CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
Matthew G. Arnall

Project Number
J1801

Project Title
Applying Wave Refraction Principles including Snell's Law to Differentiate Unknown Materials

Abstract

Objectives/Goals
The objective is to apply refraction principles, including Snell#s Law, and basic trigonometric principles, to differentiate known and unknown materials and their properties.

Methods/Materials
First, I used a laser to measure refraction in seven containers of a sugar water solution of varying densities. Second, in a rectangular glass container of oil and water, I directed a laser at an angle into the liquid and reflected it off of a mirror at the bottom of the container. I then measured the angle of refraction of the laser through each of the layers of oil and water, and measured the distance between the point of entry of the laser into the liquid and the point of exit of the reflected laser out of the liquid, and also measured the depths of the respective layers of oil and water.

Results
In my sugar solutions, I found that refraction correlated directly to the density of the solution. In the container of oil and water, I found that by measuring the angle of the laser entering the surface, measuring the distance between that point and the point of exit of the reflected laser, and measuring the depths of the respective layers, I could determine the identity of the lower layer liquid. Alternately, by knowing the identity of the liquids, I could then separately calculate the depths of the layers of the liquids.

Conclusions/Discussion
My first experiment with sugar water confirmed that density of a material directly correlated to the level of its refractivity. My second experiment confirmed that with the application of Snell's Law and basic trigonometric principles, I could identify an unknown subsurface material knowing just some basic data. My original idea of this experiment was application of these principles to identifying subsurface strata in the Earth, and also quantifying materials and their properties such as polar ice caps.

Summary Statement
Applying wave refraction principles, including Snell's Law, to differentiate materials and their properties.

Help Received
Mother and father helped type report and prepare layout of project board. Father helped prepare test taking equipment and double-checked some measurements. Sister took photos.

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
Colin D. Aziz

Project Number
J1802

Project Title
The Violin Sound Post

Abstract

Objectives/Goals
The purpose of my science fair project was to see how the position of the sound post affects the tone quality of the violin#s note. My hypothesis for the project was that when changing the position of the sound post, there will be no effect human ear. However, an audio analysis program will pick up a change.

Methods/Materials
The constants in my experiment was the violin tune, length of the note, and the violin itself. Also, my control group with the sound post in the normal position. The variable in my experiment was the position of the sound post. The way I measured the responding or dependent variable was by playing the notes into program measured with Hz or Hertz. I tuned the notes to the appropriate hertz, played each note multiple times into the program, and recorded the data. I did this for each note and sound post position, multiple times.

Results
The results of the experiment matched up to the scientific aspects of how violin works, which really surprised me. The results shows that my hypothesis is correct because, since the changes were small, I, nor my mentor heard them, but my computer picked them up. Because the sound post in a violin acts like a fulcrum that bridge rocks on, its position controls the balance and tension of notes. The original position of the sound post was under the A string. When the post was moved to the right, everything changed, except the E string because it was right above the post. When it was moved left, the opposite happened, only the E string was off. Finally, when moving it forward and back, the sound posts is still in the the same mine so, the A string did not change, but all the other strings did.

Conclusions/Discussion
If I was going to do this experiment again in the future, or expand on this experiment, I would measure in different forms of units such as decibels for volume. Or, I would test how the different types of wood violins are made of effect the quality. I was very happy about how the experiment turned out, and how I could contribute to the debate on the proper position of the sound post.

Summary Statement
I shifted the sound post in a violin to various position changing the quality and tone of notes.

Help Received
My mentor, James Wimmer, helped me move the sound post (because if moved improperly, it can really damage the instrument). But besides that, i did everything.

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
Nastassja V. Carusetta

Project Number
J1803

Project Title
Boyling Down: The Effects of Pressure on Air

Abstract

Objectives/Goals
The experiment measured the effects of pressure, at 1, 2, 4, 6, 8, and 10 meters underwater, on air contained in multiple containers of varying lengths, widths, and volumes. It was expected that, due to the properties of Boyle's Law, the more pressure put on the air, the smaller in volume and greater in density the air would become, regardless the container's shape or size. It was also expected that the tallest, skinniest containers would produce the most accurate results because the change in gas volume would be more visible and thus show more precise results for the experiment.

Methods/Materials
Four groups of 3 containers each were taken upside down (so as not to spill air) on a scuba dive. The level of air in each container was marked using a file at each depth. Once the experiment was carried out, the volume of each container at each depth was precisely measured based on the weight, in ml, of the water contained.

Results
The air collapsed steadily when under pressure, with a decreasing volume of 100%, 91%, 81%, 70%, 63%, 56%, and 49%, proportionately. The rate that the air collapsed changed seemingly more rapidly during the first few measurements. At 10 meters, which is almost equal to two atmospheres, the air volume of each container was roughly half (47%) of the volume that it had been in the container at 0 meters.

Conclusions/Discussion
The conclusion is that the greater pressure placed upon a cylinder of air, the lesser in volume, denser, and more collapsed the air will be. Through this experiment the effects of increased atmospheric and water pressure on amounts of contained air were thoroughly investigated. The hypothesis was supported.

Summary Statement
Air was taken down in different containers and the rate that it collapsed and condensed was calculated at 1, 2, 4, 6, 8, and 10 meters to investigate of the natural phenomenon known as Boyle's Law.

Help Received
Grandfather helped hold apparatus steady during dive, and was dive buddy to ensure safety.

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
Chester H. Charlton

Project Number
J1804

Project Title
The Dissipation of Magnetic Force through Steel Bars

Abstract

Objectives/Goals
My objective in this experiment was to develope an equation for the amount of magnetic pulling force that would travel through a steel bar if a magnet is placed on one end.

