the fighter jet) and an RC propeller engine for the propeller plane. We collected data by blowing 1 tablespoon at a time of sand, simulating the ash in the air, flying at the engine. We made the amount flying in as accurate as possible by funneling the particles towards the intake area. Once the engine stopped working, we analyzed how many tablespoons were used and averaged the results. We wore safety gear all the while.

Results

The fighter jet used 13 tablespoons to become stalled. The commercial jet: 55 tablespoons. The propeller plane: 37 tablespoons to stall. We also had high speed tests where we threw the particles into the engine. This was inaccurate; the particles missed.

Conclusions/Discussion

Our tests showed that the jet is the most vulnerable and the propeller is the least. The intake of air, in engines like the jet airplane, makes the engine prone to damage because particles are pulled in and pass through. Less protection of the engine also contributes to the factor of more danger to the engine. Blowing air like the propeller reduces the amount of particles able to pass through. The speed of particles also affects the amount of damage done to the engine. The faster the particles, the more damage that is done; there are more particles passing through in a certain amount of time. Larger, heavier particles do more damage than smaller particles; they can make a larger impact and are heavy enough to pass through the engine.

Summary Statement

Our project is to test how volcanic ash affects airplane engines and which airplane engine is the most vulnerable.

Help Received

mother helped srite report; Calvin's dad helped build simulation

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)

Madison P. Meredith

Project Number

J0214

Project Title

The Effect of Heat Transfer on the Resiliency of a Golf Ball

Abstract

Objectives/Goals

My objective was to see if the core temperature of a golf ball effects its flight distance. The purpose of my science project was to test the results of heat transfer on the resiliency of a golf ball. My hypothesis for this project was that by adding additional heat the resiliency of a golf ball will be increased and the golf ball will recover its original size and shape and thus bouncing higher.

Methods/Materials

25 golf balls, one steel cylinder, a golf ball dropper, a 304.8 centimeter ladder, a metric stick, two thermometers, a bowl, a test sphere cooling unit, a hot plate, water, a camera, a flip video camera, poster board, and a marker. The constants and controls in my experiment were using the 3 meter dropper, the height always stayed the same, I used the same type of thermometers, the steel target never moved, and the ball hit in the strike zone constitute, and I used the metric system. The variable in my experiment was the temperature, and I tested a wide variety of golf balls. The way that I measured the responding or dependent variable was I had 2 thermometers to double check the temperature, the ball stayed the same temperature as the other balls when taken out of the bucket, and the temperature in the bucket never changed.

Results

At the lower temperature (4°C), the molecules in the golf balls were relatively less active; it made it harder to have a reaction to the club. At room temperature (22°C), the molecules in those golf balls were in a more active state and the ball produced to be more resilient. However, in the highest test (44°) temperature the molecules being in a more active state increased the resiliency to a higher level. Those molecules were going crazy and bouncing off the walls.

Conclusions/Discussion

The results of this experiment were the balls with a higher core temperature proved to be more resilient and bounced higher. The balls that had a lower core temperature proved to be less resilient and responded by bouncing to a lesser level. My hypothesis proved to be correct, that the balls with a higher core temperature did indeed bounce higher. If I were going to do this experiment again, in the future, or expand on this experiment, I would make a machine that actually hit the golf ball and test the actual flight of a golf ball.

Summary Statement

My project is about golfing and temperature.

Help Received

Mr. McNutt is a science teacher that helped me get the golf ball dropper; mother helped me edit research paper and put the ball in the dropper; sister helped with pressing the button for the ball to drop; grandma and grandpa helped edit research paper; and golf pro lent me the golf balls.

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)

Joseph P. Monaghan

Project Number

J0215

Project Title

Building Buildings Better. Which Design Does Better in an Earthquake: Tuned Mass Damper or Base Isolator?

Abstract

Objectives/Goals

The purpose of this project was to determine which type of earthquake resistant design for a building would create less sway. The hypothesis is that a building with a base isolator would create less sway than a building with a tuned mass damper.

Methods/Materials

A model building made of flexible metal wires and wood squares was constructed. A shake table was constructed with wood, pvc pipe, wire, rubber bands and a drill to create consistent shaking. A tuned mass damper was built out of washers, nuts and a bolt, then attached to the top of the building with wire. A base isolator was made by placing marbles in a shallow cardboard box, and secured to the shake table top with large rubber bands. A small hole was drilled at the top of the building to place a stick with an arrow on it. This was the guide for recording the numbers seen on the paper taped on the wall behind the building. Data was gathered by videotaping ten, ten second trials for each condition tested on the shake table: control, tuned mass damper, base isolator, and a combination of the tuned mass damper and base isolator. Videotape was viewed in slow motion to record where the arrow moved from left to right. Numbers were recorded and amount of movement was calculated . Bar graphs were made.

