CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Skye Aaron

Project Number
J1501

Project Title
Measuring the Speed of Light: To Jupiter and Beyond

Abstract

Objectives/Goals
Measure the distance to Jupiter in order to measure the speed of light.

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Methods/Materials
I used parallax to find the distance to Jupiter at opposition, and then derived equations to calculate this distance at other times. I observed and recorded the times of numerous Io eclipses, and used these to find a time lag. By coupling the distance changes and the time lag, I calculated the speed of light. I used the telescope that I built as part of my project from last year, CalSky star maps and viewing predictions, a stopwatch, a clock, and recording materials (pen, paper, etc.).

-

Results
Distance to Jupiter at opposition: 4.2 AU (4.4 AU actual)
Changes in Distance: 0.0486 AU (0.0482 AU actual)
Speed of Light: 383,000 km/sec (299,729 km/sec actual)

-

Conclusions/Discussion
My parallax measurements yielded a result with about 5% error. However, errors in my estimated change of distance were smaller (about 1%). While these distances were fairly accurate, my overall speed of light estimate was very sensitive to small timing errors. The result was too high, almost 30% faster than the accepted value, and could easily have been off by much more.

My procedure presents a valid approach, but is not necessarily the most practical method; extreme accuracy in observations is required to get good results. However, taking into consideration my homemade telescope and the needed precision, my project produced a surprisingly close estimate.

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Summary Statement
I measured the distance to Jupiter and timed Io's eclipses to estimate the speed of light.

Help Received
Father checked calculations and drove me to observation sites; Friend suggested project idea; Mother helped with display board

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Devon L. Abdo

Project Number
J1502

Project Title
Solar Tubes vs. Conventional Fluorescent and Incandescent Light Bulbs

Abstract

Objectives/Goals
My objective are to test whether solar tubes produce more light than traditional florescent & incandescent lights. I want to determine which is most cost effective.

Methods/Materials
One Conventional Incandescent Light Bulb, One Florescent Light Bulb, One 11-Centimeter Diameter Drier Duct, Two Simple Light Fixtures Tree, Large Storage Boxes(same size), Box Cutter, and Light Meter.

Make three test boxes the same size. Lable them: 1. Incandescent Light Bulb, 2. Florescent Light Bulb, or 3. Solar tube. Cut a 10-centimeter hole in each. Put the appropriate light source in each box. Test each light source on three different days and in three different parts of the box (top, middle,& low) using a light meter. Measure both filtered and unfiltered light, in lumens. Teh different light sources three different days using the light meter. Write down the observaton and the results.

Results
My results show that the Soloar Tube produced the least light, the least heat, and was the most cost effecitve for a long-term setting(2+ years). Also, my results show that the incandescent light produced the middle amount of light, the most amount of heat, and was the least ncost affective. Last, my florescent light produced the most light(for it's wattage), the midle amount of heat, and was least cost affective.

Conclusions/Discussion
I have found that each light source is suited for it's own particular funcition. The solar tube made no heat but the laest abount of light. th9is was the most cost affective for a long-term prodject. I found that the florescent light made the most light. This was theh most efficient for all the time usage. Last was the incandescent light bulb and it made the most heat, the middle amount of light, and was most efficient if you were to use it very rarely.

Summary Statement
I compaired and contrastied Solar tubes and Incandescent & Florescent Light Bulbs.

Help Received
My father helped me with puting together the lights, with grammar and spelling, and geting me inside box.

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Sarah J. Adams

Project Number
J1503

Project Title
Eddy Who? The Study of Alternating Magnetic Fields and Their Effect on Non-ferrous Conductors

Abstract

Objectives/Goals
My objective was to learn why an alternating magnetic field repels non-ferrous metals and why a magnet slides slowly down a non-ferrous conductor.

Methods/Materials
A wheel was created with six alternating magnets. The wheel was set up under a structure and a power drill was added to keep the wheel spinning at a constant speed. Then, pieces of copper, aluminum and wood were suspended next to the rotating magnetic wheel to exhibit Faraday's Law. Then I measured the distance that the pieces were repelled away from the wheel. To demonstrate Lenz's Law, I placed a copper plate at the end of the axle. A magnet was placed on the steel hinge next to the spinning copper plate for observations. Lastly, aluminum, copper and wooden plates were set at an incline so that a magnet could slide down. Time measurements were made on the three different materials.

Results
In the experiment demonstrating Lenz's Law, the magnet slides slower down the copper than the aluminum. The magnetic field around the magnet, when moving relative to the copper makes the electrons within the copper move in swirls, called eddies. These eddies generate an electromagnetic field around the copper, which then repels the magnetic field around the magnet. By studying Faraday's Laws of Induction, I learned how non-ferrous metals can be repulsed by a changing magnetic field. The positive side of the magnet makes the electrons within the conductor swirl one way, while the negative side of the magnet makes the electrons swirl the other direction. The moving electrons create an electromagnetic field around the copper, which is then repelled by the wheel's changing magnetic field.

Conclusions/Discussion
An alternating magnetic field repels a non-ferrous conductor because non-ferrous conductors have a certain atomic structure which allows easy movement for the electrons. When the alternating magnetic field makes the electrons within the conductor move in different directions rapidly, the movement of electrons creates an electromagnetic field around the conductor. My observations show that the copper has a stronger repulsion than the aluminum. My conclusion is that the electrons flow more freely through the copper than the aluminum. This project may benefit society by applying the principals of Faraday's Laws to extract non-ferrous metals from municipal waste streams.

Summary Statement
The study of alternating magnetic fields and thier effect on non-ferrous metals as they pertain to the preservation of natural resources.

Help Received
Physics teacher and science teacher helped with comprehension; Father helped construct demonstration

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Sarah M. Beshir

Project Number
J1504

Project Title
The Greenhouse Effect

Abstract

Objectives/Goals
In this science project I attempted to find out how colors and type of surfaces affect the heat trapping ability of a greenhouse. My hypothesis was that light colors and smooth surfaces affect the heat trapping ability of a greenhouse more than dark colors and rough surfaces.

Methods/Materials
Filling each of six bottles (three of which have white paint on the upper third to represent greenhouse gases) with dirt, sand and water and then putting them under various amounts of light intensity.

Results
My results show that, in most instances, the black-colored dirt always had the lowest temperature while the light-colored sand and smooth-surfaced water had the highest temperature.

Conclusions/Discussion
I learned a lot about the Greenhouse Effect, the impact of the various surface materials and texture on the Greenhouse Effect, and the various things humans could do to reduce the emission of greenhouse gases. The Greenhoue Effect is caused by human activities.

In my experiments, I had dificulty with the plastic bottles and temprature reading. It would be a good idea to use glass bottles instead of plastic bottles because glass bottles can withstand higher temperatures than plastic bottles. It also would help to use digital thermometers to make sure of the exact temperature because if the temperature reading is not correct it could change the results. It would also be a good idea to start with a lower light intensity than where I started, and gradually go to higher light intensities by either putting more distance between the bulb and the bottles or by starting with light bulbs that have lower intensity.

Summary Statement
The effect of color and type of materials on the heat-trapping ability of a greenhouse.

Help Received
Mother adviced with board display. Father adviced with report.

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Peter K. Blanchard

Project Number
J1505

Project Title
Stellar Parallax

Abstract

Objectives/Goals
The objective of my project was to test stellar parallax theory, a method used to determine the relative distance of stars, through a series of observations taken on a football field.

Methods/Materials
To test parallax, I set up a board with a grid on it and had an assistant place two very small objects at different distances from the grid. Then I moved one hundred meters from the grid and used a telescope to record observations from points two meters apart. I took two sets of observations: the first observations were taken at night and recorded using a digital web camera and laptop computer; and the second set of observations were taken during the day and recorded by hand on graph paper. For each observation, I measured, in arc seconds, movement from one position compared to the other position.

