CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)
Rosemary J. Chapman

Project Number
J1801

Project Title
The "Eggsact" Speed of Light

Abstract

Objectives/Goals
The objective of this project is to measure the speed of light using the hot spots created by the interference of microwaves in a microwave oven, on different foods.

Methods/Materials
The rotating mechanism was removed from a microwave oven to produce hot spots that caused uneven cooking. After heating different foods, a metric ruler was used to measure the distance between the centers of the hot spots. This distance represents half of the wavelength of a microwave produced by the oven. The frequency of the microwaves produced by the oven was given on the oven's label.

Results
The speed of the microwaves was calculated by multiplying the average wavelength determined from the hot spots of each food and the frequency of the microwave oven. Since microwaves and visible light are both electromagnetic waves, they have the same speed. When using egg whites, the speed of light was calculated to be 304,000,000 m/s, which was a 1.33% error when compared to the actual speed of light, 300,000,000 m/s. Egg yolks yielded a 3.0% error, marshmallows a 3.6% error and sour punch straws a 4.6% error.

Conclusions/Discussion
By removing the rotating platter in a microwave oven, hot spots were produced which are the antinodes that form when the microwaves reflect off the walls of the oven and interfere with each other, producing standing waves. The distance between the hot spots did not depend on the type of food tested, but the egg whites gave the best results because their hot spots had a more defined center making it easier to measure the distance between them.

Summary Statement
This project is about measuring the speed of light using the microwaves generated by a microwave oven.

Help Received
My mom supervised my experimental procedure and explained some of the concepts of electromagnetic waves.

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)
Mariah G. Cox

Project Number
J1802

Project Title
Oh, No! The Dryer Broke!

Abstract

Objectives/Goals
My project was to see which would evaporate water faster, wind or radiant heat. I believe that the wind will evaporate water faster because the wind blows the water molecules apart. It also blows the humid air away. The heat just speeds the water molecules up.

Methods/Materials
I used a weather station with an anemometer to measure the wind speed of a fan. I used a thermometer to measure the heat of a radiant heater. I used three different speeds (4mph, 6.4kph), (7mph, 11.3kph), (9mph, 14.5kph) and temperatures (80F, 26.7C), (90F, 32.2C), (100F, 37.8C). I wet sponges with an equal amount of water and measured how long it took to dry them out. I also had a control that was seperate from the wind and heat.

Results
On the two lower speeds and temperatures the fan evaporated the water faster. On the third trial, when the temperature was at 100F(37.8C), the heater dryed the sponge faster, but not by much.

Conclusions/Discussion
My conclusion is that wind without heat will dry things quicker than mild heat alone. My hypothesis was correct. Best bet for evaporation is a combination of wind and heat. (My dryer!!)

Summary Statement
My project was to find out which causes faster evaporation, wind or radiant heat.

Help Received
My mother taught me how to make the spreadsheet and graph.

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)

Thierry de Crespigny; Austin Hartman; Ed van Bruggen

Project Number

J1803

Project Title

Visualizing the Invisible: At Home with a Schlieren Camera

Abstract

Objectives/Goals

Energy is being produced from many household objects in the form of heat. This heat is invisible to the human eye and goes unnoticed. Visualizing heat would help us appreciate energy loss and maybe help us be more energy efficient. Schlieren photography is one way to visualize heat convention but the equipment is expensive and only available in science labs. Our objective was build an inexpensive version of the Schlieren camera for everyday use.

Methods/Materials

Using an inexpensive 16 centimeter diameter concave mirror and a pinpoint light source (modified LED thats 17 candela bright) was focused onto the edge of a razor blade. A camera fitted with a high zoom was focused onto the mirror and arranged to image the distorted light beam. After the LED is in focus and lined up with the camera and blade, the image was displayed. Various test objects that produce heat convention, including candle, computer fan and hairdryer, were used to distort the light and record an image.

Results

Using the methods described above we found that a very bright LED and a pinpoint was required in order to produce enough light for anything to work. Focusing the light to the edge of the razor blade was critical to have the experiment work at its best. With this arrangement the camera was very sensitive to any light distortion by heat, leaving a amazing image. To demonstrate the sensitivity of this device we imaged the heat wave coming from the human mouth when someone was breathing and even a burp!

Conclusions/Discussion

We were able to build a Schlieren camera from modified but readily available resources found around our house. Using this setup, and given enough patience and time, we were able to demonstrate heat convection from many objects. We were amazed at how sensitive and precise the camera was and how much energy we waste every day. In conclusion we succeeded in making a low cost Schlieren camera and being able to see light being distorted by heat.

Summary Statement

Visualizing the convection of heat with a reengineered Schlieren camera.

Help Received

Parents helped glueing poster, soldiering wires and buying supplies

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)

Shashank H. Dholakia; Shishir H. Dholakia

Project Number

J1804

Project Title

The Sky Is No Limit: A Photometric Analysis of Short Period Variable Stars and Extra-Solar Planetary Systems

Abstract

Objectives/Goals

Our project was aimed at finding the internal characteristics of variable stars by analyzing their light curves. Last year's experiment showed us that we could capture a variable star's light curve using just a digital camera. This year, we wanted to extend our experiment to analyzing the internal characteristics of short period variable stars and extra solar planetary systems.

Methods/Materials

We used a method called photometry to analyze the brightness of three types of variable stars - Eclipsing binary systems, Cepheid variables and Exoplanet systems. We attached a DSLR camera to a 4" telescope to take sets of images of a star. We averaged each set of images to enhance the precision of our data. We then located a few stars of known and fixed brightness, called comparison stars and used them to derive the magnitude of the variable star. This process was repeated from 30 to 100 times, and the brightness at each point in time was graphed. We analyzed the light curve to deduce some of the internal characteristics of the variable stars.