Results

Results were consistent for all four conditions. The base isolator had the least amount of sway with an average of 3.63 centimeters. The tuned mass damper and base isolator combination had an average sway of 5.82 centimeters. The tuned mass damper alone averaged 10.84 centimeters. The control had the most amount of sway with an average of 24.55 centimeters.

Conclusions/Discussion

The base isolator was better than all other earthquake resistors tested in this experiment. The base isolator was even better than a combination of base isolator and tuned mass damper. In this particular test, I observed that the sway of the weighted tuned mass damper began to sway the building on a base isolator. More testing could be done on how much weight to use in a tuned mass damper in proportion to the size of the building. Tuned mass dampers and base isolators alone can reduce the amount of sway and result in less damage to the contents of a building.

Summary Statement

The purpose of the project was to determine whether a base isolator, tuned mass damper or a combination of the two would create the least amount of sway on a model building exposed to simulated earthquake activity created by a shake table.

Help Received

Mother helped with construction of shake table; turning on and off drill when data was being collected; typing and layout of display board.

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)

Ryan D. Montag

Project Number

J0216

Project Title

How Does Tire Pressure Affect Gas Mileage?

Abstract

Objectives/Goals

The overall purpose of my project was to determine at what tire pressure optimal fuel efficiency is achieved. I believed that a tire at 32 psi would be able to roll further than an under inflated tire could from the same ramp.

Methods/Materials

A ten meter strip of sidewalk was acquired and measured, and then a thirty centimeter bicycle ramp was secured at one end of the sidewalk. Two identical large scale hobby tires were then pumped with air; one with 32 psi, and one with 15 psi. Then each tire was rolled across the sidewalk from the ramp four times, and distances were recorded for each trial.

Results

The 32 psi tire consistently rolled further than the 15 psi tire was able to. Even the longest distance the under inflated tire traveled was shorter than the least successful run of the properly inflated tire. On average, the 32 psi tire traveled 8.4 meters, whereas the 15 psi tire was only able to cover 7.06 meters. These results show that for every pound per square inch of pressure your tire loses, your car will lose about 2% fuel efficiency.

Conclusions/Discussion

After this experiment, I have come to the conclusion that keeping your tires well inflated is very important to saving money, gasoline, and the environment. By keeping your tires properly inflated, you can avoid losing up to as much as 12% fuel efficiency.

Summary Statement

How does the air pressure of a tire affect it's fuel efficiency?

Help Received

Name(s)

Dominique R. Ochoa

Project Number

J0217

Project Title

Smooth or Fractured Aggregate: Which Will Make a Stronger Concrete Mix?

Abstract

Objectives/Goals

I tested to see which aggregate would make a stronger concrete mix. I used two of the most commonly used aggregates: river and fractured aggregate.

Methods/Materials

For the concrete mix I used a volume method of 1:2:3. I mixed 5 kg. of cement powder, 10 kg. of sand, 15 kg. of aggregate, and 15 kg. of faucet water. I made 8-10cm X 25cm cylinder samples to test per mix. I mixed two batches following this outline with fractured and river aggregate. I mixed a control with the same basic outline but substituted the aggregate with sand and no aggregates were in this mix. The mixes cured for intervals of 8, 16, and 24 days (2 of the cylinders were for backups). Two cylinders of each mix were then stripped, capped, and vented on each of the three test days. They were put in a compression machine to test the strength of the mix. The strength was taken in PSI, pounds per square inch, and had to be converted to Mps, mega paschals. The weights were recorded and then I averaged the strengths of the two mixes to draw the conclusions.

Results

The mix with the fractured aggregate was stronger than the river aggregate, but the control was the strongest of them all. In the testing the two aggregate mixes stayed relatively low. The control was very high in all tests.

Conclusions/Discussion

I had thought the fractured aggregate would be the stronger between the two aggregate mixes, and I was right. I was surprised to find that the control mix was the strongest of all three. The river rock would work better with small home jobs that don#t need to hold a lot of weight. The fractured aggregate would work better with bigger projects as well as small home projects where a stronger concrete mix is needed. The mix with just sand will work sometimes with patch up jobs but mostly will not have the strength of the other two.

Summary Statement

I tested which aggregates will make a stronger concrete mix.