Results
The results from the first set of observations taken at night were inconclusive due to the poor quality of images I was able to obtain from the web camera. However, in the daytime observations, I was able to accurately determine for each set of data, which object was closer and calculate the relative distances in arc seconds.

Conclusions/Discussion
For years, astronomers have used a method known as stellar parallax to determine the relative distance of stars. I set out to test parallax. Parallax is the apparent change in the position of a nearby object relative to a distant object when the observer moves to a new position. Astronomers use the opposite sides of the earth's orbit as the observation points, when measuring the relative distance of two stars. Through this land based experiment I proved that the concept astronomers use to calculate how far real stars are away from the earth is accurate.

Summary Statement
I was able to contruct an entirely land based experiment to test and prove that stellar parallax theory is an accurate method to measure the relative distance of stars from earth.

Help Received
My science teacher, Mr. Smith, loaned me his telescope, laptop computer and web camera as well as assisted in setting up the experiment on the school football field by placing the objects I would observe at distances unknown to me. My father helped type portions of my report.

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Matthew D. Brown

Project Number
J1506

Project Title
A Comparison of the Adhesion of Liquids on Regular Shapes

Abstract

Objectives/Goals
The original goal of my project was to discover whether or not different shapes would affect adhesion. Adhesion occurs when to substances meet and it does not matter how little it is. As my project progressed though I came to ask myself four other questions. Does the amount of area affect adhesion? Does the type of liquid I'm using affect adhesion? Does the depth of the liquid affect adhesion? Lastly, does temperature affect adhesion?

Methods/Materials
To start answering these questions I began with four shapes at three different sizes. The shapes were circles, squares, triangles, and hexagons. I took these shapes and hung them on the simple balance beam that I constructed. On the other side I used gram weights to counterbalance the adhesion between my plexi-glass shapes and the liquids I used. The liquids I used were water, rubbing alcohol, and motor oil. I tested the shapes at depths of one quart and two quarts. When I did the temperature test I used boiling water and cold water from my sink at home. I tested each shape to see how much force it would take to detach it from the surface of the liquid I was using. I did this three times each for more acurate results.

Results
After each test was completed I was able to come up with some average results. These results show several things. First they showed that the best shape for adhesion was a cirle, and the more sides the shape had the better adhesion except in the case of the hexagon. Second, that the best liquid to use was water. Third, that the largest shape did best. Fourth, that the cooler the liquid was the better adhesion was. Lastly it showed that the two quart depth was better than the one.

Conclusions/Discussion
Using the results I was able to draw a couple of conclusions. First, that the more sides a shape had the better adhesion it had, and that the hexagon was problaby cut wrong or had less area so it did poorly. Second, since the water was the densest liquid, and the others followed in order of density, that the denser a liquid the better the adhesion. Third, the more area you are attaching the better adhesion. Fourth, that adhesion works best when the substances are colder. Lastly, I determined that the difference in results of the depth test were so miniscule that it does not affect adhesion.

Summary Statement
The goal of my project was to discover the properties of adhesion.

Help Received
My mother helped with the board; My father helped assemble the balance beam; and my teacher Mr. Susman proofread the report

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Rachel E. Brown

Project Number
J1507

Project Title
Catch a Wave: Choosing the Right Soundboard

Abstract

Objectives/Goals
Soundboards used in stringed instruments are pieces of wood that enhance the sound of the notes played. Does the type of wood used for the board affect the way the notes sound? Does wood density, thickness, size or any other identifiable factor act as the source of the enhancement?

Methods/Materials
The researcher constructed eight soundboards using tuning pegs and guitar strings on different types of wood. She used an oscilloscope to capture the wave. Then she copied and saved the wave which was then converted using the Fourier Transform. Each board was tested five to ten times with comparisons made of data that was generated. Wood density was also calculated.

Results
The harmonics generated had a clear connection to the density of the wood used in the board. An example of this is that walnut, one of the densest boards, had harmonics that were not very supportive of the fundamental tone. The absence of supportive tones contributes to a clearer, better qualitative tone. The cedar fence board was the least dense and the harmonics were very supportive. Its qualitative sound was judged least pleasing.

Conclusions/Discussion
The denser boards had a better qualitative sound. The walnut board was one of the densest and had the best sound. The cedar fence board was the least dense and had the worst sound. Also the boards had to have tight grain. The composite board was the densest board and sounded the worst because it had no grain. The pine board had tight grain but was not dense so therefore it did not sound good. Also, if the board is enlarged, the note will sound better than when the board was small.

Summary Statement
My project is testing if the type of wood used for sound boards influences what the note sounds like.

Help Received
My dad helped write a program to analyze data and helped construct the sound boards.

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Janell P. Bryant

Project Number
J1508

Project Title
The Whispering Gallery Effect: Sound Propagation Near a Curved Surface

Abstract

Objectives/Goals
This experiment deals with the study of the acoustics of a whispering gallery. The type of gallery I am studying does not involve focussing of the sound, but rather a channeling of the sound along the curved surface of the wall. I wanted to test the results of several previous studies (some of which contradicted each other) and see if I could discover anything new. Most of these studies are quite old and predate modern electronic test equipment needed to verify their claims experimentally.

Methods/Materials
I loosely based the design of my gallery upon St. Paul#s Cathedral, a well-known example of this type, located in London, England. I made a circular model, about 3 meters (10 feet) in diameter, that is one-eleventh the scale of that of the real gallery. The walls of St. Paul#s Cathedral are made of stone; however; I built my gallery out of hardboard, which my tests confirmed reflected sound adequately for my experiments. I used a small speaker to generate the sound and a microphone to receive the sound. I used high frequencies, 2.5kHz to 20kHz, to produce short wavelength sound waves for my scaled model. I used several pieces of electronic equipment including a signal generator, two amplifiers, a filter, an oscilloscope and a digital voltmeter.

Results
My results confirmed that sound waves travel along the curved surface of the gallery. I found that the signal strength fluctuates rapidly with the position of the microphone and speaker as suggested by some references and not by others. I found an unexpected and dramatic improvement in performance at low frequencies, the opposite of what was suggested by other studies. I also found less enhancement of the effect than expected when the speaker was moved closer to the wall.

Conclusions/Discussion
My most important new result is the enhancement of the gallery effect at lower frequencies. Several of the previous studies suggested that the gallery should work better at the higher frequencies corresponding to whispering than to the lower frequencies of normal speech.

Summary Statement
This is an experimental study of the acoustics of a scale model of a circular whispering gallery, which found new results including a frequency dependence that is opposite to that suggested by previous studies.

Help Received
My father, Paul Bryant, provided technical help and advice. Some electronic equipment used was provided by my father#s work, Recording Physics, Inc.

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Gabriel H. Burnworth

Project Number
J1509

Project Title
Ruben's Tube

Abstract

Objectives/Goals
The objective of my experiment was to observe the interactions of sound waves using a flammable gaseous medium. I calculated and determined through experimentation the frequencies that resonated in a Ruben's Tube, causing standing waves to be established.

Methods/Materials
I filled a 6-foot long and 3-inch diameter galvanized steel tube with propane gas using a propane torch valve. On one end of the tube a speaker emitted frequencies from a frequency generator program loaded on a laptop computer. A plastic stopper in the other end set the length of the Ruben's Tube. Gas coming out of one-sixteenth of an inch holes drilled one inch apart along the top of the tube became flames when lit. Fine-tuning the frequencies generated on the computer allowed me to use the antinodes (peaks) and nodes (valleys) in the flames to determine the frequencies that resonated in my tube.

Results
The resonating frequencies determined in my experiment closely matched the calculated frequencies. When the longitudinal sound waves traveled through the tube, bounced off the end and returned, I was able to observe the compressions and rarefactions of the waves by the effect of the pressure on the gas. I was able to see standing waves clearly and determined frequencies for the fifth through tenth harmonics.

Conclusions/Discussion
By using the scientific method and paying close attention to the many different variables that might have thrown off my results, I was able to experimentally confirm the resonating frequencies calculated for the tube. The knowledge gained in this experiment is useful in the design of musical instruments such as organ pipes.