Results

We were able to detect the dip in brightness caused when the exoplanet transited its host star. From the light curve we derived some of the exoplanet's internal characteristics, such as the amount of light it blocked from the host star. We also could find out about the internal characteristics of the eclipsing binary and Cepheid stars. One of the eclipsing binaries, Beta Lyrae, exhibited qualities of a system where the stars are very close but are separate, while the other star, W UMA, exhibited qualities of a system where the two stars are conjoined. The light curves of the both the Cepheids were quite similar, but had differences in the amplitude of brightness change and period length. Using properties unique to Cepheid type variable stars we were able to calculate the mass, luminosity and even distance of these two stars.

Conclusions/Discussion

The fact that we were able to observe the minute dip in brightness characteristic of an exoplanet transit shows the precision of our experiment. Although our data supported our hypothesis for the most part, we also were surprised by some very interesting features in the light curve such as a plateau of brightness in one of the minima of W UMA. In the future, we hope to be able to conduct wide field surveys with high precision for the detection of Earth-sized exoplanet systems.

Summary Statement

In this experiment, we were able to derive the internal characteristics of short period variable stars and exoplanet systems by analyzing their brightness over time.

Help Received

Father helped with Excel formulae

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)
Abigail F. Hernandez

Project Number
J1805

Project Title
Index of Refraction: Correlation with Chemistry and Density

Abstract

Objectives/Goals
Objective is to determine correlations between the index of refraction (IOR) and density and chemistry. The initial hypothesis was that denser liquids will have higher IORs because as density increases, there will be more absorption between light and liquid molecules.

Methods/Materials
Density was measured using a calibrated laboratory scale and IOR was measured using a laser pointer for ten liquids in two categories, water-based and oil-based. Each was measured at three incident angles, and IOR was calculated using Snell's Law. A total of 48 tests were done on three test dates.

Results
Data was plotted (x-axis = density, y-axis = IOR). The initial regression showed a negative correlation for all 10 liquids, but I noticed that water-based and oil-based data grouped together independent of each other. By running linear regressions separately on each subset (water-based and oil-based), I found positive correlations between IOR and density with good values for r^2 even with relatively small sample sizes (5 each).

Conclusions/Discussion
My conclusion is that the basic chemistry of the liquid is the most important factor affecting the index of refraction, and that density is second. This is because some molecules are more likely to absorb laser light than others, independent of density, meaning, that a lighter liquid such as oil will have a higher IOR than a heavier liquid like tap water. Yet, within a subset of liquids with common chemistry, the IOR vs. density correlation holds.

Thus, liquids with simple molecules (e.g., water-based liquids where the primary constituents are oxygen and hydrogen in a 1:2 ratio) are less likely to absorb light than more complicated molecules (e.g., oil-based molecules where the primary constituent are oxygen, carbon, and hydrogen in a 1:8:9 ratio).

My results contain one outlier, silicone oil, but the chemistry differences are marked enough with the other oils that I am confident declaring silicone oil as belonging to a third chemistry type.

Summary Statement
I measured the density and index of refraction of ten liquids (48 total tests) to determine that a liquid's index of refraction correlates with molecular structure (e.g., chemistry) first and density second.

Help Received
Father helped with experiments and research; mother helped with poster; science teacher let us use her scale.

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)

Julia G. Jorgensen

Project Number

J1806

Project Title

The Effects of Temperature on the Resonant Frequency of a Singing Wineglass

Abstract

Objectives/Goals

This experiment investigates the effect of temperature on the resonant frequency of a wineglass. As a wineglass at room temperature is filled with water, its resonant frequency decreases nonlinearly. If the wineglass is heated (or cooled), or if the water in the wineglass is heated (or cooled), the hypothesis is that the resonant frequencies will follow the same nonlinear pattern as the glass at room temperature, but will be comparatively higher (or lower). This hypothesis is based on the principle that molecules at higher temperatures oscillate more quickly, thus resulting in higher resonant frequency.

Methods/Materials

A wet finger was rubbed along the rim of a wineglass filled with water at varying levels to produce a tone. Using a SEIKO ST757 Chromatic Tuner, the pitch of this tone was detected, along with its offset in cents (1/100th of a musical half step). This value was converted to frequency in Hertz, mean averaged with four other trials, and recorded. The experiment was conducted under four temperature conditions: hot wineglass, hot water in the room temperature wineglass, cooled wineglass, and cold water in the room temperature wineglass.

Results

For each temperature condition, the curve did have a similar shape to the control. Only the cooled wineglass produced consistently lower resonant frequencies than the control. At every water level, the resonant frequency of the cooled wineglass was between 2 and 22 Hz lower than that of the glass at room temperature. The mean resonant frequencies produced by the heated glass, hot water, and cold water at each water level fluctuated both above and below the resonant frequency of the room temperature glass, on the order of less than 20 Hz, a difference barely perceptible to the human ear. No general trends could be detected for the resonant frequencies of the heated glass, the glass with hot water, and the glass with cold water.

Conclusions/Discussion

While the data did not contradict the hypothesis, it was inconclusive. In the condition of the cooled glass, the hypothesis was supported by the results: the resonant frequencies were lower at every water level. In the other conditions, however, the data was inconclusive, and did not clearly prove or disprove the hypothesis. In these cases, the molecules of the glass were not heated up or cooled down sufficiently to change the resonant frequency of the wineglass consistently.

Summary Statement

The experiment determines the effects of temperature on the resonant frequency of a wineglass.

Help Received

My mother helped me decipher the conversion from values in cents shown on the tuner to frequency in Hertz.

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)
Madeline L. Karnes

Project Number
J1807

Project Title
Speed vs. Thrills: A Study of Potential and Kinetic Energy

Abstract

Objectives/Goals
A roller coaster is amazing when it has both high speeds and thrills, like those offered by a vertical loop, but does one have to be sacrificied for the other? To test this I dropped marbles, of the same weight, from the same height, therefore having the same potential energy (E potential = .0938) on a roller coaster track. I used tracks with three different diameter vertical loops, and calculated the speeds and kinetic energies. My goal was to see if increasing the diameter of the loop will proportionally change the kinetic energy, as measured with a decrease in the speed of the marble, and make predictions about other sizes of loops and marbles.

