CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)
Eitan S. Acks

Project Number
J0301

Project Title
Tongue Untwister

Abstract

Objectives/Goals
Speech disorders such as Apraxia and Dyspraxia are very common in our society. Unfortunately, they have been known to affect more than just one's ability to communicate verbally. Difficulty speaking can lower confidence and self-esteem. It can even hurt one's education. The purpose of this engineering project is to create a therapeutic device that will treat these conditions faster and more effectively than has been done to date. By using the proper tool, people who suffer from these disabilities will be able to improve on their speaking abilities. The goal of this project is to create that tool.

Methods/Materials
After the device has been inserted into the mouth, a series of different exercises are performed. These tasks emphasize pushing a lever up and down with the tongue for certain amounts of time. The tongue is fundamental in executing correct speech, so these exercises are designed to strengthen the muscles that are necessary for speaking. While following the instructions, and using the device daily, I am confident that improvement will be seen.

Results
Five different versions of the device were created, each an improvement on its predecessor. The purpose of the device is to show the user his own tongue's muscle strength and to guide him along the path of improving it. The device has the ability to send its data to Excel and put the measurements straight into easy to read scatter graphs. These charts can then be compared with previous trials to track progress. When testing a person without any speech problems, it was clear that he had no issues completing the tasks given to him. The same exercises were given to the patient with a speech disorder and proved to be much more challenging. The device does it's job very well and has room to be optimized.

Conclusions/Discussion
I have proved that a device can be created to help those with speech disorders. One of the people tested has a background of almost ten years of speech therapy. Even after the first seven days of using the device, improvement was seen in the patient. The testing hasn't been completed yet, but more and more progress can be seen every day. With continued use I am sure that the user will be able to talk as clearly and precisely as those without speech disorders.

Summary Statement
A therapeutic device was created to treat people with speech disorders and measure their improvement.

Help Received
Marlowe Fischer (Speech Therapist) provided information on modern speech therapy; Sarah Rines (Science Teacher) provided science fair advice; 5th prototype was 3D printed by Incept3D.

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)
Trinity R. Barrett

Project Number
J0302

Project Title
Build Destroy Build: Better Homes for Earthquake Country

Abstract

Objectives/Goals
The goal of my project is to find out if the shape of a house is relevant to how much damage a tectonic earthquake leaves on the house after the earthquake. I believed that the A-frames would have the least amount of damage.

Methods/Materials
The goal of my project is to find out if the shape of a house is relevant to how much damage a tectonic earthquake leaves on the house after the earthquake. I believed that the A-frames would have the least amount of damage.

Results
If you combine the results from both the A-frames, there are twenty damaged points, while for the single story flats, there were only sixteen points of damage.

Conclusions/Discussion
My results conclude that a single story flat would be more earthquake resistant than an A-frame. However, more tests following a more uniform state regulation code may vary my results.

Summary Statement
My project is about testing different types of houses against tectonic earthquakes to find out which one is the most earthquake resistant.

Help Received
Mother helped edit and type report, cut materials after I measured, helped design #shaker-box#, led me in the direction of information and Dale Dingman built the #shaker-box#, according to my design, advised on roof pitch and stud spacing.

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)

Ryan T. Beck

Project Number

J0303

Project Title

Football: Coming to a Crashing Halt

Abstract

Objectives/Goals

Over 300,000 sports related, traumatic brain injuries are reported yearly in the U.S.A. alone. Most of these injuries are because of receiving one or more blows to the head, causing a traumatic brain injuries or T.B.I. Of those, approximately eighty five percent or more occur on the football field. Many of these injuries can lead to permanent brain damage or a long term brain condition called chronic traumatic encephalopathy or C.T.E. In sports related accidents, TBI's are also a leading cause of death. My idea is to take some of the impact out of helmet to helmet hitting by applying outer padding to the average football helmet. I would like to lessen the amount of serious head injuries in the game of football.

Methods/Materials

I built a pendulum with two swinging football helmets to recreate helmet to helmet hits. I used a tool called an accelerometer placed inside one of the faux heads to measure the G-force obtained during these hits. I first measured helmet to helmet hits with no pads to create my baseline. I then tried 5 different foam materials in neoprene pockets and placed them on the impact zone. Each test was repeated 5 times using 5 different foam materials.

Results

Using the best foam and neoprene, I created a prototype design. It is essentially a removable foam jacket that can go over an existing helmet. It is designed to be waterproof and adds less than one pound to the helmets overall weight. My design was able to reduce the overall G force of an impact by an average of fifty-five percent.

Conclusions/Discussion

My conclusion is that outer padding has a dramatic effect on the impact taken by a helmet to helmet hit. I feel my prototype could reduce injuries and would be a functional design.I would like to help improve the lives of football players.

Summary Statement

What foam applied to the outside of a football helmet can be most effective in reducing the G force experienced during a helmet to helmet hit.

Help Received

Greg Hoshal from Instrument Sensor Technology, accelerometer rental; Rusty Haight from Crash Safety Institute, understanding Dynamax software and accelerometer use; Dr.Tracy Love from Cognitive Neuroscience Lab, research.

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)
Blaine A. Benham

Project Number
J0304

Project Title
Regenerative Braking Experiment

Abstract

Objectives/Goals
What I set out to do was to try to figure out if my experiment question, How high will a weight be lifted by a wheel spinning at a certain RPM and how much RPM can be recovered?

Methods/Materials
I used a 24 inch bicycle wheel from my bike, then I attached it to a frame made of wood and aluminum. I connected a skateboard wheel to the freewheel threads on the bicycle wheel to provide a good friction surface. I used an aluminum lever assembly that was connected to both the frame and another skateboard wheel. A 50 lb-test fishing line with a 5 pound weight on the end was connected to the skateboard wheel on the lever. A bicycle cadence meter was used to measure the RPM of the wheel.
The wheel was spun by hand at different RPMs and the lever was used to engage the skateboard with the fishing line attached to the spinning skateboard wheel on the bike wheel. The energy of the spinning wheel lifted the weight. Then I recorded the height of the weight versus the RPM of the wheel. Then I used the lifted weight to start the bike wheel spinning again and I recorded the amount of RPM that was recovered.

Results
The higher the RPM of the wheel the higher the weight was lifted. What I found out was that the average recovered RPM was over 70 percent of the original RPM which tells me that the system was over 70 percent efficient at re-generating energy.

Conclusions/Discussion
Why my results are important is because it shows a very clear and simple example of the effectiveness of a regenerative braking system and why it is so important for it to be improved and implemented wherever possible to save energy and use it more efficiently.

Summary Statement
My experiment shows that Regenerative Braking could recover and save energy that is usually wasted.

Help Received
My Dad helped me to get my materials and drill holes.

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)

Cade Berrett; Connor Hatton

Project Number

J0305

Project Title

Earthquake Proof?

Abstract

Objectives/Goals

Does the height of two different buildings affect it#s stability in an Earthquake?

Methods/Materials

Place dowel on surface with different heights at 3 inches, 6 inches, 9 inches, 12 inches, and 15 inches. Drilled a hole so the dowel can snugly fit in the hole. Drill into the middle of the golf ball one inch, then #screw# it into the top of the dowel. Shake the 2 X 4 on each marker for 5 seconds, and measure how long the dowel shakes for. Record how long it shakes each time, and then average the times. Find which length shook the dowel the longest; this is the frequency. Repeat steps 1-8, but now with a new dowel height (35-65 cm). Use the frequency for each of the two lengths of the dowels for next section of the experiment. *There will be two different frequencies for the pairs-except for the pair of 25 cm dowels. Drill a hole 2 inches away from the original, and then a half inch away from that hole. Place dowels next to each other in sets of 2 (25 cm x 25 cm, 25 cm X 35 cm, etc).

*When you do the set of 25,25, that is the only time you need to use the farthest hole from the original (step #10). Repeat shaking for each set at the 2 different frequencies found from step #6. Average the number of hits for each frequency (step #9).

