CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)

Katherine D. Arriola; Danielle Lopez

Project Number

J0301

Project Title

Preventing Earthquake Destruction

Abstract

Objectives/Goals

Our project is to determine the best bracing types for buildings in earthquakes and to find the best terrains to make the building on. We show the best architecture bracing design of the buildings and the sturdiest terrains in California.To prevent great destruction, we must take into consideration the best types of bracing and landscape to settle in. The question we set out to answer is what are the best building bracing that can last longer in case of a natural disaster such as an earthquake? And what are the best terrains to establish a building on?

Methods/Materials

We used four bracing types in which buildings could be made with. We also had three terrains. Next we made the models by using 14 grams of modeling dough and three wood pieces. After we had all of our structures built we built an earthquake simulator. We used nails and rubber bands to make handles for our simulator and we put a foam board at the bottom of the box for extra support. The third step was putting all the structures to the test. We placed each structure in the simulator and recorded the amount of seconds each building lasted.We discovered our strongest building structure was x bracing.Next, we built four buildings each with the cross bracing.After we had the structures and terrains we then put them on the earthquake simulator and tested the strength of the three terrains. We used 620 grams of sand, 680 grams of gravel, and 420 grams of dirt. Finally, we recorded the seconds that each building survived among the different terrains.

Results

The cross bracing made the building last 15.5 seconds and the gravel lasted 17.9 seconds.The best bracing is the cross bracing.Also the sturdiest terrain was the gravel. Compared to our hypothesis, our results were accepted and proven to be correct. The question that we posed during our experiment was answered when the gravel and cross braced were the strongest.

Conclusions/Discussion

We conclude that we can#t prevent earthquakes but we can prevent the destruction caused by buildings by wisely choosing a location to construct buildings and choosing the correct bracing. Our findings have led us to believe that by using cross bracing the buildings will have support from every angle along with a strong foundation made by gravel.

Summary Statement

We tested different bracing and terrains to provide support for a building during an earthquake and we found out that gravel along with cross bracing are the best choice.

Help Received

None. We designed, built, and performed the experiments ourselves.

CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)
Enzo F.S. Banal

Project Number
J0302

Project Title
The Effect of Bridge Designs on the Forces They Can Endure

Abstract

Objectives/Goals
The objective of this study is to find out which bridge design can endure the most force before breaking.

Methods/Materials
Up to 2,000 cm. of balsa wood, strong glue, an x acto knife, weights, a platform, several sheets of foam core board, a self-healing mat, a ruler, several nuts and bolts, a scale, a notebook and a pencil/pen. Tested several bridge designs by slowly applying weight to the bridge.

Results
The bridge design that was capable of sustaining the most force after I placed weight atop each bridge was the through truss bridge. It held 2230 grams of weight. The bridges with more support at the top that were battling compression generally did better.

Conclusions/Discussion
After testing each bridge design once, I came to the conclusion that bridges with more support at the top (i.e. the through truss and suspension) sustained forces superiorly to bridges with more support at the bottom (i.e. the deck truss and beam bridge). It is also concluded that bridges with a triangular truss design were (generally) capable of sustaining more weight that other designs.

Summary Statement
I built four bridge designs and slowly applied weight and found out that the through truss bridge can hold more weight than other designs.

Help Received
I used West Point Bridge Designer 2015 to help design my bridges. My father, Wayne Shepherd, helped me find the design program explained the forces and design tips of the bridge. I built the bridges and conducted the experiment by myself.

CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)

Ryan M. Beam

Project Number

J0303

Project Title

Utilizing Human Motion for Intuitive Control of Robotic Joints

Abstract

Objectives/Goals

Design goal is to create an inexpensive and intuitive motion-based controller for a robotic arm.

Methods/Materials

Using components such as an Arduino Board, RC Servos, Potentiometers, and a 3D printer, created an arm-mounted controller that converts the rotation and movement of human joints into signals that control corresponding actuators on a robotic arm.

Results

By creating several prototypes over the course of several months, I was able to achieve my goal of making an intuitive and inexpensive human-motion based controller. Most recent prototype successfully captures the wearer's shoulder and elbow movement, and costs less than $50, including the additional servo-driven arm I made to demonstrate my controller's effectiveness.

Conclusions/Discussion

My most recent prototype serves as an adequate proof of concept that I can achieve my desired goal while remaining within my desired criteria. It takes advantage of the most advanced computer for controlling humanoid robots, which is the human brain, and essentially cuts out the middle man that is the conventional remote control. It allows a human to make the motions they want a robot to make, without needing to translate the desired movements into any sort of commands. My controller still has plenty of flaws, but none that I think cannot be fixed given more time and resources, for example, a future prototype could use more precise potentiometers, hydraulic actuators instead of RC servos, and PCBs instead of breadboards. It is concluded that a controller for robotic joints that is inexpensive and intuitive to use is possible.

Summary Statement

I created an inexpensive, arm-mounted remote control that captures human movement, and based off of this input, controls a corresponding robotic arm.

Help Received

I designed, programmed, 3D printed and assembled my project by myself.

CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)
Zachary J. Becker

Project Number
J0304

Project Title
Constructing a 3D Printer from Scratch

Abstract

Objectives/Goals
My objective is to construct a working 3D printer without using a pre-assembled kit.

Methods/Materials
3D Printer assembled from parts from multiple sources, including homemade. Laptop, Repetier-Host and Repetier-Firmware, freeware 3D printer software developed by Repetier.

Results
I was successfully able to construct and program a 3D printer constructed fully from scratch.

Conclusions/Discussion
I realized that it is fully possible for someone my age to assemble complex systems. However, there are also many improvements that I would make if the experiment were done again.

Summary Statement
3D printer constructed entirely from scratch.

Help Received
My father helped me to cut the wood and metal rods, and taught me how to solder. Various users of the #Reprap Freenode IRC Chatroom, helped me to program the 3D printer.

CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)

Francisco C. Catanzaro

Project Number

J0305

Project Title

Changing Angular Momentum in Midair

Abstract

Objectives/Goals

The goal of this project is to determine if the rotation of a mass can change the angular momentum of a car in mid-air, causing it to land on four wheels. This involved multiple trials in which the car would drive off a platform rotating as it fell. Counter rotating masses were used to reorient the car.

Methods/Materials

The hardware I used was an RC car, metal tail with servo, tables, camera, Plexiglas, Arduino, Oscilloscope. I used these materials to build a car and attach a tail. I wrote software to control the speed of the car and the rotation of the mass (tail).