Methods/Materials
I created three roller coaster tracks using 3.6576 meter sections of foam pipe insulation and duct tape. Each track began 1.26 meters high, attached to a step ladder, and the three loops had diameters of 20 cm, 30 cm, and 40 cm. The marble used was 0.0076 kg and was dropped 30 times, for 30 trials, for each of the loop sizes. The speeds were averaged and then the kinetic energy of each loop was found using the formula E kinetic = 1/2 mass times velocity squared.

Results
I calculated a ratio of kinetic to potential energy to measure the differences between each loop size. My results were that the 20 cm loop's ratio of kinetic energy to potential energy was 20.1%, the 30 cm loop's ratio was 17.9%, and the 40 cm loop's was 16.4%. This showed a difference of almost 2% in the ratio as the diameter of the loop was changed by 10 cm.

Conclusions/Discussion
From these results one could extrapolate that a loop of 50 cm would have a ratio of kinetic to potential energy 22%, and so on. This proved that you do give up a proportionate amount of speed for the thrill of a bigger loop.

Summary Statement
I built 3 models of roller coaster tracks, with 3 different sized vertical loops. I measured the speed, calculated the kinetic energies, and made a ratio with the potential energy to show the ratio of speed to thrills.

Help Received
My father helped me stabilize the track so I could run my trials. My mother helped me time the trials, and do the standard deviations in Excel.

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)
Austin T. Kim

Project Number
J1808

Project Title
Super Cooling and Snap Freezing

Abstract

Objectives/Goals
My objective was to see which type of water samples can be supercooled before freezing;distilled water,spring water,or plain tap water.

Methods/Materials
My objective was to see which type of water samples can be supercooled before freezing;distilled water,spring water,or plain tap water.

Results
The only water sample to supercool and snapfreeze was the distilled water on its third and final trial.

Conclusions/Discussion
It appears that my data and results did indeed support my hypothesis in the fact that distilled water would be the only water sample to supercool and snapfreeze. I believe with this experiment the fundamentals of the phenomenon known as supercooling can be better understood.

Summary Statement
The capabilities of different types of water to maintain its liquid state when below freezing.

Help Received
Father helped with experiment.

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)
Margo K. Kuney

Project Number
J1809

Project Title
Does Temperature Affect a Magnetic Field's Strength?

Abstract

Objectives/Goals
My project's objective is to determine whether the temperature of a magnet will affect the strength of a magnet and its magnetic field.

Methods/Materials
I used 80 1.25 ceramic (ferrite) ring magnets. I tested 20 magnets in the following temperature testing environments: 1) a hot oven (204 deg. C), 2) room temperature (23 deg. C), 3) the refrigerator (2 deg. C), 4) and an ice chest filled with dry ice (-17 deg. C). Meanwhile, I placed 700 copper covered steel bb's in a paper bowl. Upon removing the magnets from their respective testing environments, and using one magnet at a time, I placed a magnet on a stone surface and placed the paper bowl with bb's on top of the magnet until the magnet attached to the bottom of the bowl. I then picked up the bowl and slowly poured the bb's into a second paper bowl until the only bb's remaining in the first bowl were those being held by the magnet's magnetic field. I then counted and recorded the number of bb's remaining in the first bowl and recorded the data for each magnet.

Results
The magnets exposed to the coldest testing environment (-17 deg. C) created the strongest magnetic field based upon the number and weight of the bb's held by the magnet with an average lifted weight of 73.02 grams. The magnets in the hot environment (204 deg. C) created the weakest magnetic field with an average lifted weight of 53.75 grams.

Conclusions/Discussion
From my results, I conclude that temperature does affect the strength of a magnetic field with the coldest environment creating the strongest magnetic field for a magnet and the hottest environment creating the weakest.

Summary Statement
This experiment explores whether a magnet's magnetic field is affected by extremely hot and freezing temperatures.

Help Received
My father helped me obtain the magnets. He purchased and handled the dry ice and then helped me test the magnets exposed to the two extreme temperature environments. He also helped me count and weigh the bb#s.

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)
Rennie M. Lembo

Project Number
J1810

Project Title
Can Thermoacoustic Refrigeration Be a Functional Alternative to Conventional Refrigeration?

Abstract

Objectives/Goals
My objective was to see if thermoacoustic refrigeration can be a functional alternative to conventional refrigeration.

Methods/Materials
The project was tested by building a primarily display function thermoacoustic refrigerator. This was done by taking a base design from several different sources and modifying it heavily. The first comportment of the refrigerator, and possibly the most important, was the stack. This was created by gluing fishing line to film in 5 mm intervals. The next part was the base of the refrigerator which was created by taking clear acrylic pipe, a high power commercial grade amplifier, a plastic box, and a standard speaker. Other smaller components were used. The stack was then placed in the tube 5 cm from the top, and was sealed off to prevent sound from escaping. The speaker was connected to the amplifier and sealed at the bottom of the pipe. Two micro thermoprobes were inserted directly above and below the stack, and then sealed in with clay.

Results
The refrigerator was tested by playing three different tones in 20 minute intervals and recording the temperatures of above the stack, below the stack, and the ambient room temperature before and after the 20 minute mark. In the case of the first frequency, 250 Hz, a somewhat stable temperature change was recorded. Currently, I am unsure if there would have been temperature crossover of the room temperature and below the stack. Nearly the same results were recorded for the frequency of 213 Hz. The frequency of 340 Hz hardly changed at all.

Conclusions/Discussion
In the end, it is somewhat hard to know. Due to the unfortunately rushed nature of the project, it was assembled with care, but not the care I would have liked to use. Also, this is a very small scale project asking a very big scale question. Can thermoacoustic refrigeration replace conventional refrigeration? It is hard to know at this point. Considering I did get a temperature change, I would believe that it will happen-one day in the future. All I have proved is that this can be done, and it is a viable technology.

Summary Statement
My project is about the idea of using sound waves to expand and contract gases, effectively cooling and heating them.

Help Received
Father helped construction of refrigerator; Used micro thermoprobes and amplifier from Cyberdata Corp; Mother helped cut letters for board.