Results

Our building heights showed us that the more change, the more movement occurred after finding the frequencies. There were some high frequencies and low frequencies. Both the 45cm dowels and the 65 cm dowels had a frequency of six, which was the lowest frequency we had. The 25cm dowel and the 35cm dowel both had frequencies of 12, which was the middle number for our frequencies. The final dowel, which was our 55cm dowel, had the highest frequency, which was 15.

Conclusions/Discussion

During an earthquake it is better to have buildings that are similar in height so they do not hit each other. When we change the difference between the heights by 10 cm, there was more destruction than having buildings be the same height. Our hypothesis was supported because our data shows that when we increased the 25 cm dowel and 25 cm dowel to the 25 cm dowel and 35 cm dowel, the hits increased by 0.8. A more intense example is when we experimented with the 25 cm dowel and the 65 cm dowel, the 65 cm dowel snapped right off. This example is proof that different height buildings are not a good idea when they are next to each other in an earthquake.

Summary Statement

When buildings are at different heights, and when an earthquake occurs, the smaller building will hit the taller building making the taller building collapse.

Help Received

Dads helping us drill. Coach helping us with board layout.

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)
Travis R. Campbell

Project Number
J0306

Project Title
Is Bigger Faster? How Pulley Diameter Affects Rim Speed

Abstract

Objectives/Goals
To find the effects of various diameters of pulleys on the outside travel (rim) speed of the pulley using a constant turning speed (RPM).

Methods/Materials
3 different sized pulleys: 4" diameter, 3" diameter and 2" diameter, a motor, a Variable Frequency Drive (VFD), a tachometer, pens, pencils and paper and calculator. The method is to use a tachometer to test the rim speed of each pulley at various motor speeds and then take the average of the tests to determine how the size of the pulley affects the rim speed (FT/M).

Results
The 4" diameter pulley had the highest rim speed, the 3" had the second highest, and the 2" had the slowest rim speed.

Conclusions/Discussion
My results proved my hypothesis was correct that the larger the diameter of the pulley, the faster the rim speed would be. Other variables could be added to the testing such as chains, sprockets and belts to further prove this theory of mechanical advantage. These results can be applied in any situation involving motors, pulleys, shafts and wheels such as ATV's, vehicles, and factory equipment.

Summary Statement
My project tested different diameter pulleys with a motor to determine how the size of the pulley affected the rim speed.

Help Received
My father and grandfather helped me obtain the materials needed for testing. My mother helped me with my writing and laying out my presentation.

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)

Jesse T. Casey

Project Number

J0307

Project Title

Siege Weapon

Abstract

Objectives/Goals

If I test which arm length will go the farthest, then I believe that the longest arm shall fire the farthest and the shortest arm will fire the shortest. If I test which sling length will go the farthest, then I believe that the longest sling will fire the farthest. The scientific basis for this hypothesis is that the longer the throwing arm and the sling, the greater the speed at which the projectile will be launched.

Methods/Materials

Make sq.base/Add 2 vertical planks to oblique cut plywd plks/Make cement cylinder/Add cyl. to 61cm.arm & then to crossbar/connect to catapult frame./Add 4 diff.arms/Make 4 diff.sized slings /Identify space of launch/ Launch 10 tests length of arms & sling with the 2mtr arm/adjust pin so launch angle is a cons45 degrees/Record data.Materials:27.2kilo cement cyl. 2.5cm round metal pipe arms & wire slings 61cm/122cm/183cm/244cm/4#104 9*9 cm oblique cut plks/5.06cm nails/2#61.5 9*9 planks/2#153 9*9 cm plks/4- 2.5cm wheels/2#87 9*9 plks/18 & 2Tbraces/1-152.5*51cm plywd/189cm crossbar2.5cm.rnd/2#5cm knobs/1field/Softball

Results

My results were that initially the longer the arm gets the farther it throws, but after a certain point the distance curve began to plateau and increases were small. In the case of the sling the distance fired was also initially greater as the sling length increased, but the sling eventually got longer than the arm and distance fired dropped dramatically.

Conclusions/Discussion

My investigative question was how the length of the arm and sling affects the throwing distance of a catapult. I thought that the longest throwing arm would go the farthest and the longest sling would also go the farthest. My data showed that the distance the arms fired was always higher than the arm before as the arm length got longer, but it slowly began to flatten out into a plateau. This data & research done shows that this would eventually hit a peak of the farthest distance possible to throw and drop in distance from there, because the longer the arm gets the more it weighs which means it will eventually weigh more than the counter weight. For the sling as it gets longer my data shows that there is a peak, much like the arms peak, of the farthest distance that can be thrown. The difference is that the sling#s peak has a much more dramatic rise and fall than the arm#s peak. This decrease in throwing distance with longer arm and sling shows that my hypothesis is incorrect.

Summary Statement

this project is about the effect that throwing arm length and sling length will have on the distance that a catapult throws a projectile.

Help Received

dad edited papers, mum took photos

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)
Krista Celo; Francesca Legaspi

Project Number
J0308

Project Title
Building Stability during Earthquakes

Abstract

Objectives/Goals
The objective of our experiment was to test the effect of different building modifications on its performance during a simulated earthquake. Our goal was to determine which building structural modification provides the most stability and earthquake resistance.

Methods/Materials
With the assistance of a family friend, we built an earthquake simulator made from sheet metal attached to wooden rods which served as rollers. We used a 7-amp, 120 volt electric drill to power and control the speed of the table. Next, four (4) blocks of wood were overlapped nine (9) stories high, and were placed in the center of the earthquake simulator. The machine was left 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, we modified the building by adding a cross brace made of popsicle sticks, then a base isolator made of cardboard box filled with marbles, then the last set was a combination of both.

Results
The building with both cross-bracing and a base isolator was the most stable. It was able to withstand the earthquake simulation the longest time than the 3 other building structures. This building's stability increased by 263% than our original control structure.

Conclusions/Discussion
Before we commenced this project, our hypothesis was that adding both cross-bracing and a base isolator to our control structure will be the most earthquake resistant. Our experiment confirmed that our hypothesis was correct. The combined modification prevented the building blocks from collapsing longer than any of the other tested structures.

Summary Statement
Our project shows that buildings can be more earthquake resistant by making certain structural modifications (such as cross-bracing, base isolation or a combination of both) to make it more stable during an earthquake.

Help Received
Francesca's father and a family friend helped in designing and building the earthquake simulator table.

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)
Andrew J. Chaffee

Project Number
J0309

Project Title
Energy of a Rubber Band

Abstract

Objectives/Goals
This project analyzed how temperature affects the distance a rubber band travels as a projectile as well as verifying its potential energy by finding the spring constant utilizing Hooke's Law. My project's hypothesis is that the cooler the rubber band, the more it will retain energy due to its molecules being more relaxed and distributed and will have greater resistance to force, therefore, travel farther.

Methods/Materials
The rubber bands were subject to three distinct temperatures:-20F, room temperature and 220F. There was 30 projectile launches for each of the three temperature conditions. Potential energy was determined by measuring the displacement of the rubber band against force, then calculating the spring constant. With the spring constant (k) and (x)-the distance the band was stretched, potential energy can be measured.

Results
The data and results supported my hypothesis. The cooler the rubber band, the farther it flew and its spring constant was greater. The variance of length traveled and displacement was much closer between room temp and heated bands than room temp and cooled rubber bands. I believe this showed the significant energy stored in the cooler bands and that the molecules were more widely distributed to create a better allocation of energy for a longer trajectory of the rubber band in flight.

Conclusions/Discussion
Most surprising observation was the how the surface of the rubber band literally absorbed the temperature changes until the band was stretched for release. It would be interesting to analyze whether products with rubber should be manufactured at cooler temperatures to make them more resistance to breakage. If i were to extend this project, i would test varying sizes of rubber bands to observe whether there is a correlation between size and potential energy.

Summary Statement
How does temperature affect the flight of a rubber band and its potential energy

Help Received
Parents assisted with design of the board and calculating the slope constant using Excel

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)
Deanna N. Cunningham

Project Number
J0310

Project Title
Preventing Hurricane Damage: Stilt Homes Put to the Test

Abstract

Objectives/Goals
The objective is to find a stilt home design that will suffer the least damage in a hurricane.

