CALIFORNIA STATE SCIENCE FAIR
2015 PROJECT SUMMARY

Name(s)

Jonathan M. Abrams

Project Number

J0301

Project Title

The Claw Cane; A Cane with a Claw Mechanism for Picking up Dropped Items

Abstract

Objectives/Goals

The objective of this experiment is to compare a cylindrical grasp claw and a lateral prehension grasp claw in how well they can pick up objects, and how well each one can be walked on when attached to a cane. The ultimate goal of this experiment is to find out which will function better for the construction of my invention, the cane claw.

Methods/Materials

I attached a bicycle brake mechanism to each cane. One cane had two brakes, and the other had one brake attached to it. The brakes had aluminum flat bars, which were attached to cane tips, attached to them. Brake handles were attached onto each of the cane handles and had bicycle wire attaching the brake handles to the brakes.

Results

The lateral prehension grip (2 prong cane) ended up being able to pick up a wider variety of items and overall more items than the cylindrical grasp (4 prong cane). Also, it was sturdier, according to test subjects, than the 4 prong cane when walked on. The 4 prong picked up a total of 47/66 of the items throughout the trials. The 2 prong picked up a total of 58/66 of the items throughout the trials.

Conclusions/Discussion

The reason why the 2 prong cane was able to pick up more objects is because the 4 prong cane's prongs would interfere with each other's paths when trying to grasp something small, while the 2 prong cane's prongs would provide each other support when grasping something. The reason why the 2 prong was sturdier than the 4 prong cane is because the 4 prong's brakes would wobble more. This would happen because they were not as tightly attached to the cane as the 2 prong's brakes. Also, the 4 prong was not as stable as the 2 prong because it is cane tips and flat bars on one of the brakes had to be attached at an angle.

Summary Statement

To invent a cane with a claw mechanism attached to it that can be walked on, and when necessary, can pick up dropped items.

Help Received

CALIFORNIA STATE SCIENCE FAIR
2015 PROJECT SUMMARY

Name(s)

Tayla Rae Beauchesne

Project Number

J0302

Project Title

Cool Tool

Abstract

Objectives/Goals

My project is a solar powered fridge that works from Avaporation and Condinsation to keep materials cool in places that dont have axcess to electricity.

Methods/Materials

I took a insulated contanir and drilled 1 1/2" holes all around it and lined inside with mesh screeing, then I inserted a aluminum contanier on the inside and added certain materials between outter contanier and inner container, then added water and threw the holes water would evaporate and cool the inside of the aluminum contanier.

Results

This Cooling process did work with certain materials but not with all of materials also the Tempature on certain days made a big differience on how well the cooling process worked.

Conclusions/Discussion

My fridge worked , I think that I needed alot hotter and dryer conditions
so the evaporation process would happen more rapidly witch would create more condinsation witch would cause the inner aluminum container to get alot cooler and would act more like a fridge.

Summary Statement

Keeping important items cooled in places that dont have axcess to electricity.

Help Received

My Fater helped me build fridge.

Name(s)

Jeanie C. Benedict

Project Number

J0303

Project Title

The Chinchiller: For the Coolest Pet on the Block: The Effect of Air Flow Restriction on Evaporative Cooling

Abstract

Objectives/Goals

During a major heat wave last September in Los Angeles, my pet chinchilla died from heat stroke. My objective was to create a evaporation-based cooling device for pet chinchillas and determine the optimum air flow rate to produce the greatest amount of cooling. I believed that too much or too little warm airflow would not produce the best cooling effect.

Methods/Materials

I designed and built a cooled resting block called the "Chinchiller" that goes inside the chinchilla's cage. The glass block is chilled by pumping water through it that has been cooled by evaporation. Evaporation rate is adjusted by varying the amount of air flow that blows across a wet cloth that has water pumping over it. I adjusted the airflow using different sizes of holes in disks that were placed in front of a fan. Using thermocouples and a computerized data acquisition program, I was able to record the temperature of the water. For each disk hole size and over the course of several days, the fan was alternately turned on and off at least 5 times to determine the effect of evaporation.

Results

I recorded the temperatures of the water exiting the evaporator (my dependent variable) for different disk hole sizes (my independent variable) compared to the temperature without the fan running (my control). I varied my disk hole sizes from 7.62 cm, to 5.40 cm, to 4.13 cm, and 2.86 cm. The air flow through the smallest-hole size disk (2.86 cm) cooled the temperature down an average of 2.3°C, which was the same amount the pump warmed the water due to friction. The 4.13 cm disk brought down the temperature by an average of 3.9°C. The disk with the larger hole, 5.40 cm hole and the 7.62 cm hole, both brought the temperature down by about the same 4.6°C.

Conclusions/Discussion

The airflow through 5.40 cm hole and the 7.62 cm hole was successful in cooling the block below room temperature, overcoming the warming effect of the pump by several degrees. My prediction was partially correct; the evaporative airflow through medium-sized hole cooled down the water better than the smaller holes, but was the same as the larger hole, so restricting the airflow does not actually help. My results showed that air flow beyond a certain rate did not result in any additional cooling effect.

Summary Statement

I created a Chinchiller device that will keep a pet cool on hot days that works bencause of evaporative cooling.

Help Received

I received help from my dad, who helped me design the Chinchiller, supervised me when I was using power tools, helped me install and use the Dataq data acquisition software, and taught me how to use Excel to make the tables and graphs.

Name(s)

Alexa Britton; Miranda Hauke

Project Number

J0304

Project Title

Which Bridge?

Abstract

Objectives/Goals

Compare 3 bridge designs with regards to their ability to hold a fixed amount of weight. The 3 bridge designs were Arch, Cable-stay, and Beam. We also considered the amount of time and resources it took to make each bridge.

Methods/Materials

Balsa, Pine and Bass wood
Scale
I-bolts
String
Bottles of water

Results

The arch design had the least sag with a fixed weight. Cable-stay was second while the Beam designed sagged the most. The Beam was easiest to build with the least resources with Arch being second and Cable-stay being third.

Conclusions/Discussion

Bridges using the arch design are the strongest but moderately difficult to build. We think the arch bridge is strongest because it is supported at 4 different points.

Summary Statement

The varying strength of bridges based on their design

Help Received

Parents helped refine idea. Teacher helped with board appearance

CALIFORNIA STATE SCIENCE FAIR
2015 PROJECT SUMMARY

Name(s)

Seth F. Carney

Project Number

J0305

Project Title

How Far Can It Go?

Abstract

Objectives/Goals

In my opinion, learning the difference the follow through of a shot makes is very important, because it can help many athletes get better at what they do. My objective was to discover if the follow through actually changes the distance of a kick. I was attempting to figure out if all of the coaches are right about telling us that we should always follow through when we shoot.

Methods/Materials

A golf ball
A golf tee
Screws
Hammer
Long metal rod
Two eight foot, two by three pieces of wood
Decent sized piece of plywood

Results

After my experiment, I saw some very interesting results. I found that I was correct because the free swing went the farthest with an average of 364.066 cm, but the one that stopped on contact got second with an average of 270.086 cm. I was expecting the one that stops shortly after contact to get second but it got an average of just 257.386 cm. These are the results I found in my experiment.

Conclusions/Discussion

My hypothesis stated, #if I adjust the follow through to right on contact, shortly after contact, and a free swing, then the free swing will make the ball go the farthest.# My hypothesis was proven by the data I collected. I know my hypothesis was proven because I calculated the results and found the averages and the free swing average was the farthest. I found that the farthest was the free swing, the second farthest was the stop on contact, and the shortest was the stop shortly after contact. In the future, I would like to test other variations of this project. For example, I would like to see if changing the degrees that the hammer starts at would affect the follow through. I would also like to try it on a larger scale. For example, I would like to make it to a large enough scale that I could use a real soccer ball instead of a golf ball. Lastly, I would like to see if different weighted hammers affect the follow through.