Help Received

used lab equpment at Caltrans Kerny Mesa lab, mom & dad helped mix the cylinders and profread my report, was supervised by caltrans workers, and cylinders were donated by G-Force

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)

Brenna M. Ram

Project Number

J0218

Project Title

Will It Stand? What Specific Features Make a Structure Stronger?

Abstract

Objectives/Goals

My experiment was designed to test three different building structures to determine which commonly-used structure design would be the safest, sturdiest, and most stable. I tested these three designs against earthquakes and weights. Where I come from, earthquakes are common, and I found that some typical building designs used in the world today are not able to stand up to them!

Methods/Materials

The three buildings I used - Cube, Tall Building, and Crossbeam Building - were constructed out of uncooked spaghetti, held together at corners by 1/2 inch diameter balls. I designed and built my own Earthquake Simulator, which imitated the jolts and vibrations of earthquakes of different strengths. Using three examples of each type of building (nine structures all together), I figured out the strongest earthquake each structure could hold up to. Lastly, I used four AA batteries to test how musch weight each structure could hold.

Results

My hypothesis was that the Cube design would be the strongest, because it was small, compact, and sturdy. But as I tested each model, I found that the Tall Building was weakest, the Cube was only somewhat sturdy, and the Crossbeam Building stood up to everything without giving an inch! It stood up to the strongest earthquake and the full amount of batteries! The Tall Building, as I predicted, collapsed at the slightest earthquake and only a single battery.

Conclusions/Discussion

Though my hypothesis was wrong, I did learn why. The Cube's joints, like those of the Tall Building, were weak and unsupported. They were weakened by the weight of the beams, and had nothing to hold them up. The shaking of the earthquakes and the mass of the weights were too much for them, and they let the beams crack and wobble out of place. However, the Crossbeam Building had the strongest, most supported joints of the group, and was able to support its own weight when threatened by earthquakes and batteries.

Summary Statement

In my project, I tested three 'real-life', commonly used building structures in order to determine which was the most stable, testing them against an Earthquake Simulator that I designed and by figuring out how much wieght they could hold.

Help Received

Mother bought spaghetti; Father took me to the Home Depot, found the wood for the Earthquake Simulator, helped me cut it to the length I wanted, and showed me how to use the power drill; Sister helped collect rubber bands from newspapers

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)
David L. Reich

Project Number
J0219

Project Title
Which Bridge Design Is the Strongest: Arch, Truss, or Suspension?

Abstract

Objectives/Goals
The purpose of this project was to find out which bridge design is strongest: arch, truss, or suspension in a scenario where an increasing quantity of load is hanging from the bottom of the bridge. For the actual experiment of this project, a wooden scale model of each bridge design was built. The load was represented by different size weights weighing 1, 2, and 2.5 pounds, and 4 and 3 ounces. The load was placed in a metal container that was tied to the center beams of each bridge. Each bridge#s ends were resting on bricks or bins. Two trials of this experiment were performed, one of them videotaped. The video was used to recreate the breaking sequence of each bridge on an advanced visual editing software, AutoDesk Maya. Therefore, part of the hypothesis was right. The test can be recreated on the computer. The results of the first test were that the suspension bridge broke at 11.45 kilograms, the truss broke at 14.46 kilograms, and the arch broke at 16.16 kilograms.
Small items and procedures were changed for the second test, including weights and supports. The weights and the order they were put in were changed. The arch bridge broke at 17.61 kilograms, the truss broke at 11.23 kilograms and the suspension, at 14.86 kilograms.
In conclusion, the results of this test suggest that the experiment can be recreated on the computer and that the arch bridge design is strongest in the specific scenario of this experiment.

Summary Statement
This project is meant to test the strength and find the breaking points of arch, truss, and suspension bridge designs.

Help Received
Teacher-Guidance, Civil Engineer-Interview, Sister-Camera footage, Animation Instructor-Assistance for animnations

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)

Mariah Rogers; Shelby Smalley

Project Number

J0220

Project Title

Going the Distance: Launch Angles and Projectile Trajectory

Abstract

Objectives/Goals

Our project was to determine which launch angle results in the greatest distance for a projectile. We believed that the 45 degree launch angle would make the projectile go the greatest distance.

Methods/Materials

We constructed a projectile launcher and its projectile. We placed the projectile in the launcher and set it at one of the test angles: 0 degrees, 20 degrees, 45 degrees, and 60 degrees. We launched the projectile from the launcher. When the projectile stopped, we measured how far it went from its exit from the launcher to where it stopped moving. Then we recorded the distance it traveled. Each test variable angle was tested 15 times.