Summary Statement
I calculated and measured resonating frequencies observed in standing waves created by the constructive and deconstructive interference of sound waves in a Ruben's Tube.

Help Received
Brother helped with the design of the apparatus and with the understanding of the physics; Dad encouraged me and made sure experiment was done safely.

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)

Bryce W. Cronkite-Ratcliff

Project Number

J1510

Project Title

Enlightenment: A Study of the Wavelike Properties of Light

Abstract

Objectives/Goals

The objective was to examine and demonstrate the wavelike properties of light.

Methods/Materials

I performed several different experiments in which the wavelength effects of light are evident to the naked eye, even thought the wavelength is very short. Two of these experiments are classics that are historically significant in the development and acceptance of the wave theory of light. Lasers of two different wavelengths were used in addition to a number of rulers, ball bearings, computer-generated slits, and other conventional items. The experiments were performed over very long path length so that the patterns were large enough to be easily observed and photographed. Measurements were made both directly and using photographs. Analysis of the results was performed using Microsoft Excel.

Results

I observed interference patterns from two different classical experiments : the Young's Slit experiment and the Poisson's Spot experiment. In the Young's Slit experiment I used slits generated on a computer printer to demonstrate that the projected interference pattern behaved as predicted. I changed parameters such as the distance between the slits, the distance between the detection screen and the slits, and the color of the light source. For the Poisson#s Spot experiment I used ball bearings mounted to glass slides to create interference patterns from laser sources. Again I varied parameters such as ball diameter, laser color, and the distance from the bearing to the detection screen. I then used a steel ruler as a reflection-diffraction grating to obtain accurate measurements of the light from my two lasers of different colors (red and green). Lastly, I used my knowledge of interference and the wavelength of my light sources to measure miniscule distances including groove spacing on a CD and DVD and the width of a human hair.

Conclusions/Discussion

The nature of light is a question that sparked centuries of debate among the world#s greatest scientific minds. I demonstrated that light did in fact exhibit wavelike properties, and I made a number of specific measurements of light interference phenomena. Finally, I not only took loads of beautiful pictures, but also had a great deal of fun with this project.

Summary Statement

My project is an exploration of the wavelike properties of light.

Help Received

Father served as my mentor; Mother helped mount project.

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Emily L. Denton

Project Number
J1511

Project Title
Liquid Viscosity and Temperature

Abstract

Objectives/Goals
Viscosity is a property of a liquid and is defined as the resistance of a liquid to flow. The purpose of this experiment was to determine if the temperature of a liquid affects the viscosity of the liquid. A homemade viscometer was made to measure the flow of five different liquids including water, canola oil, dishwashing liquid, corn syrup, and molasses.

Methods/Materials
The five liquids were tested at three different temperatures (65, 40 and 95 degrees F). The elapsed time for the liquid to flow out of the homemade viscometer was measured three times for each liquid at each temperature. Because viscosity is related to how a liquid flows, the volume of liquid that flowed through the viscometer in each test was divided by the average time in minutes to get a flow rate in liters per minute. The flow rates of each liquid at the three different temperatures were compared. Relative viscosity of other liquids to water was also calculated.

Results
The viscosity of each liquid tested was found to be dependent on the temperature of the liquid. As the temperature of the liquid rises, my experiment showed that the viscosity of the liquid goes down. As the temperature of the liquid goes down, the viscosity of the liquid goes up. My calculations of relative viscosity of liquids to water also showed significant changes with temperature.

Conclusions/Discussion
Accurate measurements of viscosity are essential in engineering calculations and design of equipment that move liquids, such as pumps, pipes and valves. My experiment shows that effect of temperature on a liquid's viscosity must be taken into account in the design calculations.

Summary Statement
My experiment was designed to determine if the temperature of a liquid affects the viscosity of the liquid.

Help Received
My mom helped me with some research, and helped me with the experiment. My mom and dad helped me edit my report. My dad also helped me by showing me how to make graphs on the computer and showing me a log scale and how to use one.

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Steven P. Dewey

Project Number
J1512

Project Title
Liquid Light

Abstract

Objectives/Goals
The objective of my project was to see how bright different colors of light were when passed through a stream of water.

Methods/Materials
Using a plastic bottle covered with duct tape with a hole near the base, a flashlight, a white board, and color filters (yellow, orange, green and blue) I built an apparatus. The flashlight would shine through the color filter and into the bottle of water. The light would then pass through the stream of water at the base of the bottle, hitting the white board. Before the assistants observed each color filter they observed the brightness of white light as it passed through the stream of waster. As each color filter was put in the apparatus an assistant observed the brightness of the light as it hit the white board. The brightness was recorded on a scale of one through five, five being as bright as the control (white light).

Results
In my experiment it was observed that all of the different colors were less bright than the control. Yellow was the brightest, followed by orange and red, then green and lastly blue.

Conclusions/Discussion
My conclusion is that when white light is passed through a color filter and a stream of water it will project the color of the filter only slightly less bright than without a filter. All the colors were less bright than the control because white light is made up of all the colors and when you filter some of the colors away you end up with less total light.

Summary Statement
My project is about how colored light behaves when passed through a stream of water.

Help Received
Daniel Dewey helped me to understand the physics of light and was an assistant. Chris and Amy Dewey were assistants. Amy Dewey also helped typed. Tom Dewey helped me build the apparatus.

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Shay C. Edwards

Project Number
J1513

Project Title
Transmissivity: Observations of Gas in the Infrared Spectrum

Abstract

Objectives/Goals
The purpose of my science project was to study the influence of the chemical composition of gas on its ability to absorb and transmit infrared radiation. My main objective was to obscure a heat source with a visibly transmissive gas. I will also be studying the transmission of infrared light through the gas. I hypothesized that the composition of each gas would affect infrared viewing.

Methods/Materials
To test my hypothesis I constructed a 5" x 29 ½" gas cell from PVC pipe. I used a Spectroradiometer, which operates in the spectral range from 2.5 to 14.5 um, and an 8-12 micron infrared camera with digital imagery. Testing was performed on Sulfur Hexafluoride, Carbon Dioxide, Tetrafluoroethane, Ammonia, Isopropyl Alcohol, Acetone, Freon 13, Resmethrin, and a Can of Air. A Blackbody was used as a constant heat source. Every gas was tested in a controlled environment and photographed before and during the testing.

Results
Using the SR5000 Spectroradiometer wide range capabilities, I was able to look at one micron at a time with each gas tested. After the SR5000 testing, I was the able to proceed using the information that I had gathered and test with the infrared imaging system on the same gases to visually look for obscuration of the heat source.

Conclusions/Discussion
The data from both types of test supports my hypothesis that the chemical composition of gas will directly affect the transmissivity in the infrared spectrum. I was surprised to find that the can of air had high areas of absorption therefore making areas of low transmissivity causing some obscuring in the infrared spectrum.

Summary Statement
This project examines the chemical composition of gas on its ability to absorb and transmit infrared radiation.

Help Received
Testing was performed at NAVSEA in Corona under the supervision of Ed Trovato and Kevin Janosky. My dad tapped in the valves on the gas cell. My mom drove me to all of the testing and Staples for supplies.

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Lizzie Eisenstein; Heather Kitada

Project Number
J1514

Project Title
Good Conductors: The Comparison of Thermal Conductivity for Different Metals

Abstract

Objectives/Goals
Our objective was to compare the thermal conductivity of different common metals. We thought that aluminum would be the best conductor.

Methods/Materials
Rods made of aluminum, brass, copper, and steel were bent into the shape of a U. Then the ends of the U were placed in two Styrofoam cups of ice and room temperature water. We measured the decrease in temperature over a thirty-minute time period of the room temperature water.

Results
The results were that the copper rod conducted 3.7 degrees Celsius out of the room temperature cup and it was the best conductor of heat. The worst conductor was the steel rod and it only conducted 0.1 degrees Celsius.

