CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
Austin Aldrich; Ari Freedman

Project Number
J0301

Project Title
Testing the Relative Strengths of Three Arches Defined by Mathematical Equations

Abstract

Objectives/Goals
Our objective was to investigate which arch, defined by a mathematical equation, had the highest weight bearing capacity. Based on mathematical predictions, we hypothesized that the parabolic arches would be the strongest, next strongest would be the catenary arches, and the weakest would be the elliptical arches.

Methods/Materials
The materials that were used in this project were a Pitsco structure tester, foam core, band saw, Geometer's Sketchpad 5 (an interactive geometry software), and Elmer's glue. Our method was to create the mathematical equations for the arches, create the physical arches out of composite foam core, and then use the Pitsco structure tester to crush the arches and find the arches' weight bearing capacities.

Results
Our results were that the elliptical arches were the strongest, the next strongest were the catenary arches, and the weakest were the parabolic arches.

Conclusions/Discussion
Our results turned out to be the exact opposite of our hypothesis, which stated that the strongest arches would be those that distributed the most weight towards their feet. We believe that our hypothesis was contradicted because of the arches' varying areas, which were impossible to control given the other controlled parameters. Since the strongest arches had the largest areas, we concluded that the arches' weight bearing capacities and their areas were directly related. Our results can be applied to architectural constructions such as arches, arch bridges, or any other construction that requires the use of strong arches.

Summary Statement
In our project, we chose three mathematical curves, made them into foam core arches, and then tested for their weight bearing capacities.

Help Received
Science teacher supervised the breaking of the arches; Woodshop teacher helped cut out the arches.

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
Maximillian J. Audick

Project Number
J0302

Project Title
Honeycombs: The Shape of the Future

Abstract

Objectives/Goals
To create a possible highrise tower design that is more space and money efficient than current designs. This would be accomplished by building the tower higher and by using only a little more if not less material in order to construct it than currently existing designs.

Methods/Materials
First, eight towers of tube-in-tube and hexagonally honeycombed design (four of each type) were constructed out of balsa wood. The adhesive used was cyanacrylate. Then, a testing platform was constructed on which each tower was tested for axial and lateral strength. The towers# axial and lateral strength was measured in the amount of mass in grams that they withstood axially and laterally respectively.

Results
In the lateral strength test, the hexagonally honeycombed type towers withstood an average of 3,700 grams while the tube-in-tube type towers withstood an average of 2,540 grams. So, the hexagonally honeycombed type withstood about 46% more mass than the tube-in tube type towers. In the lateral strength test, the hexagonally honeycombed type towers withstood an average of 12,282.5 grams while the tube-in-tube type towers withstood an average of over 23,000 grams (they withstood all of the available mass). So, the tube-in-tube type withstood about 87% more mass than the hexagonally honeycombed type towers.

Conclusions/Discussion
In a highrise building, the axial load resistance is more important than the lateral load resistance, as the wind speed, and therefore force, does not increase as much as the load which the tower must support axially as the tower rises higher. Therefore, it was determined from the results of this experiment that the tube-in-tube type tower is the most efficient design because it withstood a much higher percentage of axial loading than the hexagonally honeycombed towers even though they withstood less lateral loading.

Summary Statement
This project compared the axial and lateral strength of two types of building structures- a conventional tube-in-tube design and an experimental hexagonally honeycombed design.

Help Received
Parents funded project; Father helped with usage of power tools; Father drove to shops so that materials could be purchased; Mr. Hank Berthiaume helped in material selection; Mr. Brian Finley provided metric masses; Andrew Nichols provided some background information about the forces that act upon towers.

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
Ashwin Bhumbla; Balaji Rajan Kumaravel Rajan

Project Number
J0303

Project Title
Perpetual Motion: The Myth That Never Stops

Abstract

Objectives/Goals
We tried to make Newton's Cradle more efficient by replacing the metal balls with magnets, removing the energy-consuming variables of heat and sound, and adding lubricant, lessening friction.

Methods/Materials
6 6" x 6" Wooden Planks; 4 12" x 7/8" Wooden Cylinders; 6 2" x 1" x 1/2" Ceramic Magnets; 3 7" x 1/2" Metal Cylinders; Screws; Duct Tape/Masking Tape; WD40; Newton's Cradle.

The machine consisted of three magnetic pendulums suspended from a plank supported by wooden cylindrical columns. The pendulums were oriented to ensure that adjacent pendulums repelled each other. The pendulums were hung on metal cylinders passing through corner braces attached to the plank.

For the experiment, a Newton's Cradle was used as the control. We provided energy to the cradle by raising one of its outer balls a measured distance, and then released. We measured the amount of time the system continued to move after this energy input. This was repeated five times for each energy input level to have a statistically valid sample.

Then, we tested the machine with the same energy input levels that were used with the Newton's Cradle. Since the machine's pendulums had a different mass and shape than the Newton's Cradle's balls, they needed to be moved to a different height to provide the same amount of energy. Finally, the machine was tested with lubricant applied to the cylinder to reduce friction even further. Again, multiple observations were taken each time.

Results
The machine moved for a slightly longer period than the Newton's Cradle at each energy input level. The addition of lubricant to the machine made it move much longer (relatively) than the prior two setups.

When given 16 millijoules, the Newton's Cradle moved for 126.32 seconds, the machine continued to move for 127.3 seconds, and the machine with lubricant kept moving for 134.24 seconds. The results at other energy input levels were similar.

Conclusions/Discussion
The machine did better than the Newton's Cradle as expected, primarily because the repelling magnets had less heat and sound related energy losses due to them not touching. The machine with lubricant did

Summary Statement
We attempted to get close to perpetual motion by improving on the Newton's Cradle's design.

Help Received
Father helped with sawing planks and drilling holes.

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)

Mahima S. Chillakanti

Project Number

J0304

Project Title

Tension on Knee Joint and Quadriceps Muscle

Abstract

Objectives/Goals

The objective of my project was to find how the amount of force put on the human knee and quadriceps muscle is affected by the knee#s angle. The results of this experiment can be used to prevent knee injuries by not putting it at angles that put immense force on it. The knee is the most complex hinge-joint that enables the leg to flex and extend. My hypothesis was that at a 180 degree angle, the knee and quadriceps will not feel tension since the quadriceps muscle and tendon will not expand. As the knees bend further down, the force will increase because the muscle will continue to expand. When the knees are bent completely, the quadriceps muscle will stretch the most, putting more force on the knee.

Methods/Materials

To do this experiment, I built a knee model where a spring represented the quadriceps muscle, and a string represented the quadriceps tendon. Different sizes of wood were used for the shin bone, femur, hip, and foot. To find the force for each angle I used Hooke's Law (F= -kx). Hooke's Law shows that the force on the spring is related to the change in length of the spring. By multiplying "k", the stiffness of the spring, with "x", the change in length of the spring, I was able to find force four times for seven different angles, and calculated the average of the four trials.