Results

I did a control and an experiment for each of two mechanical configurations. Each control and experiment was tested three times. The car drove off the platform, fell and I measured its clockwise rotation frame-by-frame in a video recording. For each control, the car drove off the platform without counter rotating the mass. The control trials of the tail-less robot hit the ground at 58 degrees +/- 10 degrees. The experiment trials of the tail-less robot used the rotation the wheels in midair to cause a change in the pitch. The car left the platform, rotated and then reoriented itself, landing at 20 degrees +/- 10 degrees. The control trial of the tailed robot had a non-active tail throughout the fall. The car left the platform and hit the ground at 86 degrees +/- 10 degrees. The tailed experiment trials rotated the tail in midair and caused a change in the pitch. The car left the platform, rotated and then reoriented itself, landing at 45 degrees +/- 10 degrees.

Conclusions/Discussion

In both experiments the pitch of the car was changed by the rotation of a mass. I was surprised by the fact that accelerating in midair changed the pitch of the car so much. I had thought that rotating the tail would cause a greater pitch change than it did. The reason that this happened was because the torque that can be applied by the spinning wheel is greater than the torque applied by the rotation of the tail. The wheel can apply more torque than the tail because it is rotating for the entire period of time that the car is in midair. The tail could only rotate for .5 seconds. There are two main factors that make the angular momentum of an object. The factors are the speed an object is going and the moment of inertia of the object.

Summary Statement

My project is about designing a car that will rotate in midair so it can safely land and continue driving.

Help Received

Thomas Libby from UC Berkeley

CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)

Rohan Chaudri; Arya Krishnan; Chloe Retika

Project Number

J0306

Project Title

Grasping the Future: A Fully Functional, Affordable, Electromechanically Controlled Bionic Hand

Abstract

Objectives/Goals

The objective of our project is to create an easily operated, lightweight, affordable prosthetic hand. We believe with better designs and modern 3D printing technology, it would be possible to achieve the construction of this bionic hand.

Methods/Materials

We used a 3D printed hand model, fishing wires to act as flexor tendons, and elastic bands to act as extensor tendons. Five servos were programmed to act as forearm muscles, and received signals from an Arduino microprocessor connected to a breadboard. A six volt battery pack provides power to the microprocessor and motors. After experimenting with various programs and designs, we decided to implement pushbuttons placed on the breadboard to control various hand gestures performed in day to day use.

Results

In the end, we were able to complete our set goals. We created an easily controlled, lightweight, and cost-effective prosthesis. We settled on a design that used a wooden plank as a forearm where the servo motors, breadboard, Arduino microprocessor, and external battery pack were mounted on. All servos were set at a 0 degree resting position, where all fingers were fully extended. The thumb servo rotated a total of 160 degrees when fully contracted. The index and middle servos rotated 180 degrees when fully contracted. The ring and pinky servos rotated 170 degrees when fully contracted.

Conclusions/Discussion

This hand has the potential to help millions of amputees worldwide who are in need of a low-cost, functional prosthetic. In the future, we plan to incorporate the technology of myoelectricity in our project, essentially allowing the hand to be controlled neurologically.

Summary Statement

Our project is an electromechanically controlled prosthetic that is lightweight, easily operated, and a fraction of the cost of equally functional prosthetics.

Help Received

We designed, built, and tested our model entirely by ourselves. Our coach, Sanjib Homchaudhuri, made sure we were working on time and meeting our deadlines.

CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)
Christopher T. Dahlgren

Project Number
J0307

Project Title
Bottle Rocketry

Abstract

Objectives/Goals
Objective: The objective is to determine what amount of water between one and seven cups will allow a bottle rocket to reach its maximum height if all other conditions remain the same.

Methods/Materials
Methods and Materials: Two 2L bottles, Water, Air pressure, Estes altitude finder.The bottle rockets are constructed out of identical two liter bottles. They are made using four lower fins and four upper fins. A nose cone was attached for aerodynamics. Clay ballast was added under each nose to bring the weight of each rocket. to 150 grams. Each rocket was launched using a non-launch tube system and pressurized to a consistent 50 psi using a bicycle pump. Each launch has pre-measured amount of water ranging from one to seven cups. The height of each rocket will be measured by the Estes altitude finder. The entire process will be repeated twice to verify results and average altitude findings.

Results
Results: I found out that four cups of water produced the highest launch. Any amount below four cups of water did not give the rocket enough propellant to reach its maximum height. Any amount above four cups of water proved to be too much propellant and did not allow enough air to be pumped into the rocket. This was seen on the last launch where the rocket landed still having water in it.

Conclusions/Discussion
Conclusion: Four cups of water produced the highest launch. Therefore, my hypothesis was correct.I thought that filling the bottle halfway would produce the highest launch. If I were to do the experiment again, I would increase the air pressure to 100 psi.

Summary Statement
The project was to determine the optimum amount of water that would propel a bottle rocket to its maximum altitude.

Help Received
Due to the distance between the launch site and the data recording position and basic safety, I required help from my family with launching the rocket. Otherwise I was able to do the project myself.

CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)

Markus Fleischer; Robert Smith

Project Number

J0308

Project Title

Wonderful Whiffle Bats: Which Is Best?

Abstract

Objectives/Goals

The objective of this project was to determine if plastic Whiffle ball bats could be modified, to make them hit a plastic Whiffle ball further.

Methods/Materials

Official plastic Whiffle ball bats: Bat-1, was unaltered. It was the control bat. Bat-2, was cut open at the end, filled with bouncy super balls, and resealed with Duct tape. Bat-3, was filled with spray foam and resealed with Duct tape. Bat-4, was cut open, and filled with a broomstick core, and Duct tape. Bat-5, was wrapped with Duct tape. A bat-swinging machine was constructed to apply exactly the same amount of force to each bat swing during the trials. Each bat was placed in the bat-swinging machine in exactly the same way. The tension of the spring was the same for each trial, because the machine was wound to the exact same position before each swing. This is how we controlled the "swing strength" variable. Each bat hit the same ball 20 times, off the same batting tee, for a total of a 100 trials.

Results

Bat-1 hit the furthest, averaging 16'7.4" and was the lightest at 5oz. Bat-1 was our control bat. Bat-2 hit the shortest distance, averaging 11'10.8" while being 2nd heaviest at 17oz. Bat-3 came in 3rd for distance, averaging 15'1.6" while being the 3rd lightest at 7.3oz. Bat-4 came in 4th for distance averaging, 12'11.6". Bat-4 also was the heaviest bat at 18.5oz. Bat-5 came in 2nd for distance, averaging 15'8.9". Bat-5 was the 2nd lightest bat that we tested at 6.8oz.

