CALIFORNIA STATE SCIENCE FAIR
2005 PROJECT SUMMARY

Name(s)
Erik J. Aidukas

Project Number
S0201

Project Title
Does Altering the Mass Distribution of a Drumstick Affect Its Rebound off a Snare Drum?

Abstract

Objectives/Goals
The purpose of this experiment was to see if there was a measurable difference between the rebound heights of drumsticks on a snare drum according to how the mass distribution of the drumstick was altered. Rebound contributes to the speed of play and effort required by the drummer. The hypothesis was that if weights were added to the butt of the stick, then the balance point would be closer to the axis of rotation, resulting in higher rebound.

Methods/Materials
An apparatus that mimicked the way a drummer holds a stick and hits a drum was designed and built. The force was measured with a Newton spring scale. The torque was 0.24 Nm for trials 1-5, 0.43 Nm for trials 6-10, and 0.53 Nm for trials 11-15. The mass distribution of the drumsticks was altered by drilling out the center of the butt end of the stick, then either filling the hole with weights or leaving it unweighted. The rebound heights of the drumsticks were measured against a backdrop of graph paper using a camcorder.

Results
The drumstick with the greatest rebound was the stick that was weighted in the butt. This is because the center of mass was altered to be closer to the chosen axis of rotation. The negative torque due to gravity was extremely small, but contributed to higher rebound in the weighted sticks.

Conclusions/Discussion
In conclusion, my hypothesis was correct. Newton's 2nd Law for rotation states that the resistance to change, i.e. moment of inertia, is less the closer the center of the mass is to the axis of rotation, and so the more freely the object will be able to move. This is why the weighted sticks had greater rebound compared against the undrilled drumsticks and the drilled/unweighted drumsticks. I intend to finalize my patent with this information.

Summary Statement
Altering the mass distribution of a drumstick to make the center of mass coincide with the axis of rotation improves its rebound, thereby allowing faster and easier playing.

Help Received
My school's woodshop teacher drilled the drumsticks. My neighbor used his drill press and helped me build the apparatus with my dad. My dad assisted during the testing. My mom proofread my work and helped with the display.

CALIFORNIA STATE SCIENCE FAIR
2005 PROJECT SUMMARY

Name(s)
Paul T. Baeyens

Project Number
S0202

Project Title
Isodynamic Spring Resistance System

Abstract

Objectives/Goals
My main objective was to create an isodynamic resisting force provided for the user wishing to "arm-wrestle" my machine. I wanted the resisting force to be constant at every point of rotation by using a cam with specific dimensions attaining to the spring used. One of my main goals was to construct a machine which is more efficient than the traditional "free-weight and pulley" system, ultimately eliminating inertial forces to a negligable proportion, creating an isodynamic resisting force.

Methods/Materials
Methods: I used the law of summation of torques (which equals 0) to calculate the length of the cam at each degree of rotation. I used nylon rope, scrap wood, plywood board, bolts and screws, foam padding, 5-minute Epoxy, Elmer's Wood Glue, a dowel rod-0.022225 meter diameter, a spring, a compact fish scale, and a surplus of scratch paper. [All materials were found by using available resources except for the plywood board, spring, and fish scale, which ultimately brought my project cost to a slim $24.74]

Results
After construction of my project, I tested the machine with a fish scale, which proved that an isodynamic resisting force was obtained.

Conclusions/Discussion
After completing my project, I found that my project theory was successful and could be used in large-scale quantity, replacing various free-weight and pulley machines in local gyms. Not only would a spring resistance system provide a safer environment, it weighs less, is much less expensive, is more efficient, and provides a constant resisting force unlike free-weights, which could be accelerated upwards, decreasing force applied.

Summary Statement
I created an arm-wrestling machine with a constant resisting force throughout the entire process, eliminating all inertial forces to a negligable proportion as involved with a pulley and free-weight system.

Help Received
Father helped operate skill saw; Father permitted me to use spare parts lying around house.