Methods/Materials
Materials:
In this experiment I used various materials: 1.Plank of wood; 2.Permanent magnet 0.5 in by 0.5 in(NFeB); 3.Iron bars with lengths 2cm-24cm (annealed); 4.Wooden bench; 5.Lab notebook; 6.Electronic scale (Measures up to 10 kg); 7.Spring scale (measures up to 40 pounds); 8.Wooden clamp.

Procedure:
1.Attach correct length of bar #1 to the wooden clamp; 2.Attach permanent magnet to the top of bar #1; 3.Attach container to bar #2 and bar #2 to bar #1; 4.Empty container (everything is attached and not in motion); 5.Start adding water; 6.Once the container drops, weigh the container (filled) and bar #2; 7.Enter data into lab notebook.

Results
The results showed that the longer the bar was, the less the magnet attraction force increased or decreased. I fit an equation to the data that was a quadratic equation, not an exponential. However an exponential equation would seem more logical since it will not increase after the vertex.

Conclusions/Discussion
The data did support my hypothesis. The equation was a polynomial, not exponential. I think that my tests (after perfection of the method) were fairly accurate since the average deviation was 0.995. If this experiment were to be repeated, I would use rods (circular) instead of bars so that the bars wouldn#t hang on edge. I learned in this experiment a formula for the relation of magnetic force to length. I also learned to view magnetic waves as lines that get farther spread apart the farther you are away from the magnet.

Summary Statement
The formula for the amount of magnetic force able to travel through an iron bar (a magnet on one end of the bar).

Help Received
My father helped craft the wooden clamp.

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
Samuel T. Crossman

Project Number
J1805

Project Title
The Ups and Downs of Elevator Science

Abstract

Objectives/Goals
The purpose of this experiment is to observe weight changes that occur while riding on an elevator.

Methods/Materials
I gathered three objects (an empty 2 liter soda bottle, an empty syrup bottle, and myself) and two scales. I measured the weight gain and loss of each object on an elevator. I repeated the experiment ten times for each object. I collected data for each try. I averaged the change in weight and calculated the percentage of weight change. I repeated this process on three elevators.

Results
When and elevator moves upwards at first you gain weight but you mass stays the same. When an elevator slows you lose weight. In the middle of an elevator#s travel the scale returns to normal.

Conclusions/Discussion
I found that the percentage of weight change stays constant for each elevator. The Crown Plaza had 10.2% weight gain. The Double Tree had 6.7% weight gain. Hilton Gardens had a weight gain of 7.2% I would guess that I would have similar results on any elevator. I would also conclude that the faster the elevator the more weight that you will gain.

Summary Statement
The purpose of this experiment is to observe weight changes that occur while riding on an elevator.

Help Received
My grandpa brought me to the hotels ans video taped me. He also helped me with the computer program that did the calculations.

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)

Shashank Dholakia; Shishir Dholakia

Project Number

J1806

Project Title

The Sky Is No Limit: A Photometric Comparison of the Variable Stars Beta Lyrae and Delta Cephei

Abstract

Objectives/Goals

In this project, we asked the question "How do the light curves of different types of variable stars differ and is it possible to identify a variable star type by its light curve?" We also wanted to know if a digital camera in a light polluted environment can obtain accurate photometric results and if variable star photometry can expand our understanding of the universe.

Methods/Materials

We chose two types of variable stars, Beta Lyrae, an eclipsing binary and Delta Cephei, a Cepheid variable. We used a digital camera to perform photometry and record the variation in brightness and plot their light curves.

We took a series of images of the variable star and a few calibration stars of known and fixed brightness. We stacked the images using the software DeepSkyStacker to obtain a single image. Iris was then used to obtain the pixel value of the variable and calibration stars. By comparing this pixel value of the calibration stars with their actual brightness, we derived brightness of the variable star. This entire process gave us one data point on the light curve. We repeated this process for 73 and 23 nights for Beta Lyrae and Delta Cephei respectively to plot their light curves.

Results

We found that Beta Lyrae had an irregular light curve with two minima and two maxima, while Delta Cephei showed a simple periodic light curve. Delta Cephei#s light curve was far more regular than Beta Lyrae, however the brightness ascended faster than it dimmed, resulting in a saw tooth shape light curve.

Conclusions/Discussion

Our hypothesis that an eclipsing binary has two minima was supported. Our hypothesis for Delta Cephei was partially supported. Its light curve was regular but had a saw tooth shape instead of a sine wave. The study of variable stars can help us understand many things about our universe. Exoplanet systems can be detected because they change in brightness in similar ways to eclipsing binaries. Cepheid variables are standard candles. By measuring their magnitude, we can measure the distance of the galaxy they are in. Our experiments also showed that photometry using a digital camera, even in a light polluted environment can provide accurate measurements of variable stars. This is important since it shows that amateur astronomers can significantly contribute to our understanding of the universe in ways such as discovering supernovae and exoplanet systems.

Summary Statement

This project analyzes two variable stars over a period of time and demonstrates how accurate variable star photometry can help us understand more about the universe.

Help Received

Mrs. Fohner and Mr. Asekomeh for providing support and advise; Father for encouragement; Dave Majors for introduction to variable stars; Dr. Aaron Price for information on photometry

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
Jesse T. Feinstein

Project Number
J1807

Project Title
All Fuels Are Not Created Equal

Abstract

Objectives/Goals
My objective was to test the hypothesis that bioethanol (E85) would have the highest heat content compared with other commonly used fuels, specifically diesel, kerosene, gasoline, ethanol and isopropanol. My hypothesis was based upon the extensive media coverage devoted to bioethanol.

Methods/Materials
I built a homemade calorimeter with materials provided by Dr. Eric McFarland (UCSB Dept. of Chemical Engineering). Specifically, the calorimeter had ceramic insulating walls with a small porcelin "boat" inside. Fuel was injected into the boat with a syringe pump and the fuel ignited by a platinum wire hooked up to an electric supply. Finally, a flask with 50 ml water was suspended above the boat, with a thermocouple to measure the changing temperature of the water, sending the data to a computer as a function of time. Finally, I combusted a defined volume of each fuel, measured the change in temperature of the water and determined its heat content in calories/ml of fuel.