Conclusions/Discussion
In conclusion, we found out that pure metals, such as copper and aluminum were the best conductors. The alloys (materials made of several elements) such as steel and brass did not conduct heat nearly as well. This is helpful when engineering and buying cookware because pots and pans with pure metal bottoms can conduct heat fastest. It is also important for building other metal appliances or equipment for which thermal conductivity is a concern.

Summary Statement
Our project is about the comparison of different metals and how well they conduct heat.

Help Received
Dr. James Eisenstein helped bend the rods and set up the plans for taking data. We used his lab at Caltech for bending the rods.

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Leandra A. Fraser

Project Number
J1515

Project Title
How Low Can It Go?

Abstract

Objectives/Goals
For my project, I was trying to test whether or not water pressure has an affect on magnetism. My method is stated below. I compared salt water to tap water and did each test with each water five times. I wanted to also see how many paperclips the magnet would hold at each level of water.

Methods/Materials
Hand made cylinder (plastic tubing, plastic circular piece, cement; meter stick tape etc.); salt water; tap water; 100 jumbo paperclips; bar magnet; string; recording materials.

I created a large graduated cylinder out of 180cm of plastic tubing and marked increments from 18cm all the way to 180cm. I got salt water from the ocean and filled the cylinder to a certain amount. Then, I submerged a clump of paperclips; dropped in a bar magnet tied to a string; and tried to pick up the clump. If the magnet could not hold the clump, I would take away a few paperclips. If it could hold the clump, I would add more paperclips until I found the exact number of paperclips the magnet was able to hold. I repeated this test at each increment and did it five times for more valid results. I also performed this test five times in tap water for comparison.

Results
I performed five tests with the salt water and five tests with the tap water. I took the averages of each increment of water for each test. The averages were as follows for the salt water:180cm-36.6pc; 162cm-68pc 144cm-46.4pc; 126cm-50.6pc; 108cm-58pc; 90cm-62.6pc; 72cm-65.4pc; 54cm-68.4pc; 36cm-69.4pc; 18cm-72.
Averages for the tap water were as follows: 180cm-35.2pc; 162cm-36pc; 144cm-42.6pc; 126cm-48pc; 108cm-56.8; 90cm-60.4; 72cm-63.8; 54cm-66; 36cm-67.2; 18cm-69.

Conclusions/Discussion
I thought the two factors (magnetism and water pressure) would vary inversely; meaning, as the water pressure increases, magnetism decreases (weakens). I was correct. My tests showed that at the greater levels of water, the magnet was not able to hold as many paperclips. Between the salt and tap water tests, I thought the salt water would be able to hold more paperclips than the tap water because things in salt water are more buoyant, possibly making it easier for the magnet to hold more paperclips. I was correct with this hypothesis as well.

Summary Statement
I tested to see if greater water pressure weakens magnetism.

Help Received
My mother and father helped with transportation and purchasing materials; Mr. Miller, a science teacher at Vista Heights, helped me to improve my project.

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Kevin T. Grasel

Project Number
J1516

Project Title
Safely Thawing Meat Used while Backpacking

Abstract

Objectives/Goals
I did this project so I would know how long I have when bringing meat backpacking until it spoils and which environment would be best for keeping the meat safe. My goal was to keep chicken, hamburger meat, and steak under 40 F until dinner time. From my research, I learned that 40 F is the temperature at which meats begin to spoil rapidly.

Methods/Materials
First, I inserted a thermometer into a chicken breast and covered it with plastic wrap. Then I froze the chicken overnight along with two other similarly-prepared pieces of chicken. In the morning, I inserted another thermometer outside each chicken piece just under the plastic wrap, and I put one piece in a backpack, another in a bear can, and the last one in an insulated lunch bag. All were put in a shaded area. I took temperature readings every half hour. I repeated these steps using hamburger and steak, and additionally, I repeated these experiments with steak in the sun.

Results
For all the meats, the temperature rose to about 32 F and stayed there until the meat was thawed. Once the meat thawed, its temperature rose quickly to 40 F and higher. The steak stayed coldest the longest, then the hamburger meat, and lastly, the chicken thawed the most quickly. When not in direct sunlight, the insulated lunch bag kept the meats the coolest, then the backpack, and finally, the bear can allowed the meat inside to thaw the quickest. The inside and outside temperatures of the meat did not vary considerably. Also, when the containers were put in direct sunlight, the meat thawed extremely quickly.

Conclusions/Discussion
All the heat and energy being placed into the meat is used in the process of thawing and keeps the meat temperature at about 32 F until the meat is unfrozen. As I predicted in my hypothesis, the insulated lunch bag proved to keep the food the coolest. The backpack was next, and finally, the meat in the bear can thawed the quickest. As I predicted, all of the meats thawed in the shade would have been safe to eat for at least eight hours. However, when I extended the experiment to include the thawing of the steak in the direct sun, the steak did not even last five hours in any of the environments. The most important conclusion is that to remain safe, you should not take frozen meat backpacking.

Summary Statement
I studied the thawing of different types of meat in different environments to find out whether it is safe to bring frozen meat while backpacking, and I concluded that it is not safe.

Help Received
My mother proofread my reports, and my father helped make the graphs using Microsoft PowerPoint.

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Jeremy M. Hahn

Project Number
J1517

Project Title
Using Solutions' Absorbance Spectra to Predict Their Heating by Light

Abstract

Objectives/Goals
It is interesting and practical to determine exactly how much a solution is heated by light. In this project I developed a model to predict a solution's heating rate, used this model to determine what factors affected heating rates, and tested the predictions of the model in real situations.

Methods/Materials
I derived a mathematical model and, using Excel, created a program to predict the heating rate of a given solution under lighting from a given source. Using the yabasic programming language, I created a program to generate fake absorbance spectra of imaginary solutions to compare within the program. I used Sharpie ink solutions in experiments with a tungsten bulb and a laser to test the program in real situations.

Results
Comparisons of artificial spectra showed that heating rate is not directly proportional to concentration, that two solutions with equal total absorbance can heat very differently depending on the wavelengths absorbed, and that "color" and "darkness" are good predictors of heating. Surprisingly, the program predicted the heating rate of the Sharpie solutions held close to a tungsten bulb to be only 3.08*10^(-5) degrees over 12 minutes. Testing showed that the heating rate was very small as predicted. Later, experiments with a laser showed the model to be accurate to within 8%.

Conclusions/Discussion
The program created correctly predicts that heating rate is not proportional to concentration because of absorbance's logarithmic dependence on energy, and the uneven power output spectrum of a typical light source caused two different, equally absorbing solutions to heat differently. The two major surprises of this project were the small predicted heating rate of Sharpie ink solutions irradiated by the tungsten bulb and the fact that color and darkness are actually predictors of heating.

Summary Statement
This project is about how solutions are heated by light, and what factors produce what effects on heating.

Help Received
Father: providing access to equipment at The Scripps Research Institute, editing my work, and advice; Mother: editing, gluing and preparing of board; Teachers: editing; Mike Adams of the Scripps Research Institute: laser experiment.

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Karen A. Hauser

Project Number
J1518

Project Title
What Didge You Hear?

Abstract

Objectives/Goals
My objective was to build a didgeridoo (didge) type musical instrument of any desired base frequency by using and verifying the appropriate acoustic physics model. I tried to determine how modifications and playing technique affect the total sound produced.

Methods/Materials
Using 2 inch PVC pipe and fittings I constructed a set of 6 didges ranging in frequency from 110 Hz to 51 Hz by adding different lengths of tubing to a 110 Hz base unit. A 7th didge for the set and 2 more identical single piece didges all of a specific desired C2 (65.4 Hz) frequency were made to verify predictions. A heat gun was used to modify the two identical didges with grooves, dimples, bends and an end bell. Sound spectral analysis of each didge played by me was done using a computer program (Amadeus II). Data recorded in table form allowed analysis and recognition of patterns for conclusions.