CALIFORNIA STATE SCIENCE FAIR
2005 PROJECT SUMMARY

Name(s)
Lydia J. Bates

Project Number
S0203

Project Title
How Strong Is That Knot? A Study of the Knot Efficiency of the Double Fisherman's Knot

Abstract

Objectives/Goals
The purpose of this experiment was to determine if the tying of a typical fireman's rescue knot using a static kernmantle rescue rope would cause a tensile strength reduction compared to the rope's rated average breaking strength. This is known as knot efficiency. Two sizes of rope, 7/16" and 1/2", and the double fisherman's knot were tested. Due to testing apparatus limitations, this experiment was limited to testing single looped ropes. The hypothesis was that the tying of a double fisherman's knot in the static rope will cause a measureable reduction in the rope's tensile strength.

Methods/Materials
Tests were performed using various methods of securing the rope to eliminate the clamping method as a variable. This led to the use of a looped rope over guide pulleys for testing. Looping the rope distributes the force over two lengths of rope, doubling the rated strength of the rope. Therefore, knot efficiency was compared to 200% of the rated strength of a single unknotted rope. The testing equipment used was a 450K lb tensile testing machine. The rope sample was secured and pulled at a constant rate until the rope failure point was reached. Five samples each of the two sizes of rope were tested using this method. The results were compared to the rope's average breaking strength supplied by Underwriter's Laboratories (UL). These UL values were used as a control, as limitations of the equipment prevented separate control testing on single rope strands.

Results
Tensile strength of the rope was reduced by the addition of the double fisherman's knot. The knot in the 7/16" rope failed at an average of 77.4% and the 1/2" rope at an average of 74.8% of the UL breaking strength of the unknotted rope. The knot efficiency for the double fisherman's knot is listed from 21% to 30%. The knot efficiency ratings obtained by this experiment were within the published ratings for the double fisherman's knot.

Conclusions/Discussion
The data indicated that the hypothesis was correct. The hypothesis was based on the theory that the knot would create a stress concentration in the rope, crushing the rope's core and causing the rope to fail before a non-pinched rope. Inspections of the broken rope samples showed in every case that the rope failed at the stress concentration of the knot. In conclusion, the tying of a double fisherman's knot in the static rope will cause a measureable reduction in the tensile strength of the rope.

Summary Statement
The purpose of this experiment was to determine if the tying of a typical fireman's rescue knot using a static kernmantle rescue rope would cause a tensile strength reduction compared to the rope's rated average breaking strength.

Help Received
Bruce Miller, Terry Tilton, & Gary Peddecord - Training and assistance in operating the tensile testing equipment.

CALIFORNIA STATE SCIENCE FAIR
2005 PROJECT SUMMARY

Name(s)
Daniel Bliman; Carl Lindner; Sherman Ng

Project Number
S0204

Project Title
How Much Energy Is Lost to Friction?

Abstract

Objectives/Goals
The purpose of this project is to find out exactly how much energy friction exerts on the motor. It was hypothesized that friction should constitute most of the resisting energy of the motor.

Methods/Materials
1. 400 watt Power Supply, to supply Hard Drive with clean and stable power.
2. Stripped Hard Drive, to test the motor.
3. Tachometer, to read RPM on Hard Drive.
4. Reflective tape, for Tachometer to have accurate readouts.
5. Black construction paper for Hard Drive. This would enable us to put reflective tape on the paper and get accurate RPM.
6. Tape, to keep black construction paper attached to Hard Drive.
7. Screw driver set, to strip the Hard Drive, and to attach the black construction paper.
8. Compass, to make Circular disks to place on the Hard Drive.
9. Ruler, to measure certain dimensions of the motor, and to get the radius for the black construction paper to be attached to the Hard Drive disk.
10. D.M.M.(Digital Multi Meter), to measure voltages and current usage of the motor.
11. Stopwatch, to measure the time needed to stop the motor.
12. Calculator, to calculate the kinetic energies.
13. Scale, to weigh each part of the motor

Results
Work/second = 9.84 joules/4.94 seconds =
1.99 joules/second or 1.99 watts
The results showed that for every second the motor runs, friction in the motor exerts 1.99 joules of energy in the backward direction.

Conclusions/Discussion
After running all the tests and experiments with the motor, our hypothesis proved correct; most of the energy acting against the motor came from friction as the energy of friction represented 82.5% of all the energy acting in the backward direction. Every single set of data supported my hypothesis as all of the trials produced results that were not far from the mean value.