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)
Marcus Luebke

Project Number
J1811

Project Title
Laser Transmission of Energy: To Power the Future

Abstract

Objectives/Goals
The purpose of this project was to figure out whether lasers might be used to transfer energy efficiently. Specifically, to measure the efficiency when power is converted into light and then back into power.

Methods/Materials
In order to model & measure the energy transmission efficiency, electricity was converted into laser light and then back into electricity using a laser pointed at a photo detector. An oscilloscope was used to measure the input voltage into the laser and the output voltage from the photo detector.

Results
The response of the system had several different characteristics. From 0-1.7 volts there was no output voltage. Greater than 2.1 volts the output voltage stayed at 0.5 volts. The only significant changes from the system came in the medium input voltage region of 1.7 to 2.1 volts, the band-gap region for the laser where electron flow is proportional to an increase in voltage. The maximum transmission efficiency, measured as the ratio of the output voltage to the input voltage, was ~23%.

Conclusions/Discussion
This experiment showed that with desktop equipment a ~23% transmission efficiency was achieved when simulating Space Based Solar Power via conversion of input power to laser light and then back to output power. Conclusion: Space Based Solar Power using lasers is feasible, with a superior 23% transmission efficiency compared to an equivalent 18% Earth based solar power system.

Summary Statement
To determine if lasers might be used to transfer energy efficiently as part of a Space Based Solar Power system, power was converted into light and back into power, resulting in a transmission efficiency of ~23%, greater than the 18% goal.

Help Received
My Dad taught me about soldering, cutting wires & time management. My Grandma helped me cut welding glass filters. My Mom helped me research and put together my report & display board. SLAC Researcher Mike K. & NIF Engineer Fred W. inspired ideas on high energy physics & lasers.

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)

Henry A. Mason

Project Number

J1812

Project Title

Who Packs the Most Punch, Superman or Flash? A Study of the Relationship between Mass, Velocity, and Force

Abstract

Objectives/Goals

With Superman and Flash as metaphors for "big and strong" versus "small and fast," this projects investigates the relationship between mass, velocity, and force, illustrating how mass and acceleration affect the displacement of an object at rest.

Methods/Materials

Using a pendulum (because it is easy to predict its speed), two different lead weights (enameled for safety) will be used with the larger, blue weight representing Superman's larger mass and the smaller, red weight representing Flash's smaller mass. Each lead ball will be raised on the pendulum at different angles and let go, allowing it to strike an object at rest, representing a "bad guy," knocking it over. Afterward, I will measure how far it was displaced in each test.

Results

The maximum average throw-back using the smaller, red ball, when swung from 90 degrees, was 77cm, with the ball having reached 300cm/sec. Almost the same throwback distance for the blue ball happened with the pendulum having been swung from 70 degrees, with that ball having reached 246cm/sec. The red ball's kinetic energy at that speed should have been 1.17J. The same kinetic energy should happen for the blue ball between 70 and 80 degrees. The kinetic energy of the blue ball at 70 degrees should have been 1.03J. I expected the throwback to be more, which I do find in the blue ball's median throwback for 70 degrees.

Conclusions/Discussion

The experiment does prove my hypothesis that a small mass can exert more force when traveling at a high velocity than a larger mass traveling at a lower velocity, but not as much as I had expected. In one calculation at the end of my trials, I figured out that the red ball swinging from 90 degrees would exert the same force as the blue ball swinging from around 0.02 degrees, which works out to the same proportion as the example in the video of Flash traveling at 36,787,559,000 m/s and Superman moving at 600 m/s when facing off against their "bad guys."

Summary Statement

This project gauges the impact of two objects of different mass on the same stationary object.

Help Received

David Mason helped assemble final pendulum; Valeria Mason contacted DC Comics for permission to use images; Dr. Charles Prince recommended physics textbooks; Dr. Graeme Mason coached for presentation; Mr. Ryan Flagg helped appreciate Newton's laws and math

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)
Sumer A. Mukhey

Project Number
J1813

Project Title
Living in Harmony

Abstract

Objectives/Goals
How does adding mass change the period of a spring? My hypothesis was the more weight added to a mass-spring system will increase the length of the period of the spring#s harmonic cycle in a manner proportional to the amount of weight added. The results of this experiment could help improve a company#s suspension on its machinery such as, improve its spring quality and efficiency.

Methods/Materials
Materials
1. Spring; 2. Three (3) gram weights; 3. Stopwatch; 4. Lab notebook; 5. Graph Paper; 6. Scale; 7. Scientific calculator.
Procedure
1. Measure the mass of one of the weights. 2. Hang one end of spring off a table and let it bounce gently down and then back up. 3. Count number of cycles the spring makes in sixty (60) seconds with no weight hanging. 4. Hang one weight from spring. 5. Count the number of cycles the spring makes in sixty (60) seconds with the weight attached. 6. Perform ten (10) trials for each weight. 7. Repeat steps four (4) through six (6) for a series of different weights. 8. Analyze data. 9. Make another table to convert the raw data into numbers that can be used to determine the spring constant and spring#s effective mass. 10. Make a graph with "Added mass," m, in kilograms, on the y-axis, and T2/4π2, in sec2, on the x-axis. Use kilograms so that the value of k is in units of N/m, which is equivalent to kg/sec2.

Results
The average cycles per minute for 100 grams was 90 cycles per minute. The average cycles per minute for 50 grams was 124.4 cycles per minute. the average cycles per minute for 20 grams was 177.9 cycles per minute.

Conclusions/Discussion
As stated in the hypothesis, the more weight added to a mass-spring system will increase the length of the period of the spring#s harmonic cycle in a manner proportional to the amount of weight added. The more weight added to the spring, the longer the cycle resulting in fewer cycles per minute. The smaller the amount of weight added to the spring, the shorter the cycles resulting in more cycles per minute. The spring constant of the spring was 9.319010397. The spring#s averaged effective mass was 34.06%. The fact that the person counts in their head may affect the results of trials due to miscounting.

Summary Statement
My project is simple-harmonic motion in a spring-mass system.

Help Received
Borrowed gram scale from school.

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)
Gajan R. Nagaraj

Project Number
J1814

Project Title
Why Are Motorcycles and Bicycles Less Visible in Traffic?