Conclusions/Discussion

We were surprised that the control bat-1 hit the Whiffle ball the furthest. Neither the taped bat-5, nor the foamed bat-3, out did the control bat. Therefore, or hypotheses' were not supported. The control bat was the lightest of all 5 bats. We think that because it was the lightest bat, it generated more bat speed, while in the bat swinging machine. This made the ball go farther. This experiment proves that our modified bats were not as effective as the original Whiffle Bat! Further experiments might have us test the bats again. We could apply more force, by increasing the tension of the bat-swinging machine's spring, simply by winding it tighter, to each swing to see if we would get different results. Finally, another way to test the bats would be to calibrate our bat-swinging machine, using a radar gun, to see if there would be different results if we were able to swing all 5 bats at exactly the same bat speed.

Summary Statement

We wanted to find out if plastic Whiffle ball bats could be modified to hit plastic Whiffle balls further.

Help Received

The Moms helped cut and hot glue the pictures and text on to the display board. Markus' dad helped us with the power tools during modifications of the bats and the construction of the bat-swinging machine. We did all the testing and measuring ourselves.

CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)
Caitlin Maya Gorin

Project Number
J0309

Project Title
Which Type of 3D Printed Plastic Is the Strongest?

Abstract

Objectives/Goals
The objective of this experiment is to find out which 3D printed plastic is the strongest given the variety of plastics available. This is a home designed experiment that focuses on the Tensile Strength of 3D printable materials, leveraging from ASTMs D638 Standard Test Method for Tensile Properties of Plastics. 3D printing has become more available and affordable in the consumer market. It would be advantageous for home users to know which 3D printed plastic is the strongest, so they can use it when printing objects.

Methods/Materials
To conduct this experiment, the Test Equipment had to be first designed and fabricated. The Test Equipment consists of a Frame Assembly, digital hanging scale, Test Block Assembly, Drive Mechanism, and a drill. Ten Test Specimens of each plastic filament (PLA, Polywood, ABS, HIPS, and PET) were 3D printed, for a total of fifty samples. The Test Specimen was then incorporated into the Test Block Assembly and hooked up between the scale and the Drive Mechanism. During each test run, a drill was used to turn the Drive Mechanism and pull each Test Specimen apart, while a video camera recorded the scale display. Load values were extracted from the video and used to calculate the Tensile Strength of each Test Specimen.

Results
PLA had the highest Average Tensile Strength of 6.9 ksi while PET came in second with 5.3 ksi. Polywood, ABS, and HIPS followed with 3.7 ksi, 3.5 ksi, and 2.8 ksi, respectively. PLA had the highest Average Load of 82 lbs. before the samples broke. PET followed closely behind at 80 lbs. Polywood, ABS and HIPS had significantly lower Average Loads at Break.

Conclusions/Discussion
The data collected did not support the hypothesis that PET is the strongest 3D printed plastic. PLA was the strongest 3D printed plastic given that it had the highest Average Tensile Strength. This project recommends that home users use PLA filament when printing models that require high Tensile Strength.

Summary Statement
Tensile Strength testing of various 3D Printed Plastics to determine which material is the strongest, using a home designed test set up.

Help Received
My father taught me how to use the 3D Printer and showed me how to use the power tools to build the Test Equipment.

CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)

Marcus B. Hall

Project Number

J0310

Project Title

Buoyancy Homeostasis: How a Flexible Swim Bladder Naturally Stabilizes Submarine Buoyancy

Abstract

Objectives/Goals

A dynamic buoyancy device should expand/compress to counteract the lost/added buoyancy in the water from heat or salinity. I built a sub with a swim bladder that works like a modern fish and wanted to test if it is better than a modern day submarine that uses a hard tank and better than ancient (400 million years) sharks and Coelacanth that use livers.

Methods/Materials

I tested dynamic buoyancy devices made from stiff materials (ping-pong ball) and from soft materials (air-filled balloon) and static devices made from stiff materials (glass tank), and soft materials (water-filled balloon). Each time, buoyancy devices were the same volume (33ml) and made neutral with weight at the same starting temperature. The water was heated or cooled to see when the device changed buoyancy with a thermometer. Salt or fresh water was added to see when it changed buoyancy with a density hydrometer.

Results

The static systems did not counteract the added/lost buoyancy from the change of temperature and salinity in the water. For example, the glass tank just sinks when the water is heated. However, the dynamic systems counteracted the added/lost buoyancy and gave the device more stability. The dynamic bladder that was made from the stiff material (ping-pong ball) handled the temperature change better than the soft material (air-filled balloon) because the stiffer material only expanded slightly, but the softer material over expanded which made it float quickly. However, the soft bladder was very good at counteracting the change in salinity and the weight of the salt compressed it and lowered the displacement. But the stiff bladder was not able to compress and reduce displacement and it quickly floats. The dynamic bladder fails with warm and salty conditions combined. The stiff bladder counteracts the temperature but the salt does not compress it, and the soft bladder counteracts the salt but expands from heat.

Conclusions/Discussion

My UROV and fish can control buoyancy in fresh, salty, cold, and warm water by changing the stiffness of the swim bladder, unlike the static hard tank used in modern day submarines. But the bladder can fail if the water changes to both warm and salty. This can explain why ancient fish do not have swim bladders. The ancient oceans were twice as salty and warmer than the modern oceans, and it is only in the colder and less salty modern oceans that fish evolved to use swim bladders.

Summary Statement

The swim bladders in fish, unlike the hard tanks in subs, make better buoyancy controls because they naturally counterbalance the effects of changing temperature and salinity.

Help Received

I designed and built an Underwater Remotely Operated Vehicle (UROV) by myself and tested the buoyancy devices in my mom's kitchen. I had a lot of good conversations with Mr. Norman Negus, Mrs. Linda Patterson.

CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)

Gisele Inaba; Diana Labonville

Project Number

J0311

Project Title

A Working Submarine with Magnetic Coupling Propulsion System

Abstract

Objectives/Goals

Our goal was to build a working submarine out of materials that we could get easily and that could be built at home. It needed to be able to submerge and rise, propel forward, and take video. In order to accomplish this it required a ballast tank to float or sink the submarine, a propeller to move forward, and an underwater camera to take video.

Methods/Materials

Our final submarine design is approximately two feet long built inside a 5" diameter clear acrylic tube. The tube is sealed with sewer cleanouts that are attached with silicone sealer. The parts are attached to an 1/8" sheet of Plexiglas. A LEGO Mindstorms kit was used for the controller and the motors. The ballast tank is made from a 150ml syringe, which pulls in water to cause the submarine to sink. A Mindstorms motor operates the syringe through two threaded rods. The propeller is made from a computer fan blade. Another Mindstorms motor turns the propeller through a magnetic coupler. The Mindstorms controller is programmed to turn the motors when needed. Diving weights are attached to the outside of the submarine to make it heavy enough to sink when the ballast tank is full of water, but float when the ballast tank is empty. A Hero GoPro camera is attached to the front of the submarine to take video.