Summary Statement
This project attempts to calculate the amount of energy lost to friction in a motor

Help Received

CALIFORNIA STATE SCIENCE FAIR
2005 PROJECT SUMMARY

Name(s)
Thuc Cao; Arti Karmur; Evan McDermott

Project Number
S0205

Project Title
Slope vs. Mechanical Advantage

Abstract

Objectives/Goals
The title of our project is #At what angle does the mechanical advantage of a bicycle disappear in comparison to running?# Our purpose is to discover the effects of slopes on mechanical advantage on a bicycle. To find out which size slope was the turning point, tests were performed consisting of time trials of multiple test subjects on variously sloped hills.

Methods/Materials
The procedure was as follows: First, measure multiple slopes that were all of different angle measures to have an array of test areas. Then, gather test subjects of different athletic ability in order to provide results that are not only narrowed down to conditioned people, but include both physically fit and unfit subjects. Next, have each test subject run and bike on each slope multiple times and collect the results. Finally, compare the results from each of the test subjects and identify at which slope the times from the bicycles became equal to or slower than the running ones. Our materials included a white chalk stick, ten slopes with varying degrees, and a graphing calculator. To run the trials we also needed our ten test subjects, the single speed street bicycle, and a GPS stopwatch. The stopwatch also contained the necessary equipment to measure the slopes in degree measures and the distance of 100 meters.

Results
Our results showed that when the test subjects were tested on slopes with angles greater than thirty degrees, the running times were more efficient than the bicycling. On average the point at which the greatest change occurred was in between the thirty and thirty-five degree hills. Any angle less than thirty degrees, the bicycles mechanical advantage was present and provided a greater output with the energy supplied.

Conclusions/Discussion
Overall, our project accomplished the goal of finding the slope at which mechanical advantage is no longer present. However, it was different than the angle measure that was hypothesized. Now, when riding a bicycle up a slope there is a known angle at which the rider should dismount the bike and begin running up the slope.

Summary Statement
The project is designed to calculate the angle at which the mechanical advantage of a bicycle is no longer present by comparing trial times to those of running trials.

Help Received
Mr. Beach, a former teacher, helped formulate the process by which the problem would be tested. Also, the school track coach, Mr. Newton, supplied the test subjects for our project.

CALIFORNIA STATE SCIENCE FAIR
2005 PROJECT SUMMARY

Name(s)
Elizabeth (Bethie) M. Conlan

Project Number
S0206

Project Title
Acceleration Factors

Abstract

Objectives/Goals
To see if acceleration remains constant between three different balls, with different masses and different diameters and different materials.

Methods/Materials
To test my hypothesis I tested three balls on a 4.5 meter wooden plank. I measured the acceleration at three different increments on the board to see if the acceleration between the balls remained constant. I tested each ball at each increment on the board ten times. I raised the ramp from a 10 degree angle to a 30 degree angle and repeated the test.

Results
The acceleration remained constant for each ball type for each angle. The only differences in the acceleration was due to human error in recording the time.

Conclusions/Discussion
The acceleration graphs showed the acceleration remained constant for each ball type and angle of the ramp. Expansions on this project could include further studies on moments of inertia or test how different friction factors would effect the experiment.

Summary Statement
To see if acceleration remains constant between three different balls, with different masses and different diameters and different materials.

Help Received
Father helped construct ramp using power tools.

CALIFORNIA STATE SCIENCE FAIR
2005 PROJECT SUMMARY

Name(s)
Robbie Eaton

Project Number
S0207

Project Title
The Hiller Flying Platform: Simulating a Pilot's Dream

Abstract

Objectives/Goals
The overall objective of my project is to develop a realistic and fully functional flight simulator for the craft known as the Hiller Flying Platform. A fundamental goal is to create enough realism in the simulator to be considered for inclusion as an active museum exhibit. An additional objective is to accurately represent the flight dynamics of the craft.

Methods/Materials
The Flying Platform simulator is controlled by leaning motions, as was the original. I used two plywood discs connected with a universal joint: one as a base, and the other as a movable standing platform. I also used large bedsprings to center the platform. I constructed a handrail for pilots to use for grip and leverage.
Over a period of 18 months, I developed 7 versions of software that would simulate the unconventional flight characteristics. I modeled the dynamics of the Hiller Flying Platform with a strong centering force and stable characteristics. To counter the unrealistic attributes of a computer flight simulation, such as limited field of view, I used virtual reality techniques like shifting a handrail on the screen in the direction of leaning. I designed scenery for the simulation that was somewhat simple and colorful to appeal to younger pilots. All the objects in the simulation were slightly larger and closer for easier referencing.