Results

The 45 degree angle made the projectile go the farthest.

Conclusions/Discussion

Our conclusion is that the 45 degree angle measurement caused the projectile to travel the greatest distance.

Summary Statement

Determining which launch angle results in the greatest distance for a projectile.

Help Received

Teammates father helped build the launcher; science teacher helped with project display; employees at Orchard Supply Hardware helped choose project parts.

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)

Carina I. Salcedo

Project Number

J0221

Project Title

Feeding My Flock

Abstract

Objectives/Goals

Goals: This project#s goal is to modify a mass manufactured (barrel-style) poultry feeder in order to raise the level of food in the feeder#s trough area to three centimeters deep and use less food, reducing stale and wasted feed.

Methods/Materials

Methods/Materials: The hypothesis specified testing two variables separately and combined. The first variable was the angle at which the food is delivered to the trough. The minimum desired angle was determined by observing tests of 50 grams of chicken feed placed on a flat piece of aluminum and positioned at different angles. The second variable tested was height of the gap through which the feed flows to the tray. The ideal gap was found by measuring the depth of pellets while a vertical piece of cardboard was used to simulate the barrel at different heights. Each modification was then constructed and tested in the actual feeder.

Results

Results: Slope tests demonstrated that a 20° angle consistently aids in the flow of the feed. Gap tests showed a four-centimeter gap would dispense the desired three-centimeter depth of pellets to the tray.

Conclusions/Discussion

Conclusions: A cone with a 20° angle not only helps consistently deliver food to the tray but also replaces feed which would otherwise go stale. Tests showed the gap variable was the key factor to achieving the desired height of food in the trough. While each of the two variables can improve the feeder, the combination of the two is the most beneficial.

Summary Statement

This experiment determines design modifications reducing the amount of food wasted in a mass manufactured, barrel poultry feeder.

Help Received

My parents helped me edit; Mrs. Johnston taught me trigonometry; my grandfather advised me on the design of equipment.

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)

Matthew G. Smith

Project Number

J0222

Project Title

The Perfect Trebuchet: Effects of Arm Length and Counterweight on the Projectile Distance

Abstract

Objectives/Goals

The objective is to determine how changing the arm length or counterweight mass affects a trebuchet's projectile distance? I think that the combination of a longer arm length and a heavier counterweight will make the projectile go farther.

Methods/Materials

Change the arm length and/or counterweight to see its affect on the projectile distance. First thing is to obtain the materials to build a trebuchet. Then make the trebuchet. Next is to choose different combinations of arm lengths and counterweight masses. Then choose a projectile to launch. Next, launch and observe their results. Continue to test different combinations until all of the combinations have been tested. Lastly, record their results and answer the problem.

Materials used: 14 Screws (6.35 cm) 4 Carriage Bolts (8.89 cm) 6 Washers 6 Lockwashers 6 Nuts 28 Screws (3.175 cm) 1 Bushing (1.27 cm 10.16 cm thick) 2 Carriage Bolts (6.35 cm .9525 cm thick) 2 Copper Pipe (1.27 cm x 10.16 cm long) 4 Wing Bolts (.635 cm x 5.715 cm) 20 Captive Nuts (.635 cm) 1 T Splice 2 3 7/10 x 3 7/10 x 78 7/10 cm boards 4 3 7/10 x 3 7/10 x 74 7/10 cm boards 3 3 7/10 x 3 7/10 x 12 7/10 cm boards 2 3 7/10 x 3 7/10 x 64 7/10 cm boards 2 3 7/10 x 3 7/10 x 44 9/10 cm boards 1 3 7/10 x 3 7/10 x 90 ½ cm board 1 2 x 6 4/10 x 83 2/10 cm board 2 2 x 6 4/10 x 38 1/10 cm boards 1 Racketball

Results

It looks as though the longest arm never had a chance to reach its farthest distance; even at the max weight of 22.68Kg. The shortest arm length achieved its peak distance at approximately 14kg and had the farthest distance out of all at 13.61kg, but it did not improve at any higher weight. The longest arm length never achieved its peak distance and had the best distance out of all the arms. I used a racquetball for a projectile in all of the tests.

Conclusions/Discussion

My hypothesis, that the combination of a longer arm length and a heavier counterweight will make the projectile go further, was approved based on my results. I learned that at some point adding more weight will not help make the projectile go any further. This was a fun experiment and I liked learning how to use all of the power tools necessary to build the trebuchet.

Summary Statement

This project measures the affects of the arm length and counterweight of a trebuchet's projectile distance.