Abstract

Objectives/Goals
To evaluate why motorcycles are less visible in multi lane traffic, and develop methods to increase their visibility.

Methods/Materials
I measured and compared the view factors of motorcycle and other vehicles from different viewpoints in multi-lane traffic. The view factor is the angle subtended by any vehicle, from one edge to another in the eyes of a viewer. I tried to use a protractor to measure this view factor and analyze the data to see how this affects motorcyclist, but this was impractical for measuring 3D view factors. So I devised my own new method to measure 3D view factors. After this I created a method to increase the view factor of a motorcycle in traffic, using fiber/glow optics. When lined the fiber/glow optics on the motorcycle I experimented to see in what way do the fiber optics/glow optics increase visibility the most. Thus the view factor subtended by the motorcycle at the viewer increased, making them more visible and making them safer in traffic.

Results
I calculated the change in view factor, to before and after I added the fiber optics/glow sticks. Using the percentages, I was able to prove my hypothesis that motorcycles are less visible in multilane traffic, and that my method to create a visibility footprint around them did increase visibility for motorcycles in multi lane traffic.

Conclusions/Discussion
In the end I found out that though motorcycles are less visible in traffic because their 3-D view factor and visibility are less than that of a car, bus, or truck, I was able to create a new method to increase the visibility of motorcycles using optically lighting, shaped and placed strategically, resulting in dramatic increase of the 3-D view factor and visibility. This has the potential to thus saving thousands of motorcyclists and preventing many more accidents every year.

Summary Statement
My project is about finding out why motorcycles are less visible in traffice, and how we can make them more visible in traffic.

Help Received
Dad bought all the materials for the project.

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)
Vinisha D. Prajapati

Project Number
J1815

Project Title
Is Your Watermelon a "Lemon"? Can "Tapping" a Watermelon Really Predict How Ripe or Sweet It Is?

Abstract

Objectives/Goals
My objective was to determine scientifically if percussing a watermelon predicts how sweet or ripe it is. I hypothesized that ripe watermelons transmitted a different sound wave frequency than unripe watermelons when percussed.

Methods/Materials
I tested 10 watermelons to find the average percussion frequency transmitted. I built a pendulum which could percuss a watermelon with constant energy each time it was struck. I recorded physical characteristics of each watermelon, such as density and volume (using the water displacement method). A microphone was set up to record the sound that traveled through the watermelon on the side opposite to where it was struck. The microphone was connected to a computer, which had an oscilloscope program. The watermelon was struck with the pendulum. The sound waves transmitted were recorded and converted into a graphical wave form by the oscilloscope program. Using this graphical wave form, I determined the sound wave frequency (percussion frequency) that was transmitted through the watermelon. This was repeated 10 times for each watermelon. I tested two controls, a wooden block and an air filled box, in the same manner. I cut and tested each watermelon's sugar content by taking out some watermelon juice and testing its sugar content using a refractometer. The sugar content was tested 3 times for each watermelon. The watermelon's sugar content and the percussion frequency were then correlated.

Results
Ripe or sweet watermelons transmitted a different sound wave frequency than unripe watermelons. The ideal percussion frequency for ripe or sweet watermelons was from 1000 to 1600 Hertz. If the density was high, then the watermelon was sweet. Personal sized watermelons were sweeter than large watermelons. Other physical characteristics of the watermelon did not correlate with its sweetness.

Conclusions/Discussion
My hypothesis that ripe watermelons would transmit a characteristic sound wave frequency was supported. For a sweet watermelon the ideal percussion frequency was between 1000 and 1600 Hertz. These results could be helpful to farmers to determine whether their crops are ripe. This would also be beneficial to consumers as they can now take home a sweet fruit. An extension to this project would be that I could create a hand-held device that could use ultrasound waves, record its reflected waves, and correlate them with the sugar content, all in one device.

Summary Statement
My goal was to determine if percussing a watermelon really predicted how sweet or ripe it was.

Help Received
My family helped with the taste test and the poster; my grandfather helped with the building of the pendulum.

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)
Tyler E. Robertson

Project Number
J1816

Project Title
No Pane, No Gain: How Window Placement Affects Passive Solar Heating

Abstract

Objectives/Goals
The objective of my experiment was to determine which direction a house faces will absorb the most heat from the sun and record the highest temperature.

Methods/Materials
Four identical model houses were made out of shoe boxes with identical windows cut out on one side. Each window was covered with a single layer of plastic wrap. The houses were set out in the Sun for twelve trials, oriented in different directions for at least three hours. Using thermocouples, temperatures were monitored every minute in the houses as well as outside the houses in the shade and in direct sunlight. At the end of each trial, data was downloaded directly to a computer for analysis.

Results
The house facing south recorded the highest average temperature difference relative to shade (26.9°F). The house facing south also recorded the highest average maximum and minimum temperatures (94.3°F and 77.6°F, respectively) even above the temperatures recorded in direct sunlight (83.9°F and 66.7°F). Internal house and direct sun temperatures were affected by cloud cover. With occasional cloud cover, temperatures dropped until the clouds passed. When it remained overcast for the rest of the data collection, internal house and direct sun temperatures all dropped to about the same temperature at the same time. The house facing north recorded the highest temperatures on two days. This may have been due to location of the north facing house relative to my home.

Conclusions/Discussion
Thousands of years ago, ancient people used power from the sun to heat their homes. In this experiment, I wanted to see to see how the direction a house faces affects the amount of passive solar heating inside the house. This experiment supported my hypothesis that the house with the windows facing south recorded the highest average maximum temperature as well as the highest average temperature relative to shade. Due to the greenhouse effect, these temperatures were even above those recorded for direct sunlight. When clouds moved in and there was no direct sunlight on the boxes, there was no real difference between the houses. For places where it is cloudy a lot or where there is a lot of fog, having a south-facing window doesn#t mean as much for passive heating. For places with sunny climates, passive solar heating can be an effective way to warm your house and can be a good alternative to oil and gas heating systems.