Results

The hypothesis was partly supported. At 180 degrees there was no force since the spring (quadriceps) stayed the same length, and as the knee bent more, the force increased because the spring stretched further. I was incorrect because I did not predict that at a 45 degree angle there would be less force due to gravity. At this point the gravity was pulling the spring in the opposite direction that the tension in the string (quadriceps tendon) was pulling the spring. Because of this, the spring did not expand as much, leading to less force. At 30 degrees, even though the gravity and tension forces were opposing each other, the tension force was greater than the force of gravity and was able to expand the spring.

Conclusions/Discussion

The results indicate that gravity also plays a role in the amount of force that is exerted on our knees and quadriceps. To maintain healthy knees my research indicates that one must not bend the knees while sitting, he or she should stretch muscles and exercise often, and when lifting heavy objects from the ground, going to a 45 degree angle rather than a 30 degree angle is best.

Summary Statement

Using Hooke's Law, I discovered how the amount of force put on the human knee and quadriceps muscle varies based on the different angles of the knee.

Help Received

My father bought all the materials required for this experiment. My brother helped me understand Hooke's Law thoroughly and taught me how to safely use a drill.

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
Megan E. Dean

Project Number
J0305

Project Title
Internal Ballistics: How Do Different Gun Powder Loads Affect Performance in a Rifle Match Competition?

Abstract

Objectives/Goals
The objective of this project is to determine if there is an ideal gun powder load that produces the best results in a bench rest rifle match competition.

Methods/Materials
Five different gun powder loads of 25 grains, 26 grains, 27 grains, 28 grains, and 29 grains were loaded into fifteen cartridges each. Each load was fired using a rail gun at targets 50 yards down range. Three 5-shot groups were fired for each of the loads of gun powder. Velocity data was collected using a chronograph for each group. Using a caliper, each group size was measured and documented. The data was analyzed to determine the results.

Results
The 29 grain gun powder loads produced the smallest average 5-shot group size. As the loads increased from 25 grains to 29 grains the velocity of the bullets increased and the average group size decreased.

Conclusions/Discussion
My investigation showed that the powder load made a big difference in group size on my targets. In a bench rest competition the smallest 5-shot group wins. The lightest load was 25 grains and produced an average group size of 0.161 inches. The 26 grain load produced an average group size of 0.152 in. The 27 grain load produced an average group size of 0.141 in. I noticed there was a consistent 0.010 in. decrease from load to load. When I shot the 28 grain load this decrease changed to 0.030 in. The average group sized dropped to 0.109 in. The smallest average group size was achieved with the 29 grain load. The average group size was 0.091 in. The average velocities of the bullets increased by approximately 120 ft/sec as the loads were increased from 25 to 28 grains. The velocity only increased by 100 ft/sec as the load increased from 28 to 29 grains. Due to cartridge size 29 grains of gun powder was the most I could safely fit into the cartridge.

Summary Statement
This project is about determining how different gun powder loads affect performance in a bench rest rifle match competition.

Help Received
Mother helped type the report. Grandfather help load cartridges. Grandfather helped set up gun and Chronograph.

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
Archer Defterios

Project Number
J0306

Project Title
World's Strongest Shape

Abstract

Objectives/Goals

My goal for this project was to test the strength of three angular shapes - triangles, squares and rectangles. I had read that triangles are the strongest shape and I was curious to see this tested in three dimensions. Testing the strength of shapes is important, especially for construction in poorer areas, because using stronger shapes can make buildings sturdier and safer, and may even save costs.

My question was - which foundation shape can hold the most weight; one made out of popsicle stick triangles, squares, or rectangles?

My hypothesis was - if I test how much weight each popsicle stick foundation will hold, then the foundation made out of triangles will hold the most weight.

Methods/Materials

I glued together foundations made out of popsicle stick triangles, squares and rectangles. I place books on top of each foundation until the structure started to break or did break. I did this three times and found the average amount of weight held by each structure.

Results

The triangle structure held the most weight, an average of 55.2 kilograms. This was almost five times as much as the rectangle structure, which held an average of 11.3 kilograms, and 16% more than the square structure, which held an average of 47.6 kilograms.

Conclusions/Discussion

My hypothesis was correct, the foundation made out of triangles held the most weight. Therefore, triangles are the strongest shape. This idea is supported by research and real uses of triangles in construction and design. I learned that triangles are the most rigid shape because forces on a triangle are distributed evenly along its three sides. The pushing force on a triangle's top two sides balances the pulling force on the triangle's bottom side. Unlike a rectangle, a triangle will not change shape when the length of its sides are fixed. A steel rectangle may be stronger than a wooden triangle, but if only wood is available - using a triangle will add stability to a structure. I believe triangles will solve more building and design problems in the future. Maybe triangles will make a difference in low-income housing or building in earthquake zones. Maybe triangles will be used to design a record-high skyscraper or a new invention.

Summary Statement

This project tested the strength of three angular shapes; triangles, squares and rectangles, by testing how much weight popsicle foundations made out of each shape held.

Help Received

Mother helped (1) take photos during testing, (2) do some typing, (3) find some research.

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
Samuel P. Ferguson

Project Number
J0307

Project Title
Lessons in Speed Learned in My Soap Box Derby Car

Abstract

Objectives/Goals
This experiment was conducted to test the effect that weight distribution and driver height have on the speed of a Super Stock soap box derby car. The hypotheses being tested is that the car will go the fastest when ballast weight is placed in the rear of the car and the driver position is low in the car when driving. The experiment will prove or disprove the two common practices of front placed weights and elevated driver position and the idea that these will slow the car, not speed it up. Competitive soap box derby races are often won or lost by as little as .001 seconds in time differentials when drivers cross a finish line so understanding the impact of these two variables are critical to a successful racing strategy.

Methods/Materials
The experiment used a Super Stock, All American Soap Box Derby (AASBD) car. The car was built using a standardized kit and plan, for a regulation Super Stock soap box derby car and these were procured through the AASBD. The variables tested were done by using an accelerometer and GPS app in an ipad 2, to track the speed and velocity achieved in the car on a track that was 500 feet in length. The car was weighted to 240 pounds, driver and car total, per AASBD rules.

Results
The results of the experiment proved that rear ballast weight and low driver position gave the fastest speed down the track. Common practices that racers engage in, which are: placing weight in the front of the car and not sitting low enough in the car, were proven to have a negative impact on speed and distance traveled when crossing the finish line

Conclusions/Discussion
To conclude it is clear that sitting as low as possible and placing as much of the ballast weight in the rear, will give a driver the best chance at crossing the finish line of a race quicker than a racer who is sitting higher in their car or who has placed their ballast weight in the front of the car.