Help Received

Dad helped superviser the use of power tools and making the video. My whole family helped to measure the distances.

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)	Project Number
W. Ethan Soo Hoo	J0223

Project Title

Using Simple Models to Predict the Effects of Gravity on Projectiles: Discovery of a Synergistic Effect of Two Variables

Abstract

Methods/Materials

Catapults make good model systems to study certain aspects of motion. In the present study, a homemade catapult was constructed to study the movement of different projectiles. Several parameters related to the initial launch of the object were found to affect the flight of the projectile. These parameters were studied over a range of values. The resulting data demonstrated that each change would produce a set of distance values that were found to be consistent and therefore, predictable within certain ranges.

Results

Two patterns emerged from these findings. The first pattern resembled a simple relationship between force and the distance traveled. As the force increased, so did the distance traveled by the projectile. This is described as a positive relationship. In contrast, the data curve of the second pattern resembled a hill. As the mass of the object increased in the lower ranges, the data showed a positive relationship. However, as the mass of object passed 50 grams, the relationship became negative. In other words, as the mass increased, the distance decreased. Using this data it was possible to predict the distance traveled by completely different projectiles when only the mass was known.

Conclusions/Discussion

Finally, it was postulated that the combination of optimal conditions (angle and mass) would result in the farthest distance indicating synergy. Although the results did not indicate a greater distance, it showed that the synergy allowed for the catapult to have a much more sensitive flexibility in range. This is a synergy that was an unexpected discovery.

Summary Statement

Predicting projetile behavior and the discovery of synergism between two variables using a simple mechanical model.

Help Received

Father helped build catapult.

Name(s)

Michelle C. Stanley

Project Number

J0224

Project Title

The Distance a Trebuchet Catapult Can Throw Projectiles of Different Masses: A Study in Energy Transfer

Abstract

Objectives/Goals

The objective of this experiment was to determine if the mass of a projectile affects the distance it will travel when launched from a trebuchet type catapult. It was hypothesized that the lightest projectile would receive the greatest amount of energy transferred from the catapult and travel the furthest distance.

Methods/Materials

A catapult is any non-held machine that hurls an object without the aid of an explosive substance. It works through a central lever that is mounted "counterpoise" and has a see-saw movement. A trebuchet is a type of catapult that was used in Europe in siege warfare during the Middle Ages.

A miniature model of the trebuchet was purchased on-line and constructed.

A marshmallow, a foosball, and a golf ball were weighed. The weight of the projectiles was the only variable in the experiment. The sling length and the weight in the counterweight were fixed variables.

Each projectile was launched twelve times to determine the average distance traveled.

Results

The marshmallow traveled an average distance of 40.38 cm.
The foosball traveled an average distance of 29.44 cm.
The golf ball traveled an average distance of 16.34 cm.

Conclusions/Discussion

The results supported ny hypothesis. The marshmallow, the lightest projectile, clearly traveled the furthest distance in this experiment because the marshmallow received a greater amount of energy from the trebuchet than the heavier objects.

Summary Statement

The mass of an object influences the distance it can travel when launched from a trebuchet due to the principles of energy transfer.

Help Received

My mother purchased the model trebuchet. My science teacher gave me a scale to weigh the objects. My dad helped me measure the distances the projectiles traveled.

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)

Brian M. Sussex

Project Number

J0225

Project Title

The Survivability of High Rise Structures in Earthquakes

Abstract

Objectives/Goals

My objective was to find out which types of building techniques in skyscrapers withstand earthquakes the best.

Methods/Materials

Four different miniature skyscrapers were constructed out of spaghetti and glue. The four different kinds of skyscrapers were one with exterior uprights, one with exterior uprights and cross bracing, one with exterior uprights, cross bracing and interior uprights, and one that was round, or an octagon, with perimeter uprights and cross bracing. I tested each structure on a shake table that had ten different speed variables and was made out of wood, rubber bands, and a motor to simulate an earthquake. I would test each structure for forty seconds on each speed variable. If the structure did not collapse I would test it on the next speed variable. I would then record which structure was able to withstand the highest speed setting.

Results

My results were that the structure with just perimeter uprights made it to 1st power setting, the structure with perimeter uprights and cross bracing made it to the 8th power setting, the structure with perimeter and interior uprights and cross bracing made it to the 9th power setting and the round structure with perimeter uprights and cross bracing made it to the 10th power setting.

Conclusions/Discussion

My conclusion is that the round building with perimeter uprights and cross bracing was able to withstand the most amount of shake from the shake table. I think it performed the best because the strongest parts of the buildings were their corners and the round building had eight corners because it was an octagon.