Results
Diesel, kerosene, gasoline and E85 all had about the same heat content per ml of fuel. While the trend was diesel>gasoline>kerosene>E85, the differences were not statistically significant. Pure ethanol had statistically less heat content than these fuels, and isopropanol was statistically even lower than ethanol in heat content.

Conclusions/Discussion
While E85 did not have greater heat content than the more conventional fuels (gasoline, diesel, kerosene), its heat content was equal to each of them (within experimental error). Therefore, my original hypothesis was not supported. However, this is still a very exciting outcome, because the United States can produce large quantities of E85 through our agricultural system. Additionally, E85 burns cleaner than gasoline, diesel and kerosene, which will reduce pollutants.

Summary Statement
My project sought to assess the hypothesis that bioethanol contains enough energy to eventually replace other commonly used fuels.

Help Received
Used laboratory equipment and facilities in the laboratory of Dr. Eric McFarland, Department of Chemical Engineering at UCSB

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
Ethan T. Gomer

Project Number
J1808

Project Title
Marvelous Magnetics: Do Opposites Always Attract?

Abstract

Objectives/Goals
The objective of this experiment was to determine how graphite, paper, plastic, aluminum foil, or no material would affect levitation using diamagnetism. My hypothesis stated that the graphite would require the least amount of distance lowered for the lifter magnet because graphite is one of the strongest diamagnetic materials, compared to the control would require the most distance for the lifter magnet to lower, and lift the floater magnet because there is no diamagnetic material to support it in its levitation process.

Methods/Materials
To conduct this experiment, I placed the levitation pedestal on a flat surface with no magnetic items nearby. I then placed the graphite on the lower arm of the pedestal and placed the floater magnet on top of that. Next, I slowly turned the adjustment screw until the floater magnet started to levitate, and then flew upward. I repeated but with the other materials, which are paper, aluminum foil, and plastic in place of the graphite. When I finished the tests with the remaining materials, I then took off the remaining material, and tested the experiment with the control.

Results
The results of the experiments were diverse. In this case of results, the lower the number, the stronger the diamagnetic forces in the material. The tests involving no material and the aluminum foil both ended with the same results, and the same average of 12 mm. Also as strange, the plastic material ended with an average of 12.1 mm. The graphite ended with the least distance of 10.2 mm, and the paper with 11.7 mm.

Conclusions/Discussion
The hypothesis that I made that stated that graphite will be the shortest distance whereas the control being the longest distance in terms of the most assistance the lifter magnet has to give, was correct. My hypothesis on terms of the graphite being the most diamagnetic material was correct, where as having no material was equal to having aluminum foil, and lower than plastic by . 1 mm, but shows the difference between different materials. This experiment could also connect to the world in the reference of how many man made objects today use magnetism or even diamagnetism. For example, the fastest train in the world is in Japan, and runs on magnetism.

Summary Statement
My project was to determine how graphite, paper, plastic, aluminum foil, or no material would affect levitation using diamagnetism.

Help Received
Ms. Fisher provided amazing guidance for the project and notebook; Mrs. Diaz provided guidance for my research report and annotated bibliography; My mother helped me lay out by board; My father helped me organize the project, experiments and notebook.

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)

Michael L. Hand

Project Number

J1809

Project Title

Heat Transfer in an Incandescent Lamp: An Investigation by Computer-Controlled Experiment

Abstract

Objectives/Goals

How much of an incandescent lamp's electric power input is wasted by thermal conduction from the filament? If these losses are substantial, their reduction could significantly improve the operating efficiency of incandescent lamps.

Methods/Materials

The subject of the investigation is a common 25-watt evacuated light bulb. I connected it to a programmable power supply and used two high-precision digital meters to measure the current flowing through the lamp and the EMF across it. The ambient temperature was measured by a precise digital thermometer. The four instruments were connected to a computer via a GPIB-to-USB interface. I wrote a program in Visual Basic for Applications to control the experiment and bring the data into Microsoft Excel for analysis. The program commands a timed sequence of approximate current values and obtains precise current and EMF measurements at each condition. From each pair of measurements, I calculate the lamp power (product) and resistance (quotient). I infer the filament temperature from the resistance using existing data on the temperature dependence of tungsten resistivity. Using the power, filament-temperature, and ambient-temperature data, the input power can be decomposed into thermal-conduction and thermal-radiation components. This is possible because the conduction is linearly proportional to the filament temperature (Fourier's Law), but the radiation is proportional to the fourth power of the filament temperature (Stefan-Boltzmann Law).

Results

I obtained data over seven decades of lamp input power (0.002mW to 22.7W) in which the lamp resistance increased nearly thirteen fold (45 to 567 ohms). Up to about 0.5mW (T=315K), the filament temperature appears to vary linearly with input power with a slope of 40 K/mW. Fourier's Law allows the thermal conduction to be thus extrapolated into higher power ranges where radiation is important. At about 10mW (T=485K) the contributions of conduction and radiation are approximately equal. Faint incandescence was first observed at 136mW (T=850K). At this point, thermal conduction accounts for 10% of the input power. At the highest power tested (22.7W, T=2395K), the conduction loss fraction is only 0.2%.

Conclusions/Discussion

These results imply that the prospects for improving the efficiency of incandescent lamps by reducing thermal conduction losses are dim. Existing lamp technology appears to be extremely good in this respect.

Summary Statement

This project is an experimental study of the thermal behavior of an incandescent lamp, looking for opportunities to improve lamp efficiency.

Help Received

Father coached me on the research plan, apparatus construction, experimental procedure, and data analysis. Mother helped me edit the report. Like in athletics, coaching helped me acquire the knowledge, develop the skills, and do the work.