Summary Statement
Winning a soap box derby race requires a solid strategy and superior skill and to help my soap box derby team at Literacy First Charter I need to understand the impact that driver position and weight placement have on the speed of our cars.

Help Received
My mentor for derby racing was consulted during the building of the car, Paul Gale

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
Bronwyn S. Gilfillan

Project Number
J0308

Project Title
Trash Bags Away

Abstract

Objectives/Goals
To build a hot air balloon using trash bags and other house hold items such as birthday candles, straws, string, foil, skewers.

Methods/Materials
build base, attach balloons and lite the birthday candles, then watch and see if the balloon flies. repeat making slight changes to candle count or other modifications until enough consecutive flights that the pattern can be tried with more different bags.

Results
that it is very difficult to build a balloon base that will fly all the different sizes of trash bags. But if you limit your self to 2 different sizes that are similar, one can build a base to fly more bags.I was not able to fly the smallest bags and the biggest bag using the same size base, the heat requirements and other variables made it to difficult using basic household items.

Conclusions/Discussion
I was not able to fly the smallest bags and the biggest bag using the same size base, the heat requirements and other variables made it to difficult using basic household items.

Summary Statement
my project is to see if you can make a small, medium,large trash bag fly.

Help Received
Family helped with safety, and providing materials.

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
Sarah G. Gonsalves

Project Number
J0309

Project Title
Rac Attack

Abstract

Objectives/Goals
I am tired of the raccoons coming into my yard at night to go through the trash and/or dig up the lawn. Most of all, I am concerned for my dog's safety. What can I invent to keep raccoons out of my backyard without hurting them?

Methods/Materials
I know that raccoons are nocturnal so I needed to invent a device that would detect the raccoons' motion at night. I also know that a motion sensor light alone would not be enough to scare them away, however adding a spray of water might. I needed to figure out how to invent a device that would combine some type of motion sensor with a water source. My materials consisted of 1 light and motion sensor unit, 1 irrigation control valve, 1 low voltage transformer, 1 irrigation sprinkler, 5 PVC fittings, 1X12 piece of wood, drill, screws, clamps, saw, black paint, hose adaptor, 2 plugs and a timer. My method/procedure is as follows:
1. Cut wood, made base and painted base black. 2. Measured then drilled holes in the wood base. 3. Installed motion sensor with light. 4. Installed low voltage control valve. 5. Installed low voltage transformer. 6. Installed PVC fittings. 7. Installed irrigation sprinkler. 8. Installed hose connection. 9. Connected wires from motion sensor to transformer. 10. Connected wires from transformer to control valve. 11. Hooked up water source. 12. Connected to electrical source. 13. Tested invention. 14. Activated RAC ATTACK

Results
I placed RAC ATTACK in my backyard for a period of 23 days. Prior to that, I recorded raccoon activity over the course of three months by observing torn up garbage and/or lawn. For the month of October, I recorded a total of 18 times, in November, 12 times and in December 15 times. From January 1-23rd with RAC ATTACK in place, I found no evidence of raccoon activity.

Conclusions/Discussion
My invention worked because after RAC ATTACK was in place, there was no evidence of raccoons digging up the lawn or going through the trash.

Summary Statement
My project is about keeping the raccoons out of my yard without hurting them in order to protect my dog and property.

Help Received
Father helped with the construction of the invention. Mother helped by taking me shopping to pick out materials for board.

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
Claire C. Hsu

Project Number
J0310

Project Title
Give Me a Brake: A Study of How Various Brake Pad Patterns and Other Factors Affect the Braking Performance of a Bike

Abstract

Objectives/Goals
This project is a study of how different factors such as brake pad patterns and weather conditions affect the braking performance of a bike.

Methods/Materials
Methods: 1)Put bike upside down so that the rear wheel can rotate freely. 2)Put brake pads on the bike and a weight on the brake wire to provide load. 3)Attach the luggage scale tangentially to the wheel rim to measure frictional force. 4)Divide frictional force by load to get frictional coefficient. 5)Repeat test for different loads, water/sand, temperature, tire pressure, and different brake pads.

Materials: Columbia Trailhead Bike, Aztec Rim Brake Pads, Diatech Hombre Black Threaded Brake Pads, Low Noise Water and Sand Repellent V-Cut Brake Pads, luggage scale, water, sand, weights, cardboard box for drag test

Results
During the bike test, the 4 ridged pads had the most friction (0.29), followed by the flat pads (0.17), the wide ridged pads (0.1), and the slanted dotted pads (0.09). In the water/sand test, frictional coefficients were approximately 0.05 lower than those at the normal condition for all the pads. In the temperature test, the 4 ridged pad#s frictional coefficient was 0.18 while hot and 0.31 while cold. The trend is less clear for the flat pads, the frictional coefficient was 0.14 while hot and 0.15 while cold.

During the drag test, the trend for the different brake pad patterns was the same as in the bike test. The frictional coefficient for the 4 ridged pad was the highest (0.67), followed by the flat pads (0.55), the slanted dotted pads (0.39), and the wide ridged pads (0.51). The trends for weather conditions were again consistent with those of the bike test.

Conclusions/Discussion
The results showed that the 4 ridged pads had the most friction and also the most contact area with the rim of the wheel. The trend that the more contact area between the rim of the wheel and the brake pad, the more friction there is, can be seen with the other three pads as well. Water/sand did act as a lubricant, which lowers the friction. For temperature, the hotter pads exhibited lower friction.

Summary Statement
This study identifies the effect of contact area and weather conditions on friction in different bike brake pads.

Help Received
Father helped perform experiment. Mother and Teacher helped edit report.

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
Christopher D. Isozaki

Project Number
J0311

Project Title
Building an Earthquake Safety Desk

Abstract

Objectives/Goals
My goal was to design a desk that would protect a person during an earthquake. Based on my research, the greatest risk of serious injury or death during an earthquake was because of collapsing buildings. I decided that a good goal would be if the desk could survive a 3000 pound object falling from a height of at least 10 feet.

Methods/Materials
The first test was to help decide on the shape of the frame. I created 5 inch wire models of 3 desks: 4-legged, triangular, and arched. I placed a plastic bucket on the models and added water until they either collapsed or were significantly deformed. The second test showed how the impact would distribute the force to different parts of the desk. I used 3 support legs and the 4th leg had a scale. I took weights and placed them on different parts of the desk and recorded the results from the scale. The third test was meant to confirm that the desk met the overall goal. A metal salvage company used a crane to drop a 3000 pound car on the desk from higher than 10 feet.
I made the desk using the following materials: wood (tabletop), steel tubes (structure), thin sheet steel(skin), clay and EMT (crumple zone), rebar and cement (distribution layer), and steel bolts for connecting the parts. I used many tools to make the desk including hand grinders for cutting, drills, a vise, pipe wrench, screwdrivers, wrenches, hammers, etc.