Results
Once I completed both the software simulation and the actual pilot's platform, I interfaced the platform to the software using digital encoders to convert the tilting motions of the pilot to digital data. Next, I tested the system with numerous Beta subjects and modified the program based on user feedback. After trimming and scaling, the simulator was ready for use by patrons, and now is displayed as an opening exhibit at the Hiller Aviation Museum.

Conclusions/Discussion
I finished a realistic and educational simulation system by incorporating both my skills of computer simulations and those of mechanical engineering.

Summary Statement
I created a flight simulation system that applies virtual reality techniques in the software and the pilot's sense of balance to produce a greater sense of reality than standard flight simulators used on home computers.

Help Received
Mr. North E. West was my shop mentor and advisor for the hardware section of the project. He taught me how to weld and use machine shop equipment, and recommended usage of certain parts or materials. Mr. Eric Johnson provided the microcontroller board.

CALIFORNIA STATE SCIENCE FAIR
2005 PROJECT SUMMARY

Name(s)
Vivien Y. Fang

Project Number
S0208

Project Title
How Damping Can Passively Control the Dynamic Behavior of a Structure

Abstract

Objectives/Goals
The objective of this study is to determine the dynamic behavior of a structure and how to passively control the vibrations. Or else stated as: how would damping affect the dynamic behavior of building structures when an outside force, e.g. earthquake, was to cause the structure to vibrate.

Methods/Materials
Two different types of metal beams (carpenter tape beams, and steel beams), each with three different amount of damping; forming a total of 6 different beams were tested with Photon II Dynamic Analysis System. Fundamental frequency and damping coefficient of every beam were experimentally determined by using the results found by the Analysis System.

Results
The fundamental frequency (f) and damping coefficient (d) of each beam are:
1. Carpenter tape beam without external damping: f=12Hz, d=0.0437.
2. Carpenter tape beam with medium external damping: f=14Hz, d=0.0825.
3. Carpenter tape beam with the highest external damping: f=20Hz, d=0.1341.
4. Steel beam without external damping: f=19Hz, d=0.0064.
5. Steel beam with a medium external damping: f=20Hz, d=0.1412.
6. Steel beam with the highest external damping: f=35Hz, d=0.1802.

Conclusions/Discussion
The results of this study indicated following conclusions:
1. The vibration magnitude of a beam with higher damping coefficient drops faster.
2. A beam with higher damping coefficient dissipates vibration energy faster.
3. Damping is helpful to reduce the vibration magnitude of a structure while it is shocked by an external force such as earthquake.
4. Damping is helpful to minimize the accumulated vibration energy of a structure during sever external excitation.

Summary Statement
Experimentally determine the dynamic behavior of a structure, and how damping can passively control the vibrations.

Help Received
Father helped to borrow the equipment.

CALIFORNIA STATE SCIENCE FAIR
2005 PROJECT SUMMARY

Name(s)
Michael A. Fukuda

Project Number
S0209

Project Title
Statistical View on Bowling

Abstract

Objectives/Goals
My objective was to determine whether or not the 16 pound bowling ball was better than the lighter bowling balls and to determine whether or not a hook is better than a ball without side rotation.

Methods/Materials
Metal ramp, tape, 8 bowling balls of different weights, bowling alley.

Results
Data showed that the 16 lbs ball was not the best, but the 15 lbs ball had the highest pinfall average. The ball with hook was much more accurate and effective.

Conclusions/Discussion
The heaviest ball being the 16 lbs, was not the best. The 15 lbs ball had a higher average pinfall. The extra pound of weight makes the ball harder to deflect off pins to cause more chaos and reactions. The four different shots constructed each had higher pinfall averages compared to the other experiment. Therefore, the ball with the hook is much more effective.

Summary Statement
I did this experiment to determine whether the heaviest ball is best over the other weights and to determine whether or not side rotation is better than no rotation.

Help Received
The bowling alley allowed me to use some of their lanes.

CALIFORNIA STATE SCIENCE FAIR
2005 PROJECT SUMMARY

Name(s)
Jonathan R. Glicksberg

Project Number
S0210

Project Title
Creating Binocular Vision with Only One Eye

Abstract

Objectives/Goals
The purpose of this project is to create a noninvasive Depth-Displaying Device (DDD) that would help people with only one functioning eye perform tasks, such as threading a needle, which are much more difficult to accomplish without binocular vision and depth perception.