Methods/Materials
The materials used were a hose, hose nozzle, ruler, clay, coffee stirring sticks, hot glue sticks, hot glue gun, pennies, duct tape, topsoil, scissors, rocks, and cardboard. Construct a honeycomb, cross-bracing, pyramid, and control structure. Test the structures against a hose at 20, 15, 10, 5, and 0 cm away from the structures. Record the number it will receive on the Scale of Damage.

Results
The cross-bracing structure had the least damage. Up next was the pyramid structure which had fairly similar results when compared to the cross-bracing structure. Damage wise, the control structure was second to worst, and then came the honeycomb structure. The amount of damage to the honeycomb structure was very close to the control structure.

Conclusions/Discussion
The cross-bracing structure did the best because of the triangle shapes formed within the design. It makes the structure very strong due to its ability to resist downforce and cross-pressure. Also, since cross-bracing can be repeated throughout the length of the stilts, it can make the building stronger.

Summary Statement
A honeycomb, cross-bracing, pyramid, and control structure were tested to find the strongest stilt home design.

Help Received
Father assisted throughout the project and provided supplies; John Blake gave ideas on structures to test and ways to fix test issues; Dr. Sheehan answered physics questions; Riley Neal answered questions on structures; Ms. Rosichan reviewed entire project and helped formulate the question.

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)
Amy F. Domae

Project Number
J0311

Project Title
Cell Shape in a Honeycomb Structure vs. Structure Strength

Abstract

Objectives/Goals
The objective is to determine which basic shape among triangular, square, hexagonal, or circular cells in a honeycomb structure has the strongest compressive strength.

Methods/Materials
Method: 1. Create Columns: a) Make 288 half-sheets of cardstock. b) Create a pattern for various columns so that all columns of a given shape are as uniform as possible. c) Build 72 columns for 3 honeycomb structures for each shape. 2. Test Setup: a) Arrange 24 identical columns into 4 rows of 6 as a parallelogram in a honeycomb structure that minimizes space between columns. b) Put each honeycomb between two identical cardboard pieces. 3. Test: a) Incrementally place known weights on top of each of the twelve honeycomb structures until each structure fails. b) Record the weight at which the structure fails. 4. Analyze the data.

Materials/equipment: 110 lb. 8.5" x 11" cardstock, Mini round "High-Temp" hot glue sticks, Bostik 6-g hot glue gun, Artskills Project Board cardboard, Paper cutter, Known weights, Scale

Results
The strongest column shape is the cylinder (circular cell). The weakest shape is a triangular column. For each of the three honeycomb structures of each column shape, the weight causing each structure to fail are: Cylinder: 147.9 kg, 177.8 kg, 168.7 kg; Hexagon: 113.4 kg, 142.9 kg, 154.2 kg; Square: 129.3 kg, 133.8 kg, 117.9 kg; Triangle: 86.2 kg, 79.4 kg, 102.1 kg

Conclusions/Discussion
While hexagonal cells are used in beehive honeycombs and some packing materials because of their strength and dense packing, this study shows that circular columns can make a stronger structure. The list of structures from strongest to weakest are: (1) cylinder (averaging 164.8 kg of load at crushing weight), (2) hexagon (averaging 136.8 kg of load at crushing weight), (3) square (averaging 127 kg of load at crushing weight), (4) triangle (averaging 89.2 kg of load at crushing weight). The results suggest that the larger number of sides of the shape (smaller the flat faces on the column sides), the higher amount of weight that it will support. Cylinders may be the strongest because there are no flat faces. Further testing is needed to study this.

Summary Statement
Honeycomb structures are lightweight and do not crush downward easily; this project studies which honeycomb cell shape among triangular, square, hexagonal and circular columns will provide a structure with the highest compressive strength.

Help Received
Parents helped with lifting of the weights and with photography. Mother helped to edit the report. Science teacher, Mr. Briner, reviewed project progress and gave advice.

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)
Brett W. Draper

Project Number
J0312

Project Title
Rubber Bands in Flight

Abstract

Objectives/Goals
The Objective of my experiment was to determine what affects the flight of the rubber band shot from a wooden rubber band toy gun. I believe the longer the barrel length of the gun the further the distance the rubber band will fly.

Methods/Materials
Old Timer 8-12-16 in Rubber band shooter guns
Rubber bands 3 5/8# & 3#
Ruler
Calculator
High Speed Camera
Weights
Tape Measure
Ply Wood
Glue
Three Old Timer brand Rubber band Shooters with 8,12,16 inch barrels were used. Each gun was shot 25 times both inside and outdoors to determine the average distance the rubber band traveled. Elastic potential energy was measured in the un-stretched rubber band and used to convert PE to KE and theoretical range was calculated. A high speed camera was used to calculate that muzzle velocity and flight characteristics.

Results
The longer the barrel length, on average the further the rubber band flew; however, the results were not overwhelmingly conclusive. High speed photography showed that the rubber band flies backwards throughout the flight and the trigger velocity was about the same for both types of rubber bands about 40 meters/sec.

Conclusions/Discussion
A variety of factors affect the distance bands will fly. My Hypothesis regarding barrel length was partly correct, but other factors such as drag, inconsistent air currents, wind resistance, and deterioration of rubber band elasticity also affected the flight. I learned to calculate muzzle velocity using a high speed camera and math. There were differences between theoretical values and actual data. This could be due to human error or environment. Rubber bands are very inconsistent pieces of latex, that can change during flight. The one thing that is for certain is that a rubber band can generate

Summary Statement
My project is about the "physics" of what affects the flight of a rubber band.

Help Received
My Mom helped me type the report, My friend and mentor Mr. Morton a retired physicist helped me determine the elastic potential energy. He also helped me with the high speed photography and he taught me the math to compute velocity, PE, KE and range. We worked in his garage.

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)
Christopher C. Gereke

Project Number
J0313

Project Title
Tsunami: Reducing the Impact

Abstract

Objectives/Goals
The objective was to find out which of four barrier designs would be most effective in reducing the impact of a tsunami wave on land.

Methods/Materials
Testing was done by constructing a wave tank and placing the different barriers into the tank. To keep them from floating away, they were screwed into the tank. A tsunami was then created by dumping a 5 gallon bucket of water from the opposite shore and measuring the distance the wave traveled inland. I also tested the distance the wave traveled without a barrier. Each barrier was tested two ways: underwater and at sealevel. Each barrier was tested three times each, except Barrier #4 broke beyond repair after the first test. After each tsunami wave, the distance was recorded in inches with a ruler that was taped to the base of the waterline, measuring upshore.

Results
The results showed that Barrier #2 was the best for both the sea level and underwater tests. Barrier #4 was the worst, having broken during the first test.

Conclusions/Discussion
My hypothesis was incorrect. I thought that Barrier #3 would be the best for reducing the impact of the tsunami. Barrier #2 was the best.
Although Barrier #2 was the best in reduing the impact of the tsunami on the land, I would like to see Barrier #1 used in the real world because it would allow sea life to return to the sea as well as diminishing the impact on the shoreline.

Summary Statement
Reducing the impact of tsunamis on land through the use of sea level and underwater barriers.

Help Received
My dad helped me construct my wave tank. My mom took photos and helped me with the project board.

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)
Nicholas Haroutiounian

Project Number
J0314

Project Title
More Pulleys Can Make an Object Feel Lighter!

Abstract

Objectives/Goals
The purpose of this project is to see if pulleys or multiple pulleys can actually make an object feel lighter than it really is.

Methods/Materials
A pulley system was constructed using 3 different types of pulleys: Simple Pulley, Compound Pulley, and Block and Tackle Pulley. Using 3kg bricks as the load, the experiment was tested 5 times with each type of pulley and the data was recorded.