Results
The first test showed the arch shape was the strongest but only a little stronger than the triangle. I also used the arch shape because it is able to withstand more impact from different angles. The second test showed the weight was not distributed very well across the board. To distribute the weight better, I decided to use a reinforced concrete layer and thin steel skin. The third test confirmed that the desk could withstand the impact of a 3000 pound object falling from a height of greater than 10 feet.

Conclusions/Discussion
The testing confirmed the desk was able to survive a large impact. In my research none of the other earthquake desks used an arch shape. I believe desk designers should consider the arch shape and the crumple zone design if they are trying to be earthquake safe.

Summary Statement
My project was to design, build and test a desk to keep a person safe during an earthquake.

Help Received
Father and brothers helped with dangerous or too difficult manufacturing and testing tasks, Carson Auto Recyclers dropped the car, various members of the community offered advice on manufacturing, materials and sources of information, vendors donated tools and materials.

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
Derek K. Lindquist

Project Number
J0312

Project Title
Wave vs. Barrier: Different Shapes of Barrier and Their Effects on a Tsunami

Abstract

Objectives/Goals
The purpose of this experiment was to determine how three different shaped blocks, acting as barriers,affect a tsunami. How do different barrier shapes on the shoreline affect a tsunami? If the wave hits the rectangular barrier with the half circle cut, then the barrier will stop the tsunami because this particular shaped barrier makes a focal point which compresses the wave. When the wave is compressed,its speed will be reduced drastically.

Methods/Materials
A rectangular plastic bin was filled with water and 2 pieces of plywood were placed at each end of the bin to act as drop zone and run-up ramps. A third plywood piece clipped with paper was supported horizontally to simulate the shore. Each barrier was placed at the beginning of the shoreline and the tsunami was created by dropping a medicine ball down the drop zone ramp. The brown paper absorbed the water that went over the barrier. The absorption limit on the brown paper represented the distance the wave traveled behind the barrier. The distance was measured from the back of the barrier.

Results
The triangular barrier was most effective. When the wave hit the tip of the triangle, it separated the water into two different paths. The wave did not flow over the barrier because was diverted to the sides. Only twice did water come over the barrier. The rectangular barrier with the half circle cut was the second most effective. Because of the concave shape of the barrier, the wave met at a focal point when it hit the barrier. When the wave met at the focal point,it traveled over the barrier with less energy. The rectangular barrier was the least effective having the highest average distance. When the water hit the flat surface on the face of the rectangular barrier,the energy was directed upwards and then over the barrier.

Conclusions/Discussion
The hypothesis was not supported through the experiment and the data gathered. It was learned that a triangular barrier can be effective in tsunami defense. The triangular barrier was most effective because when the wave hit the tip of the triangle, it separated the water into two different paths thus diverting it from flowing over the barrier.

Summary Statement
The purpose of this lab was to determine how three different shaped wood blocks, acting as barriers, affected a tsunami.

Help Received
Mom and Dad mentored throughout entire project development; Uncle provided tools and guidance for the construction of the wave simulator.

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
Quinn Marsh

Project Number
J0313

Project Title
How Far Can That Potato Go?

Abstract

Objectives/Goals
I wanted to figure out how to launch a potato the furthest by finding the optimum barrel length and trajectory(launch angle) for my potato cannon, the Potato Cannon 5000.

Methods/Materials
To find the best barrel length I measured speed of the potato rather than distance because measuring speed is easier, more accurate, and takes up less space. Because the Potato Cannon 5000 is pneumatic (dealing with pressurized air) the tests were done at a given pressure of 25 psi. Then to figure out the optimum trajectory I just set up the barrel at various angles and measured how far the potato went.

Results
The barrel length results were extremely consistant and showed that the best barrel length is 10 feet at 25 psi. The best trajectory is 40 degrees but anywhere in the 35-40 degree range is good.

Conclusions/Discussion
The Potato Cannon 5000 can launch a potato the furthest using a 10 foot barrel at a 40 degree trajectory. When I put my results into one shot I concluded that the furthest distance at 25 psi is 375 feet.

Summary Statement
What is the best barrel length and the best trajectory for a potato cannon?

Help Received
My dad helped me with some of the experiments. My dad also funded the whole project.

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
Jenna M. Mazza

Project Number
J0314

Project Title
Wave Bye Bye: Would a Different Jetty Design Reduce Tsunami Wave Amplitude in the Santa Cruz Harbor?

Abstract

Objectives/Goals
The objective was to determine if an alternate jetty design would reduce tsunami wave amplitude in the Santa Cruz Harbor from a tsunami wave similar to the one that resulted from the Japan 2011 earthquake.

Methods/Materials
An open-ended wave flume was constructed to replicate the design of the current Santa Cruz Harbor and jetty. It measured 72 inches long by 20 inches wide by 12 inches deep. A wave generator was constructed to create a scale size tsunami similar to the tsunami in the Santa Cruz Harbor that was a result of the Japan 2011 earthquake. A scale model Santa Cruz Harbor jetty was built and placed in the end of the flume opposite to the wave generator. An alternate jetty design, the Marina Del Rey Harbor in southern California, was built to scale and compared. Wave amplitude on the inner side of the jetty was compared to wave amplitude outside the jetty for both designs. 10 trials were conducted for each jetty design.

Results
The alternate jetty design indicates a 68% wave reduction inside of the harbor, while the current jetty design indicates a 38% wave reduction. The results of the experiment suggest that both jetty/breakwater designs reduce inner-harbor tsunami wave amplitude, but the alternate breakwater design reduced inner-wave amplitude almost 2 times more that the current jetty design.

Conclusions/Discussion
The results support the hypothesis, that an alternate jetty design would better protect the Santa Cruz Harbor from tsunami waves.
After the tsunami wave resulting from the Japan 2011 earthquake hit the United States west coast, it caused substantial damage to boats and infrastructure in the Santa Cruz Harbor. Said Santa Cruz Harbor Port Commission member Jeff Martin, "Could they have designed it [the Santa Cruz Harbor jetty] better? I think so." Martin is a civil engineer. This supports my project, which determined that an alternate jetty design would better protect the Santa Cruz Harbor.

Summary Statement
An alternative breakwater design to the existing jetty design would reduce tsunami wave amplitude within the Santa Cruz Harbor.

Help Received
Dad helped cut wood for flume; Mom videoed experiment so I could go back and look at the videos to get accurate measurement of wave amplitude.