Summary Statement

Using a device I created, it tested that the difference in follow through of a kick affects the distance of a soccer ball.

Help Received

My brother helped me build the device.

CALIFORNIA STATE SCIENCE FAIR
2015 PROJECT SUMMARY

Name(s)

Hannah Chernavsky

Project Number

J0306

Project Title

The Strongest Wood

Abstract

Objectives/Goals

The objective of the experiment is to determine the strongest material to build a beam bridge, given a situation where the only resources to create a simple beam bridge are Balsa wood, Western White Pine, and White Oak. There are several factors to consider while building wooden bridges: the elastic property of wood, the physical characteristics of wood such as texture affect its bending strength, and finally, the structural design of the bridge.

Methods/Materials

Beams of western white pine, white oak, and balsa wood; Sand weights and bricks; Bar stools; Bucket; Loading bar; Scale.

Results

The hypothesis stated that White Oak would be able to hold the most weight while Balsa would be the weakest wood out of the three woods tested (White Oak, Balsa, and Western White Pine). The experiment supported the hypothesis. White Oak held 45 lbs on average, Western White Pine held 30 lbs, and Balsa held 3 lbs.

Conclusions/Discussion

As predicted White Oak was the strongest material to build the bridge out of the given choices. As with any experiment some lab errors did occur that could have led to inconclusive results. The bucket was too small, forcing the weights to overflow from the bucket and rest instead on the rope. The weights added were in large increments. For each wood, there was a general trend of a 2 to 5 pounds difference in each result.

Throughout the trials, uncontrolled events occurred that could have affected the results. One uncontrolled variable was the order in which the weights were deposited into the bucket using small increments rather than large bricks to avoid sudden stresses. There are several ways this project could be expanded and improved; the bending points of the woods could be measured; use the same wood but test different truss models to observe how the lattice work affects a bridge's strength; use smaller weights for consistent load-increasing. Finally, the project could expand by analyzing in-depth the structural strength of wood, specifically grain alignment, the strength of cellulose, and how the two come together to form wood.

Summary Statement

The purpose of the project is to determine the strongest material to build a bridge, given a situation where the only resources to create a simple beam bridge are Balsa wood, Western White Pine, and White Oak.

Help Received

My father helped with getting materials and assisting with the execution of the experiment; Mrs. Jacobson, guided me through the steps of this project

CALIFORNIA STATE SCIENCE FAIR
2015 PROJECT SUMMARY

Name(s)
Lucy A. Conover

Project Number
J0307

Project Title
What's the "Pointe" of an Uncomfortable Pointe Shoe?

Abstract

Objectives/Goals
I love to dance en pointe. It is my passion, but during every leap, rise, and turn, I ache with discomfort. This motivated me to engineer a better safer, cushion for your toes when en pointe! Based on my research on pointe shoe comfort, I think my test subjects will prefer to wear my sponge cushions instead of not wearing them at all.

Methods/Materials
I made a non-toxic cushion for pointe shoes that was thick to provide comfort, but thin to feel the floor. It is small so dancers would not have ill-fitting shoes. I engineered my cushions from plant-based sponges to be placed under the toes, where the most force is applied. While dancing en pointe, the test subjects (ages 11-17) executed selected ballet steps with the cushions and without. The test subjects were randomly assigned to dance with the cushions first, or not. They filled out a comfort assessment form after each level of the trial. A comfort rating of 1 meant it was uncomfortable, and 10 meant they felt no pain.

Results
For the test, the average comfort ratings were 6.9 (without cushions) and 8.7 (with cushions). The test subjects preferred the cushions 26.1% more that not wearing them at all. For the test there were 20 subjects, of that 20, 15 preferred to wear the sponge cushions (because their comfort ratings were higher), four of them preferred the cushion equally, and one person preferred to not wear the sponge cushions. The most commonly chosen (by the test subjects) comfort rating without cushions was a 7, and the most common chosen comfort rating with cushions was a 10.

Conclusions/Discussion
To conclude, many ballerinas suffer from discomfort. Injuries, ill-fitting shoes, and the wrong padding may be the reason why. A plant-based sponge toe cushion is a unique and earth friendly solution to other toe pads, plus it is a renewable resource. My hypothesis was proven correct. My sponge cushions are more desirable among dancers. All average comfort ratings were higher when the cushions were worn on the dancers feet.

Summary Statement
Creating a safe toe cushion to alleviate the discomfort of pointe shoe dancing.

Help Received
My teacher helped me with my timeline and was my mentor, my dance instructor at school let me use her studio and class time to test subjects.

Name(s)

Dina S. Dehaini

Project Number

J0308

Project Title

Project Double Tsunami Walls

Abstract

Objectives/Goals

The purpose of this project is to test retractable tsunami walls that stop the negative tsunami(the drawback before the initial wave) and the positive tsunami(the initial wave). These walls lie on the floor when not in use and rise using the force of the tsunami waves and then lock into place using sliding locks. This project tested flat and curved walls while testing each barrier solitarily and together ten times each. It was hypothesized that the curved walls would be the most efficient walls because it would repel the wave and that stopping the negative wave would reduce the force of the positive wave.

Methods/Materials

Build a box structure from wood and stransparent material(5'by1') with a wave generator at one end(comprised of a wooden board,bungee cords, and hinges) and a wooden "shore" at the other. Build the walls from two polycarbonate sheets(12"by14" and 12"by12"). Attach wood strips to the top of the walls so that they could catch the water and rise. Use hinges to attach them to the bottom of the structre 7" away from the shore facing opposite directions with 1" between them. Pull the generator out and release to generate tsunamis. Video tape trials to input into tracker software which calculates speed, height and distance travled by wave in the video. To curve walls, bend them to a curve depth of 1/2 an inch.

Results

Stopping the negative tsunami wave decreased the force of the positive tsunami wave by 20% and decreased the height by 40%. Both types of walls were able to rise and fully protect the shore from both tsunamis, however, the curved tsunami walls came up faster than the not curved tsunami walls and were able to repel the wave back more efficiently. This is because the curved structre stops the trough(bottom) of the wave before the rest of it resulting in a withdrawl of the wave and more stable stuctures.

Conclusions/Discussion

After testing each retractable wall, it became apparent that both hypotheses were true. The curved wall structures were able to rise faster therefore decreasing overall damage. The curved structure was able to catch the water like wind in a sail. The walls were also able to repel the wave backwards, thereby, making the walls more stable. Also, stopping the negative tsunami was able to reduce the overall force of the positive wave greatly so the positive tsunami was easily stopped by the positive tsunami wall.

Summary Statement

To test retractable tsunami walls that stop both the drawback before the initial tsunami and the initial tsunami and rise utilizing the force of the of the two tsunami waves.

Help Received

Father helped with supplying equipment needed for testing structure. Coach or mentor helped find software to measure speed, height, and how far the tsunami waves travelled up the shore throuout the videos taken of each trial.

CALIFORNIA STATE SCIENCE FAIR
2015 PROJECT SUMMARY

Name(s)

Ryan M. Dubois

Project Number

J0309

Project Title

Most Effective Home Made Solar Heating Device

Abstract

Objectives/Goals

My objective was to find out if there was an easy way to help poor people in third world countries be able to cook without electricity. This led me to the question: Which of the three main ways to collect heat from reflecting sunlight with mirror optics is the most effective when home made: Trough System, Power Tower System, or Dish Engine System?