Results
It was concluded that each additional pulley made the force applied to pull the 3kg load decrease according to the number of pulleys. For the simple pulley, the tension force was equal to the weight of the load. For the compound pulley, the tension force was equal to half of the weight of the load. For the Block & Tackle pulley, the tension force was equal to a quarter of the weight of the load.

Conclusions/Discussion
By adding additional pulleys, the force applied to lift a load decreases.

Summary Statement
More Pulleys make an object feel lighter by reducing the tension force necessary to lift a load.

Help Received
Father helped build the pulley system. Mother helped with buying supplies.

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)

Samuel H. In

Project Number

J0315

Project Title

The Sweetest Bat: How Does Sound Amplitude Affect the Sweet Zone of a Bat?

Abstract

Objectives/Goals

The objective of this experiment was to see whether or not the difference in sound amplitude between the sweet spot and the sweet zone affected the difference in ball exit speed off of the sweet zone. The experimenter hypothesized that 80% of the bats with the least difference in sound amplitude would have a difference in ball exit speed that would also be smaller.

Methods/Materials

A bat swinging machine first had to be made by stabilizing a pole to a wooden base, and then attaching a garage door spring to the pole using U-bolts. Then, the spring was also connected to the wood base, by attaching another block of wood to the base and then connecting the wood to the spring with zipties. Bats were then attached with Velcro straps and ball exit speed and sound amplitude was measured from 5 ft. away. Each bat took three measurements of exit speed and amplitude for every 2 in. from the handle of the bat.

Results

The results showed that the difference in sound amplitude correlates with the difference in ball exit speed, meaning an effect on the size of the sweet zone. For the most part (about 76%), bats with a small difference in sound amplitude also had a small difference in ball exit speed. In order to further prove and support the hypothesis, more trials and more bats would be necessary.

Conclusions/Discussion

The results proved the experimenter's hypothesis wrong, due to the fact that not enough bats with a small difference in sound amplitude also produced a small difference in ball exit speed. However, enough bats, especially of the alloy material (7 out of 7), had positive results to prove the theory right that sound can affect the size of the sweet zone. Also, based on the data, the optimum choice for a bat would be a big barrel bat of the Demarini or Combat brand. In order to save money, get a bat with these characteristics. But, considering that not many patterns appeared, the swing itself is much more important than the actual bat.

Summary Statement

Sound amplitude does impact the sweet zone of a bat; meaning a small difference in sound amplitude leads to a small difference in ball exit speed.

Help Received

Dad helped conduct experiment; Michael Smart and the Scripps Ranch Renegades provided bats; Darren Critchlow mentored and guided me; Mrs. Elaine Gillum helped edit and revise my papers.

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)

Cameron C. Jones

Project Number

J0316

Project Title

We're Jammin': Using the Jamming Principle to Construct a Universal Gripper

Abstract

Objectives/Goals

My goal is to construct a universal gripper based on a flexible membrane (balloon) filled with a granular substance (e.g. coffee grounds) that is capable of picking up and holding a wide variety of objects. When connected to a vacuum, the granular material becomes rigid and the membrane can grasp objects without having any prior knowledge about the shape, size, or configuration of the object. This design can be used for many robotic applications in factories or other environments.

Methods/Materials

To test the capability and design of my gripper, I performed a series of tests to determine its limits. I tested the ability of the gripper to grip and hold three different shapes with increasing weights. The first shape I tested was a 40mm Ping-Pong ball. The second was a 16mm diameter hollow brass rod, and the third was a 48mm square block. For each shape I held the item for 5 seconds to see if it could hold the weight. The test was repeated 10 times for each weight to estimate the reliability of the gripper. I then increased the weight and repeated the test until high failure rates were observed.

Results

The universal gripper lifted a 40mm Ping-Pong ball reliably up to 250g in weight. It lifted a 16mm x 305mm cylindrical rod reliably up to 275g, and was able to lift a 48mm x 48mm x 16mm block up to 178g in weight. The performance of the gripper was more variable when I used the smaller diameter cylindrical rod than the Ping-Pong ball. I believe this is a due to the positioning of the rod on the balloon being more varied than a larger sphere, which normally was closer to the center of the balloon. The block was the most challenging object to lift given its size relative to the diameter of the balloon. The gripper is capable of picking up a variety of different sizes, weights, and shapes without knowing any further information.

Conclusions/Discussion

I demonstrated that building a universal gripper using the jamming technique was possible. I successfully built a gripper that lifted different objects with significant amounts of weight. The gripper is capable of picking up a variety of different sizes, weights, and shapes without knowing any further information.

Summary Statement

My project demonstrates a robotic gripping device capable of picking up objects with different sizes and weights without complex control software.

Help Received

My dad helped me with the purchase of the parts, the attachment of the vacuum lines, and with debugging my control program.

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)
James G. Karroum, II

Project Number
J0317

Project Title
Mechanical Advantage and Efficiency of Pulley Systems

Abstract

Objectives/Goals
The objective of my science fair project was to find out how changing the number and configuration of sheaves (pulley wheels) in a pulley system affects mechanical advantage and efficiency of the pulley system. My hypothesis stated that if correct, mechanical advantage will not increase with the number of sheaves in fixed systems, but will in block and tackle systems, and mechanical efficiency will decrease for both systems.

Methods/Materials
I built two frames to hang pulleys from # one for fixed systems, the other for block and tackle systems. My fixed systems have one, three, and five sheaves; my block and tackle systems have one, two, three, and four sheaves. To test my hypothesis, I threaded rope through the sheave(s), attached a weight to the load side of the rope and another to the fall side, recorded the amount of weight needed to lift the load, and repeated it for all systems.

Results
My data showed that in fixed systems there is no benefit to using more than one sheave because it progressively increases the fall weight to lift the load. Block and tackle systems have a benefit (even with friction) because they increase mechanical advantage, meaning that a smaller fall weight is needed to lift the load.

Conclusions/Discussion
My conclusion is that when the number of sheaves increases, mechanical advantage does not increase in fixed systems, but does in block and tackle systems. Mechanical efficiency decreases in both systems when the number of sheaves increases. My hypothesis has been proven correct.

Summary Statement
How the number & configuration of sheaves in a pulley system affects mechanical advantage & efficiency.

Help Received
Dad helped me build the apparatuses. Mom helped me gather the materials and proofread my report.

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)
Maryam Khan

Project Number
J0318

Project Title
Power of the Arch: How Much Can 4 Eggshell Arches Hold & Will the Weight They Can Hold Double with Twice the Eggshells?

Abstract

Objectives/Goals
My project was to discover the strength of arches using the questions: how much can four eggshell arches hold up, and will the weight they can hold up double with twice the number of eggshells? My hypothesis was that the eggshells will be able to hold up about 2 kg, and yes, the amount of weight will double with the number of eggshells.

Methods/Materials
I used twelve eggs, cellophane tape, scissors, a toothpick, three different sets of plates, and a gram scale. First, I poked a hole into the bottom of the egg with a toothpick and let out the contents. I then wound tape around the middle of the egg, to cut it in half easily. I had to make each egg as smooth and even on the bottom as possible. Because it was almost impossible to make all the eggs the same height, I piled star stickers on top to even it out. Next, I arranged four eggshells into a square and the remaining eight into another one. I stacked plates on top of the set of four eggshells until they broke down, and I recorded the results. I repeated the experiment with eight eggshells, and placed plates on top of them until they broke as well. I then recorded the results.

Results
I discovered that the set of four eggshells held up approximately 12 kg. The eight eggshells were able to hold up about 18 kg.

Conclusions/Discussion
These results show that my hypothesis of 2 kg was very off. I was also wrong in that the set of eight was only able to hold a little over 1.5 times the weight, not double.

Summary Statement
My project is about the amount of weight arches constructed of eggshells can hold.

Help Received
After I wrote my rough draft, my mother helped typed my report. My mom, aunt, and cousin helped organize my display board. My teacher, Selena Khan, proofread and helped me edit my report. My teacher, Selena Khan, advised me on how to improve my project.

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)

Skyler Mattos; Morgan Waldner

Project Number

J0319

Project Title

Comparing Bridges: Arch, Suspension, or Beam?