Summary Statement
My project is about how the amount of passive solar heating is affected by the direction a house faces.

Help Received
Mother helped type report. Dad provided thermocouples from his work and taught me how to use Excel.

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)
Julienne Sauer

Project Number
J1817

Project Title
Quantum Locking: The Future of Frictionless Motion

Abstract

Objectives/Goals
The purpose of this research project is to compare the various properties of superconductors with respect to how much weight they can hold when levitating in a magnetic field. The properties tested were the area of the superconducting disk (1/2" and 1" diameter), the type of superconducting material (YBCO, BSCCO), and levitation technique (Meissner Effect versus Quantum Locking).

Methods/Materials
Yttrium barium copper oxide (YBCO) and Bismuth strontium calcium copper oxide (BSCCO) superconductor disks were immersed in liquid nitrogen, cooled below their critical temperatures, and then suspended in a magnetic field. Weight was added to the top of each disk until it could no longer levitate and then they were weighed. It was hypothesized that if various types and sizes of superconductors are suspended in a magnetic field, then the BSCCO superconductor disk with the largest area will hold significantly more weight. And if different types of levitation techniques are tested, then the superconductor that undergoes Quantum locking will hold significantly more weight.

Results
When comparing superconductor area, both the YBCO and BSCCO 1" diameter disks held the most weight. When comparing the two different types of superconducting material, it was found that BSCCO holds more weight than YBCO. Finally, when comparing YBCO and BSCCO disks with an Enhanced Flux Pinning (EFP) YBCO superconducting disk, it was found that the EFP disk held more weight showing that Quantum locking is a better alternative for levitation than just the Meissner effect. A one-tailed paired t-test was used to determine whether the average weight held was statistically significant for each of the tested superconductors. The obtained p-values between all data distributions were less than the assigned alpha value of 0.05. This shows that the 1" diameter BSCCO disk held significantly more weight than the other disks, and that the Quantum locked disk held significantly more weight than the disks experiencing only the Meissner effect. This supports the research hypotheses and rejects the null hypotheses.

Conclusions/Discussion
This research concludes that Quantum locking is a better alternative for levitation of superconductors than just the Meissner effect. Quantum locking has the potential to revolutionize many applications in transportation, energy conservation, space travel, and eventually can be used to design frictionless bearings.

Summary Statement
This project investigates whether Quantum locking is a better alternative for levitation of superconductors than just the Meissner effect .

Help Received
Parents supervised liquid nitrogen use.

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)
Sam Scherz; Nathan Stull

Project Number
J1818

Project Title
Tesla's Egg of Columbus

Abstract

Objectives/Goals
The objective/goal of our experiment is to determine what set of conditions would lead to rapid, stable rotation of various objects within a rotating magnetic field.

Methods/Materials
To set up our experiment we made our controls a steel sphere at 16g and 0 degrees on the axis of the rotating magnetic field; and the constants were the wind, amperage, bowl, and many others. We setup our experiment by drawing different rings to help determine stability and drew different lines to help determine the position of the egg of the on the axis. For our experiment we used our machine, several different spheres/eggs, markers and a compass.

Results
We tested our project by seeing what area these objects spent a majority of their time in, and by testing what angles provided the most change in direction. Nate's results that the controls stayed perfectly in the center, the steel sphere 6 g was 5.8 cm, the steel 19 g was 2.8 cm off the center, the steel egg at 14 g was 3.9 cm, the steel egg at 17 g was 3.6 cm, and the steel egg 22 g was 3.2 cm. For Sam's results, we found that the area which showed the most amount of change were between 30-40 degrees on the 2nd quadrant.

Conclusions/Discussion
In conclusion, the more round and more heavy a shape, the more that it will stay close to the center, and that 30-40 degrees on the second axis showed the most change, and actually self started.

Summary Statement
Our central focus was to build a machine that would generate a rotating electromagnetic field, so that we could test its affect and relationship to different objects.

Help Received
Paul helped order parts, helped in the design, supervised the building and over saw the testing of material.

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)
Nathaniel J. Tran

Project Number
J1819

Project Title
UV Rays in Water

Abstract

Objectives/Goals
The objective is to determine whether ultraviolet absorption varies throughout water depth. I believe an object at greater depth would absorb less ultraviolet rays than an object at a lesser depth.

Methods/Materials
Four plastic UV beads were used. These UV beads contain pigments that intensify when exposed to UV radiation. Three UV beads were suspended at different depths in tap water. The beads were placed at 1 cm, 31 cm, and 60 cm below the water surface. The fourth bead was used as the control bead. After 5 minutes of UV exposure, photographs of the beads were taken and compared to the control bead intensity chart; the results of 17 trials were recorded and charted.

Results
The results indicate a decline in light intensity as it travels deeper through water. Hence, the bead placed closer to the water surface absorbed the most ultraviolet rays, whereas, the bead placed at a lower depth experienced less UV radiation. Various factors contribute to the decay in light intensity as it passes through water. The water#s extinction coefficient and scattering of ultraviolet waves cause a reduction of light energy through water.

Conclusions/Discussion
An object at a greater depth would absorb less ultraviolet rays than an object at a lesser depth. Because the extinction coefficient of pure water is 0.035 (1/m), UV rays do not travel straight through water. Rather, the UV light lost energy as it passes through water depth; the deeper the depth, the less energy available to absorb. Another contributing factor to the loss of light energy was through Raman scattering. Raman scattering occurs when light scatters, causing a reduction of light energy as it travels through water. This resulted in the highest levels of absorption in the bead closest to the water surface. The results supported the mathematical equation I(D) = I(0)e^-kD. Hence, the hypothesis stated is true; ultraviolet absorption varies throughout water depth.

Summary Statement
My project studies the absorption of ultraviolet rays as it travels through water.

Help Received
My father helped to take photographs. My mother helped to assemble the display board.

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)
Wil C. Valtakis, III

Project Number
J1820

Project Title
How Does Color Affect the Absorption of Single Wavelength Light Energy?