Methods/Materials

1. Build 3 devices from cardboard, mylar, and some scrap pieces of wood: Dish Engine System, Trough, and Power Tower. Make sure each has a 3 ft by 3 ft reflective area
2. Build a stand that can hold an empty soda can in the focal point/line of your trough and dish engine.
3. Paint a soda can black.
4. On a sunny day aim your devices toward the sun. Prop if necessary.
5. Put the can in the focal spot of the dish engine and measure temperature for 2 min and take the highest reading, then measure the temperature of the can using an infrared thermometer. Repeat for the trough and power tower.
6. Repeat steps 4) & 5) as many times as possible until it gets dark.

Results

The Dish engine system was by far the most effective solar heating device, with an average of 605.85 degrees fahrenheit, the other two devices were both below 300 degrees fahrenheit.

Conclusions/Discussion

The Dish Engine System is the most effective home made device, because it concentrated the same amount of energy to a smaller area.

I discovered that it would be possible for citizens of 3rd world countries to cook using solar power, and some cardboard, glue, and reflective material. One thing I noticed about the dish was that it reached its peak temperature at around 1 minute and 30 seconds then it started to decrease. This shows that if you really wanted to cook with the device you would need to constantly be adjusting it to the angle of the sun.

Summary Statement

I wanted to help people in third world countries be able to cook without electricity, so I made three home made devices and explored which is the most effective.

Help Received

My dad helped me build the devices and helped when I needed an extra hand

CALIFORNIA STATE SCIENCE FAIR
2015 PROJECT SUMMARY

Name(s)

Fletcher Gaucher; Rohan Sethi

Project Number

J0310

Project Title

Stop Drop and Quake

Abstract

Objectives/Goals

Our goal was to design and test the best way to retrofit a two story house to make it earthquake safe.

Methods/Materials

-Foam Board
-Duck Tape
-Bungee Chords
-Tape
-Tennis Balls
-Bean Bags

Results

Our hypothesis was accurate that one of the retrofitted houses will survive the best. During the process we thought the "X" and pole bracing would survive the best but it ended up surviving the second best. The rubber band bracing was an idea that our expert recommended. We were given blueprints of a building being retro fitted. The design on the prints was an old building that was having steel rods placed below the floors to hold the was together. The designs were all successful. We tested them all on the same shake table at a 7.0 magnitude and as it progressed all the earthquake retrofitted houses survived better. We learned that concrete rebar would help it survive because it still might move even if there is no damage. The basic house survived for the shortest time period at the same 7.0 magnitude. The best design was the elastic bracing. The design lasted 41 seconds at a 7.0 magnitude.
After analyzing our results we found that using a stretchable material will hold a building together. When the building was placed on the table it held together. The data shows that if a house was to be retrofitted adding steel rods would hold the walls and the building together. In most buildings the weight of the roof is rested on the walls, so when the walls buckle the roof comes down. With the rubber bands the walls are much stronger.

Summary Statement

How can We retrofit a house to make it earthquake safe?

Help Received

Jessie Lizama (Disaster Kleenup Specialists) and Art Werner (Structural Engineer)

CALIFORNIA STATE SCIENCE FAIR
2015 PROJECT SUMMARY

Name(s)
Zian M. Ibrahim

Project Number
J0311

Project Title
Dealing with Diabetes: Building an Artificial Pancreas Model

Abstract

Objectives/Goals
The objective is to design, build, and test a model of an artificial pancreas to investigate the challenges of getting such a device to work and to examine how accurate the model is compared to an ideal model.

Methods/Materials
I built an artificial pancreas model which I tested with 3 acidic solutions vinegar, powerade and lemonade to mimic #Insulin# and a base solution of baking soda to neutralize acidic solution. I used different electronic components and a conductance sensor for the pump to detect the acidity in the solution. Firstly, I calculated how much baking soda needed for the base. Then, I pumped the base solution in to the 3 acidic solutions at different trials to neutralize them. Afterwards, I measured how much baking soda I had left and compared with ideal of 100mL. I recorded my results and found out that my model is very accurate as an artificial pancreas

Results
After running 3 trials with different Acid Solutions, my results came close to ideal remaining solution level of 100mL.
Result for Vinegar solution neutralizing with Baking soda came around 115mL and pH scale around 0.99 and difference is 0.0061 ~ 0.07 from the ideal case.
Result for Powerade solution neutralizing with Baking soda came around 78mL and pH scale around 2.47 and difference is -0.108 ~0.11 from the ideal case.
Result for Lemonade solution neutralizing with Baking soda came around 138mL and pH scale around 1.63 and difference is 0.13 from the ideal case.

Conclusions/Discussion
After observing all data points and my results, my artificial pancreas model works very accurately. The accuracy also depends what kind of acid + base solution is used to neutralize the solution. In all 3 trials, it came very close to ideal case. The ideal case is 100mL of baking sodas solution remaining after being neutralized with the acidic solution. I had 115ml left for the first try, 78ml for the 2nd try, and 138 ml for the 3rd try. Even though there were not exactly 100ml of baking soda left, my results are very close to the ideal in Log scale. My model will pave the way for finding the cost effective artificial pancreas device that any type I diabetic patient can use. The Cost of my model was $39 and could be used to develop a low cost device compared to a real artificial pancreas which is about $7000

Summary Statement
To design, build, and test an artificial pancreas model and examine the accuracy of the model

Help Received
From my father Sajjad Ibrahim

CALIFORNIA STATE SCIENCE FAIR
2015 PROJECT SUMMARY

Name(s)

Todd C. Kelley

Project Number

J0312

Project Title

Stop It! Which Brakes on a Car Work Best?

Abstract

Objectives/Goals

The purpose of this project is to determine whether a car#s front or rear brakes are more efficient.

Methods/Materials

Materials needed, 2x Wood pieces 25in x 9in x 2in, Hinge, Protracor, Saw, Drill, Screws, Sand paper, Spray glue, X-acto knife, Large rubber bands, Toy car, Notepad, Pencil, Internet scources.First we gathered materials and built the test ramp. The test ramp works by placing two pieces of wood together with a hinge at the end of both planks and placing a protractor on the side of the bottom plank so that 0 degrees would be flat with the top of the bottom plank then we placed sandpaper and glued it to the top of the ramp so the cars tires would try and spin and not slide.The test ramp is used to measure the angle between the test surface and the horzontal table.Then we placed the car at a determined place with the rubberbands off and slowly raised the ramp until the test car started to roll, the resulting angle was recorded. Then we placed the rubberbands on the sides of the rear tires and under the chassis. Then we repeated the test procedure and recorded the data. Then we put the rubberbands around the front tires, repeated the test procedure and recorded the data. Then we put the rubberbands around both wheels, then repeated the test procedure and recorded those results. Then we examined the data and formed our conclusion.

Results

With the rear tires locked with rubberbands the car started to roll at 42 degrees.With the front tires locked with rubberbands the car started to roll at 53 degrees.Then with both brakes locked with rubber bands the car finaly moved at 61 degrees. Then we did one more test with no brakes and the car slid at 8.5 degrees.

Conclusions/Discussion

After looking over the results we can tell that the front brakes are more effective than rear brakes, although using front and rear would be best.The front brakes did better than the rear because stopping power depends on traction, which is the force of friction between the tires and road, which is dependent on the weight pushing the tire down onto the road. When you apply the brakes the weight transfers to the front of the car due to momentum, increases the friction between the front tires and the road,and allows the front tires to apply more braking force to the road without slipping.