Results

There was a great deal of trial and error involved in trying to devise both the propulsion system, ballast tanks and control mechanisms. For propulsion, we went with a magnetic coupling system and if it didn't work, we were going to try a stuffing box design to keep water out of the propeller shaft, but eventually went with a magnetic coupling system. For the Ballast tanks we looked at using CO2 canisters, but a design proved inefficient. Instead we decided to use a syringe that could be operated using power from the Mindstorms kit. Controlling the submarine while underwater proved difficult as well. At first we were hoping to use bluetooth communication with the Mindstorms kit, but discovered that bluetooth does not work underwater. We ended up using a light sensor that could be activated using an underwater flashlight.

Conclusions/Discussion

During the project, we discovered that creating a water tight, self contained submarine is not an easy task. We were able to successfully get our submarine to submerge and rise, move forward and take video.

Summary Statement

Design and build a self contained submarine that can move forward, submerge and rise and can take underwater video.

Help Received

Mr. Labonville taught us how to use the tools needed and helped work through engineering issues that arose. Mrs. Inaba showed us how to use AutoCAD to draw the mechanisms.

CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)
Kate E. Jackson

Project Number
J0312

Project Title
Constructing Science: Comparing the Strength of Wooden Joints Made with Nails, Screws, and/or Glue

Abstract

Objectives/Goals

I wanted to find out how the strength of wooden joints made with nails, screws, and/or glue compare. After researching the topic and choosing 15 joint types, I hypothesized the following:

Strongest joint: Red oak cross joint made with two screws and glue

Weakest joint: White pine butt joint made with two nails

I chose these joints because I believed that glue was going to be very strong and would be strengthened by screws and I believed nails alone would be the weakest. I also inferred that joints made with red oak would be stronger than joints made with white pine and cross joints would be stronger than butt joints.

Methods/Materials

I built a jig using a bathroom scale, a car scissor jack, and a wooden platform to apply moment (or a twisting motion) to my sample joints. I made test samples using 15 joint types and two wood types (red oak & white pine). I clamped each sample joint to my test jig and raised the scissor jack until the joint failed or the jack reached its limit. I used a video camera to record the maximum scale reading during each test. I repeated each measurement three times for a total of 90 measurements. I converted all results into moment in Nm and calculated average values along with error bars for analysis.

Results

After completing my experiments, I analyzed my results and found a few general patterns:

Adding Glue to Cross Joint = 500 -> 1000% Stronger

Adding Glue to Butt Joint (3 of 4) = 6 -> 11% Stronger

Adding Fastener to Cross Joint = -22 -> +4% Stronger

Adding Fastener to Butt Joint = 50 -> 300% Stronger

Red Oak vs. White Pine = 100 -> 600% Stronger

Conclusions/Discussion

In conclusion my hypothesis was reasonably correct. I hypothesized that the strongest joint would be a red oak cross joint made with two screws and glue. This was a reasonable prediction because this was the second strongest joint on average. The strongest joint was a red oak cross joint made with only glue. But, I cannot conclude that my hypothesis was incorrect because the error bars for the two joints overlap. I also hypothesized that the weakest joint would be a white pine butt joint made with two nails. This prediction was correct, but this joint got the exact same average results as the red oak cross joint made with two nails and the white pine cross joint made with two nails.

Summary Statement

I constructed an experimental setup and measured the strength of wooden joints made with nails, screws, and/or glue.

Help Received

My father supervised and assisted me with the use of power tools during the construction of my experimental setup and test samples.

CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)

Phoebe N. Kellogg

Project Number

J0313

Project Title

How Model Houses Made of Different Materials Resist Earthquakes and Wind

Abstract

Objectives/Goals

This experiment was conducted to understand how different materials withstand problematic weather conditions and which materials would be ideal for what type of environment.

Methods/Materials

I made 60 small, simple, four wall houses out of different materials (20 of each kind). The combinations of materials I used were brick and grout, straw and string, and wood and nails. I then tested ten of each type on a homemade shake table and the rest against a leaf blower to see how they would hold up.

Results

When tested against wind, Brick and grout held up the best, and straw and string only slightly did better than wood and nails. In the earthquake experiment, however, straw and string and wood and nails performed equally well, above brick and grout.

Conclusions/Discussion

I wanted to know if straw and string, which is viewed as a deficient material combination traditionally, could hold up against more commonly used materials, as it is a cheaper resource to build with. From my research, I have found that, yes, it can hold up against these other materials and it may be something to consider incorporating into smaller or poorer countries building plans.

Summary Statement

I tested small houses made of different materials against different weather conditions.

Help Received

My father helped me to build houses and perform my trials, while my friends helped wiht some of the house construction.

CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)

Brady J. Knowlton

Project Number

J0314

Project Title

Is Your Head in the Game?

Abstract

Objectives/Goals

From this research, I formulate that I indeed will successfully find a way to show the force that is put on a brain for different sports that causes a concussion.

Methods/Materials

Materials:Battle Sports Science Adult Impact Indicator, Black
2 lbs. of Clay,Coconut,Sports Equipment,Sculpting Materials,Tape,Cameras,and Heat from Blow Dryer.
Procedures: Collect all materials. Then build a clay head with coconut as skull. Then put chin strap on head and make a are with .3048 meter increments for 5 of .3048 meters increments. Then attach cameras from 2 different angles and video throwing each item once and then resetting indicator. Once you have done that. Throw or kick item again until at 50% or red light start flashing. Then using the camera put into sports Techniques app and find the speed and acceleration of each item for each foot or .3048 meter step. Once the Acceleration is found, find the Force or F=MA.

Results

First, the fastest item on the graph was the baseball as it should be. Then the acceleration was all very similar for all of the items. Then the force graph shows that the greatest force for a concussion comes from the helmet. As it should with a shorter distance and greater mass.

Conclusions/Discussion

My project was successful in Hypothesis, but in a way it will never be finished. People spend their lives on researching and doing what I did working for the cause of others. They will most likely never be done figuring out concussions and the injury it not only does to people's brains but what it does to them as a person. People have died and been driven to suicide. I was happy because I was throughout this project able to realize that I would miss the head and it would hit the wall and make a dent and I thought people do crazy things for science. I started to doubt myself because I did not think that it would be able to be done with the time, I had. The way my project helps humanity is it makes people more aware of the injury and how life threatening it actually is. It may not be bad when people think about it but it is and this project may help save lives and as science and sports advance I think people will work to make sure and secure people are the safest they can possible be so they are as good before as they are after. People may under look this project but the amount of impact it could have is amazing.

Summary Statement

My project is about showing the exact force in Newtons that it takes to get a concussion and to get people more aware of the seriousness of head or brain injuries.

Help Received

I did all of the building and math on my own. But Mr.Elliott as my math teacher over the last two years taught me all the math to find speed, acceleration, and force.

CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)
Tess N. Koval

Project Number
J0315

Project Title
Can Papercrete Compete with Concrete?

Abstract

Objectives/Goals
My project was to determine whether papercrete was a good alternative building material in place of concrete. I hypothesized that concrete would be the strongest and most water resistant, and that newspaper papercrete would be the most insulating.

Methods/Materials
To make papercrete, I created two types of paper pulp, one glossy and one newspaper, and mixed them with Portland cement, sand, and water. I made the concrete by mixing Portland cement, sand, and water. I put the two different types of papercrete and concrete samples through tests to compare strength, water resistance, and insulation.

Results
I found that the concrete was the strongest, holding 84.45 times its own weight, while glossy papercrete held 40.45 times its weight, and newspaper papercrete held only 7.11 times its own weight on average. In the water resistance test, the papercrete made with glossy paper absorbed the most water, averaging 7.41% of water absorbed based on its own weight, compared to 6.80% for newspaper papercrete, and 4.63% for concrete. None of the samples were good at insulating, but the newspaper papercrete was slightly more insulating than the other samples, with a temperature change of -70.00%, versus -71.43% for concrete, and -70.79% for glossy papercrete.

Conclusions/Discussion
My hypothesis was mostly correct. Overall, papercrete was not a very good building alternative to concrete because it was not nearly as strong or water resistant. If I did this experiment again, I would focus on one test at a time, and first I would figure out how to make the strongest papercrete by adjusting the formula. I think that climate can affect how long the papercrete needs to dry, and how strong it ends up being. Another experiment could be to see if it makes a difference to the strength of papercrete if you dry it at a higher temperature, or in a less humid place.

Summary Statement
I found that papercrete was not a good alternative building material in place of concrete.

Help Received
My parents helped with getting supplies and with overseeing my experiment.

CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)
Hadrien P. Lackner

Project Number
J0316

Project Title
Childsplay: Using Playgrounds to Benefit Mankind

Abstract

Objectives/Goals
My aim is to demonstrate the feasibility of supplying power and water to small, isolated communities by the use of simple mechanical playground devices powered by children at play.

Methods/Materials
Playground devices such as swings, sea-saws, carousels and treadmills, using small mechanical models.

Results
These devices can be adapted to generate power and to pump water, as well as to mill grain.

Conclusions/Discussion
By using simple, durable mechanical devices, I will demonstrate that off-the-grid communities can generate cheap, reliable power and can also pump water for agriculture, sanitation and consumption. These devices can also be used for milling grain.

Summary Statement
I will demonstrate that off-the-grid communities can generate power, pump water and mill grain using simple, mechanical, human-powered devices.

Help Received

CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)

Andrew T. Land

Project Number

J0317

Project Title

The Last 3 Meters: Development of a Multi-Sensor Method for Safe Multicopter Landings

Abstract

Objectives/Goals

Develop a procedure based on novel hardware and software for a compact, low cost multi-sensor system to enable safe remote landings for autonomous multicopter operation. The landing procedure should be capable of a smooth, controlled descent at a specified location.

Methods/Materials

The multi-sensor system utilized GPS, barometer, Sonar and accelerometer sensors interfaced to Arduino microcontrollers, with data recorded to microSD memory cards. Arduino sketches were written to acquire data (GPS 10Hz, other sensors 30Hz). A tricopter model "Crusty" was custom built for flight duties. Raw data were processed with novel C applications. Results were exported for 3D-plotting with a custom Gnuplot script.

Results

GPS data met specifications (<4 m) for latitude and longitude, but GPS altitude data showed drift errors of up to 10 m. The accuracy of barometer data was limited by variations in atmospheric pressure arising from changing weather (1 mbar : 8.4 m). Accelerometer data was numerically integrated to calculate changes in altitude, but variations in the sensor's zero offset made this approach impractical. Despite noise spike problems, the Sonar data proved to be very reliable for low altitude measurements (<3.5 m). Combing GPS data for position measurements, and barometer and Sonar data for altitude determination allowed 3D plots of actual flight paths to be reconstructed.

Conclusions/Discussion

A compact, low cost multi-sensor system for a proposed multicopter landing method has been developed. GPS, barometer, accelerometer and Sonar sensors have been evaluated. Combing GPS data for position measurements, and barometer and Sonar data for altitude determination, allowed 3D plots of actual flight paths to be reconstructed.

Blending Sonar data (for low altitude) with barometer data (higher altitudes), and GPS for location, suggests a reliable approach for safe, autonomous landing.

Summary Statement

A multi-sensor system combing GPS data for location, and blending barometer and Sonar data for altitude determination, has been developed and evaluated for a proposed autonomous multicopter landing procedure.

Help Received

I built the hardware and wrote the software myself. My school district mentor, Dr. Jamshed Gahndhi, provide guidance and helped to keep me on track. My grandfather helped with some math and the data smoothing algorithm.

CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)
Dylan J. Lee

Project Number
J0318

Project Title
How Does the Addition of Diagonal Braces Affect the Rigidity of a Wall?

Abstract

Objectives/Goals
The objective of this project was to determine what kind of diagonal bracing renders a wall most rigid. My hypothesis was that, out of four different configurations of diagonal bracings (X configuration, chevron configuration, parallel configuration, and no bracing), the X configuration would render a wall most rigid.

Methods/Materials
The materials used for this project were one Vernier Dual-Range Force Sensor, one LabQuest Mini, one Dremel drill press, balsa wood, cyanoacrylate wood glue, and one Xacto knife. There were twelve walls of each configuration, therefore yielding a total sample size of 48 walls. Each of these walls was tested under the drill press, and the force required to compromise the wall was recorded. After all twelve trials of each configuration, the two extreme points of data were eliminated to keep the data more consistent.

Results
The results of the experiment actually showed that the configuration of diagonal bracing that withstood the most amount of vertical load was the chevron bracing, contrary to my hypothesis. However, the results may have varied if a horizontal or shear load had been applied, since the chevron bracing would probably not perform as well under those conditions.

Conclusions/Discussion
The conclusion that can be drawn from this experiment is that the chevron bracing performed the best in the circumstances given, but the other walls could have performed better in other given circumstances. Some factors that might have skewed the results were the inconsistencies of the quality of wood, cutting, and gluing. However, an assembly jig was used to help assemble the walls. Also, the rate at which the drill press was pulled could have affected the results, though it was tested with spare walls that the rate did not affect the amount of force required to compromise a wall.

Summary Statement
My project tested what kind of diagonal bracing added to walls would render it the most rigid.

Help Received
Father helped modify drill press to hold force sensor.

CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)

Felimon Charles L. Legaspi, III

Project Number

J0319

Project Title

Building Better Earthquake Resistant Structures

Abstract

Objectives/Goals

My objective in conducting this experiment was to test the effect of varied structural improvements on a building's performance during a simulated earthquake. My goal was to determine which building structural improvement provides the most earthquake resistance and stability.