Methods/Materials
I designed and built a DDD using a series of mirror pieces arranged at 45-degree or variable angles. I also constructed a wooden test box, for use in a depth-perception test, containing a 1-inch pegboard grid that holds dowels vertically and non-permanently at different depths. Subjects chose when 2 dowels appeared to be at the same distance. The test was repeated 15 times (5 depths x 3 repetitions, in a predetermined random order). Subjects were tested using two eyes (if both functioned), with one eye, and with one eye using the DDD. I also created a safe threading task, testing subjects with a dowel "needle" at 5 different distances, with and without the DDD.

Results
Four individuals with two functioning eyes achieved perfect scores on the depth-perception test when both eyes were used. When these subjects used only one eye, they correctly identified the depths only 15% of the time, with a range of -4 to +7 inches relative to the actual dowel positions. With the DDD these subjects matched the exact depths 98% of the time. The two subjects with only one functioning eye exhibited a coping mechanism, as evidenced by the proximity of their incorrect answers to the actual dowel positions; although only 20% of their answers without using the DDD were exactly correct, 97% were within one inch of the correct locations. Significantly, when the one-eyed subjects used the DDD, their scores were boosted to 97% exact depth answers.
One-eyed subjects improved their ability to perform the practical application (threading) task, threading the loop with fewer attempts when using the DDD.

Conclusions/Discussion
Although the monocular test subjects had developed some methods of compensation, their accuracy in the depth-perception test and their performance in the practical application test were both greatly improved by using the DDD. My Depth-Displaying Device enabled individuals with one eye to distinguish relative depths nearly as accurately as their two-eyed counterparts achieved using both eyes.

Summary Statement
I created a Depth-Displaying Device that enables monocular subjects (with one usable eye) to detect relative depths, a feat that normally requires binocular vision.

Help Received
Parents helped shop for supplies, supervised me while I used power tools, and had useful discussions with me.

CALIFORNIA STATE SCIENCE FAIR
2005 PROJECT SUMMARY

Name(s)
Tom J. Hiel

Project Number
S0211

Project Title
The Effect of Suspensions on a Car's Vertical Acceleration

Abstract

Objectives/Goals
Suspension serves two purposes in a car, it use an energy absorbent material that supports the weight of the body and flexes freely to absorb harsh blows in the road (How suspensions work, 2004). The second purpose is to ensure that all four wheels of the vehicle are always in contact with the road (Physics of your Car, 2003). When a car hits an object, a force is created, measured in G#s. In this project, suspensions made of various materials were mounted onto a model car and tested to see how much vertical acceleration they could absorb. My hypothesis was "If a car is fitted with a suspension when driving over a bump, then the vertical accleration shall decrease."

Methods/Materials
To measure the vertical acceleration, a model car was created on which an accelerometer was mounted. The car rolled down a track and hit a bump. The accelerometer recorded the vertical acceleration and gave readings on the computer. Five different kinds of suspensions were tested. They were each rolled down the track five times and the average vertical acceleration was determined.

Results
The average vertical acceleration for each of the suspensions was determined as well as the percent decrease when compared to a car with no suspension. All the results have been graphed and analyzed.

Conclusions/Discussion
My hypothesis, "If a car is fitted with a suspension when driving over a bump, then the vertical accleration shall decrease", has supported by the data. This project has several other real world applications such as the shock absorbing cartilage found between joints and cartilage.

Summary Statement
The focus of the project was to determine what effect suspensions had on the vertical acceleration of a car.

Help Received

CALIFORNIA STATE SCIENCE FAIR
2005 PROJECT SUMMARY

Name(s)
Carmel Imani; Camellia Imani

Project Number
S0212

Project Title
Its Gotta Be the Oil

Abstract

Objectives/Goals
Our experiment was to determine what used cooking oil would run a lawn edger the longest. we thought that it would be the Wesson Pure Corn oil.

Methods/Materials
The only variable in my experiment was the type of cooking oil. i used Corn, Vegetable, Peanut, Canola, Olive, and Safflower Oils. Each oil was tested four times, for a total of twenty-four experiments. French fries and fish sticks were cooked and oil filtered. I timed how long the lawn edger ran on one hundred ml. of oil. We controlled the brand and amount of food, heating, cooking, and cooling times, amount of oil, and outside temperature. We always used a new cooking filter, new spark plug, and a gas cleaned lawn edger.