Summary Statement

My project is about seeing what brakes work better for a car; front or rear.

Help Received

My dad gave me a list of subjects to research such as how brakes work and why, What friction is and what kinetic energy is. My brother helped me make and fit my board.

CALIFORNIA STATE SCIENCE FAIR
2015 PROJECT SUMMARY

Name(s)

Noah A. Kovacs

Project Number

J0313

Project Title

HomeMade Amputee Arm: H.M.A.A.

Abstract

Objectives/Goals

My objective was to make a homemade, functioning prosthetic hand.

Methods/Materials

High density styrofoam, small plastic gears, 6 Volt Battery, standard electronics kit motor were used to build the hand

An Arduino Uno Board and V-3 muscle sensor are used to make the hand open and close with muscle impulses.

Results

I created a functioning prosthetic hand that opens and closes on command using muscle impulses from the upper arm.

Conclusions/Discussion

My final project has a strong grip with extra space for shaking hands with someone, and grasping a ball. The hand also has a low density, so it will not stress patient's remaining stub. This system provides a low cost ($200 per hand) alternative to traditional, expensive prosthetics. My next steps include creating a stronger grip, and covering the device with a skin-colored rubber to provide a "true to life" appearance and feel. I would also like to add a discrete rechargeable battery back to power the system. My long term goals for this device include adding sensory tips to the fingers and palms that send nerve impulses back through the muscle sensors.

Summary Statement

My goal for this project was to create an amputee arm to provide a functioning prosthetic arm to those that cannot afford a traditional prosthetic.

Help Received

My teacher, Mrs. Faircloth, My mom, Evelyn Flores

CALIFORNIA STATE SCIENCE FAIR
2015 PROJECT SUMMARY

Name(s)

Jae Won Kwak; Alessandro Villain

Project Number

J0314

Project Title

Comparing the Versatility of an Aftermarket Controller from Its Standard Counterpart

Abstract

Objectives/Goals

The goal of the experiment was to create a controller that was better fitted for single armed people than the normal controller designed to be operated with two hands. A second objective was to devise a test method to quantitatively measure the difference between the two controllers.

Methods/Materials

Soldering iron and solder. Four buttons, Cherry MX# red linear switches from Cherry . A PR2H2 ProtoBoard-2H-2 printed circuit board (PCB). An Altoids# aluminum container. A WLtoys# Mini Race Car.

Results

When the participants in the study drove the car in the predefined track five times with each controller, there was an average of 2.25 mistakes and an average time of 10.63 seconds for the WASD Controller, and an average of 4.92 mistakes and an average time of 13.58 seconds for the standard controller. The WASD controller produced better times in the course than the other controller. Fewer mistakes were detected with the WASD controller than the Standard Controller. Even though the times are better, they are only so by a small portion. The WASD Controller use was able to produce significantly less mistakes. The concept of mistake was put in place to help better evaluate the efficiency of the controller. The data support that the WASD controller was significantly easier to use with one hand. A Student T Test was conducted on the data acquired and it supported the theory of the controller with less than five percent uncertainty (>5%).

Conclusions/Discussion

In conclusion, the hypothesis presented was supported; the WASD Controller was superior to the Standard Controller. The amount of mistakes clearly provided evidence of the superiority of the WASD controller. Based on the combined improved time and the reduced number of error it can be concluded that the WASD Controller performed better than the Standard Controller. This small car competition is not the direct application for this type of controller. This experiment is just an introduction into the world of interphases, showing that the in some cases the standard is not the best

The amputated limbs are just the beginning of the long list of purposes this experiment had.

Summary Statement

Design of a controller for one armed persons

Help Received

None

CALIFORNIA STATE SCIENCE FAIR
2015 PROJECT SUMMARY

Name(s)

Lindsey B. Labadie

Project Number

J0315

Project Title

Beyond the Pond

Abstract

Objectives/Goals

My objective was to build an operational miniature ice hockey rink. I hypothesized that I could keep the surface of the ice rink frozen by running a super-cooled saturated brine water solution through copper tubing under the rink. The brine water solution would be kept below 12 degrees Fahrenheit after running through another set of copper coils in the refrigeration section. The refrigeration section will be a Styrofoam cooler packed with a mixture of standard and dry ice. The brine solution will be circulated by a fountain pump through the copper tubing back to a coffee bean can in the cooler.

Methods/Materials

1. 2 11"x17" cookie sheets for the rink
2. 10 quart Styrofoam cooler
3. 40' copper tubing
4. 1 fountain pump
5. 10 lbs ice + 10 Lbs dry ice

Results

I am able to sustain ice on the surface of the rink for a period of 8-10 hours.

Conclusions/Discussion

The ice was able to be formed and maintained as a result of two seperate "heat exchange" systems. The first heat exchange system is under the rink where the super cooled brine water absorbs the heat through the copper coils from the rink at a fast rate. This allows the ice to form. The heat collected from the rink is carried by the brine water to the cooler where the second heat-exchange system is located. The return copper coils transfer the heat from the brine water where it is then absorbed by the ice laying on top of the coils. The brine water returns to the resevoir in the cooler and waits to be recirculated again.

Summary Statement

My project is to create a fully functional miniature ice hockey rink using saturated brine water, cooled through a heat exchange system of copper coils.

Help Received

My dad taught me how to use the tools like the tubing benders. A guy at home depot gave me ideas of how to use the valves; a man at the Irvine Spectrum out ice rinkshowed me how they use cooling loops and what temperatures I needed for my rink. My mom helped me with design and decoration ideas. My

Name(s)

Andrew T. Land

Project Number

J0316

Project Title

Newton and Arduino Loop the Loop: Development of an Inertial Navigation System for Model Aircraft

Abstract

Objectives/Goals

Develop novel hardware and software for a compact, low cost inertial navigation system (INS) for use in model aircraft. Data recorded in-flight by the INS should allow an accurate reconstruction of the model's flight path. Instead of 'rule of thumb', INS data will allow quantitative evaluation of model aerodynamics.

Methods/Materials

INS hardware was constructed from an Arduino microcontroller, on-chip gyroscope and accelerometer sensors, and a micro-SD memory card. An Arduino C-sketch was written to acquire data during flight (90Hz). A control-line model aircraft, the Lil' iHacker, was custom built for flight duties. Video recordings were made of flights to compare with calculated results. Raw data were processed with a novel C application. Results were exported for 3D-plotting with a custom Gnuplot script.

Results

Accelerometer data showed high levels of various forms of noise. High frequency vibration noise (230Hz) from the model's electric motor was removed using a data smoothing algorithm. Airframe 'flutter' noise at ~6Hz remains a challenge. Data from the gyroscope's "yaw" axis correlated very well with the model's main circular rotation. Gyroscope "pitch" data showed significant baseline drift, probably caused by the high-g flight conditions. Linear fits to sections of the data allowed recreations of the flight path to be calculated, comparing well with video.

Conclusions/Discussion

A compact, lightweight, low cost INS has been developed and evaluated. Software applications to acquire, process and plot the data have been written. Plots and animations of actual model flight paths have been generated. A novel technique for utilizing gyroscope data for recording circular control line flight paths has been developed.

Summary Statement

A compact inertial navigation system suitable for use in model aircraft has been developed, allowing reconstruction and display of actual flight paths.

Help Received

My Grandpa taught me about data smoothing. My Dad helped with the computer graphics.

CALIFORNIA STATE SCIENCE FAIR
2015 PROJECT SUMMARY

Name(s)

Ryan W. Lehman

Project Number

J0317

Project Title

Tsunami Hits California

Abstract

Objectives/Goals

My objective of this project is to test if placing walls underwater and above water will reduce the damage of a tsunami.