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
Mason B. Harris

Project Number
J1810

Project Title
Thermal Conductivity

Abstract

Objectives/Goals
I wanted to determine what type of metal would be the best thermal conductor, distributing heat the furthest and fastest from a heat source.

Methods/Materials
I tested three types of metal: copper, aluminum, and steel. One end was bent and placed boiling water and the other end was bent and placed in an empty beaker. Each wire was marked every 200mm. After 20 minutes I measured the temperature at each mark with an infrared thermometer. I recorded the temperature at each mark for every wire type.

Results
Copper was the best thermal conductor with the highest temperatures along the length of the wire. Aluminum was the second best conductor. The steel wire was the worst thermal conductor, with not much difference along the length of the wire.

Conclusions/Discussion
My hypothesis that copper wire would be the best thermal conductor was proven to be true. Knowledge of thermal conductivity can be used to make better cookware for cooking food and boiling water. When a pot is placed on the stove, thermal energy is transferred form the heat source to the metal pot and eventually to the food or water. Good thermal conductors will do this more efficiently. Materials with poor thermal conductivity could be useful as thermal insulators.

Summary Statement
What wire conducts heat the fastest and the longest.

Help Received
My mother helped design board.

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
Holly M. Jackson

Project Number
J1811

Project Title
Super Sound Science

Abstract

Objectives/Goals
My objective was to find the speed of sound in different materials and how that speed changes with temperature. In my experiment, I measured the speed of sound in 12 materials at room temperature (21.7°C) and at 76.7°C. My hypothesis was that sound would travel the fastest in steel. I also hypothesized that sound would travel faster through steel at a higher temperature.

Methods/Materials
I measured the speed of sound in the materials using an oscilloscope, a function generator, and two ultrasound transducers. With this setup I measured the time it took for sound to travel from one end of the material to the other. Next, I calculated the rate using the formula d = r # t. I repeated all of the tests at three lengths and averaged the results. The lengths were 40, 30, and 20 centimeters. I compared all the results at two different temperatures.

Results
I found that the speed of sound through glass was the fastest at 5270 meters per second (m/s) and air was the slowest at 334 m/s. My results for the influence of temperature were unexpected. The speed of sound in water increased 20% with temperature. Though, the speed of sound in teflon decreased 37%. Since I took into account my measurement errors, my results on the effect of temperature were inconclusive for a few materials.

Conclusions/Discussion
My hypothesis that sound would travel fastest through steel was incorrect. The speed of sound in steel was second fastest behind glass. I also hypothesized that sound would travel faster through steel when heated. However, my experimental results for the effect of temperature on steel were inconclusive. I found conclusively that heat increased the speed of sound in air and water but surprisingly had the opposite effect on acrylic, PVC, and teflon.

Summary Statement
In my project I measured the speed of sound in different materials and how that speed changes with temperature.

Help Received
My father loaned me electronic test equipment and taught me how to use it. He also helped me with the layout of the display.

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
Michelle A. Karpishin

Project Number
J1812

Project Title
Hiding In "Plane" Sight: Minimizing Radar Reflection

Abstract

Objectives/Goals
The Radar Cross Section (RCS) of a plane can be lowered by the design of the shape of the aircraft. Also, some stealth aircraft have skin that is radar transparent, behind which are structures termed reentrant triangles. Radar waves penetrating the skin get trapped in these structures, reflecting off internal faces. My project is to use light to simulate radar waves and investigate different types of reentrant triangles to minimize light reflection back to the source. Although visible light is at a different wavelength than radio waves, the scattering and reflection of the waves is similar.

Methods/Materials
A light and a light meter were attached to the top of a stand inside a black shoebox. The test objects were placed directly under the light meter. The light meter measured the reflected light from the test objects. Different three-dimensional shapes were tested to examine the reflectivity of light/radar.

Results
Thirteen shapes and surfaces that were identical in size and color were examined for their light reflectivity. Six measurements were made for each shape, and standard deviations were determined. Large differences in light reflectivity were observed for the test objects. My experiments showed that a simple up-down-up-down (zig zag) shape was the best to reduce the reflection of the light, and instead, scatter the waves.

Conclusions/Discussion
Stealth aircraft are designed to avoid large flat surfaces. Sharp edges on the body of the plane and a thin profile reduce the RCS. In addition, some aircraft use small shapes beneath a radar-transparent skin to maximize the scattering of the radar signal. In this experiment, I was interested in looking at different triangular and pyramid shapes to see which ones were the best at minimizing reflection. My experiments demonstrated that beneath the large flat surfaces of a stealth aircraft, a zig zag pattern could be used to increase radar scattering. This would reduce the RCS of the aircraft, and make the plane much more stealthy to avoid detection.

Summary Statement
I examined the scattering and reflection of light off various shapes to model the properties of radar waves in order to improve stealth-aircraft technology.

Help Received
Father helped paint test objects.

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
Benjamin Lee

Project Number
J1813

Project Title
Repulsive Fruits

Abstract

Objectives/Goals
This controlled study investigated the diamagnetic property of fruits. Diamagnetism is the property of a substance being repelled by both poles of a magnet. This phenomenon exists in materials that are often considered non-magnetic. The aims of the experiment were to investigate: 1) Whether grape and strawberry moved under the influence of a magnetic field because of their water content. 2) Whether a plastic vial was diamagnetic. 3) Whether the surface area and weight of the material tested affected its diamagnetic properties.

Methods/Materials
Method: Strawberry, grape, and raisins were tested under the influence of neodymium, a rare-earth magnet. Each material was placed on a Styrofoam platform floating on a tub of water with tracks made of dental floss. The negative test control was the floatation platform without any test substance except for a dry or wet toothpick and the positive test control was the highly diamagnetic pyrolytic graphite The time taken for each material to move 30 centimeters was recorded. Results were tabulated, graphed, and analyzed.