Abstract

Objectives/Goals
My question, as stated above, was chosen because I had seen my dad pop balloons with lasers before, and I thought it would be a great base for a science fair project. I wondered how the different colored balloons would be affected by the laser wavelengths. If the balloons are a darker color than the laser used, then the single wavelength light energy from the laser will pop the balloon quicker.

Methods/Materials
Equipment:
High Powered Lasers: We used 3 lasers for the experiment.
Green- 532nm wavelength- 250mW, Blue- 405nm wavelength- 1W, Red- 650nm wavelength -500mW
Safety Goggles: Protect eyes from the radiation and spill from the laser beam.
Laser Blocking Material: To stop the beam and enable me greater control for timing. (Carbon Wool)
Balloons: Variety of balloon colors: Black, Blue, Green, Red.

I selected 10 feet as the range for my experiment. This is the distance between the laser and the balloon. Too close, and it would be really hard to time how long it took the balloon to pop, and too far away, and it may not pop at all!
To act as a blocking agent, I attached carbon wool to the back of the briefcase, so there would be time to set each balloon up to time the popping. The balloon itself was wedged on a step stool so it would remain steady. I counted down, and my dad dropped the briefcase lid to let the laser beam hit the balloon. With a stopwatch, I timed each laser pass. I decided to attempt to pop 3 balloons of each color, so I could average the time for a better understanding.

Results
My hypothesis held true, but there were some surprising results that I hadn't considered. When the laser and balloon colors matched, it took significantly longer for the balloon to absorb enough energy for it to pop. In the case of the Red laser coupled with the red balloon, it never popped, it could not absorb enough energy to pop the balloon. In the case of the Green laser and green balloon, our third trial, it burned a hole through it without popping!

Conclusions/Discussion
My conclusion is that there are more factors than just how dark the balloon is that affects how the lasers energy is absorbed. However, black balloons definitely popped consistently fast during my trials.

Summary Statement
The purpose of this project was to observe the affect of laser beams on different colored balloons and how popping times were influenced, which translates to energy absorption.

Help Received
My father helped operate the high powered lasers, and my mother oversaw my research and development of my presentation as my teacher.

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)
Alexis M. Valtenbergs

Project Number
J1821

Project Title
Using Refraction to Determine the Speed of Light through Different Substances

Abstract

Objectives/Goals
The objective is to determine if it is possible to use a red laser beam and the index of refraction to find the speed of light traveling through four different substances; water, vegetable oil, corn syrup, and lemon juice.

Methods/Materials
Using a laser mounted on a ring stand using a ring stand clamp, I shined the laser through different fluids. I then took measurements to calculate the index of refraction. From this information I calculated the speed that the light was traveling through the substances.

Results
My calculations showed that it was possible to calculate speeds of light that approximated known speeds of light traveling through different substances. I was able to achieve results that were near to the known indexes of refraction and speeds of light.

Conclusions/Discussion
My conclusion is that my hypothesis was correct. It is possible to use a red laser beam and the index of refraction to find the speed of light traveling through different substances. While my results were not exactly the same as the known speeds of light, they were reasonably close. I believe that with a larger scale, my results would have been more accurate.

Summary Statement
Using the index of refraction to find the speed of light in different substances.

Help Received
My mother helped me put the project together and my science teacher helped me check my calculations and equations.

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)
Marc F. von Oepen

Project Number
J1822

Project Title
Wire on Ice

Abstract

Objectives/Goals
My objective was to learn if wire could move through ice without cutting it in half, and how weight, material and size of wire, vibration and temperature influence this process.

Methods/Materials
The project consisted of eight experiments which used different types of wire, three steel wires, varying in widths, a nylon wire and a vibrating steel wire. In each experiment up to two wires at the same time were suspended from the ice block and two weights were hung on each end of the wire, these weights varied by experiment. The experiments were conducted with two different surrounding temperatures.

Results
I found out that skinner wire moves through the ice faster than thicker wire because it covers less surface area and therefore there is more pressure on that surface area. Higher temperature and greater pressure speeded up the progress of the wire. Steel wires moved through the ice faster than the nylon wire because steel is a good conductor of heat and nylon is a poor conductor of heat. Lastly, vibrating wires moved twice as fast as the static wire. The wire does not cut the ice in half, because of regelation, melting ice under pressure and resolidifying or in this case refreezing when the pressure is released.

Conclusions/Discussion
In all, I learned many interesting facts, for example regelation also occurs while ice skating and underneath glaciers.This project intrigued me to investigate farther and to learn more, for example I could add more weight at a below freezing state, or add vibration at below freezing, and different materials, like nano wire.

Summary Statement
How wire moves through ice and what would influence this process.

Help Received
Dad helped with graphs.

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)
Isabella M. Williams

Project Number
J1823

Project Title
The Effects of Wavelength on the Refraction of Light

Abstract

Objectives/Goals
My experiment was based on the principles of Snell's Law, or the Law of Refraction. I wished to find out whether the wavelength of a laser beam affected how much it was refracted and consequently slowed down in different mediums. My hypothesis was that the beam of the lowest wavelength would be refracted the most and would thus have the slowest speed, or the smallest angle of refraction.

Methods/Materials
My experiment involved measuring the angle of incidence vs. the angle of refraction to compare the speeds of three lasers of different wavelengths; a 645nm red laser, a 532nm green laser, and a 405 violet laser. Each of these was to be refracted through three different solutions containing different percent amounts of sugar to increase the refractive index. The measurements were to be compared through three solutions for consistency. The materials necessary were: a rectangular glass container, three laser pointers, a protractor, a measuring cup, sugar, and water. The sugar and water were measured and combined to form 30, 50, and 80 percent solutions. These solutions were then poured into the glass container at separate intervals. Each laser was fired though each solution one at a time. The protractor was then set at 90 degrees in line with the beam before it entered the medium, and it was recorded in a lab book what the angle of refraction in the medium was. These results were written down in order of percent of the solution, from least to greatest. They were then observed and made into a graph displaying the results.