Summary Statement

I was testing which types of building techniques in skyscrapers withstand earthquakes the best.

Help Received

Science teacher: Dr. Dunn helped with experiment, Dad: Greg Sussex helped conduct experiment

Name(s)

Emily J. Sutton

Project Number

J0226

Project Title

Castles Made of Sand: Comparing the Strength of Sandcastle Walls Made from Caribbean Sand

Abstract

Objectives/Goals

The purpose of my experiment was to determine which Caribbean island has the best sand to build sandcastles. The optimal sand for sandcastle construction is strong enough to support weight when it is mixed with water and compacted into a sandcastle mold.

Methods/Materials

I constructed a sandcastle wall mold out of wood and clamps. I mixed ½ cup of sand with one teaspoon of water, which is an eight to one ratio of sand to water. I filled the mold with the sand/water mixture, compacted it, and then released the clamps. The mold disassembled, leaving a sandcastle wall. I placed marbles one at a time into a plastic container, which was placed on top of the sandcastle wall, until the sandcastle wall collapsed. I measured the weight of the marbles the sandcastle wall held. I repeated the procedure two more times and got an average weight each sand sample was able to hold. I then met with my teacher and looked at each sand sample under a magnifying glass, determining the minerals in each sample and the size of the sand grains.

Results

The sandcastle wall made from sand from Antigua held the most weight, with an average of 868.3 grams. The second strongest sandcastle wall was made from sand from St. Lucia (855.2 grams), then St. Thomas (744.7 grams), Puerto Rico (536.7 grams), Dominica (391.0 grams), St. Kitts (286.1 grams), and Barbados (253.4 grams).

Conclusions/Discussion

The sandcastle walls that held the most weight were made from fine-grained sand, and the sandcastle walls that held the least amount of weight were made from coarse-grained sand. Smaller grains of sand are able to fit together (compact) better. More surface tension is achieved with smaller grains of sand, allowing for better bonds between the water molecules which hold the sand grains together, providing more strength to the sandcastle wall.

Summary Statement

I compared the strength of sandcastle walls made with sand from seven different Caribbean islands.

Help Received

Mrs. King, my teacher, helped me identify the mineral content of the sand and the size of the sand grains.

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)

Caroline E. Vance

Project Number

J0227

Project Title

Machines in Your Motions

Abstract

Objectives/Goals

The objective of my project was to determine a possible explanation of why people lean forward to stand up from a sitting position. My hypothesis was that if a person leans forward, moving their center of mass closer to their knees, then it requires less force to rise.

Methods/Materials

Through research, I was able to find that the knee joints and legs, parts of the body heavily involved in standing up, act as a lever. With this knowledge, I built a third class lever to simulate the body standing up. The fulcrum was the knees, the lever was the body above the knees, and the effort was a person pulling up with their leg muscles. The center of mass was simulated by a container of weights, moved to a different place on the lever for each measurement. The lever was lifted to a given distance with the cup of weights at a point on the lever. The amount of force needed to lift the lever a given distance was then recorded from the spring scale.

Results

I found that the farther away the weights were from the fulcrum, the greater the force needed to lift the lever a given distance. This was consistent through every trial including those that lifted the lever to greater heights.

Conclusions/Discussion

Using the data achieved during testing, I derived a conclusion relevant to the human body. By moving the center of mass closer to the knees, the fulcrum, it took less force to raise the lever, the body above the knees. I proved my hypothesis correct because moving the weights closer to the knees required less force to raise the lever.

Summary Statement

My project was about finding a reason why people lean forward when standing up from a sitting position.

Help Received

Neighbor was interviewed for background research.

Name(s)

Cameron W. Wallace

Project Number

J0228

Project Title

What Is the Optimal Release Angle for Shooting a Free Throw?

Abstract

Objectives/Goals

Research on the optimal release angle for shooting a free throw compares effectiveness for low (35-45º), medium (45-50º) and high (50-58º) release angles. My hypothesis states that shooter release angle will be a determining factor in the number of free throws made. I tested this hypothesis for four different release angles (42,47,52,57º), predicting that the highest number of free throws will be made at a release angle of 52º. I used my results to model the parabolic trajectory of a free throw, calculating the maximum height and the angle of entry into the hoop for the optimal release angle.

Methods/Materials

To control for release angle I built a freestanding release angle guide that locates where the basketball must pass at 10 feet above the ground on the path to the basket. I determined the x and y coordinates of the release point of a free throw for each subject, and used the tangent ratio to calculate the horizontal location of the guide for each release angle tested. Subjects shot ten free throws at each release angle over two separate trials, and the number of free throws made was recorded. Parabolic trajectories were calculated both by hand and using a TI-83 calculator, were graphed using LoggerPro software, and were recorded digitally for video analysis.