Results
All test substances except for the dried raisin moved. The flat graphite moved the fastest among the test substances. When the thin graphite was tested, it had the penultimate slowest median time of 32.15 s. The slowest moving test substance that completed the course was the empty plastic vial with a median time of 33.70 s. When the plastic vial was filled with water, it moved slower than the fruits. When the raisin was rehydrated, it completed the course with the second fastest median time. The scatterplots showed mixed results of the materials tested in relation to its surface area and weight.

Conclusions/Discussion
The fruits moved, likely because of their water content. Plastic and water were shown to have diamagnetic properties. The surface area and weight could influence the diamagnetism of the substance.

Summary Statement
This experiment was to show the diamagnetic properties of fruits, plastic, and whether surface area and weight affected the results.

Help Received
Father helped acquire the materials, recorded time during the experiment and assisted in board assembly.

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
Julianna L. Morton

Project Number
J1814

Project Title
Heat Wave: How Colors Affect the Absorption of Light Energy

Abstract

Objectives/Goals
The scientist tested to see what color paper absorbed the most light energy from a 100 watt incandescent light bulb. The scientist's hypothesis was that the following colors, in order from those that would absorb the greatest amount of heat to those that would absorb the least would be: black, blue, green, red, yellow and white.

Methods/Materials
METHODS
1. Place the poster board with colored circle 12" below the desk lamp.
2. Turn on the desk lamp and allow it to shine on the colored circle for 20 seconds.
3. Turn off the desk lamp and immediately measure the surface temperature of each slice of the colored circle using the FLIR infrared thermographic camera.
4. Rotate the poster board with colored circle 1/6 of a turn and repeat steps 1-3 five more times.

MATERIALS
6 8 ½" x 11" sheets colored construction paper.
1 11" x 14" sheet of white poster board.
1 Desk lamp with 100 watt incandescent bulb.
1 FLIR infrared thermographic camera.
1 Stopwatch.

Results
The results of the experiment, from those that absorbed the most light energy to those that absorbed the least were: black, green, blue, red, yellow and the control color, white. This result was mostly consistent with the research because darkest colors absorbed the most light energy and convert it to heat energy.

Conclusions/Discussion
Several factors affect a material's ability to absorb light energy and convert it into heat energy, including color, texture and light source. The texture was controlled by using construction paper that was identical other than color. The light was controlled by using the same light source.

This experiment was important because it provided information as to how to select colors for materials used on a daily basis. For example, the materials chosen to heat the water in a swimming pool should be black since black materials absorb more light energy. Conversely, one may want to choose a lighter color of car as it would remain cooler in the summer sun.

Summary Statement
The purpose of this experiment was to test what color paper would absorbs the most light energy from a 100 watt incandescent light bulb.

Help Received
My Father helped my use the thermographic camera because it is very delicate and expensive.

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
Wyatt B. Myers

Project Number
J1815

Project Title
Does the Position of the Center of Mass Affect the g-Forces of an Object?

Abstract

Objectives/Goals
The objective is to determine if the G-forces will change when I change the position of the center of mass.

Methods/Materials
I constructed a centrifuge with an Erector set that had four positions to hold a Wii Nunchuk. The Wii Nunchuk has an accelerometer that senses gravitational forces. I connected the Wii Nunchuk to a microcontroller that interfaces with the computer. I put the centrifuge in motion and recorded data three times from each mark on the centrifuge.

Results
I observed that if the mass is closer to the center of gravity then the g-force is changed. But it is such a small change you wouldn't notice it.

Conclusions/Discussion
I thought that changing the position of the center of mass, that the g-forces on a separate object would change, which it did, but my data showed that it was such a small change you wouldn't notice. The results shocked me at first, until I thought about it and realized that it did make sense because the model is small. Even though the changes were not very noticeable, I think if the project were on a real to life scale that you might notice the changes.

I could improve my experiment by making it a more accurate speed on each turn or changing the process of collecting data.

If I do this experiment again I would change how I would place the sensor, and get a more accurate sensor.

Summary Statement
My project is about finding the link between the position of the center of mass and the amount of g-forces.

Help Received
My science teacher, Mrs. Conrad helped me keep organized; My Dad encouraged me; My Mom cut paper, helped with lay out and printing for the display board; she also helped my purchase supplies.

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)

Bryan T. Nguyen

Project Number

J1816

Project Title

An Original Calorimetric Experiment to Measure the Thermodynamic Properties of a Hot Pack Solution

Abstract

Objectives/Goals

The objectives of this study are (1) to measure the specific heat and heat of solution of a mixture of magnesium sulfate (MgSO4) and water, and (2) to use these thermodynamic properties to determine the amount of solute and solvent required for a first-aid hot pack.

Methods/Materials

The following materials are used in my project: electric calorimeter, glass thermometer, test wires with alligator clips, digital multimeter, 6-volt battery, graduated cylinder, digital scale and tare weight, stopwatch, test substances (MgSO4, water), and a sealable plastic bag.

I fill the calorimeter with a volume of water and dissolve 20 g of MgSO4 in the water to form the test solution. Before the start of each test, I measure the battery voltage and DC current with the digital multimeter. I then connect the battery to the multimeter and the heating wire of the calorimeter. I start the timer and record the time, fluid temperature,and electric current every minute. To obtain a uniform temperature distribution in the solution, I continually stir it with the mixer. When the temperature reaches 10 deg C, I disconnect the battery from the calorimeter. For sampling purposes, I perform Test Series 1, 2, and 3 with three water volumes (100, 125 and 150 mL) and conduct the experiments three times for each volume. In addition, I perform Test Series A with water only to determine the specific heat of the calorimeter.