Results
I verified that a closed end tube acoustical model was consistent with the observed harmonic frequencies of my didges. The simple equation, Length = Speed of Sound / 4(base frequency), predicted the didge length to within 2% for a range of measured base frequencies. C2 (65.4 Hz) base frequency didges were successfully made by cutting tubing to the predicted length. Modifications of an end bell, a first bend and a very hard blowing technique could increase frequencies while a second bend decreased frequencies. The spectral sound pattern of harmonics in my didges was influenced far more by subtle differences in playing technique than by my specific modifications.

Conclusions/Discussion
I was able to build a didge with a desired base frequency. The total didge sound is composed of a number of harmonics combined together. The fine lip control and voice cavity modification needed to play a didge consistently are difficult skills that I did not fully master. Even though the didgeridoo is a simple and ancient musical instrument, the sound its produces is quite complex.

Summary Statement
Didgeridoo type musical instruments with specific base frequencies were constructed using acoustic physics principles, and the harmonics that create the total musical sound were analyzed.

Help Received
Father helped gathering materials, instructing proper use of dangerous shop tools; Mother helped assemble board; Dr. Kutchera-Morin gave me information through a personal interview.

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Matthew T.E. Heydeman

Project Number
J1519

Project Title
Cold Nuclear Fusion

Abstract

Objectives/Goals
My objective was to see if I could create an alternate energy source using a cold nuclear fusion reaction. I used a method similar to that of the well known cold fusion experiment by Drs. Fleischmann and Pons. If it is achieved, cold nuclear fusion could provide a nearly limitless energy source. Running on just water, scientists speculate cold fusion reactors could take the top ten feet of Lake Michigan and use it to generate enough power for the whole United States for 1500 years. Although cold fusion has been confirmed by several research laboratories, it has been dismissed by others and, hence, has not irrefutably been proven to be successful.

Methods/Materials
I used several variations of water. However, I will focus on the solution called deuterium oxide (D2O). I poured D20 into a jar and inserted a thermometer and two electrodes (platinum anode, palladium cathode) connected to a power supply. I sent electricity through the D20, which broke down into deuterium and oxygen. The atoms were ionized by electrons and moved to the electrode opposite their charge. Negatively charged oxygen moved to the positive anode, while positively charged deuterium moved to the negative cathode. Had the experiment been successful, the deuterium would have concentrated in the palladium. This high concentration would have been enough for the nuclei to touch, causing the deuterium atoms to bond with one another, forming helium. In addition, this process would have released energy in the form of heat.

Results
I did three tests, each involving a different solution. I used regular water and seawater as a basis for comparison against the D2O. In the test with D2O, the temperature only rose 1 degree (F). The current flowing through the solution fluctuated. I burned the collected gas, showing that stable helium had NOT been produced. These factors indicate that no fusion reaction occurred.

Conclusions/Discussion
My experiment shows that fusion can not be accomplished using this particular method. The deuterium gas did not condense enough to fuse. More work will be required before nuclear fusion can be generated in this way. If I were to repeat this experiment, I would get more deuterium oxide so I could perform more tests, using different variables. I would also add lithium salt to my electrolyte solution instead of table salt. Lithium salt would greatly improve conductivity, which would allow for a better chance of fusion occurring.

Summary Statement
Is it possible to conduct cold nuclear fusion using the Fleischmann and Pons method?

Help Received
Parents helped order materials and set up apparatus.

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Philip B. Hu

Project Number
J1520

Project Title
Zero Gravity Elevator Experiment

Abstract

Objectives/Goals
The objective of this project was created to test or prove three laws of gravity by Isaac Newton, his first and second law of motion, and Albert Einstein, the General Theory of Relativity.

Methods/Materials
I have created an elevator shaft with an elevator car. The elevator car has an object or weight inside that weighs differently when the elevator car moves vertically. A 30 frames per second video camera will be viewing the digital readout on an electronic scale that will be weighing the weight in the car. I will be testing to calculate the different weights of the object during the ascent, and the free fall or the car. An electric drill will be propelling the car upward during the ascent.

Results
I had hypothesized that the object in the car weighed more that its initial weight while the car was moving upward at an accelerating speed. It was proven to be correct. After the car got to a constant vertical speed, I had hypothesized that the object would weigh the same as when it was not moving. That too was correct in my experimentation. During the free fall, I hypothesized that the object will have zero weight for a short period of time, and it did weigh zero for an average of about two to three frames on the video camera.

Conclusions/Discussion
When and object is moving up at an accelerating speed, the object will weigh more that its initial weight, depending on how fast the acceleration is. When an object is moving upward or downward at a constant velocity, the object will weigh the same as its initial weight. Finally, when an object is in free fall, it will weigh zero for a short period of time.

Summary Statement
This project was created to test or prove three laws of Isaac Newton and Albert Einstein that describe different aspects of gravity and motion.

Help Received
My science explorations teacher guided me through building my project and testing it. La Jolla Country School supported most of the research for my project. My mom and dad helped me transport my project to school and home every Monday and Tuesday.

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Adam A. Iverson

Project Number
J1521

Project Title
Does the Temperature of a Magnet Affect Its Strength?

Abstract

Objectives/Goals
The objective of this project is to determine if the temperature of a magnet affects its strength.

Methods/Materials
Ten magnets of equal size and weight were tested under four different temperatures: room temperature, boiling, frozen and using dry ice. Using Lucite tongs, the affected magnets were lowered for approximately two seconds into a plastic bowl filled with 205 standard #1 size paper clips. The tongs were used for my safety, to keep my body temperature from affecting the temperature of the magnets, and to make it easier to hold the magnets in the same position when lowering them into the bowl of paper clips. The number of paper clips attracted by the magnets was counted after each trial. Each magnet was tested ten times, in each temperature. A total of 400 hundred trials were carefully counted, recorded on log sheets, graphed and analyzed for conclusion.

Results
The results of the testing show that the dry ice appeared to make the magnets attract the most paper clips, followed by the frozen magnets, then the room temperature magnets, and finally the boiled magnets.

Conclusions/Discussion
After analyzing the results of all 400 trials, I concluded that the temperature of a magnet does affect is strength.

Summary Statement
My project is about testing magnets at four different temperatures to see if their strength is affected.

Help Received
My Father helped me to graph data, my Mother helped me count paper clips and gather materials, and my Science Teacher helped me with project organization and layout.

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Jonathan Krol

Project Number
J1522

Project Title
Standing Waves

Abstract

Objectives/Goals
To study standing waves using different strings.
To study the effect of tension on standing waves.
To study the effect of tension on unit density of the string.

Methods/Materials
String was connected to a wave generator and extended over the pulley 2 meters apart; mass was connected to other side of the string to provide tension.
Wave generator was controlled by function generator.
Frequency of the function generator was adjusted to obtain standing waves. The value of the frequency for each standing wave was registered. The experiment was repeated using different values of mass and different strings.
The resonance frequencies were compared with theoretically calculated values.

Results
Calculated values that included the effect of tension on the density of the string were consistently closer to experimental results than calculated values that assumed constant string density.

Conclusions/Discussion
Experiment shows that compensation for changing of string density caused by the stretch of the string improves accuracy of calculation of the resonant frequencies.

Summary Statement
Study of standing waves.

Help Received
Mr. John Shirajian, Ribet Academy Science Departament Chair provided equipment and guidelines in preparation of this project.

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Kristina J. Leung

Project Number
J1523

Project Title
Frequency Relationship of Notes in Musical Harmony

Abstract

Objectives/Goals
This experiment is designed to determine whether musical notes in harmony bear a specific mathematical relationship in the ratio between their respective frequencies. The hypothesis is that such a specific mathematical relationship does exist for notes in an interval to be in musical harmony. Intervals (formed by two notes only) on different keys will be examined.

