CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)

Skye Aaron

Project Number

J1501

Project Title

To Jupiter and Beyond: Build a Telescope to Estimate Jupiter's Diameter and Io's Orbital Speed

Abstract

Objectives/Goals

My objective was to build a Dobsonian telescope and use it to measure the diameter of Jupiter and the orbital speed of Io.

Methods/Materials

I downloaded plans from the Internet for building an 8-inch diameter telescope. I built the telescope from scratch using a SONO tube, plywood, screws and glue. The optical elements were purchased.

After learning how to use the telescope, I used it to determine two things: the diameter of Jupiter, and the speed of Jupiter's moon, Io. I timed a transit of Io across the face of Jupiter. The number of kilometers across Jupiter was then divided by this time to determine Io's speed. I also measured how long it took Jupiter to pass one of its diameters (due to the earth's rotation). This number was used to determine the diameter of Jupiter.

As part of checking the focal length of the primary mirror, I measured the relation between image distance and object distance.

Results

My estimate of Jupiter's diameter was within 1% of the value according to JPL's website. This agreement is mostly luck. The standard deviation of my measurements was 14%.

My estimate of the orbital speed of Io was within 5% of the accepted value.

My measurements of image distance and object distance agreed very well with an equation relating these two distances and the focal length.

Conclusions/Discussion

I successfully measured Jupiter's diameter and Io's orbital speed. I was surprised that I could measure them so accurately with fairly crude methods.

Other things learned from the project are: how to draw celestial objects, how a telescope works, how to collimate the mirrors in a Newtonian telescope, and the relation between object distance and image distance.

Summary Statement

I built an 8-inch diameter Dobsonian reflector telescope and used it to measure Jupiter's diameter and Io's orbital speed.

Help Received

My mother suggested the project. My dad helped with the cutting of the wood and with the measurements. They both helped with the display board. I used Global Aerospace Corp. shop tools (with my dad's supervision).

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)

Jesse A. Alm

Project Number

J1502

Project Title

The Physics of Sound: Frequency vs. Length

Abstract

Objectives/Goals

The objective is to find the relationship between the length of a string (I tested guitar strings) and the frequency produced when the string is plucked or strummed. In addition to many lengths of string, different string thicknesses are tested as well as multiple tensions applied to the string. I predict that the relationship will be linear: length and frequency will change at the same rate.

Methods/Materials

I first had to construct my apparatus: an imitation of a cello finger board, guitar, etc. with grooves in which frets (nails) can be placed to control how much of the string vibrates. Using my ear, I compared the pitch of the length of string I was testing to that of my electric keyboard. Then I compared both of these to the expected frequency for that note (using a table of known frequencies for musical notes). I recorded three samples of each note on my apparatus into a frequency reading program on my computer. Once I had written down many many frequency readings I could graph them and see patterns relating to the length versus frequency and compare these to the frequencies expected for every note. My results turned out to be amazingly close to my chart of frequencies.

Results

I clearly proved that the shorter the string, the higher the pitch. Also, in general, as the string got shorter and shorter, the notes got closer and closer together. I noticed that for any point on my graph of data, the length times the frequency of that point equaled around the same number for every point, and confirmed that there is a definite rate at which length and pitch are inversely related.

Conclusions/Discussion

After performing many tests and examining my results, I realized that my linear hypothesis was not accurate at all. My graphs showed that there is a curve in the data which never reaches zero on either axis. There is no point where the string stops vibrating, and there is no frequency for a string with a length of zero. I wonder if the string stretched at all during the experiment and am curious if this significantly affected my results.

Summary Statement

The focus of my project is to explain the relationship between the length of a string and the frequency the string produces when plucked or strummed.

Help Received

Dad and Uncle provided advice and tools, and reviewed my work.

Name(s)

Andrew N. Booth

Project Number

J1503

Project Title

Is Everything You Read True?

Abstract

Objectives/Goals

My goal was to see if the sugar concentrations on labels of drinks are correct, and if you can build a simple instrument to verify the concentration instead of buying an expensive instrument.