Results

From Test Series A, I determined the specific heat of the calorimeter to be 5.68 J/g-deg C. From Test Series 1, 2, and 3, I obtained the specific heat of the MgSO4 and water solution as 4.19 J/g-deg C and its heat of solution as -303 J/g (the negative value shows that the reaction is exothermic). Using these thermodynamic properties, I determine the amount of MgSO4 and water needed to warm up the mass of an average male hand from 22 deg C to normal body temperature of 37 deg C. The results show that I need 94 g of MgSO4 and 574 mL of water.

Conclusions/Discussion

I performed a calorimetric experiment to measure the specific heat and heat of solution of MgSO4 in water. I then used these thermodynamic properties to determine the mass of MgSO4 and volume of water needed to warm up a human hand by 15 deg C and prevent frostbite.

My hypothesis has been proven: my calorimetric experiment enables me to design a first-aid hot pack by handily mixing in a Ziplog bag 94 g of MgSO4 with water from a 20-oz bottle.

Summary Statement

An original calorimetric experiment to measure the thermodynamic properties of a solution and design a first-aid hot pack

Help Received

Father explained concepts of thermodynamics and calorimetry; Mother helped with poster board and binder.

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
Andee L. Poole

Project Number
J1817

Project Title
Is the Lung Capacity of a Healthy Adult or the Lung Cap of an Adult w/ Lung Cancer Affected More by the Increase of Elev

Abstract

Objectives/Goals
The purpose of my science project was to determine whether the lung capacity of a lung with cancer or the lung capacity of a healthy lung was affected more by the increase of elevation. I am testing if an adult with lung cancer is affected more by elevation than a healthy adult because I wanted to understand a person's lung capacity and how it changes.

Methods/Materials
I used ten 12" round latex balloons (representing healthy adult lungs) and blew them up to 79cm round, and I used ten 5" round latex balloons (representing cancerous adult lungs) that I blew up to 53cm round. I used a black Sharpie pen and a fabric ruler to measure the center of each balloon and mark them. I then used twenty push pins and attached the balloons to four lableled yard sticks. Next, I placed the yard sticks into a vehicle at sea level to be transported. We drove to 2000ft, 4000ft, 6000ft, and stopped at Huntington Lake, CA, approximately 8000ft in elevation. At each stop in elevation I measured the balloons and recorded their size. After I found all the measurements, I found the average size of each group of balloons, and I compared the results.

Results
After numerous trials, my results showed that on average the balloons representing the lung capacity of a healthy adult increased in size by about 1.58cm. However, the balloons representing the lung capacity of an adult with lung cancer decreased in size by about 9.13cm. After completing my investigation, I found that the lung capacity of a lung affected by lung cancer changed 4.21cm more than the lung capacity of a healthy adult.

Conclusions/Discussion
After completing my investigation, I found that the lung capacity of an adult with lung cancer was affected more by the increase of elevation than the lung capacity of a healthy adult.

Summary Statement
Using the affects of elevation to test the lung capacity of a healthy adult and an adult with lung cancer represented by balloons.

Help Received
Mother drove me to different elevations to perform experiment. Mother also took photographs.

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
Patrick L. Prestridge

Project Number
J1818

Project Title
Changing the Speed of Light

Abstract

Objectives/Goals
The objective was to accurately measure the refraction indexes of different fluids using air as the constant medium and make comparisons. To accomplish this, an apparatus was constructed to measure light passing through the medium/air interface that clearly demonstrates the physical principle of the propagation of light. It was designed such that the refracted light used the full length of the apparatus and would yield the most accurate measurements. Another goal of the apparatus was to minimize the volume of fluid required for each test to less than one gallon.

Methods/Materials
A laser was used as the light source and it was directed at the air/fluid interface. The beam splits into two beams, one is reflected off of the interface and one is refracted into the liquid medium and to a target area on the bottom of the tank. This sets up two triangles and their opposite and adjacent side lengths can be measured with a ruler. Using these measurements and trigonometry all the angles needed to calculate the Refraction Index is known.
The tank was constructed from glass and silicon sealer was recommended by the local aquarium store. A small laser requiring less than 3V was used as the light source. The laser #holder# was made from wood scrap. To make the measurements as precise as possible washers on a string, tape, and some glass cleaner was also used.

Results
For the Ventura County Science Fair similar oils used for cooking were tested. Corn oil had the highest refraction index out of the tested oils as suspected because it had the highest fluid density. A modification to the laser #holder# was made for the State Science Fair to increase accuracy. This experiment is still in progress.

Conclusions/Discussion
The apparatus can accurately measure the Refraction Index for one gallon samples. The density of the fluid sample relates to the Refraction Index. The laser light can be seen easier in some fluids than others. Regardless of the angle the laser enters the fluid, the Refraction Index is the same-and it should be. Other physical phenomena were observed such as; meniscus of the fluid along the tank wall, scattering of laser light varies depending on the fluid, density and viscosity of fluids. I would like to know more about optics and lasers.

Summary Statement
My project used a homemade tank to test the refractive properties of various oils.

Help Received
Father bought glass and various oils

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
Alec M. Roberts

Project Number
J1819

Project Title
Super Cooling and Snap Freezing

Abstract

Objectives/Goals
If I supercool water and then interrupt the process by shaking it, then snap freezing will occur.

Methods/Materials
Procedure for Supercooling Water
1. Cut a circle from the cereal box to use as a cover for the plastic cup. 2. Pour a small sample of distilled water into a clean plastic cup and place the cup in the center of the bowl. 3. Cover the cup, then add ice cubes to the bowl, so that the ice is above the level of water in the cup. 4. Sprinkle 2 tablespoons of salt over the ice cubes. 5. Uncover the cup and put the thermometer inside. 6. Monitor the temperature of the water. Keep track of the time and temperature in your lab notebook. 7. When the temperature of the water reaches 1 to 3 deg C or so, carefully remove the cup from the ice bath. 8. Repeat the procedure, testing different types of water to see whether it can be supercooled before freezing. For each type of water, run at least three trials (more is better). Here are some ideas for types of water to test:
a. bottled distilled water,
b. bottled spring water,
c. plain tap water,
d. any of the above that have been boiled and then allowed to cool to room temperature.