Results
The six oils that we used in our experiment in final ranking order were: (1st) crisco Pure canola oil, (2nd) hollywood renriched gold pressed safflower oil, (3rd) crisco pure vegetable oil, (4th) wesson pure corn oil, (5th) Bertolli Classico 100% pure olive oil, (6th)hollywood enriched peanut oil, which did not run at all.

Conclusions/Discussion
Our hypothesis was that the corn oil would run the lawn edger the longest, but the Canola oil was the best fuel. it was the only one that stopped running because it was out of fuel. With other oils, not all of the saturated fat bonds were broken down during cooking, so they fouled the spark plug.

Summary Statement
Our project is about used cooked oils and which one could run a lawn edger the longest.

Help Received
no help.

CALIFORNIA STATE SCIENCE FAIR
2005 PROJECT SUMMARY

Name(s)

Donald Novak; Rey Ruiz

Project Number

S0213

Project Title

The Effect of Barrel Length on Velocity and Percision of a Paintball Marker

Abstract

Objectives/Goals

The purpose of the project was to find the optimum length of a paintball marker barrel that would yield the most precise fire possible without reducing projectile velocity.If the barrel length of a paintball marker is increased,then the precision will be higher,but the velocity will decrease.

Methods/Materials

A ballistics pendulum and a chronograph machine were used to measure projectile velocity.Five different barrel lengths were used:a 15.75in.,14in,12in,9.625in,and a 9.375in barrel.The paintball marker was fired at the pendulum and as the pendulum reacted to the shot,an attached marker recorded the movement onto paper.The paintball marker was clamped to a bench to preclude movement.A digital scale was used to measure the masses of the pendulum and projectile.The projectile velocity was calculated using the formula V=M/m*.2018*d.V=velocity of paintball.M=mass of pendulum.m=mass of paintball.d=distance of swing in inches.Precision was measured by firing 20 paintballs from each barrel at a grid 15 meters from the beginning of the barrel.

Results

Of the five barrels tested,the longest barrel measured 15.75in.,which shot the paintball at a lower velocity than the other barrels.The 15.75in. barrel was the second most imprecise barrel at 2.2SS.The 14in. barrel avg. a velocity of 219.6FPS and avg. 1.66SS,which was the second best barrel.the 12in. barrel was the best barrel in both categories;it avg. 1.63SS and 220.1FPS.The shortest barrel which was 9.375in. shot at 215FPS and had an avg.of 2.12SS which did support the hypothesis because it had low precision.The barrel with the lowest precision was the 9.625in. barrel at 2.3SS.

Conclusions/Discussion

The data did not support the hypothesis.The longest barrel partly refuted the hypothesis because it did not shoot as precise as hypothesized,this could be due to the extra length and the friction exerted on the ball that could slow the paintball down.The 9.375in. barrel refuted the hypothesis because it shot at lower velocity than all the other barrels besides the 15.75in. barrel.The data did support that the barrel lengths between 12-14in. maintained a higher velocity.The 12-14in. barrels offered the most precision.The data concluded that the optimal barrel length was the 12in. barrel.The 12in. barrel yielded an avg. of 1.63SS and 220.1FPS.

Summary Statement

To determine the optimal length of a paintball barrel that would yield precise fire while not compromising velocity.

Help Received

CALIFORNIA STATE SCIENCE FAIR
2005 PROJECT SUMMARY

Name(s)
Andreas Pena Doll

Project Number
S0214

Project Title
Propane vs. Gasoline

Abstract

Objectives/Goals
The objective of this project is to determine if propane is a cleaner and more efficient energy source than gasoline for an internal combustion motor.

Methods/Materials
I connected a lawnmower motor to an electric motor to produce electricity, which was used as a control. Then I converted the motor to propane and measured its efficiency and compared it to the motor's efficiency running on gasoline.

Results
After performing three different tests, I found that one mole of gasoline burns in 14.42 minutes and one mole of propane burns in 16.30 minutes. Then I compared their efficiencies using weight. One ounce of gasoline is consumed in 4.18 minutes and one ounce of propane is consumed in 10.30 minutes. Propane burns cleaner and colder than gasoline as shown by a visual test.