Methods/Materials

I used a laser level, 2 right triangle prisms, a variety of drinks, 2 stages, glue guns, and Duplo blocks to construct my apparatus. After making my apparatus, I made a stock of sugar, and did dilutions to make a series of solutions to calibrate the apparatus. I was able to test the different solutions and build a calibration curve. Using this, I could calculate the sugar concentration of them with the formula that my calibration curve gave me. After calculating the angle I used the formula, called Snell's Law, to find the refractive index.

Results

I found out that the instrument I made worked and that the sugar concentration on the labels are correct, except for a couple of the fruit juices whose sugar concentration were a bit off. One thing the could have been better was the accuracy of my stage. It would have been a more accurate expirement if i could measure the angle to the .01. That was one of my major problems that affected my results.

Conclusions/Discussion

I concluded that you can save money and build your own instruments instead of buying expensive and complicated ones. Also that the sugar concentration on almost all of the labels are correct. What also surprised me was the amount of syrup that they put in Coke; almost 1/3 of the amount of coke was syrup that had been diluted into the liquid.

Summary Statement

My project is about testing to see if you can measure sugar concentration with a simple instrument, and if the sugar concentration on the labels of drinks are correct.

Help Received

My dad helped on spreadsheets and aparatus; Biospherical Instruments gave me some supplies that I needed.

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)

Michael Cloward; Daniel Jaimes; Andrew Speth

Project Number

J1504

Project Title

Precise Projectiles

Abstract

Objectives/Goals

The object was to find out how the angle and force of trajectory affect the distance that a projectile travels. Our hypothesis was that the projectile launched with the angle closest to 45 degrees and strongest force (out of the three that we have chosen) will travel the farthest distance.

Methods/Materials

The materials used were: a Lego Robotics Inventions System 2.0, Lego Ultimate Builders Expansion Set, six AA batteries, computer, protractor, and a measuring tape. We used three different angles (10?, 20?, and 55?) and three different forces (the distance of stretch in the rubber bands). We did three trials with each combination, measured the distance the projectile traveled and calculated the average distance.

Results

The projectile launched at the angle closest to 45? (55?) and the greatest force (rubber band stretched to 10.4 cm) traveled the farthest.

Conclusions/Discussion

Our hypothesis was correct. This project gave us a greater understanding of the field of physics. We learned that if you need to launch a projectile the greatest distance, use the angle closest to 45? and with the greatest force.

Summary Statement

Angle and force of trajectory affect the distance that a projectile travels.

Help Received

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)

Alex D. Doo

Project Number

J1505

Project Title

Chladni Patterns: What Do Art, Music, and Physics Have in Common?

Abstract

Objectives/Goals

In this project, I studied how the shape of the medium and the frequency of the sound affect the standing wave patterns that occur in a medium when it is set into vibration. I also tried to change the patterns by forcing nodes.

Methods/Materials

16-gage steel plates were cut into four different shapes - a square, a circle, a rectangle, and a violin shape. A plate was clamped at the center parallel to the ground using a vice and a C-clamp. Sand was then placed on the plate and spread evenly across the entire area of the plate. A violin bow was rubbed vertically at different positions on the edges of the plate creating a set of pitches that displaced the sand creating the Chladni patterns. The frequency of the pitch and the standing wave patterns were recorded and analyzed.

Results

I discovered that each shape created certain types of nodes; for instance, the circular plates always created nodes that were diameters and concentric circles while the rectangular plates tended to have parallel and perpendicular lines. As the frequency of the harmonic pitch increased, the number of nodal lines, or the comlexity of the pattern, increased proportionally. I also observed that an antinode was always formed around the place of bowing and that the same pitch always created the same pattern no matter where the bowing point was (although they were rotated accordingly so that an antinode was at the bowing point). When the clamping position was altered, a node always formed around the clamp, and the entire pattern was changed.

Conclusions/Discussion

Frequency was the most important factor concerning the complexity of the pattern. Even unusual shapes like the violin can create very simple patterns when the frequency is low. Each frequency could only produce one pattern (though it may be rotated) for a unique shape and clamping position, and each plate had a set of frequencies that would produce patterns.

Summary Statement

I tested how several different factors affected the standing wave patterns in a vibrating metal plate.

Help Received

Father helped shape the plates; mother bought the supplies for the project.