Results
Angle measurements were as followed in order of 30 percent to 80 percent
645nm - 86.2;85.6;85.85
532nm - 84.8;83.7;83.2
405nm - 82.4;80.8;80.2

Conclusions/Discussion
After reviewing my results, I was able to conclude that my hypothesis was correct. The laser beam with the longest wavelength had the least amount of change from the angle of incidence to the angle of refraction (or the largest angle of refraction), while the beam with the shortest wavelength had the smallest angle of refraction in comparison. From this I reason that the violet laser was refracted the most and had the slowest speed throughout the mediums.

The findings made on the subject of light and electromagnetic waves are still crucial today. Lasers

Summary Statement
My project wanted to find out whether the wavelength of a laser beam affected how much it was refracted and thus slowed down in mediums of increasing refractive indexes.

Help Received
No help recieved.

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)

Celia Willner; David Willner

Project Number

J1824

Project Title

The Potential Effect of Decibel Levels in Certain Settings on Permanent Hearing Damage

Abstract

Objectives/Goals

This project was to determine if places frequented by children and adults had decibel levels that exceeded 85 dB, the decibel level that can cause permanent hearing damage according to the American Academy of Audiology.

Methods/Materials

We used the iphone app Decibel Tenth to record decibel levels of Jamba Juice, Starbuck#s, Abercrombie. a high school musical and getting ready for school. For each location three ten minute measurements were taken and then sent by the app in an email to an Excel spreadsheet which was then transferred to a graph. Average decibel levels were then calculated

Results

The decibel levels exceeded 85 in each of the everyday locations. The levels in Abercrombie exceeded 85 dB with a high level of 101 dB and an average of 84 dB. The levels in Jamba Juice also exceeded 85 dB with a peak of 97 dB and am average of 81 dB. In Starbuck#s, or data shows that there is a peak of 97 dB and an overall average of 77 dB. The average level of getting ready for school is 80 dB with a peak of 102 dB while the average for the high school musical was 83 dB with a peak of 101 dB. Each location had decibel levels that could be called dangerous at times but the place with the most frequent sustained high dB levels was Abercrombie.

Conclusions/Discussion

Our grandfather has been having a lot trouble hearing over the years. We know that, as a police officer, he often went to the firing range where the decibel levels were very high. We are both musicians and our father teaches high school band so we also are not strangers to loud environments.

When we were thinking about a science project, we tried to think of a problem in our world. We then found that many of the stores that we go to are too loud. We wanted to check to see if the decibel levels in these places exceeded 85 dB and found that the places did, in fact, have dangerous dB levels.

We feel that people should know the long-term risks of exposure to high decibel levels. With all of the measuring devices available, hopefully people can make smarter decisions about where they spend their time or at least take precautions when they are in loud places.

Summary Statement

Our project tests the decibel levels of certain public and private settings to see if they exceed 85dB, the level stated by the American Academy of Audiology to cause permanent hearing loss.

Help Received

Mother bought office supplies with us for the board. All else done by us.

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)
Michelle S. Deyski

Project Number
J1898

Project Title
Solar Panels: Best in Heat or Cold?

Abstract

Objectives/Goals
My project was to determine if a solar panel charges an iPod 2 faster when it has an ice or heat pack underneath. I hypothesized that the solar panel would charge the iPod 2 faster when it has the ice pack underneath.

Methods/Materials
In my experiment, I tested which iPod 2 charged the fastest with a solar panel cell phone charger. I set up the experiment outdoors on the same time and same weather, but on different dates. With a heat and ice pack, I plugged in the dead iPod 2 into my made solar panel cell phone charger and timed how long it takes to charge to 100%. After testing both packs, I repeated for accuracy and recorded my results.

Results
I found that the solar panel with the ice pack underneath charged faster than the solar panel with the heat pack underneath in all of my four trials. The solar panel with the ice pack underneath took 122 minutes and 133 minutes to charge. The solar panel with the heat pack underneath took 245 minutes and 234 minutes to charge.

Conclusions/Discussion
I proved that my hypothesis is correct through my experiment. I predicted that the solar panel charger with the ice pack underneath would charge the iPod 2 faster than the solar panel charger with the heat pack underneath. My data shows that if one wants better results with solar panels, than it is best to use the solar panels in a breezy, cool area with a bright sun.

Summary Statement
My project is about seeing if solar panels work best in the heat or cold.

Help Received
Grandfather helped build the solar panel cell phone charger.

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)
John H. Park

Project Number
J1899

Project Title
How Do Different Various Voltages Affect the Deflection Rate of Charged Particles at a Constant Current?

Abstract

Objectives/Goals
My project was designed to determine how a modulated voltage supply at a constant low current would affect the rate of deflection of charged particles by an electromagnet. The theoretical aspect of this phenomenon is described in the Lorentz equation. After reviewing those equations, I am lead to believe that higher voltages will increase the deflection rate.

Methods/Materials
My project calls for at least; one variable power supply, one detection device (Geiger, scintillator, or electroscope), one alpha radiation source, and one electromagnet. Other equipment is necessary, such as banana plugs, alligator clips, a multimeter, and other basic electrical equipment, but is commonly available and therefore not named. At its most basic, the experiment is an alpha radiation source pointed at an electromagnetic field with the source facing the detection device. All the devices will be unchanged and consistent except for the voltage going through the electromagnet to ensure that only the voltage is being tested.

Results
My data shows that the variance fields between the various voltages were negligible and were within the right of human error with attaining data through an optical spinthariscope. Therefore, I must conclude that the effect of an electromagnet at variable low voltages at a constant low current does not have a strong enough magnetic flux field to deflect alpha particles with an energy of 5.91 MeV's.

Conclusions/Discussion
Although my shield apparatus failed to deflect the alpha particles, I believe my experiment has tested many components that will be useful in future experiments. This project has also helped me determine improvements to my experiment that may yield better results in the future, such as a vacuum chamber. In the next couple of years, I hope to be able to design and build a prototype shield device for potential use as a spacecraft radiation shield.

Summary Statement
My project was designed to test how a low voltage electromagnetic field would affect the rate of deflection of charged particles, such as alpha radiation.

Help Received
This project was conducted by my self and the experiment itself was conducted at my residence without assistance from any qualified persons.