Materials List: large bowl, Ice, salt, distilled water, thermometer (good range would be -10°C to 110°C, e.g. part number 3113300 from Edmund Scientific's at Scientificsonline.com), transparent plastic cups (tip: a tall, narrow shape works best), piece of cardboard (e.g., empty cereal box), scissors.

Results
When I supercooled the water by using the materials listed above and then shook the bootle, snap freezing occurred.

Conclusions/Discussion
Conclusion

If the water is purer, it will supercool faster and then you snap freeze it to ice. If i used tap water, the water supercooled in 27 minutes because it was purer than boiled water and bottled water. If I used boiled water, I would have to use a lot of water to supercool it. If I got bottled water from the fridge, it would already be cold. The water isn't as pure as tap water so it takes longer to supercool. I think that you can make the experiment longer by doing more trials or using different brands. It would be a lot better if the

Summary Statement
To supercool and snap freeze water.

Help Received
Mom bought materials, Dad took pictures and helped with the graph.

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
Madison E. Rodriguez

Project Number
J1820

Project Title
The Effect of Weight and Shape on Buoyancy

Abstract

Objectives/Goals
The objective is to find out the effect of weight and shape on buoyancy.

Methods/Materials
Modeling clay was shaped into three different weights and four different shapes (sphere, pyramid, cube and hull). Each was attached to a spring scale and lowered into a beaker of water. The force in newtons was recorded first out of the water and after being immersed. The volume of water displaced by the object was also recorded. This procedure was repeated 30 times in water, as well as immersing the objects in oil and in vinegar. The entire process was repeated for all three liquids, changing the substance from modeling clay to playdough.

Results
When changing the weight of the object, the buoyant force increased as the weight increased. When changing the shape of the object, the buoyant force remained the same except for the hull shaped object.

Conclusions/Discussion
My hypothesis was supported by the data because the results have shown that the weight will have an effect on buoyancy, but the shape will not unless shaped as a hull. These results support Archimedes Principle of buoyancy.

Summary Statement
My project is about the effect of weight and shape on buoyancy.

Help Received
Used lab equipment at Thomas Jefferson Middle School under the supervision of Mrs. Shannon Harris.

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
Dhiren Suryadevara

Project Number
J1821

Project Title
Refraction Action

Abstract

Objectives/Goals
The purpose of my project was to determine if increasing the sugar concentration in water would increase the index of refraction. My hypothesis was that as the percent of sugar increased in the water, the index of refraction would also increase.

Methods/Materials
I tested five different sugar solutions of various concentrations (5%, 10%, 15%, 25%, and 50%) three times each. Using six 1x3" glass microscope slides, I constructed a watertight equilateral triangular prism. I positioned the prism perpendicular to a wall. Using a 532nm green laser pointer, I measured the angle of minimum deviation of each solution by measuring the change in position of the laser beam made from an empty prism to one filled with a solution. I tested all five of my solutions in this way, making sure to control all the vital angles and distances. Using the angle of minimum deviation, I calculated the index of refraction with the dispersion equation. I then analyzed all my data.

Results
From my data, I found that the index of refraction increased incrementally, as the sugar concentration increased. My results are consistent with my background research, and conformed my hypothesis.

Conclusions/Discussion
My results happened the way they did because when I increased the sugar concentration, I increased the density of the water. From my research, I found that refraction occurs when light passes through the boundary separating two mediums of different density. Refraction is caused by the change in speed of light as it travels through the mediums. The index of refraction is the measure of the bending of the light. I used Snell's Law and basic geometry to derive the dispersion equation which I used to calculate the index of refraction. Snell's Law, and the concept of refraction are used in a variety of real-world applications. These applications include x-rays, cellphones, radiation therapy, infrared technology, and sonar. The next step in my experimentation would be to test a variety mediums. I would analyze the data, and try to find a mathematical model that would directly relate the index of refraction to the density of a medium.

Summary Statement
The goal of this project was to investigate whether increasing the sugar concentration would increase the index of refraction.

Help Received
I received help from my Dad, my teacher Ms. Skiles, and our family friend Mrs. Rickard.

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)

Kentaro Tanaka; Yuji Tanaka

Project Number

J1822

Project Title

Maximizing the Effects of Radiative Cooling for Use in a Non-Electric Refrigerator

Abstract

Objectives/Goals

The objective of this project is to examine the feasibility of the production of non-electric refrigerators based on radiative cooling by constructing a prototype non-electric refrigerator. The design criteria is that the aluminum sheet metal placed inside the prototype reaches a 15 degree temperature difference from the outside ambient air temperature.

Methods/Materials

An insulated box with the top open was built, with aluminum sheet metal painted black on the zenith-facing side placed within the box. The box was left outside and measurements of the temperature of the sheet metal and the air were taken. Measurements of the humidity and the temperature of the night sky (by infrared thermometer aimed at the sky) were taken when needed. To improve the efficiency of cooling, first the opening was covered with different window materials: Glad food wrap (polyethylene), Stretch-tite food wrap (PVC), and glass. Then, different numbers of layers (1 layer, 2 layers, and 3 layers) for that window were tested. Finally, a reflector designed to block out incoming radiation was added. Then, overnight tests were performed using a simple Visual Basic code that took measurements from a thermocouple input sensor connected to the computer.

Results

The most efficient material for the window was Glad, while the glass was least efficient, even less than having no window. The most efficient number of layers was 1 layer, and 3 layers was the least. The reflector consistently showed a significant increase in the temperature difference, while effectively blocking radiation from lower skies. The temperature differences during the overnight tests never reached above 15 degrees, but on a previous test there was an instance of a 15.9 degree temperature difference.