Name(s)

J. Robbie Eaton

Project Number

J1506

Project Title

What Makes the Best Hearing Aid? Comparing a Tube, Dish, and Horn

Abstract

Objectives/Goals

I wanted to know how the sound detection ability of a hearing aid is influenced by its geometrical shape. The goal is to measure and compare the sensitivity of three sound collectors. My hypothesis is that a dish is best.

Methods/Materials

I tested each type of receiver over most of the audible range (100 Hz to 15kHz) using a condenser microphone (pickup) monitored by an oscilloscope. The sound source is a hi-fi floor speaker driven by a function generator which produces a short wave packet. The burst repetition rate and packet duration was carefully adjusted to avoid reverb and echoes. I found that a noise filter was needed to obtain accurate measurements.

Results

Contrary to hypothesis, the horn was the best hearing aid, providing a good boost throughout most of the hearing range. The dish was mediocre until the higher frequencies. The tube showed a very peaked response near 240 Hz, but was generally significantly less effective than the other shapes.

Conclusions/Discussion

Although pro football games use parabolic dishes, a horn is the best shape for a hearing aid to span a wide frequency range.

Summary Statement

I ran experiments to determine which of three shapes makes the best hearing aid; a tube, dish, or horn.

Help Received

My dad helped by recording data that I read to him during the experiment, and provided a circuit diagram for the noise filter. My mom took photos of me conducting the experiment.

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)

Shay C. Edwards

Project Number

J1507

Project Title

Emissivity: A Study on Infrared Viewing

Abstract

Objectives/Goals

The purpose of my science project was to study the influence of the surface and the temperature of a material on its ability to emit infrared radiation. I wanted to see if material, color, and texture affected infrared viewing. I will also be studying the transmission of infrared light through materials. I hypothesized that only material will affect infrared viewing, not color or texture.

Methods/Materials

To test my hypothesis on color, I tested 11 different colored tapes. Affects of texture were recorded by testing glass, Teflon, Styrofoam, tin, schedule 80 pipe, ice cylinder with a cavity, metal box, and a cardboard box. Material affects were observed and recorded while testing for texture and color differences. A small oxygen activated rapid oxidation hand warmer was also tested inside or behind all material and texture test objects. Every item tested was photographed before and during the testing. All results were recorded in my logbook.

Results

Emissivity is the measure of how much radiation is emitted from the object compared to that if it was a perfect black body. The colored tapes had the same emittance of .97. The Aluminum tape however reflected most of the heat and emitted a .02. The heat source was not detectable through objects unless it came in close enough contact to the object that heat transference occurred.

Conclusions/Discussion

Emissivity is the measure of how much radiation is emitted from the object compared to that if it was a perfect black body. The colored tapes had the same emittance of .97. The Aluminum tape however reflected most of the heat and emitted a .02. The heat source was not detectable through objects unless it came in close enough contact to the object that heat transference occurred.

Summary Statement

I used an infrared camera to test the emissivity of material, color, and texture.

Help Received

Infrared testing was preformed at NAVSEA Corona Div. under the supervision of Engineers Kevin Janosky, Dan King, and Regina Medrano. Metal box welded by my baseball coach, wood box built by my dad, and my mom helped with some typing and driving to Staples.

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)

Leandra A. Fraser

Project Number

J1508

Project Title

The Buoyancy Factor

Abstract

Objectives/Goals

I created a term called the "buoyancy factor." This means the percentage of what part of an object is submerged under water. (Equation: b-a=c; d-b=e; c/e=%) I tested twelve different objects once in tap water and once is salt water. I also made a taller cylinder so I could measure longer objects. Buoyancy factors ranged from as high as 100% to as low as 4%. Objects that sank to the bottom did not have a buoyancy factor simply because they are not buoyant.

Methods/Materials

Materials: The objects that you test and measure should all be about the same length such as: molding clay; two different sizes of wood doweling; copper piping; a crayon; etc. You will also need the longer graduated cylinder holding up to about 200 milliliters and a large amount of tap and salt water. The method I used/created is the buoyancy factor. Fill the cylinder to the 150 milliliter line with tap or salt water, drop an item in, take the measurement of where the water line is now, and subtract 150 from it. Push the remaining part of the object to the water line which should rise once again, and subtract 150 from that as well. Take those two numbers, make them a fraction, and turn that into a percentage.