Abstract

Objectives/Goals

Our objective was to determine which bridge design: suspension, beam, or arch was the strongest. We predicted that the suspension bridge would hold the most weight because there are more support systems within the bridge that will help prevent the bridge from breaking so easily.

Methods/Materials

We built three different styles of bridges. In total we built twelve bridges, four per design. So, we built four suspension bridges, four beam bridges, and four arch bridges. We built all twelve bridges using modeling glue and balsa wood. After we built all of the bridges we broke nine of the twelve bridges by using sand as the weight that we added and an old structure testing device.

Results

At the end of our experiment we found out that our hypothesis was incorrect. In the end, the beam bridge design supported the most weight at eight pounds. the arch and suspension designs held less weight, each bridge held only two to two and half pounds each.

Conclusions/Discussion

In our experimnet the beam bridge design supported more weight. The beam bridges did weigh a little more than teh other designs so we could hypothsize that as one of the reasons it could hold more weight.

We did further research after our experiment and learned that beam bridges are actually the weakest of all bridges and suspension bridges are the strongest. This led us to think that maybe our results have varied due to a fault in our design. Another factor that could answer why we got these results is due to the suspensioon bridge needing wire. Using wire made the task of building the bridge very difficult. In the end, we think we think we would have to do another experiment in order to figure out the cause of our varied results. In particular, we would need to focus on perfecting our bridge design.

Summary Statement

Our project is about comparing three bridge designs to see which one will support the most weight.

Help Received

Teachers helped gather supplies and materials. Partner's mother helped us brainstorm for our report.

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)
Kenyon B. Prater

Project Number
J0320

Project Title
Is It Possible to Construct a Vacuum Airship?

Abstract

Objectives/Goals
I wanted to investigate whether it would be possible or practical to construct a vacuum airship -- that is, an airship with a "shell" filled with vacuum rather than with a lifting gas like Helium.

Methods/Materials
I did not have the required materials and finances to build tens of model vacuum airships, so I used a computer simulation method called Finite Element Analysis. Using it, I applied the force of the atmosphere to different shapes, sizes, and materials of vacuum airship.

Results
With the designs I tested, there were no solutions that would work with ordinary building materials like metal. However, using new materials like manufactured diamond and carbon nanotube composites, it would be possible to construct a vacuum airship.

Conclusions/Discussion
While my results show that it would be possible to construct a vacuum airship, whether they would be more useful than a standard airship or an airplane remains to be seen. One possible use for vacuum airships is the exploration of other planets with an atmosphere. For example, while Venus' terrible conditions on the surface would melt away any probe we sent there in hours or minutes, a high-altitude blimp might be surprisingly stable. Of course, with a standard blimp, this means carrying large amounts of helium, which would be costly to transport into space. A vacuum airship would not have to carry anything, making it more practical.

Summary Statement
I used Finite Element Analysis, a computer simulation method, to investigate the possibility and practicality of constructing a vacuum airship using new materials.

Help Received
My father helped explain some math and troubleshoot the Finite Element Analysis program.

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)
Azzurra-Sky Riley

Project Number
J0321

Project Title
Measuring a Sand Substitute In Concrete

Abstract

Objectives/Goals
The purpose of this experiment was to determine whether coffee grinds are a suitable substitute for sand in concrete.

Methods/Materials
Materials:
Water, Cement, Coffee Grounds, Sand, Aggregate (Rock), 2 Large Mixing Bowls, Electrical Concrete Mixer, Gram Scale, Graduated Cylinder, Metal Rod, Mouth Mask, Safety Goggles, Camera, Video Camera, Cylinder Containers.

Method:
A total of 6 batches of concrete mixtures were made with different amounts of sand, coffee grinds, cement, water, and aggregate. One batch served as a control with 0% coffee grinds and 100% sand in the mixture. The second batch had 10% coffee grinds and 90% sand, the third batch had 20% coffee grinds and 80% sand, the fourth had 30% coffee grinds and 70% sand, the fifth batch had 50% of both sand and coffee grinds, and the last batch, batch 6, had 100% of coffee grinds and 0% sand. Once each batch was mixed and poured into the plastic sample containers, they were left to cure for 8 days. Then the cylinders were taken out of the cylindrical containers, capped with gypsum to make the bottoms and tops very smooth and fill any of the holes on top surface. This "capping" was done to make sure that when they were tested, by the compressive strength test machine that the pressure would be applied to the whole surface area, not just one spot. After the gypsum caps dried, the samples were tested on the compressive strength machine.

Results
The experiment showed that all of the test samples containing coffee grinds significantly underperformed the control group.

Conclusions/Discussion
The data shows that the hypothesis was not supported and that coffee grounds are not a good substitute for sand in concrete.

Summary Statement
I substituted coffee grinds in for sand when making concrete.

Help Received
Guidance by parents; use of lab equipment at Heider Engineering Services under the supervision of Mr. Denis Heider.

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)
Ken R. Ruth

Project Number
J0322

Project Title
A Better Way to Prevent Concussions: The Addition of Non-Newtonian Fluids to Helmet Padding

Abstract

Objectives/Goals
To study the effect of the addition of non-Newtonian fluid to helmet padding on the force generated on the head during a football hit.

Methods/Materials
I studied this concept by dropping a weight onto standard helmet padding material, non-Newtonian fluids (borax/glue and cornstarch/water) of different thicknesses and non-Newtonian fluids in combination with the helmet pads. I used an accelerometer to measure the deceleration of the ten pound weight dropped from 50 and 100 cm heights onto the test materials.

Results
The addition of non-Newtonian fluids to helmet padding does decrease the deceleration of the dropping weight, from 32% to 79% at a 50 cm drop height, and from 17% to 60% at a 100 cm drop height. In addition to decreasing the maximum deceleration, non-Newtonian fluids spread the forces out over a longer period of time, and decrease the rebound of the weight. At 50 cm, the borax and glue affected the deceleration the most, while at 100 cm, the cornstarch and water was superior.

Conclusions/Discussion
I learned that the addition of non-Newtonian fluids to helmet padding decreased the force of impact. This may mean that the addition of non-Newtonian fluid to helmet padding will decrease the concussion rate.

Summary Statement
I studied the ability of football helmet padding and non-Newtonian fluids to lessen the force of a impact.

Help Received
Nathan Pfaff helped with using the accelerometer, and recording the data; Dad helped construct the test device.

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)
Kaushik Shivakumar

Project Number
J0323

Project Title
Effects of Roller Coaster Configurations on the Car's Final Velocity

Abstract

Objectives/Goals
The purpose of my project is to determine the factors that make a roller coaster ride enjoyable and long-lasting. Based on my research and using the law of conservation of energy, my hypothesis is that for roller coaster configurations with a fixed starting height and fixed track length, the final velocity of the car will not be influenced by the track's configuration.

Methods/Materials
In order to simulate a roller coaster, a skyrail marble coaster was used where the marble represented the car. The plastic tracks were twisted into different shapes to mimic roller coaster tracks of twelve different configurations. A marble was gently placed at the same starting height and a video camera was used to record the movement of the marble on the last 59 cm segment of the track where the average final velocity of the marble was measured. By slowing down the video to one-eighth of the real-time speed, accurate measurement of the time was possible, and final velocity was calculated by dividing the segment length by time. To eliminate friction as a variable in the experiments, the track was set to a fixed length for all track configurations, since the track length was assumed to be the only source of friction in the experiments.

Results
The final velocities of the marbles varied with configuration. Configurations in which the marble travelled nearly horizontally, at low speeds, for a major portion of the track before quickly dropping near the end of the track had the highest final velocities. However, configurations which included early big drops and vertical loops resulted in lower final velocities. The results showed that, in addition to the track length, the speed at which the marble travelled was also responsible for the frictional effects experienced by the marble.

Conclusions/Discussion
Based on these experimental observations that the car's final velocity depended on the coaster configuration, I came up with a design for building roller coasters. By placing the thrill portions of the ride that involve big drops and loops towards the end of the tracks, the rides will last longer and be more thrilling. Some future research that I could do is to identify what forces other than friction cause loops to have lower final velocities and how they can be designed in a better way.