Methods/Materials

My grandfather helped in building an earthquake simulator made from sheet metal and wood, attached to wooden rods and powered by a 7-amp, 120 volt electric drill. I overlapped four blocks of wood ten stories high to make a building, and placed them the center of the earthquake simulator. I left the simulator vibrating and timed until the building collapsed. Three (3) trials were done. At the end of each trial, the building was rebuilt. For the next set of three trials each, I modified and tested the building as follows: 1) adding a cross brace made of popsicle sticks, 2) adding a base isolator made of cardboard box filled with marbles, 3) adding steel rods placed at the top corners of the building, 4) then I tested a combination of cross brace and base isolator, 5) combined cross brace and steel rods, 6) combined steel rods and base isolator, and lastly, 7) combination of all 3, cross brace, base isolator and steel rods. I recorded the data of each trial.

Results

After conducting multiple tests on each building modification, the results of my experiment show that adding a combination of cross-bracing, base isolator and steel rods performed the best overall by resisting simulated earthquake conditions the longest, with an average standing time of 184 seconds. This combination resulted in an improved stability of 4,873% than my original control structure.

Conclusions/Discussion

Before I started this project, my hypothesis was that adding a combination of all three improvements, cross bracing, a base isolator, and steel rods to my control structure will be the most earthquake resistant. My experiment confirmed that my hypothesis was correct. The combined improvements prevented the building blocks from collapsing the longest than any of the other tested structures. The building with all three improvements was the most stable.

Summary Statement

I tested varied building structural modifications to determine which provides the most earthquake resistance, and my findings show that adding a combined cross bracing, base isolation and steel rods provides the best earthquake resistance.

Help Received

My grandfather helped in building the earthquake simulator. My parents helped with buying materials and preparing the board. My Science teacher helped in the overall consultation for this project.

CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)
Maya G. Minagawa

Project Number
J0320

Project Title
Leave the "Wrist" of the Supports Behind!

Abstract

Objectives/Goals
The objective of this study was to challenge the commercial brand of wrist supports for gymnasts with a new invention made by the experimenter.

Methods/Materials
Leather, Velcro, and various sewing supplies, were used in the making of the invention. tested with pressure test against no form of wrist support and the commercial brand of wrist support.

Results
After gymnasts did three pressure tests (by doing thirty second handstands), one each with the invention, the commercial brand, and without support, the commercial brand provided the most comfort or the least amount of pain, followed closely by the invention.

Conclusions/Discussion
In conclusion, my experiment was technically successful, as the invention did cause less pain than the no support condition, however the commercial brand still ended up providing the most comfort.

Summary Statement
As measured by discomfort levels, the commercial brand of wrist supports provided better relief than the invention, however the invention did was significantly more comfortable than no support.

Help Received
I designed and built the wrist support myself, my adviser, Tina Brown helped finalize and perfect my ideas.

CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)
Ethan M.T. Nguyen

Project Number
J0321

Project Title
Dome-N-Egg

Abstract

Objectives/Goals
The objective of this project is to see the strength of an egg compared to its shape.

Methods/Materials
1 Caliber
1 Digital Scale
5 Jumbo Size Eggs
5 Extra Large Egg
5 Medium Eggs
5 Large brown Eggs
1 F-Clamp
1 Permanent Marker
Pencil
Notebook

Results
Several eggs were cracked using a vise to see the strength compared to its shape.

Conclusions/Discussion
My results show that if one part of a structure is weak than it will cause the whole thing to come down.

Summary Statement
My project is about seeing if the shape of an egg affects its shape.

Help Received
Mrs.Duncan, Andrew Nguyen, Annabeth Nguyen, Elizabeth Nguyen

CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)

Benjamin A. Panasyuk

Project Number

J0322

Project Title

Is Earth-Friendly Concrete Stronger than Traditional Portland Concrete?

Abstract

Objectives/Goals

The purpose of my project was to determine the strength between traditional Portland Concrete and Earth Friendly Concrete.

Methods/Materials

The experiments involved making and testing three different mixes: Earth- Friendly, Portland, and Half-and-Half. Earth-Friendly Concrete was created by combining eggshell powder, wood ash, fire clay, gravel, sand, and liquid eggs, and traditional mix was made using store bought Portland cement, gravel, sand, and water. Equal amounts of Portland and Earth-Friendly mixes were combined to create Half-and-Half concrete. The mixes cured for 14 days. On the 15th day, the break strength was tested in a compression testing machine. The constants of the experiments were proportions of the mix design, mold sizes, curing time, and same curing temperature for each set of molds to be compared. Measurements were made by cups for mix design, a fahrenheit thermometer for curing temperature, and a compression machine for testing strength to compare psi readings.

Results

The result of my experiment showed Earth-Friendly Concrete to be much weaker than Portland Concrete with low psi readings of 101, 109, and 116 of Earth-Friendly mix molds compared to high psi reading of 3514, 3543, and 3981 of Portland mix molds. Half-and-Half mix results were between Portland and Earth-Friendly mixes and still much weaker than Portland concrete with psi readings of 219, 221, and 254.

Conclusions/Discussion

The results of the test showed that Portland concrete molds were about 34 times stronger than earth-friendly concrete molds. Half-and-half concrete appeared to be only 2 times stronger than earth-friendly concrete and about 16 times weaker than Portland concrete. I believe that I got these results possibly because of the incorrect proportions of the aggregates when designing the recipe of the earth-friendly mix or because one of the aggregates used could have made the concrete weaker. It also is possible that, if I let the molds cure for a much longer time, the results of the break strength test might have been different.

Summary Statement

I created my own Earth Friendly Concrete.

Help Received

My mother helped me find research online and she guided me through the whole process, my father assisted me in buying materials, mixing concrete, and making molds.

CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)
Enzo A. Pardo

Project Number
J0323

Project Title
A Bridge to Nowhere

Abstract

Objectives/Goals
The principal objective of this project is to find out which design in bridges will sustain the most force.

Methods/Materials
The project was performed by building 6 original truss bridge designs. Each bridge was made of 1/4" X 1/4" balsa wood. The bridges were tested by using a DI2000, a machine which applied a concentrating force over the bridge to determine its breaking point.

Results
After testing different bridge designs, it became clear that the DI2000 initially found weakness within the road bed and substructures for the first two original bridge concepts.

A third bridge was constructed doubling the strength of the road bed in which case it was the bridges side wall that failed to uphold the load.

Although these tests led to the construction of stronger bridge components, it became clear that consistent controlled components would need to be developed to accurately test the structural stability of the bridge body.