Conclusions/Discussion

The efficiencies of the different window materials were directly related to the transmittance of infrared rays. The number of layers did not improve the efficiency because the transmittance was decreased too much. The reflector was definitely an important addition to the prototype, improving the efficiency by a significant amount. The overnight tests did not reach more than a 15 degree temperature difference, but a prior test during winter showed that a 15 degree temperature difference was possible, so this project should be judged as a success.

Summary Statement

This project is about maximizing the effects of radiative cooling to determine the feasibility of using radiative cooling to build non-electric refrigerators.

Help Received

Mother helped paste paper on display board; Father answered some questions and helped design prototype.

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
Lance E. Torno

Project Number
J1823

Project Title
Splashdown

Abstract

Objectives/Goals
To Find Out if a metior hit water at what angle would cause the biggist wave.

Methods/Materials
The materials in the experiment used were a 3" by 3' tube, 1 lacrosse ball, 1 plastic container, sand, camera tripod, clamp, protractor and water.

The methods in this experiment were:

1: Setting the tube to a certain hieght and angle.
2: My dad drops the lacrosse ball and takes the time while I mark the wave length on the sand.
3: We record the data

Results
The results showed that the 90 degree was the shortest wave length. The 45 degree angle created the longest wave.

Conclusions/Discussion
The reason the 90 degree angle was the shortest was because the water compressed under the ball then released losing a lot of speed. The 45 degree angle hit the water pushing the water forward causing a bigger wave.

Summary Statement
I used a lacrosse ball dropped from a specific angle hitting water to represent a meteor hitting water making a large wave/tsunami.

Help Received
Dad & Brother assisted with ball drop & timing. My Dad also assisted me with MS Excel spreadsheet.

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
Bronwyn K. Wedig

Project Number
J1824

Project Title
Temperatures and Surface Tension

Abstract

Objectives/Goals
My goal was to find whether surface tension and temperature effect each other.

Methods/Materials
I used a simple scale and a dropper to measure the surface tension of various temperatures of water.

Results
The warmer water tended to have a lower surface tension than the cold water. Two of the variables were outliers, off the path of the other tests.

Conclusions/Discussion
Warmer water will tend to have a lower surface tension than cooler water. However, you will always have some tests that don't match up smoothly with the other data.

Summary Statement
I tested the correlation between temperature and surface tension.

Help Received
My dad helped draw a trend line with a tricky equation.

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
Amy J. Zhao

Project Number
J1825

Project Title
How Does the Length of the Pendulum, Mass of the Bob, and Amplitude Affect the Period of the Pendulum?

Abstract

Objectives/Goals
My objective was to learn how the length, mass, and amplitude of a pendulum affected the period. I believed that the length was the only variable that affected the period, and that the mass and amplitude had no effect.

Methods/Materials
Nine pendulums with varying mass and lengths were constructed out of clay and string, using a musical stand to hold it. Five of them were used to correlate between the length and the period. One of those pendulums together with another three was used to correlate between the mass and the period. The last one was used to correlate between the amplitude and the period. The period and length used constant mass and amplitude, while the period and mass used constant amplitude and length. The period and amplitude used constant length and mass. Using those nine pendulums, seventy-five trials were conducted.

Results
It turned out that when the length increased, the period also steadily increased. However, when the mass and amplitude changed, the period was still constant as compared to the increase in the correlation between length and the period. When I calculated the acceleration of gravity using the results from the experiment, I compared it to the calculations using theoretical values and formulas, which turned out to be pretty close.

Conclusions/Discussion
My conclusion is that when the length increases, the period also increases, as opposed to the period still being constant when the mass and amplitude increases.

Summary Statement
My project is about how length, mass, and amplitude affect the period of pendulums.

Help Received
Dad helped with experimentation and understanding/explaining the concepts of pendulums (formulas,etc) : I directed experimentation, however

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
Sierra C. Hedstrom

Project Number
J1899

Project Title
Drop It! How the Height a Blood Drop Falls, and the Surface It Lands On, Affects a Bloodstain

Abstract

Objectives/Goals
The objective of my project is to determine how the height a blood drop falls from and the surface it lands on will affect the appearance of the resulting bloodstain.

Methods/Materials
I constructed a yardstick testing apparatus to hold a glass dropper to drop the fake blood mixture onto test surfaces. I used a recipe to make a fake blood mixture. Height tests were conducted at 6 different heights from 6" to 66" at 12" increments. The blood was dropped on white posterboard pieces for study and analysis. Tests were ran 10 times at each height. Then I tested 11 different surface types; 4 types of carpet, 2 types of flooring, 2 types of tile, denim material, plywood, and concrete. These were tested at the 6" and 66" heights. Dropped 10 drops of blood for each surface at these two heights for study and analysis.

Results
The blood dropped onto the posterboard pieces at various heights had similar shaped bloodstains. A small increase in size was noted with an increase in height,to a certain point. The surface type the blood drop landed on had a greater effect on both the shape and the size of the bloodstain, depending on the surface the drop landed on. Smooth surfaces produced more uniform, spherical shaped stains. Rough surfaces produced irregular shaped stains with uneven edges. The sizes of the stains varied with surface types.

Conclusions/Discussion
My results supported my hypothesis and enabled me to achieve my objective. The surface type a blood drop lands on will affect the size and shape of the resulting bloodstain more than the height a blood drop falls from. This information can be used in forensic science and applied to crime scene investigation.

Summary Statement
How a bloodstain's size and shape are affected by the height a blood drop falls and the surface it lands on.

Help Received
Sister helped with the typing. Mother took some of the pictures during project. Father helped gather some of the materials and helped construct testing apparatus.