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
Matthew T. Miyamoto

Project Number
J0315

Project Title
Making a Point: The Effects of Weight on the Velocity of an Arrow

Abstract

Objectives/Goals
Every year people travel into the backcountry of the United States with guns, bows, and snares to hunt wild animals. In the context of bows and arrows, there is a problem in that some types of arrows do not provide the speed or power necessary to kill the animal and it is often left suffering. If the weight of an affects both speed and penetration, then a heavier arrow will provide better sportsmanship by killing an animal instead of maiming; it demonstrates a more humane treatment of animals with in the sport of hunting with a bow.

Methods/Materials
Researcher used a Genesis compound bow weighing 1.8kg that was 70cm long with a draw of 45cm and draw strength of 1.8kg. A crossbow trigger mechanism was utilized to consistently fire the arrows by releasing the bowstring at the same point. The arrows used where 78.78cm in length with varying weights of 17.8g to 33.2g. Data of speed in meters per second and penetration in centimeters where recorded.

Results
Multiple trends were apparent in the data after analyzing the results of four rounds of the testing. In each test twelve arrows with differing weights were fired at the target.
Results showed that arrow penetration increased with weight, however there were a few exceptions. Variables that may have affected the penetration include the composition of the arrow shaft, the arrowhead, type of fletchings and the length of the shaft. Because of consistency in draw length, target distance, and materials it could be determined that the drops in arrow penetration where due to factors outside of my control. The lightest weight arrow of 17.9 grams penetrated 71mm while the arrow of 32.2g penetrated 85mm.

Conclusions/Discussion
Researcher found that heavier arrows do in fact penetrate farther into a target than lighter arrows. However an arrow that is too heavy will not fly fast enough to hit a moving target. Therefore, a balance of a heavier arrow with the lighter arrow#s attributes of speed will best suit the hunter.

Summary Statement
Finding what arrow weight can penetrate a target the most effectively.

Help Received
Father provided materials and supervised construction of materials and experiments, Mother made recomendations for design of board and critique of board, South Bay Archery club provided location for tests.

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
Dakota J. Niemann

Project Number
J0316

Project Title
Aggregate Size vs. Concrete Strength

Abstract

Objectives/Goals
My objective is to determine whether aggregate size for granite rock impact the compressive strength of concrete. My hypothesis is that it does and presumed ranking based on background research is that rock (diameter: 25.4 # 37.5 mm) would be greatest, followed by pea gravel (diameter: 9.5 mm to 12.7mm), then sand (diameter 4.75 mm) and finally the control sample comprised of water and cement.

Methods/Materials
Using screens, granite aggregates based on size were separated # manipulated variables being: sand (sample 2), 3/8 to 1/2 inch rock (sample 3), 1 # 1 ½ inch rock (sample 4). The samples were then mixed with an equivalent ratio of water and cement and poured into cylindrical molds. These molds were then stored in a vault in accordance with ASTM testing procedures and breaks conducted on the 7th, 14th and 28th day to determine compressive strength # the responding variable.

Results
At the 7th, 14th and 28th day break, the compressive strength for the samples was as follows: cement (control sample) - 351 kPa, 28,366 kPa, and 23,338 kPa; sand - 10,300 kPa, 10,938 kPa, and 10,598 kPa; pea gravel # 1,127 kPa, 19,386 kPa, and 27,289 kPa; rock # 23,660 kPa, 26,855 kPa and 29,599 kPa respectively.

Conclusions/Discussion
Based on data collected, the hypothesis, which stated concrete possessing the larger aggregate would be able to withstand more pressure, was supported. Overall, concrete with the larger aggregates exhibited greater compressive strength than that of concrete with smaller aggregates. This is due to large aggregates being able to interlock within the mixture, providing strength based on its and the cement internal properties. It should be noted that plain cement possessed more strength than concrete with sand. This is probable due to the sand not managing to dehydrate properly, and/or poor mixing, and the development of sand lenses.

Summary Statement
Does the size of aggregates for granite rock impact the strength of concrete?

Help Received
I would like to thank: my dad who supervised the mixing of the concrete; Francisco Alonso and his staff at the Orange County Materials Lab for help and use of lab equipment, storing of concrete cylinders, and testing, and my science teacher, Mrs. Galassetti, who helped me with the report.

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
Hannah Pomerantz; Venice Pope

Project Number
J0317

Project Title
Kickin' Kinetics: When Kicking a Soccer Ball Does the Angle of the Foot Affect the Ball's Placement in the Net?

Abstract

Objectives/Goals
The objective of our experiment was to figure out whether changing the angle of the foot when kicking a soccer ball for a penalty kick affects its placement in the net. Our hypothesis was that different angles of the foot would affect where the ball went in the goal. We also stated that we could find three different angles of the foot to get the ball consistently into three equal horizontal sections of the goal.

Methods/Materials
To test our hypothesis we built a machine that would kick a soccer ball with consistent force to eliminate human error. Since we couldn't produce a large enough force to get a size five soccer ball into the goal, we sized down our machine, goal, shoe size, waist height, ball size, and distance to the goal to be 66.44% of its actual size. The reason we sized everything down to be 66.44% of its actual size is because that is what the size 1 ball was compared to the size 5 ball.We built our machine so we could manipulate the angles of the foot from 90 to 140 degrees, which we measured and marked.

Results
After conducting our tests, we determined three angles of the foot to consistently get the ball into each section of the net. 115 degrees got the ball into the top, 125 got it into the middle, and 130 - 140 got it into the bottom section.

Conclusions/Discussion
We concluded that our hypothesis was correct and we found three consistent angles of the foot that got the ball into the three sections of the goal. So when you are kicking a soccer ball for a penalty kick, know that the angle of your foot directly affects where the ball goes in the net.

Summary Statement
The objective of our project was to figure out whether changing the angle of your foot when kicking a soccer ball for a penalty kick affects the ball's placement in the goal.

Help Received
Venice's father helped us put together the machine.

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
Kathryn (Kay) E. Smith

Project Number
J0318

Project Title
Myth of the Juiced Baseball

Abstract

Objectives/Goals
The goal is to determine if changing the humidity of a baseball affect its performance. This experiment will test dehydration and a baseball's performance. The question is: "Does changing the amount of water or humidity of the inner portion of a baseball affect the distance it is hit?" This experiment is testing a myth that has circled around the Colorado Rockies baseball team for many years.

Methods/Materials
Materials
1. Concrete Wall; 2. Measuring Strip; 3. Pitching machine; 4. 36 Rawlings Tournament Grade Little League Baseballs (12 per group); 5. 5 Gallon Bucket filled with water; 6. Oven; 7. High-Speed Video Camera; 8. Drain Pipe.