Results

In all but one trial, each shooter made the highest number of free throws at the release angle of 52º. Each shooter's average number of free throws made across both trials was the highest at 52º. Finally, the highest number of free throws made over two trials for all shooters, 7.1/10, was at 52º. The next highest average was 5.6/10 for the release angle of 47º.

Conclusions/Discussion

I proved my hypothesis correct that the highest number of free throws will be made at a release angle of 52º. I calculated the parabolic equation for each shooter for each release angle using points on the path of the free throw. I duplicated these calculations for selected free throws by completing a quadratic regression using video data. I took the first derivative of each parabolic equation to calculate the maximum height and angle of entry for each release angle. The maximum height at the optimal release angle of 52º was consistent for all shooters, and the angle of entry was exactly that predicted by the research. My research is important because many young people play basketball, and this can teach them a new approach to making a free throw.

Summary Statement

My project determines which of four free throw release angles results in the highest number of shots made, then calculates the ball's parabolic trajectory to develop conclusions regarding the maximum height and preferred angle of ball entry

Help Received

My father helped me to build and transport the 10 foot release angle guide that I used to control for the release angle of each shooter.

Name(s)

Evan H. Wank

Project Number

J0229

Project Title

Does the Length of the Arm of a Catapult Affect the Distance of an Object Thrown?

Abstract

Objectives/Goals

The goal of this project is to determine if the length of the arm of a catapult affects the distance of an object thrown.

Methods/Materials

I researched catapults to determine the best type to use to test varying arm lengths.Instead of using a lever-style catapult such as a trebuchet, I decided to use a torque-style catapult where the moment arm rotates around a pivot point. Using PVC pipe, a wooden dowel, a threaded rod, and large rubber bands, as well as other parts, I designed and built a catapult with an adjustable arm. The rubber bands are used to provide the energy to fire a small wooden ball. I set the catapult up next to a large area of sand and adjusted the catapult arm from 60 cm. to 100 cm. in 10 cm. increments. Every length was tested five times to determine an average throw at each arm length. Sand was used because the ball would leave a divot which made it easier to measure.

Results

Overall, as the arm length of the catapult increased, the ball was thrown farther.

Conclusions/Discussion

My hypothesis was that a ball being thrown from a catapult, will travel a farther distance if it is thrown using a longer arm. This hypothesis was correct. Using a catapult, I extended the arm to different lengths to see how far a wooden ball would be thrown. The average distance thrown from arm length 1 (60 cm.) was 339.85 cm., while the average distance thrown from arm length 3 (80 cm.) was 352.04 cm., and the average distance thrown from arm length 5 (100 cm.) was 386.84 cm. This shows that extending the arm length does increase the distance thrown.

The results supported my hypothesis. My research showed why I got these results. According to the formula for a moment arm, which is torque = force x moment arm, the more torque, the farther the ball would be thrown. Therefore, if you increase the moment arm, this will increase the torque. This is why the ball was thrown as far as it was.

This experiment provides useful results. The moment arm of the catapult acts like a person throwing a baseball or a football. A person with a longer arm should be able to throw a ball farther.

Summary Statement

My project was to determine whether the length of the arm of a catapult affects the distance of an object thrown, based on the formula for a moment arm.

Help Received

My father helped me design and build the catapult as well as assisted me in performing the experiment.

Name(s)

Megan R. Wooley

Project Number

J0230

Project Title

Under Pressure: Which Bridge Holds the Most Weight with the Least Flex?

Abstract

Objectives/Goals

The objective of my project was to determine which bridge type, an arch bridge or a truss bridge, holds the most weight with the least flex.

Methods/Materials

An MIT bridge design program was used to design a truss and an arch bridge. From the computer design, scaled bridge patterns were created. Two models of each bridge type were built for testing. Bridges were measured and weighed on a scale. The bridges were positioned to span between two objects of equal height. Bricks were then stacked on the top and in the center of each bridge. The resulting flex in each bridge was measured with a micrometer as each additional brick was added. Weight was added to each bridge until each bridge type broke.

Results

The arch bridge withstood more weight with less flex in comparison to the truss bridge.

Conclusions/Discussion

My conclusion is that the arch bridge holds more weight with less flex. The arch bridge#s anchors push out due to compression forces. This project showed that an arch design can enable a bridge to hold more weight.