Methods/Materials
The procedure to the experiment is:
1. Setup an Electronic Keyboard configured to simulate a Flute instrument.
2. Connect the Headphone Jack output signal of the keyboard to an input channel of an oscilloscope.
3. Adjust the vertical signal gain and horizontal time base settings appropriately on the oscilloscope, as required.
4. Measure the signal wave period for each of 18 consecutive notes in chromatic sequence. The key direct measurement results are the time interval for two times the actual period of the waveforms for each of the 18 chromatically consecutive notes (i.e. C, C#, D, D#, E, F, F#, G, G#, A, A#, B, C, C#, D, D#, E). In this particular case, the first C note is an octave above the middle C key on the keyboard. From the raw data, the actual respective signal period and frequency can be calculated for each of these 30 notes. The ratio between frequencies for all 12 possible intervals (from minor 2nd, major 2nd , and so on until finally the perfect octave interval) within an octave are tabulated for the 15 keys C, C#, D, D#, E, F, F#, G, G#, A, A#, B, C, D and E respectively.

Results
From musical theory, for the notes within an octave, there are 6 out of the 12 intervals that are surely in harmony (i.e. minor 3rd, major 3rd, perfect 4th, perfect 5th Major 6th and Perfect Octave), 4 definitely not in harmony (i.e. minor 2nd, Augmented 5th, minor 7th and Major 7th) and 2 marginally/barely in harmony (i.e. Major 2nd and minor 6th). Analysis of the experimental results seems to suggest that there is always a certain specific ratio between the two notes in a particular interval independent of the actual key or the actual pitch tone (frequency) of the tonic key note.

Conclusions/Discussion
For any interval, the first note and second note must bear a certain ratio in their frequencies, though this actual ratio is dependant on the particular interval type. Given that only some of the intervals are in musical harmony, musical notes that are in musical harmony must also bear a certain fixed ratio in their frequencies.

Summary Statement
This experiment is designed to determine whether musical notes in harmony bear a specific mathematical relationship in the ratio between their respective frequencies.

Help Received
Dad taught me how to use the oscilloscope.

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Nicole Ligh; Brynna Quillin

Project Number
J1524

Project Title
Archimedes, Blubber, and Bladders: How Fish Achieve Neutral Buoyancy

Abstract

Objectives/Goals
Our objective was to determine how fish and marine mammals achieve neutral buoyancy. The hypothesis of our experiment was that if we varied the static lift of an object (modeled after the methods that fish use), then that object should be able to reach neutral buoyancy.

Methods/Materials
Fish and marine mammals use 3 different methods of static lift in achieving neutral buoyancy: balancing blubber and bone, gas or air in a swim bladder, and storing fats and lipids that are less dense than water. For all three of the experiments we used a fish tank with 9.46L capacity, an electronic scale, measuring cup, ruler, grease pencil, binder clips and tape. For the first experiment we had 10 pitted olives and we put 10 different size pieces of Crisco shortening in each, then we dropped them in the water and watched to see if they attained neutral buoyancy. For the second experiment we had 6 different size balloons and we attached each to a lead pipe to see if they achieved neutral buoyancy. For the third experiment we took a small water bottle and added teaspoons of cod liver oil until we reached neutral buoyancy.

Results
In each experiment, we were able to achieve neutral buoyancy through variance of the static lift. In each case, when the experimental density matched the water density (1.0 g/ml), we achieved neutral buoyancy. In addition, the difference between neutral, positive, and negative buoyancy conditions was very, very small.

Conclusions/Discussion
We found that our hypothesis was correct and achieved neutral buoyancy in all 3 experiments. We also discovered that the Archimedes principal of buoyancy (the buoyant force exerted by an object is equal to the weight of the volume of water displaced by that object) is a natural phenomenon. Finally, we now understand the delicate balance required to reach neutral buoyancy, leaving us with a tremendous appreciation for how fine-tuned nature is for being able to naturally achieve neutral buoyancy. These methods could be used for reaching neutral buoyancy in a variety of applications including scuba, submarines, astronaut training, and even fishing lures.

Summary Statement
This experiment tests the various ways fish and marine mammals achieve neutral buoyancy via static lift.

Help Received
Father helped in selection of materials and discussion of methods.

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Aaron J. Maciosek

Project Number
J1525

Project Title
The Greater Insulator

Abstract

Objectives/Goals
My project was to determine which household material would make the best home insulator.

Methods/Materials
I made two "insulation testers" by putting two identical soup cans into two identical large coffee cans. One "tester" acted as my control. In my other "tester", I filled the space between the soup can and the coffee can with the insultation I was testing. I filled the inner soup cans with water warmed to 60 degrees Celsius and measured the temperature drop of the water every 5 minutes for 40 minutes. I repeated this procedure for each insulation I was testing (styrofoam, polyester fiberfill, cotton balls, shredded newspaper, sand, and sawdust).

Results
Polyester fiberfill proved to be the best household insulator. Styrofoam, cotton balls, shredded newspaper, and sawdust had average effectiveness. Sand was the worst insulator.

Conclusions/Discussion
My hypothesis was incorrect in expecting that Styrofoam would be the best insulator. I expected the polyester fiberfill to be the second best insulator, when in fact, the polyester fiberfill turned out to be the best insulator. I was correct in believing that sand would be the worst insulator, since it probably acted as a conductor for heat.

Summary Statement
I wanted to know which household material would make the best home insulator.

Help Received
Home Depot Store of La Quinta supplied sawdust

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Andrew C. Morgosh

Project Number
J1526

Project Title
The Effectiveness of Recycled Materials as Thermal Insulation

Abstract

Objectives/Goals
The objective of this experiment was to find which recycled material would be an effective thermal insulator: fiberglass, wood shavings, polystyrene, polyurethane, cellulose, perlite, polyethylene foil, or bubble wrap.

Methods/Materials
I constructed two boxes out of particleboard. I sawed congruent pieces of each insulating material. For each test, I installed one of the insulators in one of the boxes. I placed a 100-watt light bulb in an aluminum reflector lamp in each box. Using a digital thermometer probe, I checked the temperature and turned on each light bulb. I started a stopwatch and heated the box to 30°C above the room temperature. At 30°C above room temperature, I turned off the light bulb and recorded the decreasing temperatures. After the temperature fell 25°C, I recorded the time. I tested each of eight materials 5 times in this same manner, using a second box as a control each time.

Results
The cellulose material averaged more than 83 minutes, and the fiberglass material averaged over 75 minutes to cool 25°C, which was significantly longer than all other test materials. The polyurethane averaged 42 minutes to cool followed by polystyrene and polyethylene foil, which both averaged about 36 minutes to cool. The perlite and wood shavings cooled quickly (25°C in 32 minutes) followed by bubble wrap, which was the least effective insulator, averaging only 25 minutes to cool. The control box averaged 20 minutes to cool.

Conclusions/Discussion
The cellulose material took the longest amount of time to cool, and appeared to be the most effective insulator. But one drawback of cellulose is that it averaged over 27 minutes to heat to 30°C above the room temperature, which was much longer than any of the other test insulators. In the summer, this might be an advantage, but in winter it many mean more would be expended to heat the house. Fiberglass also took significantly longer to cool than the other materials and only averaged about 12 minutes to heat. Fiberglass was the most effective insulator because it heated quickly and also trapped heat to conserve energy. I noticed that materials with foil such as polyethylene and polyurethane were better insulator than similar products without foil, such as bubble wrap and polystyrene. Foil acts as a heat reflector, and perhaps fiberglass, surrounded by polyethylene foil might make the best insulator.

Summary Statement
The objective of this experiment was to discover which recycled material would be the most effective thermal insulator: fiberglass, wood shavings, polystyrene, polyurethane, cellulose, perlite, polyethylene foil, or bubble wrap.

Help Received
My mother and father drove me to purchase the supplies. My grandfather and great-grandfather helped build the box by using the radial arm and table saws.

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Megan K. Morikawa

Project Number
J1527

Project Title
Saltwater and Sound

Abstract

Objectives/Goals
The objective is to determine if sound will travel faster in different salinities of water. I believe that as the salinity increases, the sound will travel slower.