Therefore, bridges D, E and F were constructed utilizing the same road bridge and substructure designs changing only the bridge body.

Initial testing of bridges D, E and F resulted in the consistent failure of the roadbed.

Further series of tests were then conducted by reinforcing the road bed resulting in dramatic bridge failure recorded as bridges G,H, and I.

Conclusions/Discussion
In the end, bridge G, the bridge with the greatest amount of triangles in the bridge wall, supported the highest level of pressure while sustaining the least amount of damage confirming that the number of triangles in the structure directly affects the overall strength, proving the initial hypothesis to be correct.

Summary Statement
I built multiple truss bridges out of balsa wood using my original designs and tested each ones structural integrity.

Help Received
I designed and built my bridge models on my own. I looked at bridges being built today and built in the past to try to come up with ideas.

CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)
Aalok N. Patwa

Project Number
J0324

Project Title
Do I Grind? A Wearable System that Detects Bruxism Ahead of Its Effect on Teeth

Abstract

Objectives/Goals
8-31% of people in the world have Bruxism (Teeth Grinding) as a clinical disorder. 92% of people have had bruxism at least once in their life. Even though bruxism is not deadly, it has nasty effects: worn enamel, cracked teeth, joint problems, and even loss of teeth. People do not realize that they have bruxism until it is too late. They only realize the fact after the lasting damage has been done: the tooth enamel has been worn down or the tooth has fractured. If there was an easy-to-use device to detect bruxism early, a huge problem would be solved; people would save their teeth and money.

Methods/Materials
I created a wearable that can detect bruxism by just having the person wear it on the chin for three nights. Firstly, I programmed TinyDuino, an Arduino circuit board with a BMA 250 accelerometer and micro-SD card to record a series of accelerometer readings. After the readings for the whole night were taken, I analyzed them using a Python program that examined each time window and applied mathematical operations to detect and report bruxism events. I calibrated my program using simulated data and then completed 13 trials on volunteers.

Results
During my trials, my subjects reported that my device was comfortable to wear and allowed them to have a good amount of sleep. After analyzing the trial data with my program and then manually checking all reported events, I found that I achieved 81% accuracy in detected bruxism, with a false positive rate of 29% and false negative rate of 15%. Also, my test results and diagnosis matched the results of a top-of-the-line EMG device that was used on two volunteers.

Conclusions/Discussion
Most of the people who have bruxism do not realize that they have it until their teeth are already permanently damaged. My results show that it is indeed possible to make a low-cost, easy-to-use bruxism detector that millions of people can use at home to detect bruxism early, and thus save their teeth and money. My detection method is 81% accurate today, but I can improve it by training a predictive algorithm with larger trial dataset. I can also make a device that detects other sleep disorders like Sleep Apnea or Acid Reflux. In general, I can make a device that improves the thing we love the most: sleep!

Summary Statement
I have created a novel wearable system that can be used by millions of people to accurately detect bruxism before the disorder inflicts lasting damage on their teeth and health.

Help Received

CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)
Abraham E. Rachlin

Project Number
J0325

Project Title
Which Is the Best Lower Limb Prosthetic for Sports?

Abstract

Objectives/Goals
The objective of this experiment was to determine which type of lower limb prosthetic has the most efficient response.

Methods/Materials
3/4 inch PVC pipe, two size 10 shoe trees, a spring, aluminum rod, scale, measuring tape. Three prosthetics: one constructed with pvc and a shoe tree; one constructed with pvc, a shoe tree, and a spring installed at the "ankle" as a shock absorber; one constructed with aluminum inside of a pvc bent into a U-shape. All 3 were weighed and measured. Each one was compressed on a scale and then released with change in height measured each time. The changes in height and the force as measured by the scale were used in the efficiency equation to determine the mechanical efficiency of each one.

Results
Several trials were performed. The U-shaped prosthetic had a higher efficiency rating in the majority of the trials, followed by the prosthetic with the spring/shock absorber. The prosthetic with a shoe tree and no spring was rigid and had no efficiency score, but instead served as a control.

Conclusions/Discussion
The structure of a prosthetic greatly effects its efficiency. The U-shaped prosthetic was the most efficient as determined through various trials. The spring/shock absorber placed in the prosthetic with a shoe tree made it more efficient than the prosthetic without a spring, but not as efficient as the U-shaped prosthetic. The rigid prosthetic with no spring had no response and served more as just a support. For the purposes of sports performance, the U-shaped prosthetic is recommended.

Summary Statement
I found that the U-shaped prosthetic had the most efficient response and is best for sports performance.

Help Received
I designed the prosthetic myself using the Merck manual, but received help from handyman Miguel Castro in constructing them. Mr. William Yarberry, physics teacher at Mater Dei Catholic High School, taught me the efficiency equation.

CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)
Aidan M.O. Ramsay

Project Number
J0326

Project Title
Geopolymers vs. Portland Cement

Abstract

Objectives/Goals
My goal in this science fair project was to see the practicality of a new kind of cement called geopolymer, and to see if it could be applied to construction in the real world.

Methods/Materials
Materials:
Metakaolin (purchased from concretecountertopsupply.com)
Fly Ash (provided free by Boral Material Technologies LLC)
Sodium Silicate (Water Glass)
Sodium Hydroxide (Lye)
Sand
Portland Cement w/ Sand (Mortar Mix)
Safety equipment including goggles, gloves, mask, apron
Small mixing container
250ml beaker
Scale
Stirring sticks
Plastic drinking cups
Method:
Make four sodium silicate lye solutions and let set for 24 hours. To sample one add fly ash. To sample two add fly ash and sand. To sample three add metakaolin. To sample four add metakaolin and sand.

Results
Results: (result of experiment)
After making samples of Portland Cement concrete and multiple kinds of geopolymer concrete, I see that the geopolymer samples are almost as easy to make as Portland cement samples (by 3.55 vs 3.15 out of 5)

Conclusions/Discussion
The conclusion to my experiment is that geopolymer sample is not as easy to make it sets quicker. Based on outside research geopolymer is more expensive and it is more dangerous to make than Portland cement but the advantages of geopolymer are 90% less CO2 emissions, 5 times longer lasting, and fire resistance.

Summary Statement
The fix to our hidden concrete crisis.

Help Received
My science teacher helped me narrow down my question, my dad helped me with my experiment, my mom spell and grammar checked my work

CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)

Roman M. Rodriguez

Project Number

J0327

Project Title

Effective Prosthetic Foot Lengthening Prototype

Abstract

Objectives/Goals

The objective of my project is to support individuals with leg prosthetics by designing a mechanism which allows the foot on the prosthesis to extend and fit appropriately in a shoe.

Methods/Materials

Air dry clay and a wardrobe door bottom guide. The clay was molded into a foot the size of an infant's (any size would work), cut into two pieces, an arch was cut into the pieces, then the wardrobe door bottom guide was placed into the arch. This connected the two pieces which allowed the pieces to extend apart.