Methods
First, a pitching machine will be set up from 15 feet away from a concrete wall. A high-speed video camera will be set up to the side of the wall so that it will be able to record the collision between the ball and the concrete. Baseballs will be divided into three groups: super hydrated, dehydrated, and untouched (control). The baseballs will individually be put into the pitching machine, thrown at the concrete wall at about 40mph, have their collision recorded with the high-speed camera, and have the speeds at which they come off the wall measured.

Results
After comparing the out speeds of Group B (Super-hydrated) and Group C (Dehydrated) to the out speed of Group A (Control) through a t-test the p-values were determined as a little over 1% for Group B and a little less than 0.4% for Group C. This means that super-hydrating a baseball does not help a batter hit the ball further. The data does also suggest that dehydrating a baseball has an affect on its exit speed as well. The average exit speed of a Group B baseball dropped to about 22 mph where as the control was about 23 mph.

Conclusions/Discussion
These changes are not statistically significant enough to say that there was change and to say that this myth is confirmed. This myth is plausible because the data suggests that it could happen in reality, but statistically most likely not.

Summary Statement
This experiment will test dehydration and a baseball's performance. The question is: "Does changing the amount of water or humidity of the inner portion of a baseball affect the distance it is hit?"

Help Received
David Smith - my dad for manning the camera and providing additional help Jeff Liebenberg - family friend and field maintenance at Siltanen Park, in Scotts Valley, for letting me use his concrete supply shed to test with

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
Jacob O. Spencer

Project Number
J0319

Project Title
Determining Strength by Measuring Strain

Abstract

Objectives/Goals
The objective is to discover how much stiffer a wooden sample will be if foam and fiberglass is added to it.

Methods/Materials
The procedures to conduct this experiment take place in several steps. The first is obtaining the necessary materials for making the samples and test apparatus. The second is building the test fixture to hold the samples. The third is cutting out the wooden test samples and applying a strain gauge to them. The fourth is the assembly of an electrical circuit which can be used to incorporate a strain gauge. The fifth is the testing of the wooden samples, including adding subsequent material layers to them (the foam and fiberglass). I tested three samples, three times for a total of 3 trials.

Results
My data proved that out of the three different samples, the one with all three layers of plywood, foam, and fiberglass was the stiffest, followed by plywood and foam, and then just plywood. This is because in order for the fiberglass samples to displace a certain amount of millimeters, a much larger amount of force was required to be applied. The additional force needed for fiberglass samples was large enough to indicate that the fiberglass is a very advantageous layer for strengthening a structure.

Conclusions/Discussion
I concluded that as the additional materials were added the strain decreased for a given applied force. Likewise, by adding additional materials the force needed to reach a certain displacement increased. The data from the plywood samples were consistent and had low applied force and high strain gauge values. The data from the foam samples tended to be more varied, possibly because the foam samples differed from sample to sample due to construction differences, and perhaps human error in the measurements. The fiberglass samples were predictable and clearly showed their superior stiffness to the other samples. My experiment can apply to construction of buildings and boats of all sorts, because my experiment shows different ways of increasing the strength in plywood.

Summary Statement
My project is about testing wood, foam, and fiberglass samples in order to conclude what material combination is the stiffest, thus discovering which would be most effective in constructing a kayak.

Help Received
I received help from my father, Nathan Spencer. He advised me on almost every aspect of the project so the experiment would yield reliable results. I would like to thank John Smalley for help in amplifying the wheat stone bridge circuit. I would like to thank Nathan Masters for supplying Adrino equipment.

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
Jackie L. Staiger

Project Number
J0320

Project Title
Magnetic Body Armor

Abstract

Objectives/Goals
The purpose of this project is to see if treating Kevlar fabric with magnetorheological (MR) fluid, improves protection compared to untreated Kevlar used in body armor.

Methods/Materials
Sample targets were created by placing treated or untreated Kevlar fabric into sealed plastic bags which were then secured in a plexiglass holder. Magnets were inserted in the holder for samples that required a magnetic field. A rifle was fired 5 meters from the sample, and the depth of penetration into a clay witness mounted behind the sample target was measured. The procedure was repeated for nine 10-layer Kevlar samples: three untreated, three treated with MR fluid, and three treated with MR fluid and a magnetic field. Other thicknesses were used for comparison.

Results
As anticipated, the more untreated Kevlar layers, the less penetration; but unexpectedly with MR treated Kevlar, penetration actually increased, and increased even more when a magnetic field was added. Also, treated Kevlar had less thread deformation than untreated.

Conclusions/Discussion
It appeared that the oil in the MR fluid acted as a lubricant, allowing bullets to more easily rip through the Kevlar threads. Adding the field seemed to distort the fabric by drawing iron particles to the sides of the Kevlar, providing less protection. MR fluid might still prove useful in treating body armor providing the lubrication properties of the oil medium can be overcome.

Summary Statement
To see if megnetorheological fluid enhances Kevlar body armor by providing more protection and allowing less bulk and weight

Help Received
Father conducted ballistic tests and helped construct apparatus; Mother helped with editing

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
Sierra N. Stein

Project Number
J0321

Project Title
Tsunami Slicer: Which Structure Will Best Reduce a Simulated Tsunami?

Abstract

Objectives/Goals
The objective is to determine which structure will efficiently decrease the height and speed (increase of time) of a simulated tsunami wave.

Methods/Materials
A 40 gallon fish tank measuring 36#x15#x17# was used. Small river style gravel was used to build sloping land into the water. Measurements were marked along the front of the tank to measure wave height and land height. A metal yard stick was taped to the front length of the tank to measure a consistent length of the land gravel and grape Kool-Aid was used to dye the water for visibility. A plastic lid approximately 12#x14# with 2 holes was submerged in the water and pulled by nylon string attached to the holes to displace the water and create a fast moving wall of water that simulated a tsunami wave. The structures are: a sea wall made from peg board, break waters made from 1#x1# dowels cut to 3#,4#,5# pieces, and under water half pipes made from PVC pipe with a diameter of 1 ½ #. Each structure was place in the tank and tested 10 times while recorded with a video camera and timed with a stop watch function on a cell phone. Later the video was reviewed in slow motion to determine the wave height.

Results
The control average height was 5.55# with an average time of 1.61 seconds. The sea wall had the best results with an average height of 4.95# and average time of 1.91 seconds. The half pipes were a close second with average height of 5.08# and average time identical to the sea wall at 1.91 seconds. The break waters were in last at an average height of 5.28# and average time of 1.77 seconds.

Conclusions/Discussion
My hypothesis was correct that the sea wall would do the best in decreasing the height the most but the wave time tied with the half pipes.
My results lead me to believe that although the sea wall did the best for height by a small margin the half pipes may be a better choice given the details of the 2011 Japanese tsunami where the walls failed due to a drop in the lands sea level. The half pipes would also be a better choice for areas that don#t want an obstructed view from a sea wall.