Methods/Materials
The salinities of the Artic Ocean (20 parts per thousand [ppt]), Pacific, and Atlantic Oceans (35ppt), the Salton Sea (44ppt), the Mono Lake (87ppt), and the Dead Sea (210ppt) were used as guidelines for my experiments. I used two transducers and set a signal of a four hertz burst at 1,000,00 cycles per second. The distance of the two transducers over the delay of sound equaled the speed of sound in water.

Results
The higher the salinity became, the faster the sound traveled. The speed of sound ranged from 1,488.1 meters/second to 1,718.4 meters/second between 20 and 210 ppt.

Conclusions/Discussion
I found that the speed of sound changes greatly as the salinity is increased. I believe that this is due to a density factor rather then what I originally thought which was that the salt would obstruct and slow down the sound waves thus making the speed of sound slower.

Summary Statement
I wanted to see if sound would travel faster in different salinities of water and found that as the salinity increased, the sound traveled faster.

Help Received
Father helped with experimentation. RD Instruments provided Oscilloscope, Signal generator, and donated transducers. Mother helped assemble presentation board.

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Vasilios A. Morikis

Project Number
J1528

Project Title
Measurement of True Noon Time Using the Sundial Principle

Abstract

Objectives/Goals
This project aims to prove the hypothesis that the true noon (or solar noon) in Riverside during the end of January-beginning of February does not occur at 12:00 Pacific Standard Time. This hypothesis is based on the observation that the sun is directly above us at a different time during the seasons. True noon is defined when the sun is directly above our location.

Methods/Materials
The physical principle is similar to that of the sun dial. A ruler was positioned vertically on a table covered by graph paper. The position of the shadow of the ruler on the graph paper was monitored between 10:30 AM and 3:00 PM at approximately 10-15 minute intervals. Once the measurements were finished I traced the lines of the shadow of the ruler on the graph paper and I measured their length. The data showed the behavior of a parabola formed by the ends of the lines. The shortest line coincided with the minimum of the parabola. This minimum corresponded to the true noon time. I performed five experimental trials at two different locations. I plotted the data using a spreadsheet. To determine the minimum I fitted the data using the function of a parabola. The fitting aimed to reduce the measurement errors and help locate the minimum of the parabola in a more precise way.

Results
The data showed that true noon at the end of January-beginning of February in Riverside is at 12:11 PM. This result is in agreement with my hypothesis that true noon does not coincide with the noon of standard time this time of the year. At true noon the angle made by the sun rays and the ruler (angle of incidence) is also minimum, resulting to shortest shadow length. The angle of incidence is a measure of the sun elevation. I measured the angle of incidence at true noon after drawing on the graph paper the right triangle with perpendicular sides corresponding to the length of the ruler and the ruler shadow. I discuss the effect of refraction of the sun rays on the measurement of the angle of incidence.

Conclusions/Discussion
True noon depends on the sun elevation. The sun elevation depends on the geographic latitude of our location and the time of the year. My results are in good agreement with values determined from the analemma drawn on a globe and the Riverside sun dial outside the Riverside public library. I have used principles from physics, geometry, and statistical fitting to make the astronomical measurement of true noon time.

Summary Statement
My data and my readings about the analemma showed that true noon time is variable throughout the year and depends on geographic location.

Help Received
Dad and mom helped me understand the concept of statistical fitting.

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Aaron M. Pearson

Project Number
J1529

Project Title
The Most Efficient Automobile Sunshade

Abstract

Objectives/Goals
The objective was to find out which type of sunshade material is most efficient for insulating your automobile when parked in the hot sun.

Methods/Materials
Take a cardboard box, cut a hole at the top, cover the hole with plexi glass, and suspend a 250 watt heat lamp above the plexi glass.
Place the insulating material to be tested inside the box, 18 cm. below the plexi glass.
Insert heat thermometer centered near the bottom of the box through a hole in the side so that the temperature can be read without opening the box.
Turn the heat lamp on and record the temperature readings at 3 minute intervals for 15 minutes.
Do six repetitions for the control group and each material tested.
Open box and cool down with fan to approximately the same temperature in between each repetition.

Results
The thin reflective bubble material was the most efficient sunshade.

Conclusions/Discussion
I concluded that my hypothesis was correct. The reflective bubble material was the most effective at keeping the box cooler. I also have discovered that the reflective foam was almost as effective, but starts to gradually let more heat in between about 6-9 minutes. This proves that it would be less effective for a vehicle that is parked in the sun for a long time. Also I figured out that cardboard is not the worst sunshade. The overall results indicated that all of the materials tested are useful because without even the least effective one, the control group results show that temperatures would reach much higher levels.

Summary Statement
My project is about determining what is the best automobile window sunshade for keeping a car parked in the sun cool.

Help Received
Dad helped me to format data collection sheets and assemble/purchase materials.

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Jacob J. Rucker

Project Number
J1530

Project Title
Quantifying the Effect of Skyglow on the Visibility of Stars: Year II

Abstract

Objectives/Goals
Skyglow caused by excess light from urban centers obscures the visibility of stars and is an increasing problem for astronomical observations. This experiment determines whether the amount of skyglow can be predicted based upon the angle of observation and a site's distance from an urban center.

Methods/Materials
I used a digital (CCD) camera to take over 300 60-second time exposures in similar weather and moonlight conditions between September 2003 and March 2004 from sites around San Diego County at distances of 30, 45, 60, 75, 100, and 124 kilometers from the urban center and at angles of 45, 60, 90 (zenith), 120, and 135 degrees. The images were downloaded and converted into bmp files. I developed a custom computer program to isolate skyglow pixel values by removing CCD noise and star pixels from the images and to compute the average intensity of the skyglow pixels, from 0 to 765, for each image. Resulting intensities for each site were averaged, graphed, and compared to known functions to determine a best-fit mathematical correlation to the intensity (skyglow) as a function of a site's distance from the urban center and the angle of observation.

Results
The average intensity of the zenith images varied greatly at the six sites, from 32.4 at 30 km from the urban center to 13.6 at 45 km, 7.1 at 60 km, 5.8 at 75 km, 3.9 at 100 km, and 3.1 at 124 km. Based upon the data, I derived an approximate formula for zenith skyglow value, "S", as a function of distance, "d": S = 2.4 X 10^2 X d^-1.9 per one degree of sky. The amount of skyglow at 45 to 60-degree angles of observation averaged up to 220% more than zenith skyglow values for the same distance and up to 87% average increase at 120 to 135 degrees.

Conclusions/Discussion
The amount of skyglow (S) decreased inversely with the distance (d) from the urban center, as approximated by the equation: S = 2.4 X 10^2 X d^-1.9 per one degree of sky, with significantly greater amounts of skyglow for non-zenith angles of observation both towards and away from the urban center. Applying the formula reveals that observable visible light from stars remains below 50% until over 50 km from a city the size of San Diego and does not improve to 90% visibility until over 115 km from the urban center, indicating an increasing threat to astronomical observations at the nearby Mt. Laguna and Palomar Observatories.

Summary Statement
This project examines the effect of urban skyglow on the visibility of stars using computer analysis of CCD pixel data and derives a formula for skyglow as a function of a site's distance from an urban center and the angle of observation.

Help Received
Thanks to my dad for driving me out to the desert so many times in the middle of the night and for teaching me to program in C++. Thanks also to John Hoot, astronomer and computer scientist, for loaning me the Meade LPI and LX90 telescopes and teaching me about CCD astrophotography.

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Zachary R. Schmidt

Project Number
J1531

Project Title
Black Holes: An Analysis of Black Hole Thermodynamics

Abstract

Objectives/Goals
The purpose of this project was to determine the effects of the temperature of the universe on Black Holes as the universe ages.

Methods/Materials
1. Determine the size of the Black Hole using the classic Schwarzschild Radius formula.
2. Determine the amount of energy being radiated through Hawking Radiation.
3. Determine the temperature of a Black Hole
4. Compare the temperature of a Black Hole with that of the universe.
5. Determine how long it will take for the temperature of the universe to reach equilibrium with the temperature of a Black Hole.