Conclusions/Discussion
Propane is a cleaner and more efficient fuel than gasoline for the internal combustion engine.

Summary Statement
I set out to determine if propane is a cleaner and more efficient fuel for the internal combustion engine by converting a gasoline motor to run off of propane and performing comparative tests.

Help Received
None

CALIFORNIA STATE SCIENCE FAIR
2005 PROJECT SUMMARY

Name(s)
Tammy E. Prado

Project Number
S0215

Project Title
Swing This Way!

Abstract

Objectives/Goals
Is the #harmonic# motion of a pendulum affected by friction? If so, does weight help resist the friction? Can a mathematical formula be developed to determine the damping factor?

Methods/Materials
To construct the pendulum frame:
Wood; Tools to build the pendulum; Saw blade, nail gun wood glue hammer
To construct the pendulum:
Screw hook; Protractor; Small weights; Fishing line; Straws; Tape; Ruler
Computer with TI- Connect Software with CBL/CBR software; Calculator Base Ranger; USB link cable

Procedures:
Assemble pendulum frame; Collect data with motion detectors; Edit data tables; Use exploratory data analysis to analyze the damping factor; Use statistical inference to determine the effects of mass

Results
My findings resulted in me proving the standard textbooks wrong. The period of motion of the pendulum indeed has a damping factor that can be mathematically evaluated with the damp motion theory. My data also resulted in showing that heavier masses resist friction more efficiently.

Conclusions/Discussion
My first hypothesis was that the motion of the pendulum would be affected by friction through time. Data collected in the second part of the experiment demonstrates this hypothesis to be correct. In every case, the amplitude and displacement of the pendulum bob from its equilibrium decreased in gradual amounts. Data collected with the motion detector shows the displacement of the pendulum through time as well. The data also proves the hypothesis to be correct. My second hypothesis was that the weight of the pendulum would affect the resistance of friction. Through exploratory data analysis and the relation of mass to weight, I was able to conclude that the weight does indeed affect the resistance of friction. The average difference in amplitude between each half swing for a mass of 20g was 1.2583° and a standard deviation of 1.1365° and for a mass of 100g the mean was 1.1° with a standard deviation of 0.8699°. Therefore, the weight as it is related to mass by the equation W=mg (Weight= (mass)(acceleration due to gravity)), does affect the resistance. Heavier objects resist friction more easily.

Summary Statement
Mathematically proving that the assumed harmonic motion of the pendulum consists of a damping factor.

Help Received
Mr. Kyle Atkin helped with motion detectors and statistical inference; Dr. Scott provided the complex pendulum

CALIFORNIA STATE SCIENCE FAIR
2005 PROJECT SUMMARY

Name(s)
Brian M. Smith

Project Number
S0216

Project Title
Shake, Rattle, and Roll: Wood vs. Brick During Earthquakes

Abstract

Objectives/Goals
My objective is to test wood and unreinforced masonry for the amount of energy that passes through to determine which is a better building material for earthquake resistance.

Methods/Materials
Materials: 1 swinging apparatus; 1800mL water; 1 fishing weight; 1 medium sized pan

Methods: I will swing a fishing weight attached to the swinging apparatus against a brick or piece of wood. This will generate a wave in the pan of water. The amplitude and frequency of the wave will be calculated for results

Results
Wood is a better bulding material because it had a smaller wave and larger frequency. This indicates that the wood allowed more energy to pass through the material and thus subject less damage on itself.

Conclusions/Discussion
The larger the wave size determined if the material allowed more energy to pass through it. The energy from the falling weight along with the centrifugal force caused a large amount of energy to be applied to the material. This energy passes through the material and is transferred to the water, crating a wave that rolled throughout the pan. The variable that had an affect on the amount of energy passing through the brick was a combination of the density, the rigid characteristics, and the hardness. The wood proved to be less dense and softer because of the molecular composition of the molecules of wood. These characteristics determined the amount of energy to pass through the material. The brick had an average wave height of 2.04mm while the wood had an average wave height of 6.99mm. This is a difference of 4.95mm. In conclusion, wood makes a better building material because it allows more energy to pass through.

Summary Statement
My project tests what building material is more resistant to earthquake damage, wood or unreinforced brick masonry construction.