Results

Each object had very different results in the tap and salt water. Nine out of the twelve items I used, floated. Buoyancy factor percentages ranged from as high as 100% like the wax crayon, which sank all the way to the 150 milliliter water line; and the lowest was the styrofoam with a buoyancy factor of 4% and did not sink very much at all.

Conclusions/Discussion

Out of all the items that did not sink, I found buoyancy factors for each. I compared the factors with tap water versus salt water. There were a few differences, but no dramatic changes. Objects made of the same material, but were different sizes (wood) had the same buoyancy factors in tap water, but were not alike in salt water. The three metals I tested, all sank even though two of them were hollow. These objects did not have buoyancy factors.

Summary Statement

The "buoyancy factor" is a percentage that tells how much of an object is submerged in water.

Help Received

My parents bought most of my materials; and Home Depot and The UPS store for their assistance

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)

Deirdre M. Fuller

Project Number

J1509

Project Title

In Search of Cosmic Rays

Abstract

Objectives/Goals

The objective of my project is to discover which direction most cosmic ray muons come from, either directly above or from horizontally.

Methods/Materials

To determine which direction muons come from, I first had to build a device to detect them. So I built a cosmic ray telescope consisting of a scintillator panel, a photomultiplier tube, a preamplfier, a shaping amplifier, and an oscilloscope. When a muon passes through the scintillator panel it gives off a bit of light which travels to the photomultiplier tube where it is converted to an electric signal. That signal passes through the preamplifier and shaping amplifier and finally to the oscilloscope where it can be viewed as a blip on the screen.

To figure out which direction the muons were coming from, I took measurements of the number of muons per second, first when the scintillator panel was flat(receiving only muons from above), then when it was vertical(receiving only muons from horizontally).

Results

After taking all my measurements, I noticed that the number of muons per second coming from above was considerably larger than that of muons coming from horizontally. Therefore most muons, and subsequently most cosmic rays, come from above.

Conclusions/Discussion

Cosmic rays themselves are massive particles that come from space. When they hit our atmosphere they break off into three different kinds of particles, the easiest of those to detect is the muon. My results certainly supported my hypothesis that most muons will come from directly above.

Summary Statement

The purpose of my project is discover which direction cosmic rays come from.

Help Received

My father, Dr. George M. Fuller, and Dr. Jim Mattison supervised my use of the equipment in the USCD physics lab.

Name(s)

Lawrence L. Gill, III

Project Number

J1510

Project Title

Don't Lose Your Cool: A Study of Insulators

Abstract

Objectives/Goals

My project's title was "Don't Lose Your Cool - A Study of Insulators". The problem of the experiment was finding which material would be the best insulator.

Methods/Materials

I had five materials. My control material was wood. The other materials were aluminum, tile, insulation foam, and glass. For my procedures I built the insulation box for testing the materials, then made five material platforms. Next I set up a lightbulb holder and a lightbulb in the source side of the box. I set the platform and material inside the box and slid the receiving box up against the insulator. Next I closed the lid on both sides and plugged in the lightbulb. I then started recording the data and temperatures once the lightbulb was on. I recorded three forty-minute runs, taking temperatures every minute. When the runs were complete I typed all the information into the computer and made the graphs.

Results

The results from least to greatest went like this: Glass, tile, aluminum, wood, and the insulation foam. There was a significant difference between the glass and the insulation foam. Even between the wood and the foam there was a four-degree difference.

Conclusions/Discussion

My hypothesis was that the order of materials from worst insulator to best insulator would be glass, aluminum, tile, wood, and the insulation foam. My hypothesis was proven correct for the insulation, but the aluminum was a better insulator than the tile. That is my abstract.

Summary Statement

My project is testing five different materials on insulation ability.

Help Received

My Dad and Grandpa helped me design and build this project.

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)

Marlis Gnirke

Project Number

J1511

Project Title

The Magic Flutes

Abstract

Objectives/Goals

My objective was to understand how the flute works as a musical instrument.

Methods/Materials

I constructed model flutes from plastic irrigation pipe. My flutes varied in length, bore diameter, and number, size and location of finger holes. To play the flutes, I sealed one pipe end with my hand, and blew over the mouth hole near the closed end. I determined the pitch by comparison to known tones played on a piano.