Summary Statement
The goal of my project is to determine factors that will maximize the thrill and duration of a roller coaster ride by studying the effects of various roller coaster configurations on the car's final velocity.

Help Received
My father and mother supervised my research and reviewed my presentation and poster.

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)
Steven A. Silverglate

Project Number
J0324

Project Title
RC Car Suspension

Abstract

Objectives/Goals
My objective was to find which type of shock oil gave the optimal absorption rate for a remote controlled car.

Methods/Materials
An accelerometer was attached to a remote controlled car and driven over a small bump at constant velocity for three trials per shock oil weight. Nine different weights of shock oil were tested from 20 through 100 weight increasing in increments of ten. The average G force across three trials for each oil weight was calculated from data collected by the accelerometer.

Results
The 30 weight shock oil provided the optimal dampening rate for the remote controlled car. The graph produced by the accelerometer for the 30-weight shock oil had neither reverberating peaks nor did it have a large spike that quickly returned to zero. This showed that 30-weight shock oil optimally dampened the car#s suspension movement.

Conclusions/Discussion
My conclusion is that 30-weight shock oil is the best oil weight because the car did not reverberate excessively nor did it have a hard impact then quickly return to zero.

Summary Statement
My project is about finding the best shock oil viscosities for a remote controlled car so that optimal shock absorption and dampening of the car can occur while driving over a road bump.

Help Received
Dad and science teacher helped me create graphs on Excel and find an accelerometer; Mom purchased the different types of oil that I told her I needed; Tutor helped me write the report while I dictated my thoughts to her.

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)

Holly B. Spurgeon

Project Number

J0325

Project Title

Who Has Short Legs? We Have Short Legs!

Abstract

Objectives/Goals

My objective was to learn if the leg length of female gymnasts affects how long they can hold a standard handstand.My hypothesis was that female gymnasts with a 67-73 centimeter leg length and female gymnasts with an 84-90 centimeter leg length both do a standard handstand,then the gymnasts with the 67-73 centimeter leg length will be able to hold the handstand for approximately 4-7 seconds longer than the gymnasts with the 79-90 centimter leg length.

Methods/Materials

The materials used for my project were 42 female gymnasts provided by Elite Gymnastics Academy, one tape measure, one stopwatch, and one mat. First, the gymnasts legs were measured in centimeters with a tape measure.Secondly, the gymnasts were instructed to perform a standard handstand.Last,the gymnasts were timed in seconds while they were in the handstand.The gymnasts were then categorized into groups determined by leg length;55-60 cm.,61-66 cm.,67-72 centimeters,73-78 cm.,79-84 cm.,and 85-90 cm.

Results

After experimenting,I found that the average amount of time a gymnast with a leg length of 55-60 centimeters could hold a handstand is 1.9 seconds.The average for gymnasts with a 61-66 centimeter leg length is 5.3 seconds.Gymnasts with a 79-84 centimeter leg length average time was 6.3 seconds.Finally,the gymnasts whose leg length was 85-90 centimeters long had an average time of 2.4 seconds.It has been shown that the female gymnasts who had the second longest leg length group of 79-84 centimeters,could hold the handstand a considerable amount of time longer than any other groups of leg length.

Conclusions/Discussion

Based on research,data,and results,it can be concluded that female gymnasts with a leg length of 79-84 centimeters can hold a standard handstand longer than gymnasts with the shorter leg length of 67-73 centimeters.The hypothesis; girls who have the shorter leg length of 67-73 centimeters will be able to hold a basic handstand longer than the gymnasts with the longer leg length of 79-84 centimeters,was disproved.Overall,the experimental procedure was a success because now the stereotype that shorter-legged gymnasts are better at handstands,has been proven incorrect.This will help the gymnastics community to not have biased opinions on which "style" of gymnastics is better-the powerhouse,muscley build for the gynasts,or the more graceful,artistic,ballerina type build for the gymnasts.

Summary Statement

This project was conducted to see if leg length has any impact on handstand hold time in gymnastics.

Help Received

Mother helped time handstands; Experiments were performed at Elite Gymnastics Academy of San Diego under the supervision of owner,Paula McCalester.

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)
Bailey E.L. Stormes

Project Number
J0326

Project Title
What Are the Differences in Bullet Velocity and Penetration on Different Barrel Lengths of Guns?

Abstract

Objectives/Goals
My project was used to determine if barrel length affects bullet velocity and penetration. I believe that the gun with the longest barrel will have the highest rate of velocity and penetration.

Methods/Materials
When conducting this experiment, three guns of the same caliber with different barrel lengths were used(Springfield Bolt Action .22 Rifle 24.25 in., Ruger .22 Rifle 18 in., Colt .22 Pistol 4.5 in.) Twenty-five shots were fired out of each gun for five trials while standing thirty feet away from the selected target. Frozen candle wax was used to measure the penetration of a projectile. Fifteen shots per gun were fired to measure the penetration of the bullets. The bullets used were XPERT HV .22 Long Rifle. A chronograph was used to measure the velocity of the projectile. A twelve inch ruler was used to measure penetration.

Results
The gun with the longest barrel (Springfield Bolt Action .22 Rifle 24.25 in) had the greatest velocity out of the three selected guns.
The gun with the mid-sized barrel length (Ruger .22 Rifle 18 in.) had the deepest penetration.

Conclusions/Discussion
My conclusion is, the gun with the longest barrel had the highest rate of velocity with an average speed of 1069.656 Feet Per Second (FPS). The gun with the mid-sized barrel had the deepest penetration with an average of 4.9 inches. My hypothesis that the gun with the longest barrel would have the highest velocity was proven correct. However, the second part of my hypothesis stating that the longer the barrel the deeper the penetration was proven incorrect.

Summary Statement
The affects of barrel lengths on the velocity and penetration of a projectile.

Help Received
Father and Mother took me to the range to shoot and supervise.

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)

Ethan P. Strull

Project Number

J0327

Project Title

Heads Up: Do Soccer Head Protectors Affect the Amount of Force to the Head?

Abstract

Objectives/Goals

Concussions are a rising problem in contact sports, especially in children's soccer. The purpose of this research was to determine whether these soccer head protectors that are currently legal in FIFA, The International Federation of Association Football, help protect against concussions.

Methods/Materials

To test whether the head protectors worked, a Dual-Range Force Sensor was attached to the Vernier Labquest and was embedded in a styrofoam head. A 1.82 kg medicine ball was rolled down a ramp and it collided with the styrofoam head. The force sensor measured (in Newtons) whether the head protectors reduced the force of the collision. Three trials were performed for the front, and then back of the styrofoam head.

Results

The head protectors reduced the force to the head only 2 to 4 percent compared to the control (no head protector). These results suggest that the head protectors do not protect the head to the extent that the product manufacturers stated.

Conclusions/Discussion

These soccer head protectors protect the head minimally. However, some of the companies that designed these protectors advertise 20 to 40 percent reduction in force to the head. This can provide players wearing the head protectors a false sense of protection, cause them to play soccer more aggressively, and increase the likelihood of suffering a concussion. Because soccer is the most popular sport in the world, there needs to be a way to make the sport safer, yet preserve the essence of the game.

Summary Statement

This study tests whether soccer head protectors reduce the force of a collision, thereby reducing the likelihood of receiving a concussion.

Help Received

Neighbor helped construct ramp; Mom was testing assistant who released medicine ball at top of ramp; Mom helped cut and glue project board

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)

Dylon M. Tjanaka

Project Number

J0328

Project Title

Up-Down Stair Climbing Robot Using Push-Pull Wheel Mechanism

Abstract

Objectives/Goals

The objective of this project is to design, construct, and analyze a simple portable robot that can climb-up and climb-down staircases. This type of robot has many applications, such as space exploration scout, home security watchdog, military drones, robotic vacuum cleaners, agriculture land surveyors, toys, senior citizen wellness monitors, and wheelchairs.