Methods/Materials

Methods: Make the wave tank and pulley system. Make wave for 5 tests against straight coast. Test bay and peninsula for 5 trials. Create wall 1 and test fro 5 trials. Repeat the last step for walls 2, 3, and 4. Analyze data.

Materials: Wave tank, pulley system, water, bricks, 13 lb weight

Results

Wall 1 completely stopped the wave to an average of 1.8 centimeters.
Wall 2 was almost as affective as wall 1, reducing the tsunami to an average of 7.4 centimeters up the coast.
Wall 3 held the wave to an average of 11.6 centimeters.
Wall 4 held the wave to an average of 10.2.

Conclusions/Discussion

The model used showed that tsunami waves are very powerful and severely damaged all three of the coastlines tested. There was still wave variability, even though a standard 13 pound weight was used. This was because the weight did not always fall on the same side, creating variations in the wave formation. Also, the sizes of the walls, particularly walls 1 and 3, were not very realistic because the sizes of the walls were much too big in all three dimension; length, width, and height. Wall 1 was the least realistic because it spanned the whole width of the model, which is about the length of the Santa Barbara coast. Even after not being realistic, wall 1 and 2 would be terribly expensive to build because they span about a mile long. Also, the fact that wall 1 and 3 were 1/3 out of the water would make them even more expensive. The walls that would be reasonable to build and reduced the wave substantially would be wall 3 because it did not span very long length wise, but was tall.

Summary Statement

This project is about trying to prevent tsunamis.

Help Received

Dad helped by assisting me in setting up the pulley system that dropped the weight to create the wave.

CALIFORNIA STATE SCIENCE FAIR
2015 PROJECT SUMMARY

Name(s)

Benjamin C. Liu

Project Number

J0318

Project Title

A Novel Spiral Microchannel Device for Urinalysis

Abstract

Objectives/Goals

The 1st objective is to establish a clear connection between the theory of dean vortices and effective particle separation in spiral microfluidic channels. My 2nd objective is to develop a spiral microchannel to separate urine sediment particles based on their inertial characteristics followed by urine morphology analysis. The particle separation efficiency will be determined and compared with the previous microfilter device I developed last year.

Methods/Materials

The spiral microchannel device (1 mm wide and 50 micron deep) was designed using AutoCAD software and fabricated in Polydimethylsiloxane using soft lithography. An equation explaining this particle separation principle was developed using Dean#s number. Real human urine samples were tested using the spiral channel. Urine was pumped through the spiral microchannel at 125 microliter/sec using a syringe pump. The device was imaged under a microscope. On-chip morphology analysis and particle counting were performed to determine particle separation efficiency.

Results

The spiral microchannels were successfully fabricated and tested. The results showed the devices sorted and separated urine particles by size and mass difference. Large particles such as epithelial cells flowed in equilibrium positions near the outside wall while small particle such as blood cells and crystal fragments took paths toward the inner walls. The spiral design created distinguishing flow patterns among similar-sized particles. These sized-grouped particles are eventually separated at downstream junctions and placed into corresponding tangent branch microchannel outlets. A separation efficiency of 92% was achieved. Following on-chip separation, the urine particles including blood cells, cast, crystal, Epithelial Cells, yeast, etc, were identified.

Conclusions/Discussion

I have successfully developed a spiral microchannel to separate different sizes of urine particles utilizing dean vortices and inertial separation principle. This device addresses the channel clogging issues that the microfilter device I developed last year encountered and significantly improves the separation efficiency. It combines both functions of a traditional centrifuge and microscopic examination into one single lab-on-a-chip device for urinalysis and could potentially revolutionize the field of urinalysis.

Summary Statement

My project is about the development of a novel spiral microchannel device for effective urine particle separation followed by particle morphology analysis.

Help Received

Used Prof. Abe Lee's lab equipment at University of California, Irvine. Dr. Robin Liu mentored me and gave me advice on the project.

Name(s)
Luciana M. Lopez-Aita

Project Number
J0319

Project Title
Which Materials Can Best Withstand a Tsunami?

Abstract

Objectives/Goals
My objective in my project was to figure out which material could stand up against a simulated tsunami. My hypothesis is that the steel block will perform better than the other substances and the wood block will not.

Methods/Materials
I used water-proof clay, wooden dowels, wooden plank, spring scale, cardboard, glue, a mass measuring scale, a tank, tap water; and blocks of wood, foam, dry foam, steel, and cardboard. First, take the mass of the blocks on the scale before performing the experiment. I attached the wooden dowels to the plank using glue and adhered the cardboard to the opposite side of the dowels. I then poked a hole at the top of the cardboard and slid the spring scale in. I then molded the clay into a slope and placed the testing materials (blocks)on the hill. I filled the tank with water and pulled the wave-making device towards the hill to create waves. Finally, take the mass of the wet blocks.

Results
I discovered that the wooden block had the least change in dry-to-wet mass. The foam block had the largest change in mass. Also, the cardboard block was the least stable and fell into the water when the waves hit. The steel block remained motionless throughout the entire experiment.

Conclusions/Discussion
My hypothesis was partially supported because the steel block did do the best, yet the cardboard performed the worst. The metal's high mass allowed it to not move during the entire trial. This experiment will allow people to build their homes/shelters in a tsunami-resistant material. Many citizens living in tsunami-prone areas could get to a safe place and be protected in a strong building during this natural disaster, saving many lives. Scientists could learn which material is best fit to stand up to tsunamis by using the results of this experiment.

Summary Statement
My project is about determining which substance can best stand up to the deadly tsunami.

Help Received
none

Name(s)

Dylan A. Manriquez

Project Number

J0320

Project Title

Does kPa Affect the Kicking Distance of a Soccer Ball?

Abstract

Objectives/Goals

The purpose of this project is to see if a pumped up ball can travel farther than a flat ball. Based on my research on a soccer balls Kilopascals (kPa), I believed that the ball with twelve kPa would travel farther than the balls with four, eight, and ten kPa. I believed this because I thought the greater amount of air you put into the ball the farther it would go. The greater amount of air you put into a ball the more of a rebound the ball would give off. This extra rebound will keep the ball in the air longer, allowing it to travel farther.

Methods/Materials

Materials: 5 Digital Protractor x1,Soccer cleat,Size 5 soccer ball,fruit net and cabinet door hook
Method
1. Draw sketch of the machine. 2. Gather materials. 3. Build base. 4. Build pendulums. 5. Build the leg with the shoe. 6. Build the leg with the ball. 7. Combine components. 8. Test machine. 9. Conduct experiment at 27.57902916, 55.15805832, 68.9475729 (control), and 82.73708748 kPa. 10. Kick ball thirty times for each kPa. 11. Record data. 12. Graph data. 13. Mount the results on the board.

Results

It turned out that the ball with 4 kPa traveled the farthest. This shows that putting more air into a soccer ball did not affect the balls distance positively. It also shows that the less air (4 kPa) that was in the ball, the more rebound it gave off. The ratio changed because I was hitting the ball with the same amount of force. This was because the ratio of weight to 4 kPa (3/4) was closer than the ratio of 12 kPa (3/12). This extra rebound given off by the 4 kPa kicks allowed the ball to travel farther.

Conclusions/Discussion

Based on my research on a soccer balls Kilopascals, I believed that the ball with twelve kPa would travel farther than the other balls. My hypothesis however was incorrect. Instead of the ball traveling farther with greater kPa it traveled a shorter distance. This was because the ratio of weight of the shoe and foot 1.4515 kg to 27.57902916 kPa was closer than the ratio of 1.4515 kg to 82.73708748 kPa. This extra rebound given off by the 27.57902916 kPa kicks allowed the ball to travel farther.