Results

The clay prototype functioned properly. The design perfectly met the expectations. The wardrobe door bottom guide allowed the two clay pieces to extend.

Conclusions/Discussion

This project is a prototype. This design would assist individuals with prosthesis by allowing their prosthetic foot to extend along with their able foot. This means that an individual may buy a pair of shoes without worrying about one foot being bigger than the other. This can also end the struggle of having the prosthetic foot slip out of an individuals shoe. This happens because as the able foot grows, the prosthesis stays the same size. This causes the shoe on the prosthesis to constantly slip off.

For example, this affects small children. As they grow, their able foot also grows. Their prosthetic foot stays the same size. When a child puts on their shoes, the shoe on the prosthesis slips off as they walk. Many young girls like to wear dress shoes and can't because the prosthetic foot does not fit properly. My design will help with these real life issues for young children with prosthesis.

Summary Statement

I created a prototyoe which extends the prosthetic foot for children as they grow, or for individuals that want to wear different types of shoes with a protheses.

Help Received

None. I designed and completed the prototype by myself.

CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)
Katherine J. Smith

Project Number
J0328

Project Title
Brace Yourself

Abstract

Objectives/Goals
This project was executed in the hope of making a knee brace for a grade two medial collateral ligament tear. The goal was to make the brace adjustable so that it can be worn throughout the whole recommended healing time yet still allow support to the injured place. The initial thought was that if the knee is exposed to more and more flexibility as the injury heals it would reduce stiffness and uneasiness once the brace is removed therefore the knee would be less susceptible to further injury. Before building the brace, multiple materials were tested and compared, once the best material was found, the brace was built and tested for flexibility and support. Unfortunately there was no physical data collected by the tests on the brace; the data consisted of observations and questions for further exploration. However other tests were completed to further understand how the brace would work most efficiently. The force of each material was measured to determine which substance used to keep the knee supported while allowing flexibility would work best with the product. After analyzing the data the materials selected proved to be supportive, flexible, sturdy, and easy to switch in and out of the brace. This conclusion shows that the brace is flexible yet still provides support and can easily be used if someone was to suffer a grade two medial collateral tear.

Methods/Materials
To carry out this project I used a knee sleeve and two lengths of coupling. I constructed the knee brace by adding the coupling to both sides of the knee sleeve using wire as thread and seat belt strapping to hold the coupling in place.

Results
After experimenting with the brace and materials used in the brace, I determined that the knee brace was sturdy enough to stabilize the knee but still allowed for flexibility of the knee joint. This showed that the brace was effective and met the initial objective of creating a brace that allowed for both stability and flexibility.

Conclusions/Discussion
The project proved that with some modifications this brace or type of brace could be applied to real-world injuries. Based on my findings I think that more study and thought should be given to the treatment of grade 2 MCL tears. I also believe that adjustable braces would be effective for most knee injuries.

Summary Statement
I created a knee brace for a grade 2 MCL tear that proves to be helpful in the healing process because it allows support and flexibility throughout the healing process.

Help Received
Tom Kramer, a medical engineer helped by giving me suggestions to enhance my project. My dad helped me collect materials for my project. Ms. Shimshock, my science teacher, answered questions and provided guidance.

CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)
Liliana Tores

Project Number
J0329

Project Title
Wind Power: Does Fabrication Material Affect Energy Produced?

Abstract

Objectives/Goals
The objective of this study is to determine how different materials used in the fabrication of windmills will affect the energy they produce.

Methods/Materials
Fabricated pinwheels (to simulate windmills) out of: Plastic, cardboard, paper, and aluminum. Once made, they (the pinwheels) were attached to a fabricated base made from an empty oatmeal container, a cup, a straw, string and hot glue. Completed pinwheel is then placed in front of a fan. The fan is then turned on to speed three and the pinwheel pulls up the cup with five pennies in it, while being timed using a stopwatch. This procedure is repeated ten times with each of the materials used to fabricate the pinwheels.

Results
After completing several trials on which of the pinwheels fabricated using, plastic, cardboard, paper, and aluminum, would pull a cup with equal weight up the fastest. The most efficient material was the plastic pinwheel produced more power than the cardboard, paper, and aluminum pinwheels. The plastic pinwheel consistently pulled the cup up in a faster amount of time, demonstrating a higher energy production.

Conclusions/Discussion
The plastic pinwheel the most efficient in producing wind power when compared to the other materials tested, cardboard, paper, and aluminum. By doing this project I have learned which type of material would be better to use to build a wind turbine.

Summary Statement
I fabricated pinwheels (to simulate wind turbines) out of different materials and found out that plastic was the most efficient in producing power.

Help Received
I designed and built my simulated wind turbines with minimal help from my teachers and parents. My teachers, Mr. Nelson and Mrs. Lickey did help me with understanding the implications of my results, and how to compare my data.

CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)
Saida M. Woolf

Project Number
J0330

Project Title
Mace vs. Flail: A Comparative Study of Impact Forces between Two Medieval Weapons

Abstract

Objectives/Goals
The purpose of my experiment was to see whether a medieval mace or a medieval flail had the most impact force. My hypothesis was the flail would have a higher impact force because the second segment of the flail would whip ahead and result in a higher velocity and therefore higher impact force.

Methods/Materials
An experimental apparatus made from Lego Mindstorms was used to repeatably swing a Lego mace or Lego flail and record the impact forces.
A 3-beam balance was used to measure the mass of the mace and flail and make sure they were equal. A free online double pendulum simulation was used to refine my hypothesis and see if the second segment of the flail would whip ahead or lag behind and result in higher or lower impact forces.
The mace and flail were swung 20 times each and the impact forces were measured.
Microsoft Excel was used to plot data in a histogram and do a statistical t-test analysis to see if the two data sets were the same or different.

Results
The mean impact force of the flail was 67 counts higher than the mace. However, the mace data had more variation than the flail data and the mace had the highest single impact force. A statistical t-test showed that the mace and flail had no significant difference in impact force.

Conclusions/Discussion
My conclusion was that my hypothesis was incorrect. Even though the physics of the flail and its ability to whip led me to believe that its impact force would be greater, the data showed the mace winning sometimes and the flail winning other times. The flail was consistently scoring the 800s, while the mace was more scattered, but had a maximum force of 900 counts. There was no statistically significant difference in impact forces.

Summary Statement
I showed that there was no statistically significant difference in impact forces between two medieval weapons, the mace and flail, that had equal lengths, masses, and velocities.

Help Received
I built and programmed the experimental apparatus, conducted the experiment, and performed the data analysis and plotting. My father taught me the physics equations and how to use a t-test in Excel.