Methods/Materials

I researched several similar robots, such as the Crawler and iRobot 110 FirstLook. I decided to engineer a stair climbing mechanism that I call Push-Pull Wheel Mechanism. The mechanism works by using the front wheels to pull and rear wheels to push. I implemented the Push-Pull Wheel Mechanism by designing and constructing a portable robot using the Lego Mindstorms NXT 2.0 kit. Then, I wrote the program for the robot using NXT-G programming language. I also built a cardboard staircase for testing purposes.

Results

I successfully built a portable robot that can climb-up and climb-down staircase steps using the Push-Pull Wheel Mechanism. To validate the functionalities, I tested my robot on the cardboard staircase and a real staircase. I also analyzed how the robot actually climbed up and down the staircase steps. During the course of the project, I encountered many challenges that I had to solve. I listed all these challenges and solutions in my report. One of the biggest challenges was how to make the robot come down the stairs without tipping over. I had to examine the physics of the robot and determine where to position the center of gravity and how to control the speed of the robot. Another big challenge was that the robot was stuck at the first step of the staircase. I fixed this issue by increasing the height of the U-shaped portion of the robot.

Conclusions/Discussion

I successfully implemented the Push-Pull Wheel Mechanism. However, I believe I could still make several future improvements. One improvement could be to use an accelerometer to detect whether the robot is going up or down. Another improvement is to use a different type of robot kit to provide more freedom with my designs. For example, I might be able to use 4 motors rather than the 3 allowed in the Lego Mindstorms kit.

Summary Statement

I am designing and constructing a portable Lego Mindstorms robot that uses the Push-Pull Wheel Mechanism to climb up and down staircase steps.

Help Received

Mr. Barber (Principal) paid for the application to Synopsys Science Fair; Mr. Tu (Science Teacher) helped with science fair preparation; Ms. Hayden (Science Teacher) taught the science fair class; Mother provided critical opinions and advice; Father provided technical advice and direction.

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)
Samuel A. Villicana

Project Number
J0329

Project Title
Foundations Under Us

Abstract

Objectives/Goals
What I am going to do is test to see what is the best foundation of all the ones I chose which were Pier Style, Pad Style and Tri-pod Style, and how much weight will destroy them. I think that the Pier Style is the most successful, and that about 22 kilograms will destroy the foundation.

Methods/Materials
I am simply going to put bricks on top of the foundation and once it breaks I will record it, the data. I am going to use a scale, 2.4 KG bricks, notebook, pencil, camera, K'nex plastic building toys.

Results
I found out that there are many foundations, and they vary, but I chose the top three. Also, I learned that weight mainly destroys a foundation. Egyptians invented the first foundation, and we are trying to build a tower a mile high! My results are very important because this pertains to contractors who build houses, buildings, and, skyscrapers. Also, Structural Engineers, because they would design, and they could build ideas off of the Pad Style. Also building designers should stay using Pad Foundation, who knows maybe a contractor will follow my follow my ideas and results!

Conclusions/Discussion
My testable question is "What is the best type of structural foundation, and how much weight would destroy the foundation?" The answer is that the Pad Foundation was the best, and the amount of weight necessary for destruction vanes was 33 Kg. The Pad foundation was very strong, the Pier Style was strong as well, but the Tripod Style was the weakest. The Pad Style was the strongest, it spread the stress out evenly on the pads. The Pier Style only had column supports, so those bent which caused the structure to collapse. The Tripod Style was very weak, with only one support column; all the weight went to the bottom and when one piece broke, it all went falling down. In conclusion, Pad Style is the best foundation out of all three styles. The weight resistance varies for all structures, but there was an average for all of them.

Summary Statement
Finding out what is the best structural foundation.

Help Received
Teachers helped edit reports; Sister helped testing; Parents helped supply me board, laminations, and ink.

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)

Reed Williams; Benjamin Zdasiuk

Project Number

J0330

Project Title

Fall Factor: Testing the Forces Resulting from Lead Climbing Falls

Abstract

Objectives/Goals

To find the forces resulting from lead climbing falls and to find an effective way to reduce these forces.

Methods/Materials

Materials: #50 meter long, 10.8 mm diameter climbing rope; #Two 25 lb weights; #Weston 320 lb scale with slider to record maximum weight; #Two slings (for anchor and to attach scale to tree); #Two carabiners for anchor point; #Kong Impact Shock Absorber (KISA); #Tape measure.

For Standard Test:

1. Assemble anchor point using sling and carabiner attached to railing. 2. Pass rope through anchor point and tie rope to weight(s). 3. Set distance of fall by measuring length of rope between weight and anchor point. 4. Tie other end of rope to scale attached to tree. 5. Drop weight from anchor point. 6. Record force of fall. 7. Repeat steps 2-5 three times for each distance.

For Friction Device Test:

Repeat steps in standard test while using the friction shock absorber device.

For Belayer Test:

Repeat steps for standard and friction device tests, tying rope and scale to a human belayer rather than a tree.

Results

For the 25 lb weight, the forces recorded ranged from 49 lbs at 5 ft up to 111 lbs for a 12-ft fall. For the 50 lb weight for a 5 ft fall, 185 lbs was the minimum. The maximum for an 11 foot fall was 285 lbs. For both weights, at 9 ft the forces started to increase less with distance. We believe this happened because a damping material in the rope started to activate at this distance or force. The friction device tests showed that the device reduced the impact forces, especially on longer falls; for an 11 ft fall the force was reduced by ~40 %. In the belayer tests, we found that a human belayer acts as a shock absorber and dampens the impact forces. Some of the forces with a real belayer and friction shock absorber were less than 50% of those without a friction device and no belayer.

Conclusions/Discussion

From our tests, we observe that long lead-climbing falls generate forces that can injure people. We also found that forces generated by these falls were not linear, and varied with fall height, most likely due to the stretch of the rope. The inexpensive, easy-to-use, reusable friction shock absorber greatly reduced the impact force during falls. This device could potentially save lives and prevent injuries if climbers used it. We also found that a human belayer acts as a shock absorber. The friction device and belayer together

Summary Statement

To find the forces resulting from lead climbing falls and to find an effective way to reduce these forces.

Help Received

Julie Foquet helped check our board, Kirt Williams let us use his 60M dinamic rope and two 25 lb weights. Mother edited writeup.

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)

Matthew R. Wong

Project Number

J0331

Project Title

Take the Shake of the Quake: Testing of Seismic Design of Structural Frames

Abstract

Objectives/Goals

Earthquakes are inevitable; however, people can seismically design and retrofit their homes to increase structure safety. Bracing is a widely used lateral resisting system. The goal of this project is to find out how effective a bracing system is for withstanding simulated earthquakes and which type of bracing system is more effective for wood structure frame.

Methods/Materials

A shake table was made of a wooden platform attached to a LEGO NXT motor and brain, which was programmed with "LEGO MINDSTORMS NXT 2.0" to simulate 15 levels of earthquakes. Every level, the strength of the motor is raised by 5. In the program, motion blocks and loops execute actions. The motion blocks make the motor shake the platform. The loops repeat the motion. Wooden Skill Popsicle sticks were used to make 18 wood structure frames. White glue was used to glue the frames' joints. Five types of bracing systems including Single Diagonal, Double Cross, Inverted V, Knee, and K Bracing were tested. Each frame was attached to the platform with rubber bands and weights. The table shook each frame for 20 seconds. If the frame did not collapse, the level increased by 1. Results were reported as levels of shaking and time that each bracing design withstood the simulated earthquakes.

Results

To standardize the measurement for each level, the product of sustained time and power is defined as Power-Time. The effectiveness of the structure is defined as the sustained Power-Time divided by the target Power-Time. In summary, Inverted V-Bracing was the most effective design. It was able to withstand up to an average of 12.7 levels on the shake table with 76.1% effectiveness. Knee Bracing was the least effective with 22.4% effectiveness and an average of 5.7 levels. The effectiveness of Inverted V-Bracing was more than 4.5 times the control. K, Double Cross, and Single Diagonal-Bracing had about the same effectiveness. The study cannot conclude which of the three is best because they were all within a range of 4% effectiveness.