Summary Statement

The purpose of this project is to test which bridge type will hold the most weight with the least flex.

Help Received

Dad helped with building bridges and buying supplies, Mrs. Borstel helped edit paper

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)

Dylan C. Young

Project Number

J0231

Project Title

Does the Circumference of a Ball Affect the Power, Work, and Distance of a Ball Fired from a Trebuchet?

Abstract

Objectives/Goals

The purpose of this experiment is to identify the ideal circumference of a ball fired from a trebuchet.

Methods/Materials

Four balls with different circumferences and masses were used for this experiment. The trebuchet was set up and each of the balls were fired 10 times and results recorded. For each ball, the time aloft and distance traveled were recorded in the logbook.

Results

The ball with a 17cm circumference and a mass of 52g put out a force of 68 Newtons, work of 1,323 joules, and a power of 642 joules/second. The ball with a 20cm circumference and a mass of 55g put out a force of 64 Newtons, work of 1,164 joules, and a power of 568 joules/second. The ball with a 23cm circumference and a mass of 138g put out a force of 42 Newtons, work of 685 joules, and a power of 250 joules/second.

Conclusions/Discussion

The hypothesis was correct. The ball with the smallest circumference put out the most work and power. Of the four balls fired from the trebuchet, the ball with a circumference of 17cm obtained the best results. This ball displayed the most power and work. It put out nearly 200 additional joules worth of work over the next ball. The ball with a 20cm circumference ranked the 2nd highest in average distance, work and power. Even though it had approximately the same mass as the ball in 1st place, the air resistance registered a little higher due to a greater circumference. In 3rd place was the ball with a 21.5cm circumference. This ball had the 2nd lowest average distance, work, and power. The ball with a 23cm circumference had the lowest force, power and work out of the four. Possible reasons for this performance were the air resistance was the greatest of the four, because of the larger circumference, and the weight was too heavy for the trebuchet. In conclusion, the distance, work, and power of each ball scaled with its mass and circumference as predicted. The balls with the smaller circumferences and mass performed the best. Further results of this study are pending additional experimentation.

Summary Statement

This experiment is to identify the ideal circumference of a ball fired from a trebuchet.

Help Received

A classmate helped with recording the data.

Name(s)

David A. Zarrin

Project Number

J0232

Project Title

Creating a GVS: Gyroscope-based Water Vessel Stabilizer

Abstract

Objectives/Goals

Seasickness affects many people on water vessels. Some people are particularly vulnerable to motion sickness and feel seasick simply by setting foot on a boat.
The goal of this project is to design, build, and evaluate two methods for reducing water vessel motion. I was inspired to create such a system after hearing a memorable seasickness story from a family member.

Methods/Materials

My hypothesis is that the physical properties of gyroscopes can be used to create a system for reducing the side to side roll of water vessels. I have always associated gyroscopes with stability and have been fascinated by their properties. My first objective is to understand the physics of gyroscopes and then apply the gyroscope properties toward creating a motionless reference device.
The overall objective is to create a system that centers around a gyroscope by using a microcomputer control system. A sonar sensor is used to monitor the roll information. The data read from the sonar distance sensor and the gyroscope reference device is used to control two stepper motors and underwater fins (like airplane stabilizers) to counter balance vessel rolls. The fins only work for moving vessels. For anchored vessels, I evaluated a stabilizing concept by attaching a gyroscope directly to the inner hull of a vessel.

Results

I built two gyroscopes, one with plastic rings from a knitting kit and the other with an old computer hard drive. I increased the effectiveness of the HD gyroscope by gluing down 40 washers to the spinning platters. I tested the hard drive gyroscope by putting it in a PVC tube mounted to rotate freely. I used a video camera to measure the effect of this gyroscope creating a force equal to 0.026 Newton.
Next, I installed the gyroscope on the inner hull of a test vessel. The gyroscope reduced the water rolls by 92.5%.
Finally, I built a prototype of a vessel, parallax microcomputer, stepper motors, sonar sensor, fins, and tested it in a pool. In order to simulate vessel motion, the vessel fins were placed in front of the pool pump pipe forcing water through the fins. The vessel rolls were reduced by ~90% with the stabilizing system running.

Conclusions/Discussion

The above experiments show the practicality of water vessel gyroscope stabilizers for commercial and military applications. Aircraft carriers, oil exploration vessels, and commercial passenger ships can all benefit from such systems.

Summary Statement

This project is about creating a gyroscope-based control system for reducing water vessel motion.

Help Received

My advisor helped operate the power tools and my sister taught me the Basic Computer Language.