Help Received
Aunt was interviewed; Father helped print digital photos

CALIFORNIA STATE SCIENCE FAIR
2005 PROJECT SUMMARY

Name(s)
Amanda R. Suzuki

Project Number
S0217

Project Title
Overall Strength of Various Suture Techniques in Wound Closure

Abstract

Objectives/Goals
The purpose was to determine the overall strength of three suture techniques used in wound repair: the simple interrupted, horizontal mattress, and vertical mattress stitches.

Methods/Materials
1.Two strips were sewed together with suture material with one simple interrupted stitch 2. The strip was fastened to a fixed point on one side, the other side was attached to a rubber band attached to the K"Nex motor on the repetitive stress aparatus. 4. The motor was turned on and the stopwatch recorded time until failure & converted to cycles. Failure is defined as the suture breaking through the strip, or until the preset two minute time limit had passed. 5. The process was repeated 4 more times with the same stitch. 6. Steps 1-5 were repeated using the vertical mattress, then the horizontal mattress stitch. 7. Two strips were sewed together with suture material with one simple interrupted stitch. 8. The edges of a simple stitch strip were attached to a string fixed to a coat hanger bent into a hook by binder clips. 9. Incremental weights were added every 10 seconds until failure. 10. Steps 7-11 were repeated using the vertical mattress stitch then the horizontal mattress stitch. 11. Each stitch was tested in 5 trials in each test.

Results
In the repetitive stress test, the mean number of cycles to failure for the simple interrupted & vertical mattress stitch was 34.4 cycles and 9.34 cycles, respectively. The average cycles to failure for the horizontal mattress stitch was 98.4+ cycles, indicating that the horizontal mattress stitch did not tear through the strip within the two minute time limit. In the maximum tension test, the simple interrupted, vertical mattress, and horizontal mattress suture technique averaged 414 grams, 414 grams, and 501 grams, respectively.

Conclusions/Discussion
The hypothesis was partially correct. The horizontal mattress stitch had the highest averages in the maximum stress test & in the repetitive stress test. Results depended on the stitch#s the distribution of tension and location of suture#s insertion. Errors caused by elasticity in the suture material & imprecise measuring tools in the maximum tension test may have effected the results and would explain the large % deviations for some of the stitches in the repetitive stress test.

Summary Statement
The project evaluates the strength of three suture techniques based on a repetitive stress test and a maximum tension test.

Help Received
Dr. Suzuki made the stitches on the strips that were tested.

CALIFORNIA STATE SCIENCE FAIR
2005 PROJECT SUMMARY

Name(s)
Geoffrey H. Woo

Project Number
S0218

Project Title
Predicting Material Failure: Correlation between Deformation Luminescence and Hysteresis

Abstract

Objectives/Goals
Material failure prediction would revolutionize modern engineering. Currently, scientists and commercial systems are unable to measure the impact of stress and, most importantly, to predict structural failure. The ultimate objective of this study is to develop a reliable material failure prediction model by analyzing the characteristics of deformation luminescence (DL) of materials under stress.

Methods/Materials
Mechanoluminescent irradiated Lithium Fluoride (LiF) crystals were utilized in experiments to observe DL as the material undergoes hysteresis. An Instron testing system was used to compress LiF with various stress, strain, load speed, cycling, and time duration variables. Photomultipliers were used to capture photon emission data. Data was collected both manually and with an oscilloscope computer data acquisition system from which mathematical models were derived.

Results
As LiF was stressed to its elastic limit, DL was found to increase drastically, signaling hysteresis. Under prolonged conditions, DL was found to decay in various mathematical relations against stress, strain and time duration. Also, DL increased logarithmically with load speed. Photon emissions were also found to be effective in identifying the presence of internal cracks and denoting the phenomena of fracture. The accumulative total of photons emitted up to fracture remained relatively constant even under different stress regimens.

Conclusions/Discussion
Conclusively, DL was demonstrated to be a superior indicator of hysteresis, the precursor to failure. The accumulative total of photons emitted up to fracture was found to be an potential predictor for material failure. The discoveries made in this study will help develop a reliable material failure prediction system. These findings will ultimately improve the safety and efficiency of vehicles, machines, and structures we use today.

Summary Statement
The purpose of this study is to develop a novel material failure prediction system by analyzing deformation luminescence of materials under stress.

Help Received
Used lab equipment at UCLA under the supervision of Dr. Putterman and Dr. Chakravarty