Conclusions/Discussion

This study showed that all wood structure frame bracing systems are effective, compared to the control. In conclusion, Inverted-V bracing is the best for withstanding simulated earthquakes. It is 29.8% more effective than the next most effective types of bracing. Clearly, it is worthwhile for residents in the Bay Area to use bracing to reduce damage in future earthquakes.

Summary Statement

This project is to find out the effectiveness of five types of bracing systems on wooden structure frames for withstanding simulated earthquakes.

Help Received

Thanks to my mom for helping me with the photos and the supplies. Thanks to my teacher for her guidance.

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)
Zana M. Youssef

Project Number
J0332

Project Title
Strongest Truss Bridge

Abstract

Objectives/Goals
The purpose of this project is to investigate the load carrying capacity of different type of truss bridges. I knew I wanted to attempt this investigation one year ago. The idea came to me at the County Science Fair Competition last year where I saw 3 types of bridges displayed for judging; Suspended, Truss, and Beam. After that I focused on trying to figure out which type of truss bridge will be the strongest, Equilateral, square, and 30-60-90 deg. I chose to focus more on truss bridges because it is more practical and economical to build. Since then I started obridges. Why not only use one type? This would be easier and probably cheaper.

Methods/Materials
1) Equilateral
2) Square
3) 30-60-90 deg
The bridges were built using Balsa wood, Popsicle sticks, and tacky glue. Once the bridges were built and were dry enough to be tested, the Equilateral truss bridges were loaded first. The bridges were supported on each side by metal stools, and I hung a bucket from the center of the bridge and filled it up with water. I added water gradually to the bucket until the bridge broke. Once the results were recorded, the same test was performed on the Right Isosceles truss bridge as well as the 30-60-90 deg truss bridge. The same tests were performed two more times on each type of bridge, and the results averaged and recorded. The following materials were used in making the bridges:

Method
In order to do a scientific and accurate investigation, the three truss bridges were built for comparison purposes to study which one carries more weight. In order to perform a logical and equal comparison, the following conditions were chosen;
1) Length of all three bridges were kept the same
2) Materials used to build all three bridges were the same
3) The loading method to break the three bridges was the same

Results
The average weight held by the square bridge was 7.56 kg with maximum deflection of o.56 inches. The equilateral truss bridge held an average weight of 17.56 kg, and the 30-60-90 deg. bridge held the maximum load of 20.56 kg.

Summary Statement
My project is about 3 types of Bridges that were all tested in order to see which is the strongest and could hold the most weight.

Help Received
My dad and Brother helped me carry the bucket and attach to the bridge in order to break them.

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)
Adam Stefany

Project Number
J0397

Project Title
Stability of Variously Shaped Buildings in Increasingly Strong Winds

Abstract

Objectives/Goals
People's homes get destroyed by tornados and hurricanes. I wanted to find out if buildings shaped like a dome or a pyramid stand up better to high winds than a normal rectangular house with a sloped roof.

Methods/Materials
I put each building on a concrete floor two meters from a fan. I pushed the fan closer to each building. I recorded how far the fan was from each building type when it was blown from its position.

Results
I found that the fan had to be closest to the dome building (26.8 cm) before it would move. When the wind hit the long side of the house-shaped building it was still far away (65.5 cm). When the wind hit the short side of the house-shaped building it was much closer before the building moved (45.7 cm). The pyramid moved when the fan was 43.1 cm away if a corner was facing the wind and 45.0 cm away if the flat side was facing the wind. I thought that the pyramid would be most easily moved.

Conclusions/Discussion
This experiment shows that the strongest winds are needed to move a building shaped like a dome. The weakest winds move a building shaped like a normal house especially if they hit the long side of the house. A pyramid stands up to winds better than a normal house but not as well as a dome. In the future I would also like to find out how easily buildings of different shapes would collapse in high winds.

Summary Statement
How well do buildings of various shapes withstand windstorms.

Help Received
Father cut buildings with power saw, mother helped type.

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)
Zherui Xuan

Project Number
J0398

Project Title
Cantilever vs. Cantilever

Abstract

Objectives/Goals
My objective in doing this project was to find out which combination of tension and compression pieces in a small wooden cantilever will carry the most weight before breaking. Because of another competition that have very similar requirements as this, my goal will be to decide on which type of cantilever I would use in my competition.

Methods/Materials
Materials:
For Building the Cantilevers: -1/8" by 1/8" balsa wood sticks, -super glue, -crafting knife, -ruler, -protractor, -paper and pencil.
For Testing the Cantilevers' Capability: -smooth vertical surface, -measuring beaker, -water, -bucket with handle, -hook, -paper and pencil.
I followed the standard scientific method: ask a question, do research, make a hypothesis, conduct experiment to test hypothesis, analyze data and draw conclusion, and share my results.
My specific methods in carrying out my experiment is basically 4 steps:
1: Draw blueprints of my soon to be built cantilevers.
2: Construct the cantilevers according to blueprints.
3: Construct the cantilevers' testing apparatus.
4: Test all of the cantilevers and record the results.

Results
The cantilevers that were doing the best were the ones with similar length of compression and tension. This makes my hypothesis false. All 10 cantilevers broke at where the base connects with the 2 supporting beams, not at the actual beams. That fact mislead my hypothesis.
Degree of cantilever each with their liters of water held(refer to the "Question" page on board to know what the "Degree" is):
Also note that the more or less the degree is, the more unequal the tension and compression beams, 70 degree being the most equal.

Conclusions/Discussion
The more unequal the degree, the more unequal the forces are distributed. The cantilevers with small degrees will be mostly against the pushing force while ignoring the pulling force, and vice versa. The base of these "extreme" cantilevers are all split at one end because of the pressure the unrestrained force put on it, leading to the cantilever bending and breaking quickly.

Summary Statement
My project is about identifying the best combination of tension and compression piece for a small wooden cantilever and to find out why.

Help Received
Father helped me pour water into testing device.

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)
Landon R. Creighton

Project Number
J0399

Project Title
Does Doubling the Amount of Cement in Concrete Improve Torque Resistance?

Abstract

Objectives/Goals
To test the torque resistance of concrete mixes when the ratio of cement is changed. I will change the ratio of cement to the sand and gravel. I will start with a normal one part cement to two parts sand and three part gravel. The next test will have one and a half parts cement and the same sand and gravel ratio. The third test will have two parts cement to the same sand and gravel ratio. This will help anybody using concrete in a place where it could be twisted.

Methods/Materials
I built wood forms to make three sets of 12 # 1.5# x 1.5#x 12# samples for a total of 36 samples. I mix each batch of concrete and poured them into the forms for the batch. The concrete cured for 14 days. I marked the samples and removed the forms. With my dad#s help I made a machine that would twist the sample. Each side of the sample would be clamped into the machine with one side ridged and the other on a bearing. An arm was welded to the bearing side clamp then I hung a bucket near the end of the arm. For weight, gravel was slowly poured into the bucket. When the sample broke the amount of gravel was weighed and recorded.

Results
My data shows the concrete mix with the greatest amount of concrete has the most torque resistance. Here are the average weight loads of the concrete samples I tested. Each of the concrete mixtures where tested with 12 samples. Ratios are displayed with cement first, sand second, and gravel third.

Mix 1 # 1:2:3 ratio Average 4.29 lbs.
Mix 2 # 1.5:2:3 ratio Average 7.96 lbs.
Mix 3 # 2:2:3 ratio Average 9.38 lbs.

Conclusions/Discussion
The higher ratio of cement greatly increased the resistance to torque. Increasing the cement contents by another 50% almost doubled the resistance to torque.

Summary Statement
This project proves that doubling the cement in concrete increased the torque resistance of a concrete sample.

Help Received
I would like to thank my dad for building the machine I used for breaking samples in my project. I also thank my sister Audrey for proofreading my project and helping me with my board. I would also like to thank my mom for getting me science library books and typing my project.