Summary Statement

My project is about determining whether or not air pressure affects how far you can kick a soccer ball.

Help Received

My Grandfather helped me construct the mechanism. My cousin assisted me in learning the conversion equation. My father assisted me with the assembly of the board.

Name(s)

Victoria M. Mott

Project Number

J0321

Project Title

Equine Teeth Cleansing Tray

Abstract

Objectives/Goals

My objective is to provide a simple, cost effective and preventative measure towards combating oral disease and the development of plaque on horses teeth which may lead to other underlying conditions and illnesses. My goal is to refine and improve my original prototype to meet the needs of horses and their owners world-wide.

Methods/Materials

Materials: 1.) Non-corrosive T-Hinges, used for support and mobility of the tray. 2.) Gentle but firm removable bristles used for cleaning the horse's teeth. 3.) A thick, durable plastic/wood non-corrosive tray used to support the bristles. A clasping lock at the top and extra support on the sides provided by corrosion resistant chain on each side of the tray.

Methods: I used hinges for the support and mobility of the tray. I will use the gentle yet firm removable bristles for putting in the tray. This is what will clean the horse's teeth, by the horse grabbing at food that is placed between the bristles. I will also use a durable tray to support the bristles.

Results

I believe that my invention will work due to my observation of how a horses mouth moves and the way it eats. My theoretical results are that my invention will help prevent oral illnesses in horses by providing a mechanism for regular, daily cleansing that is difficult to provide, but with my simple machine that is not seen on the market as of today, I believe it will help reduce dental bills for everyone that owns a horse.

Conclusions/Discussion

I am in the process of making a larger prototype that will fit science fair regulations. I am modifying the type of materials used for the tray and replaceable bristles which can vary in softness due to a horses age and in efforts to not damage their gums in any way. When plaque develops it can break off and travel into the blood stream and cause a number of other illnesses that are hard to detect because you can't always determine the underlying cause. This is true in humans as well as animals. I'm confident that once my large prototype is completed and tested I can prove my theory and objective for demonstration at the state science fair.

Summary Statement

To help prevent oral disease and decay in horses, as well as other dental related illnesses.

Help Received

My parents helped with providing supplies and my dad did what I couldn't do with the saw.

CALIFORNIA STATE SCIENCE FAIR
2015 PROJECT SUMMARY

Name(s)

Christopher J. Nagelvoort

Project Number

J0322

Project Title

Bridge Strength: Truss vs. Arch vs. Beam

Abstract

Objectives/Goals

The objective of this experiment was to determine which bridge design is the strongest against heavy loads through deflection testing on three bridge models. Also the goal was to understand and analyze how much greater the strength would be between the three models and plausibly why their strengths differ.

Methods/Materials

The project began with the design and then construction of the bridge models that were 0.75 meters long, out of glue and wooden popsicle sticks. Before deflection testing occurred, supplies need were a bucket, bag of sand, string, scale, caliber, construction paper, and a testing stand to stabilize the bridge models before loads were attached. Finally deflection testing initiated by loading each bridge model with 1 # 7 pounds of sand, with 1 pound increments. For each load the deflection was measured and recorded.

Results

For cumulative deflection, the truss bridge under 7 pounds of load deflected 0.2 cm. The arch bridge under 7 pounds achieved 0.69 cm. While the span/beam bridge deflected by 2.01 cm under the same 7 pound load. The deflection for each 1 pound load increment was also measured and recorded. This deflection is referred as incremental deflection. The average incremental deflection for the truss bridge was 0.0285 cm. For the arch bridge, the average is 0.0985 cm and the span/beam bridge#s average is 0.2871 cm.

Conclusions/Discussion

With the bridge#s designs researched and tested, it was determined that the truss is the strongest bridge, with arch the second, and span/beam dramatically weaker than the other two. Based on the incremental deflection averages, the truss bridge is 10.0736 stronger than the span/beam bridge and 3.4561 stronger than the arch bridge. While the arch bridge is 2.9147 stronger than the span/beam bridge. It is concluded that the truss bridge was the strongest from its increased weight and its geometric design of spreading the compression with a triangular design. Though the arch#s geometry also supports and spreads the compression placed on the bridge by loads, it lacked the efficient ability of the truss#s design.

Summary Statement

This project utilizes bridge deflection to test and compare the strength of three different bridge designs: Truss, arch, and beam.

Help Received

Parents helped with retrieving the supplies and building the stand for the bridge deflection testing.

CALIFORNIA STATE SCIENCE FAIR
2015 PROJECT SUMMARY

Name(s)

Jennifer T. Nguyen

Project Number

J0323

Project Title

A 40% Cheaper Alternative to Robotic Feeding Aids

Abstract

Objectives/Goals

The main objective of my goal was to create a robotic feeding aid prototype that was cheaper and easier to access. Many robotic feeding models in the market, such as HelloSpoon and Neater Eater, range from $500-$5000. HelloSpoon costs $500, but is currently in development and not for sale (it failed a recent Indiegogo campaign). Those with mild limb problems could use my model without the hassle of buying an expensive model that could cost them thousands of dollars.

I decided to utilize Lego Mindstorms as my building source. My goal was to use less than 500 Lego pieces while being able to perform its functions decently. Using Legos Mindstorms EV3 software, I planned to create a very basic program that could be understood easily by others.

Methods/Materials

-Lego Mindstorms EV3 Home Edition Set
-Lego Mindstorms EV3 Software
-Lego Technic pieces
-One average rubber band

Results

After two weeks, I created a Lego robotic feeding aid prototype that costs roughly around $300-$375. An estimated amount of 450-600 Lego pieces were used. The robotic feeding aid prototype integrates a robotic feeding aid model run by two large servo motors and one medium servo motor. It only works with semi-liquids and a thicker consistency meant more power.

Some downsides to my model is that a button is required to be pushed, the bowl would be moved, and the model would #jump# occasionally. I could fix this with a gyroscope and an ultrasonic sensor to control the motor power and indicate whether the individual is near the spoon.

Conclusions/Discussion

Though there were some errors regarding my Lego robotic feeding aid prototype, it met the basic requirements I expected and came out as cheaper and easier to access when compared to other models such as HelloSpoon and Neater Eater.

To release my model to the public and fulfill the 'easy accessiblity' goal of my project, I could put my model on Lego Cuusoo and have the public vote for it to become a real model or to share building instructions and the program so that others could build the exact same model right in the comfort of their home (if they have the right materials).

Summary Statement

The goal of my project is to create a robotic feeding aid with Lego Mindstorms EV3 that is cheaper and easier to access.

Help Received

All done by myself.

CALIFORNIA STATE SCIENCE FAIR
2015 PROJECT SUMMARY

Name(s)

Leonardo E. Pena

Project Number

J0324

Project Title

Human vs. Robot: The Final Showdown

Abstract

Objectives/Goals

In my science project "Human V.S. Robot The Final Showdown" My goal was to prove the capabilities of a robot in comparison to humans. The statement of the problem was "will a robot sorting in 360 degrees (a full circle), be more efficient than a robot sorting in a line?" I hypothesized that it will be faster and more accurate than a human.

Methods/Materials

Summarized, you must first get eight cups and label them with up to four different colors, each having two different sizes. Then you must find your test subjects and have them sort legos into the matching cups while being timed. Record your data and create graphs accordingly. Then create a design for your robot and build your robot out of Lego Mindstorms 2.0. Once completed, program your robot to sort legos using variables. For example: "Is the Lego red? Is it a 2x2 or a 4x4?" Then time how long it takes for the robot to sort the Legos and compare accuracy and speed to humans.