Summary Statement
I want to know which structures, between a sea wall, underwater half pipes or break waters, will lessen the effects of a tsunami by decreasing its height and slowing its speed.

Help Received
Mother was my assistant and edited video, father cut my materials for me using power tools

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
Julieana L. Tarantino

Project Number
J0322

Project Title
Blasting Blades

Abstract

Objectives/Goals
Experiments were performed to determine which hockey stick blade length would produce the most speed. The focus was on the speed that was being produced by the different length blades. The adult length blade was thought to have been to produce the most speed.

Methods/Materials
To test the different blade lengths, a blade swinging machine had to be built. Then the junior length blade had to be swung forty times. Next, the intermediate length blade had to be swung forty times. Finally the adult length blade had to be swung forty times. After all the data was recorded, it was converted from miles per hour to kilometers per hour.

Results
The results showed that the junior length blade produced the most speed with an average of 24.74375. The junior length blade is the shortest out of all three. The adult length blade, which is the longest length blade, did the worst with an average of 15.2045. The intermediate length blade was thought to be right in the middle for length and speed and it was.

Conclusions/Discussion
In conclusion, the junior length blade did the best. The hypothesis, which was that the adult length blade was thought to produce the most speed, was proven wrong. The adult length blade did not produce the most speed.

Summary Statement
This project is testing the speeds produced by the different length hockey stick blades.

Help Received
Teacher helped in process. Dad helped build machine and test.

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
Charlotte N. Thompson

Project Number
J0323

Project Title
Collapsed

Abstract

Objectives/Goals
My objectives for this experiment was to find out if I change the design of a bridge into a plank, suspension, or truss bridge will it affect how much mass the bridge can hold.

Methods/Materials
The 12 bridges that I made were made of balsa wood stuck together with hot glue. After I finished the bridges I got two chairs and put the bridge ends on the two chairs leaving an unsupported space. Next I tied a rope in the middle of the bridge and on the other end I tied a bucket. Then I got a few gallons of water and some weights. Then I poured the water in slowly until it broke. Then I weighed the bucket with the water in it and did the same thing this every time.

Results
After the experiment my prediction was right! I predicted that the truss bridge would hold the most weight the most it held was 118 pounds!

Conclusions/Discussion
While I was doing the experiment I learn a lot about the different bridge types and real bridges that have collapsed in the past. I have also learned that even if a bridge is much more expensive than othersd we should use the best one so people can be safe from the danger of bridge failure.

Summary Statement
does changing the design of a bridge effect how much mass it can hold?

Help Received
Father helped with heavy weights.

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
Shaelyn P. Topolovec

Project Number
J0324

Project Title
Combustion Efficiency from Ozone Induction

Abstract

Objectives/Goals
If ozone is introduced into the intake manifold of an internal combustion engine, the fuel efficiency will increase and the emissions will decrease, because ozone is a denser form of oxygen and it improves combustion.

Methods/Materials
Apparatus materials:
14,400 mg/hr ozone generator, 4# x 12# clear plastic pipe, screws nuts & washers, 12 ea 14-16 awg wire couplings, 2 ea in-line fuse holders, 2 ea 2 amp fuses, 2 ea 36 in. 16 awg power cords, Electrical tape, 4 in. x 3 in. reducer, 3 in. x 24 in. flexable metal duct, 2 ea 3 in. hose clamps
Testing materials:
2008 Chevy HHR 2.4 liter, Apparatus (above),12 in. wire ties,300 watt 12 volt to 120 volt power inverter,87 octane gasoline

Results
The result of the effect of ozone induction in an engine indicates that ozone helps the fuel efficiency of a car.
0 mg/hr. ozone results averaged:
8.556 liters used in 106.3 kms, 12.4 km per liter, 27.1 HP @ 1800 rpm, 76.9 ft-lbs torque @ 1800 rpm, 15.5% CO2,7,200 mg/hr.
ozone inducted results averaged:
7.958 liters used in 106.3 km, 13.4 km per liter, 8.1% improvement compared to no ozone, 32 HP @ 1800 rpm, 90.4 ft-lbs torque @ 1800 rpm, 15.4 % CO2,14,400 mg/hr. ozone results averaged:
7.238 liters used in 106.3 km, 14.7 km per liter, 18.5% improvement compared to no ozone, 32.7 HP @ 1820 rpm, 88 ft-lbs @ 1820 rpm, 15.4% CO2

Conclusions/Discussion
My hypothesis stated that ozone introduced into the intake of an engine will improve the fuel efficiency and the emissions. I found that my hypothesis was correct. When compared to the control, the 14,400 mg/hr. ozone induction improved the fuel efficiency 18.5%. Of the three levels, the zero ozone level performed the worst. The 14,400 mg/hr. ozone level performed the best. The level with 7,200 mg/hr. ozone performed in-between with 8.1% improvement over standard induction.
Discussion: The more ozone that was inducted, the better the fuel efficiency and power was. On the other hand, the torque did decrease slightly with the last stage of ozone induction. The higher engine speed (20

Summary Statement
Will automobile fuel mileage increase and emissions decrease if ozone is inducted into the intake of the engine?

Help Received
Dad, Construction Help; Mom, Board Assembly Help; Apache Smog, Emissions Test; Teacher, Project Advisement

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
Albert Tseng

Project Number
J0325

Project Title
The Effect of Weight on an Arrow's Stability and Damage

Abstract

Objectives/Goals
The purpose of this project is to see the effects off weight on a projectile, in this case, the arrow. It determines how random archery really is, and the effect of weight on distribution

Methods/Materials
The equipment I used was PSE Razorback Jr. Bow and 6 Gold Tip Lightning arrows. The increased weights were achieved by adding rice to the hollow shaft. The procedures were to shoot the 19.4 gram arrow first for ten times, recording after each shot was accomplished. This was repeated for all other weights. The same position was acquired for each shot by using a tripod with PVC pipes attached to mark the exact position of the bow

Results
The results were that in the #Distance from the Origin# field, the more accurate the arrow was, the more random it would be (deviation of the distance). Also, the heaviest arrow mirrored the lightest arrow (farthest from origin) and the mid-weight ones were the closest to the origin. In the #Puncture Depth# field, again the heaviest mirrored the lightest and the mid-weight ones penetrated the deepest and were the most random.

Conclusions/Discussion
My conclusions are that high and low arrow weights have the same effect, which is a less accurate or less damaging but less random result. The average of the two weights produces the most accurate result or most damaging but has more randomness.

Summary Statement
It determines how weight affects an arrows stability and damage created

Help Received
Mother helped with designing the board layout. Father took photo of arrow being shot.

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
Joey A. Tuttobene

Project Number
J0326

Project Title
Measuring Voltage with Robots

Abstract

Objectives/Goals
The purpose of this experiment was to work with robots to see how they can help save lives during unavoidable crises by investigating the dangers of live power lines.