Results

My experiments showed that the flute acoustically functions as a pipe open on both ends. I also found that long flutes with a small bore diameter perform more according to theoretical expectations than short flutes with a large bore diameter. Addition of finger holes raised the pitch by shortening the effective pipe length. Bigger holes raised the pitch more than smaller ones, while alignment of finger holes did not have an effect on pitch. By using cross-fingering, I was able to play almost a complete scale on a flute with evenly spaced finger holes.

Conclusions/Discussion

The results supported my hypothesis that reducing the flute length or adding finger holes raises the pitch of a flute. However, multiple finger holes had an unexpectedly complex effect on pitch. I also was surprised to find that the flute functions as a pipe open on both ends, although one pipe end is closed.

Summary Statement

Using simple model flutes, I determined the effect of length, bore diameter, and number, size, and location of fingerholes on the pitch of this wind instrument.

Help Received

Dad helped construct flutes; Music teacher and mom helped understand acoustics; Mom helped present results

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)

Charlie Hankin; Matt Munther

Project Number

J1512

Project Title

Can You Hear It Now? Estimating the Speed of Sound through Air

Abstract

Objectives/Goals

The objective was to estimate the speed of sound through air, and to determine if temperature and air density impacts the speed.

Methods/Materials

Using a stopwatch, we measured the time it took for a loud sound (two blocks of wood banged together) to reach the human ear at seven different distances: 100, 150, 200, 250, 300, 350, and 400 meters. We conducted our experiment on three different days with different temperatures and conditions, and used the true speed of sound at different temperatures to analyze our results. For each day, we plotted the different trials we had recorded as time against distance, and fit a linear regression with the reciprocal of the slope equaling distance against time (in meters per second).

Results

On the first day, which was overcast, humid, and had a temperature of 18 degrees centigrade, we estimated the speed at 346.4 meters per second. On the second day, which was also overcast and humid but had a temperature of 15 degrees centigrade, we estimated the speed of sound at 346.5 meters per second. On the third day, our estimated speed was 324.6 meters per second at 13 degrees centigrade in dry and sunny conditions.

Conclusions/Discussion

Our results confirmed that sound travels at approximately 344 meters per second through air at 20 degrees centigrade, but our measurements were not precise enough to see a definite change with temperature and air density. According to our research, as the temperature increases, so does the speed of sound. Also, our experiment verified that sound travels slightly faster through moist air than dry air (as we learned in our research). Although our project was only partly successful, we proved that a person does not need electronic measuring equipment to estimate the speed of sound.

Summary Statement

Using simple materials (blocks of wood and a stopwatch), we estimated the speed of sound through air.

Help Received

My dad participated in collecting the data for this project and helped fit linear regressions for our graphs.

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)
William J. Hatcher

Project Number
J1513

Project Title
Cymbal Sounds

Abstract

Objectives/Goals
My project involves testing the quality of different types of cymbals. I will be testing two consistencies of cymbals. Sheet bronze and cast bronze. Sheet bronze is 92% copper and 8% Tin. They tend to be lighter than cast bronze and also cheaper. Cast bronze is 80% copper, 20% tin and has traces of silver. These are the more expensive of cymbals. I believe that the cast bronze cymbal will produce a clearer, more consistent sound because they are heavier and more expensive.

Methods/Materials
My project involves testing the quality of the sound of different types of cymbals. Using a device called an oscilloscope, I will determine the projection and clarity of the cymbals. I will hit each cymbal a number of times each and record the clarity and loudness# given by the oscilloscope. I then will record my results. I will measure the cymbals clarity in sound volts that are functions of time. The oscilloscope will show the sound wave given by the cymbal on the computer and show how my volts the sound wave has.

Results
For the crash section of all the cymbals, the ZBT Splash had the highest frequency, the ZBT hi hats had the highest standard deviation and the Pacific China type had the lowest. For the bell section, the ZBT Hi Hat had the highest frequency, the ZBT Splash had the lowest standard deviation and the ZBT Crash/Ride had the highest. For the ride section, the ZBT Crash/Ride had the lowest standard deviation and the ZBT High Hat had the highest and the Pacific China Type had the highest frequency.

Conclusions/Discussion
My hypothesis was incorrect. Most of the sheet bronze cymbals had higher frequencies and were more consistent than the cast bronze cymbal.