Results

According to my test results, my hypothesis was correct. My robot was faster and had a lower error rate than humans.I found that the robot sorting in a line was about the same speed as the humans but had less errors. However, the robot sorting in a circle was all around faster and more accurate than humans and the robot sorting in a line.

Conclusions/Discussion

With this science project, I have learned many things. For example, how momentum affects the speed of my robot. I have proven my point and robots are more efficient than humans.

Summary Statement

My project is about comparing the efficiency between a robot and a human.

Help Received

My science teacher provided me with answers for any questions that I had along the way and guided me through my project.

Name(s)

Tyler E. Robertson

Project Number

J0325

Project Title

It's All About That Place: How Wave Barrier Location Impacts Tsunami-Induced Seiche Wave Power

Abstract

Objectives/Goals

The goal of the first year of this project was to explore the effect of different wave barriers at different locations on a tsunami-induced seiche wave. The wave barriers were effective at reducing wave power but, due to wave reflection and interference, it was unclear if they were effective because of their location within the seiche wave or their distance from shore. The objective for this year was to determine which of these factors affected seiche wave power reduction more.

Methods/Materials

A wave tank with a temporary wall and wave attenuator was built. The two most effective wave barriers from the first year (upright brackets, flat brick) were used. Another barrier was constructed with a twin turbine that could face horizontally or vertically for two additional barriers. Waves were generated by a powered chain drive motor at a frequency of 78 waves/minute. Using the temporary wall, the four barriers were tested for 10 trials at 3 locations that corresponded to 2 nodes and 1 anti-node points within the seiche wave. The temporary wall was removed and the process was repeated for the 4 barriers at the 3 locations for 10 progressive waves. Each wave was videotaped at four data points across the entire tank.

Results

Using video analysis, wave amplitude, speed, and power were calculated at each of the 4 data points for each trial of standing and progressive waves. The wave power at all four data points for each barrier was then compared to the control wave power (no barrier) for each wave type. For seiche waves, all four barriers reduced wave power at one node position differently compared to the other node position. Barrier C and D significantly increased seiche wave power at shoreline while in the anti-node position. For progressive waves, all four barriers were effective in reducing wave power at data point 4 (shoreline) no matter what location they were in although barriers B,C, and D were most effective farthest from shore.

Conclusions/Discussion

If the position within a seiche wave was a determining factor, you would expect wave power to be affected similarly at both node positions. Barrier B and D were more effective at one node position compared to the other node position. Therefore, the distance from shore is the more important factor for these barriers. These findings support my hypothesis. Barrier distance from shore does not appear to be a big factor for most progressive wave barriers.

Summary Statement

This project explored whether a wave barrier's effectiveness was determined by its location within a seiche wave or its distance from shore.

Help Received

My parents helped build the wave tank. My mom helped with typing my report. My dad helped with excel graphs and math calculations. Dr. Ed Clifton, USGS Emeritus, answered my questions about wave tank design. Gerald Nachtigall, my shop teacher, helped weld my barriers.

CALIFORNIA STATE SCIENCE FAIR
2015 PROJECT SUMMARY

Name(s)

Katie A. Shevlin

Project Number

J0326

Project Title

3D Printed Automatic Solar Powered Dog Food Dispenser

Abstract

Objectives/Goals

My objective was to create a dog food dispenser that was solar powered, automatic, and 3D printed.

Methods/Materials

I used a Solar Panel Battery Pack, Servo motor, 3D Printer, and an Arduino Uno. To make my project I had to write a program, design a 3D model of the dog food dispenser, print the components, collect data on how much dog food got dispensed with different variables, and put everything together.

Results

The results of my data was mostly surprising. One of the things that surprised me was the results I got from changing the amount of time the food had to dispense out. Another surprising element of my data was the effect of the size of the dispensing hole had on the amount of dog food. Overall, most of the data I collected surprised me.

Conclusions/Discussion

With my project I had several issues, but it was mostly good. One problem was that I had to make the original size of my dog feeder smaller because the printing pad at Wagic wasn#t big enough for the size I wanted. Another problem was that the solar panel I planned on using didn#t give out enough voltage for the arduino uno and servo motor to work so I had to buy another solar panel which didn#t get mailed in time to have it at the science fair. Also I had to reprogram the arduino uno so that it made the servo motor turn three times to give out food. Last but not least, I had to increase the size of the dispensing hole with a dremel so enough food could come out. Also I didn#t give myself enough time to create a app that connects to your phone. In conclusion, I had several problems while I was doing my science fair project. There could be many improvements in the future and there is one flaw in the method that I would change. Starting off, I would double the size of the dog feeder so that I wouldn#t have to change the model manually. I could make the arduino programed so that it ran at certain times instead of every twelve hours after it has been turned on. Another improvement would be that I would add a lid for the bottom of the dog feeder because the arduino uno and servo motor is exposed to the ground and could get ruined by water. The last improvement I would do is make the feeding bowl deeper so there is enough room for the food to be dispensed into.

Summary Statement

My project is about how I designed, programmed, and 3D printed an automatic solar powered dog food dispenser.

Help Received

Makers Factory helped tutor me with 3D designing and programming; Wagic helped 3D print

CALIFORNIA STATE SCIENCE FAIR
2015 PROJECT SUMMARY

Name(s)

Joshua Sohn

Project Number

J0327

Project Title

The Effect of Fencing on the Knee

Abstract

Objectives/Goals

To determine how different factors, such as a greater distance between the foot and the hip, the mass of the fencer, and the height of the lunge impact the overall amount of force on the knee during a lunge, thus increasing the likelihood of an injury. The application to fencing will be proposed methods to minimize the potential injuries to the knee by understanding the causes that increase the stress to the knee.

Methods/Materials

Built knee model to simulate the effect of a fencing maneuver called a "lunge" and measure the force on the knee (Device to take actual measurements from the human knee is currently only available for a person lying down in a laboratory going through a fixed set of motions, with an arthrometer like KT1000, not for a person in active motion). Simulated the effect of upper body mass applying force on the lower body, thus applying stress on the knee, by measuring force on the knee caused by different drop heights, changing body mass and varying foot-hip distance.

Results

The most amount of force was applied with a drop height of 25 cm, a foot-hip distance of 17 cm, and a weight of 741 g. This resulted in 153.8 N of force. The second most amount of force occurred when a drop height of 22.5 cm was combined with a foot-hip distance of 17 cm, a weight of 741 g, and dynamic movement. The least amount of force occurred when there was a drop height of 20 cm, a foot-hip distance of 12 cm, and a weight of 505 g, yielding 63.6 N of force. The combination of all 3 factors had a significant impact in increasing the stress to the knee.

Conclusions/Discussion

The hypothesis, which was that a greater foot-hip distance, a higher drop height, and a heavier weight would result in a higher amount of force on the knee, is supported by the results. In order to minimize the possibility of knee injuries, a fencer should strive to minimize upper body mass, smoothly slide forward the leading foot in a horizontal motion instead of lifting the leg unnecessarily, and depend less on solely the reach of the leading leg.

Summary Statement

Understand the effect of different physical variables in fencing movement that would induce high force to the knee and propose ways to avoid them to reduce the likelihood of an injury.