I set up these equations in an Excel spread sheet and solved for Black Holes with 1 to 512 solar masses. I also explored the results for smaller Black Holes, such as the mass of the earth, moon and Chevy Suburban.

Results
The larger the Black Hole, the longer it would take to reach equilibrium with the temperature of the universe because it is cooler than smaller Black Holes. Once it does reach equilibrium, a larger Black Hole radiates less than a smaller one, so it would take longer for the larger Black Hole to radiate all of its mass away.

Conclusions/Discussion
My hypothesis was that as the universe expanded and cooled, it would absorb less CMB than it was radiating away, and therefore lose mass. Eventually, it would radiate away all of its mass and evaporate. According to my results, my hypothesis is correct. However, it would take a long time for a large solar mass to reach equilibrium with the temperature of the universe, and would take an even longer time for it to radiate it#s mass away.

Summary Statement
My project is about Black Hole Thermodynamics, in which I tried to determine the effects the temperature of the universe had on Black Holes.

Help Received
Mother proofread report; Dad helped type report; Kyle Lanclos helped understanding of subject; Professors George Brown, Donald Coyne, Anthony Aguirre, and Terry Schalk of UCSC physics department critiqued report.

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Harrison G. Smith

Project Number
J1532

Project Title
Do Acoustic Tiles Really Block Sound?

Abstract

Objectives/Goals
With this experiment I tried to ascertain whether or not acoustic tiles really blocked out sound waves as they advertised.

Methods/Materials
The materials I tested were:
Pinewood
Fiberglass
Armstrong 755 Acoustic Tile
Armstrong 933 Acoustic Tile
Styrofoam

I put on the constant beep song on 100% volume on my computer then I inserted the various insulations via the top slot of the box.
I then inserted the decibel meter into the hole in the front and gradually turned down the computer volume until the decibel meter stopped picking up sound. Then I put the computer volume when the decibel meter stopped picking up sound in my journal and I repeated until I tested every acoustic material multiple times.

Results
The following list says when each acoustic material stopped picking up sound from the computer:
Pinewood - 90%
Fiberglass - 62%
Armstrong 755 Acoustic Tile - 58%
Armstrong 933 Acoustic Tile - 49%
Styrofoam - 31%
Control (nothing) - 15%

Conclusions/Discussion
In conclusion my hypothesis was incorrect because I thought that the Armstrong 933 acoustic tile would have blocked out the most sound but the pinewood blocked out the most sound by far.

Summary Statement
My project tested different acoustic materials to ascertain whether acoutic tiles blocked sound.

Help Received
My neighbor Rick helped me in the construction of the testing box, my mom helped develop my ideas further, Mrs. Armour helped me with my Review of Literature.

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Eric K. Soderstrom

Project Number
J1533

Project Title
How Does Sugar Density Affect the Index of Refraction of Water?

Abstract

Objectives/Goals
The purpose of this project was to determine how the index of refraction (IOR) of water is changed by mixing increasing amounts of sugar (sucrose) into the solution. My hypothesis was that sugar would increase the IOR, and that the increase would be linear.

Methods/Materials
First, I glued 4 glass microscope slides together to make a triangular glass prism that would hold water. I then measured the amount of refraction of a laser beam through the prism, making sure that the laser was perpendicular to the far wall, and parallel to one side of the prism. I measured the refraction distance through an empty prism (the normal), through pure water (control), and through 12 sugar solutions (from 2.5% to 80% wt/vol). I calculated the IOR of each solution using Fermat's Law, which is derived from Snell's Law, for the special case of refraction through a triangular prism.

Results
A comparison of the IORs I obtained for the pure water (1.33) and the 10% sugar solution (1.349), with the published indexes (1.33 and 1.347, respectively) shows that my results were more than 99% accurate. The results from 2 separate experiments using 2 different prisms were very similar. Increased amounts of sugar increased the IOR by about 0.135 per 1% of sugar dissolved in the water. The increase of the IOR was roughly linear.

Conclusions/Discussion
This method of measuring the index of refraction of a solution is simple, accurate, and reproducible. The results showed that the IOR of water increases in linear proportion to the amount of sugar dissolved in it. This proves my hypothesis was correct.

Summary Statement
Dissolving a substance such as sugar in water increases the refraction of light through the water, and the greater the amount of material dissolved, the more the light beam will be bent, and the higher the index of refraction will be.

Help Received
A friend (Mike Jefferson, a physicist), explained the theory to me, gave me some references, and demonstrated the method on a solid prism. My mother helped me make the first hollow glass prism, prepared the sugar solutions, and assisted me with the measurements, editing, and laying out the poster.

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Andrew L. Zellman

Project Number
J1534

Project Title
I'm Camping, I'm Cold, and I'm Cranky: Which Insulating Sportswear Fabric Will Make Me the Happiest Camper?

Abstract

Objectives/Goals
I often go camping with my family and Boy Scout troop. While camping I am often exposed to cold, windy and wet weather. At these times, I get cold and a little bit cranky.
The goal of my research is to determine which fabric commonly used in making sportwear and camp clothes is the best insulator and will keep warmest and make me the happiest camper. My hypothesis is that the synthetic fabrics will be better insulators than natural fabrics. They are used more often for low-temperature sportswear and have been specifically designed for this purpose

Methods/Materials
Five one-quart glass jars were wrapped with insulating fabrics; wool knit, cotton fleece cotton knit, Polartec200, and Thinsulate. A sixth jar was not insulated to serve as a control. One quart of 120°F water was poured into six glass jars. Metal, threaded lids with laboratory thermometers inserted were screwed on jars. Thermometers were positioned about 2" above base of jars. Jars placed on insulating pad in the refrigerator. Immediately recorded water temperature readings of each treatment & refrigerator air temperature. Continued readings every 15 minutes for two hours. Experiment replicated five times.

Results
Thinsulate was consistently the best insulator of the five sportswear materials tested. Two of the natural fabrics, cotton fleece and wool, performed about the same, but with lower values than Thinsulate. Cotton knit and Polartec performed similarly, but with lower values than cotton fleece and wool. I was surprised by the poor performance of the other synthetic fabric, Polartec, as it scored the lowest ranking of the five fabrics I tested.

Conclusions/Discussion
Based on my experiment, it seams to me that not all synthetic fabrics are created equal when it comes to living up to their manufacturer's claims of superior performance. In cold weather, I will wear a Thinsulate jacket. If it is just a little bit cold, I will put on my sweatshirt or wool sweater.

Summary Statement
I evaluated five common synthetic and natural sportswear fabrics for their insulating abilities in cold conditions

Help Received
My teacher, Danny Armanino, kept me organized and on-schedule. My grandmother loaned me the jars. My mother helped me with the board display. My father loaned me the thermometers and showed me how to use Excel to create the charts and tables

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Kimberly A. King

Project Number
J1599

Project Title
What Do Lasers Go Through?

Abstract

Objectives/Goals
The objective was to test red lasers with different items to see which items let red laser energy pass through. I thought that the clearer the item was the more energy would pass through.

Methods/Materials
Three different red lasers were used to test and calculate transmission through different materials. the transmission was measured with an energy detector and calculated with an in beam and out beam measurement. All the datta was then averaged for each item and then compared in a graph.

Results
Items such as water, canola oil and steam had very high transmission whereas ice, carbon dioxide gas and olive oil had much lower transmission.

Conclusions/Discussion
Darker liquids like olive oil, transmitted less than the lighter liquids such as water and canola oil. Clear plastic and glass allowed more energy to pass through than the darker plastics. This proves my hypothesis that clearer objects would have a higher transmission than darker objects.

Summary Statement
Will red lasersw transmit better through clear objects or darker ones?

Help Received
Dad got lasers, detector and carbon dioxide. Dad showed how to work the equipment.