Methods/Materials
A power source was used to emit a voltage through three different topsoils: sand, moist soil, and dirt. Two different robots with different mounting techniques for a 5V A/D converter offset to provide +/- 15V of measurement were tested on a five meter course to measure and record this voltage. One robot was portable and one was drivable. The hypothesis stated that sand would be the most conductive, carrying the voltage for one meter; the moist soil would be second in conductivity, conducting for half a meter; and the dirt would be the least conductive, with a radius of less than half of a meter.

Results
The portable, hand-held probe technique proved the most accurate for measurements and had a relatively linear relationship between distance to the power source and voltage. The robot-mounted sensor proved less reliable. This is because it only had half of the surface area the portable probe had actually in the ground. Sand proved most conductive, moist soil second, and dirt least conductive.

Conclusions/Discussion
The linearity of the voltage did not surprise me, but the unreliability of the robot-mounted sensor did. This makes sense though because the robot did not have a hydraulic ram to push the probes deep enough into the ground. The portable one had its probes hammered in. If a robot with these qualities were developed, it is clear that it could save lives by locating live power lines. My hypothesis was not supported by exact distance, but it was supported by conductivity order.

Summary Statement
My project examined the possibility of robots measuring voltage in soil near power lines during a crisis.

Help Received
None

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
Chad J. Wakamiya

Project Number
J0327

Project Title
The Best Semicircle Arch Design: What Angle Voussoirs Are the Strongest?

Abstract

Objectives/Goals
The objective is to determine if the angle and number of voussoirs have an effect on the pressure a model semicircle arch can hold before collapsing. I predicted that a semicircle arch with more voussoirs at smaller angles would hold more pressure.

Methods/Materials
Five model semicircle arches were constructed with the same span and height. Each arch had a different number of voussoirs at corresponding angles. One arch had 7 voussoirs; another had 9, and so on until reaching an arch with 15 voussoirs. The angles corresponded with the number of voussoirs so that each arch had a total of 180 degrees. The arches were each tested 10 times by applying mass blocks to the keystone to test how much pressure the structure could hold before collapsing.

Results
The semicircle arch with 11 voussoirs at 16 degree angles held the most pressure and proved to be the strongest design. The arches with voussoir angles greater or less than 16 degrees held less pressure.

Conclusions/Discussion
The angle and the number of voussoirs contribute to the strength of a semicircle arch. The keystone falls easily if the angle is too small, so a large enough angle is necessary for the stability of the arch. If there are too few voussoirs, each voussoir is put under great pressure and the sides of the arch slide outward, so multiple voussoirs are important. The semicircle arch with 11 voussoirs at about 15 to 17 degrees proves to be the strongest design.

Summary Statement
My project found the strongest semicircle arch design based on the angle and the number of voussoirs.

Help Received
Mother and Father helped me edit report. Teacher, Mr. Miller helped mentor me throughout the project.

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
Jane K. Whatley

Project Number
J0328

Project Title
Egg Drop

Abstract

Objectives/Goals
The experiment was to see if it was possible to make a container that can prevent a raw egg from cracking when dropped from about 15 feet above the ground. This container will be called an R.E.P. (Raw Egg Protector). If the right design was used, the raw egg should not crack when it hits the ground. The R.E.P. can also be tested to see if different materials affect the performance.

Methods/Materials
After planning a design, the R.E.P. was built using a shoebox, cardboard, tape, and Velcro. Then the egg was put in and then dropped from about 15 feet above the ground. The R.E.P. was checked to see if the egg didn't crack. When the egg cracked, the R.E.P. was adjusted to fix the problem. When the egg didn't crack, the R.E.P. was tested 3 times to make sure it worked. The R.E.P. was first tested with cotton balls. This process was repeated with bubble wrap, sponge, and shredded plastic which replaced the cotton balls as the cushioning materials.

Results
The first 4 times the R.E.P. was dropped were unsuccessful. The egg cracked the first try and the egg wasn't put in the R.E.P. for the next 3 tries. After every try, the R.E.P. was adjusted to fix the problem. On the last 3 tries, the egg didn't crack. The egg still didn't crack when the cushioning materials were replaced and tested 3 times each.

Conclusions/Discussion
The results of this experiment support the hypothesis. It is possible to make a container that can prevent a raw egg from cracking when dropped from about 15 feet above the ground. All of the cushioning materials worked successfully.

Summary Statement
My project is about placing a raw egg in a container to protect it from cracking when dropped from 15 feet above the ground.

Help Received
My mom helped me by providing the materials for my experiment. My dad helped by finding and explaining the math equations to me.

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
Andrew Shimshock; Philip Zehnder

Project Number
J0399

Project Title
HOARD: A Study into the Cancellation of Car Window Buffeting

Abstract

Objectives/Goals
Car window buffeting is the rhythmic pressurization and depressurization of a cars cabin caused by Helmholtz oscillation. The purpose of this experiment was to optimize a device to cancel this buffeting. Cancellation was attained through both passive and active means. The device we designed(the Helmholtz Oscillation Advanced Reduction Device, or HOARD) attached to the window of the car (a 2008 Honda Odyssey) and can be configured to cancel in both manners.

Methods/Materials
In order to measure the degree of cancellation, a pressure sensor was placed in the center of the car. To test two different means of cancellation, two separate procedures were employed. In the passive configuration, HOARD deflects air up and over the buffeting window to cancel buffeting. We tested tow sizes of fin, 10 fin angles (the angle the fin forms with the car), and the presence/ absence of notches in the fins. In the active configuration, HOARD pulls quantities of air into the car to cancel buffeting through destructive interference. All data from both sets of trials were then compared against control data using a graphical analysis and Fast Fourier Transform.

Results
We found that the fins that worked the best to cancel Helmholtz Oscillation were the notched fins. This is because they act as a larger fin by extending farther away from the car, therefore deflecting more air up and over the window. We also found that 60 degrees was the optimal angle for cancelling Helmholtz Oscillation because it was not to steep as to make the air go over the fin into the car, and no to shallow to make no difference at all. The active HOARD generated enough pressure to theoretically cancel car window buffeting, but was never able to completely cancel it due to a lack of synchronicity with the buffeting.

Conclusions/Discussion
After testing our results supported our hypotheses. We found that both passive and active methods for noise cancellation in cars could be effective. This technology could be applied to many cars to mitigate irritating car window buffeting.

Summary Statement
The purpose of this experiment is to determine if it is possible to cancel car window buffeting through passive and active methods

Help Received
One of our fathers helped cut wood with a table saw; A neighbor helped with CAD drawings; Dr. Ghandi helped us understand Fast Fourier Transforms; Mr. Wolfe (UNSW) answered a few questions about Helmholtz oscillation