Help Received

Neighbor and father helped with the use of power tools in knee model building and shopping for materials. Two scientists at Ask-A-Scientist Night, Ms. Sari Mahon and Mr. Matthew Bovyn advised me with the revision of the model. Mother advised on the color selections and arrangements of the display

Name(s)

Srinath Somasundaram

Project Number

J0328

Project Title

A Novel Design and Evaluation of an Air Cushioning Mechanism for Helmets to Reduce Impact Acceleration on the Head

Abstract

Objectives/Goals

The purpose of this engineering project is to reduce impact acceleration felt on the head. I added an air bladder similar to an airbag in a car in between the padding and shell of a model helmet to lengthen the time of impact and reduce force. The air bladder would be deemed successful if it reduced accelerations at the head by 50 g#s or more.

Methods/Materials

I had to build a helmet setup with accelerometers representing the head and the helmet accelerations to be able to trigger the air bladder when a 1kg weight from a tower hits. First, I built a 20-foot tower using pipes to create the equivalent accelerations of a football hit (100-150 g#s). Next, I made a model football helmet using Polycarbonate and Polyurethane. The final step was the air cushioning mechanism. For this, I used a balloon, an air compressor, tubing, a solenoid valve, wires, two accelerometers (one attached to the shell and the other attached to the padding, corresponding to helmet and head accelerations), and an Arduino microcontroller. I coded the microcontroller to read and print the accelerations and trigger the valve to release air from the compressor to the balloon when it sensed an acceleration above 50 g#s. I dropped a 1kg weight from the top of the tower, and when the threshold was reached, the mechanism was triggered. I repeated this four times with and without the mechanism.

Results

The data of repeated tests showed that the air cushioning mechanism does significantly reduce acceleration on the head throughout the impact. Three tests with the bladder show that while the helmet accelerometer#s readings were high, the head accelerometer#s readings were low. On the other hand, only one test without the air bladder showed a similar 100 g reduction between the helmet and the head accelerometer readings. The high-speed camera footage revealed that the balloon almost reflected the hit, while the helmet without the balloon didn#t give much resistance and was easily compressed.

Conclusions/Discussion

All data that was gathered showed significant reduction in acceleration with the air bladder. Also, the air bladder mechanism appeared to dampen out any oscillation in accelerations on the head. This would lead to smaller forces on the head and prevent the brain from bumping into the head from residual force, decreasing the likelihood of a concussion and other brain damage.

Summary Statement

This project determines if putting an air cushioning mechanism triggered by a microcontroller in a helmet would reduce impact accelerations on the head.

Help Received

Mentor Dr. Ismail supervised and advised me.

CALIFORNIA STATE SCIENCE FAIR
2015 PROJECT SUMMARY

Name(s)

Jerret M. Tingler

Project Number

J0329

Project Title

Will Hot or Cold Temperatures Affect How High Tennis Balls Will Bounce?

Abstract

Objectives/Goals

My objective was to find out if hot or cold temperatures would affect how high tennis balls would bounce.

Methods/Materials

Materials included tennis balls, oven, freezer, camera, infrared thermometer and a robotic arm. I used 18 tennis balls, I froze 6 to -2 degrees, heated 6 to 200 degrees, and left 6 at room temperature (72 degrees) to use as a control. Using a robotic arm to release the balls at an exact time, I dropped them all from a height of 36 inches, one at a time, while documenting it on video. Using the infrared thermometer, I recorded the exact temperatures as they were dropped.

Results

The control balls bounced on average 26 inches. The cold balls bounced on average 13 inches and the hot balls bounced on average 28 inches. Hot and cold temperatures definitely affects how high the tennis balls would bounce. The hot balls bounced on average 5 inches higher than the control, and 15 inches higher than the cold balls.

Conclusions/Discussion

My hypothesis was right. The hot balls did bounce higher than the cold balls. The hot balls bounced a little higher than the control balls, but much higher than the cold balls. The cold temperature really affected how high the tennis balls bounced.

Summary Statement

The hot balls bounced higher than the control balls and the control balls bounced higher than the cold balls.

Help Received

Siblings and parents helped set up equipment and hold materials; Mom proofread my report.

CALIFORNIA STATE SCIENCE FAIR
2015 PROJECT SUMMARY

Name(s)

Elyse G. Wong

Project Number

J0330

Project Title

A "Stirling" Idea

Abstract

Objectives/Goals

The objective of this experiment was to determine if the higher specific heat value of a gas used in a Stirling engine would increase its efficiency.

Methods/Materials

Four gases with different specific heat values, namely air, helium, carbon dioxide and butane, were used in a modified low temperature differential Stirling engine. The Stirling engine was placed over a cup of hot water, and the temperature differential between the bottom plate (resting on a cup of hot water) and the top plate created enough pressure in the chamber to power the flywheel of the Stirling engine. The temperature of the bottom plate minus the temperature of the top plate (ambient temperature) was the temperature differential. The flywheel speed was measured using a photo tachometer. Measurements were taken at ten degree increments until the temperature differential was no longer great enough to turn the flywheel. After the engine was allowed to return to ambient temperature, the working gas was replaced with another gas. The experiment was repeated for each of the gases, replenishing the hot water and measuring the RPM's of the flywheel as the temperature differential decreased.

Results

Helium turned the flywheel the fastest, followed by air, carbon dioxide and then butane at the same temperature differential. From a table of specific heat values of gases, butane was expected to perform faster than air, but it was actually the slowest of the gases.

Conclusions/Discussion

The results did not support the hypothesis that the higher specific heat value of a gas would have a positive effect on the efficiency of a Stirling engine. It was determined that it was not just the specific heat of the gas, but the k value, which is the ratio of the specific heat of a gas at constant pressure divided by the specific heat of the gas at constant volume (Cp/Cv) that may affect the efficiency of the Stirling engine. The molecular structure of the gas as well as other properties of gases need to be further researched as they may influence its behavior and consequently the efficiency of the Stirling engine. A gas that will create the most efficient Stirling engine may provide an alternative means of power generation.

Summary Statement

Four gases with different specific heat values were individually introduced into a Stirling engine to determine if a higher specific heat value of a gas increases its efficiency.

Help Received

Father helped modify the Stirling engine and supervised the experiment.

CALIFORNIA STATE SCIENCE FAIR
2015 PROJECT SUMMARY

Name(s)

Nathan Xu

Project Number

J0331

Project Title

How Much Weight Can It Hold?

Abstract

Objectives/Goals

The objective of this project is to determine how the number of trusses on a bridge affect the amount of weight it can support.

Methods/Materials

Popsicle sticks and wood glue were used to construct three different bridge designs. Each bridge design contained different numbers of trusses -- 2 trusses, 3 trusses, and 4 trusses. Five identical bridges of each design were constructed for five test trials each. The bridges were seated over a 10 inch gap with an S-hook attached to the handle of a bucket and the base of the bridge. The bucket was slowly filled with water until the bridge broke. The total amount of weight supported by the bridges were determined by weighing the bucket, water, and S-hook on a scale and the results were recorded. This procedure was repeated for all 15 bridges and the average supported weight for each bridge design was calculated.

Results

The 2 truss design supported the least amount of weight, with an average of 16,159 grams. The 3 truss bridge design was able to support a little bit more weight compared to the 2 truss design, with an average of 17,551 grams. The bridge designed with 4 trusses supported approximately 45% more weight than the 2 truss design, with an average of 23,469 grams.

Conclusions/Discussion

In this project, I have concluded that the more trusses designed into a bridge would be able to support more weight. When more trusses are used in a bridge design, weight can be transferred more evenly through the span of the bridge, and therefore the load does not focus as much on smaller areas.

Summary Statement

The number of trusses on a bridge design greatly affects the amount of weight it can support.

Help Received

My grandma helped me glue some of the bridges together.