Summary Statement
I want to find out which of the two metals of cymbals - will have a clearer and more consistent sound.

Help Received
My father helped me order the oscilliscope.

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)

Ryan H. Henze

Project Number

J1514

Project Title

Use the Force

Abstract

Objectives/Goals

How does the diameter, length, and material of a magnet affect its attraction?

Methods/Materials

8 ceramic magnet 1"diameter x ¼"
4 ceramic magnet ½" diameter x ¼"
1 neodymium iron boron magnet ½" diameter x ⅛#
1 neodymium iron boron magnet 1" diameter x ¼"
1 brass screw 20 threads per inch
particle board 4" x ½" x 8"
4" x ½" x 4"
1 steel ¼" diameter
1 aluminum plate 4" x 1" x ⅛#
wood screws to assemble
¼" 20 thread
iron filings
3 sheets of graph paper
1 sheet of cardboard
saran wrap

Results

The length and diameter of the magnet can change the magnetic field lines and the material of the magnet can change the number of magnetic lines of flux.

Conclusions/Discussion

A way of comparing the magnetic field strength of different magnet types and sizes is to compare the attractive force with another magnetic object. This experiment used a steel ball and measured the distance between the magnet and the ball where the field applied a force greater than the weight of the ball and pulled the ball to the magnet. In this experiment I learned that some magnetic materials are stronger than others and neodymium iron boron magnets are much more powerful than ceramic magnets. The data in Figure 2 shows increasing either the diameter or the length of a magnet attracts the ball from further away which means the magnet has a stronger magnetic field. This agreed with my hypothesis. I thought increasing a magnet's length would keep increasing its magnetic attraction, but the data in Figure 2 showed this increase gets smaller as the magnet gets longer.

Summary Statement

My project is about finding how the diameter, length, and material of a magent can affect its attraction.

Help Received

I had help with three different things in this science project. For the expiremental apparatus i had help sawing and drilling holes and holding the apparatus stable. I had help finding information as well. My dad helped me find information that woulds allow me to make my project better.

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)	Project Number
Melissa K. Hoffman	J1515

Project Title

Sound Off: Frequency Dependent Sound Absorption

Abstract

Objectives/Goals

My objective was to determine if sound absorption by foam and similar materials changes with the frequency of sound. Based on the energy content of sound at different frequencies, I hypothesized that foam would not absorb high-energy bass waves and would work well for lower-energy middle and high ranges of sound frequencies. More layers of foam and increased surface area should also increase absorption.

Methods/Materials

I placed 2-foot squares of light and heavy-weight flat foam, raised foam blocks, dimpled bed foam, special acoustic foam (Sonex) and soundboard in front of a speaker and measured reduction in sound pressure behind the material with a sound pressure meter. I tested 5 frequencies of simple sine waves from 40Hz to 15,000Hz at constant sound pressure (85dBC) and compared sound reduction to controls (no material) at a fixed distance from the speaker.

Results

Sound absorption did change with the frequency of the sound. Nothing absorbed low frequency bass waves and everything absorbed high frequency sounds. Foam and soundboard worked well to absorb mid-range frequencies. Greater levels of high and middle frequency sounds were absorbed with denser foam or more layers of foam. Sound absorption also increased with the amount of surface area facing the sound. Sonex was the best foam tested overall.

Conclusions/Discussion

The amount of sound that materials can absorb depends on the frequency of the sound. Foam and soundboard are lightweight materials and are able to absorb middle and high frequency sounds. This makes them useful products for controlling sound levels for environments like offices or sound rooms. My results suggest that these lightweight materials will not work well to control higher energy, low-frequency bass waves.

Summary Statement

My project demonstrated that sound absorption by foam and similar materials works well for lower-energy middle and high ranges of sound frequencies but will not absorb higher-energy, low-frequency bass waves.

Help Received

My dad loaned me his speaker, CD player and Radio Shack SPL meter, and he used his Skil saw to cut the foam into blocks. My mom helped me cut out the presentation board.

Name(s)

James J. Hriciga

Project Number

J1516

Project Title

Calculating Thickness of Soap Films

Abstract

Objectives/Goals

The objective is to calculate the thickness of a soap film at a variety of constant downward velocities.

Methods/Materials

To create an adequate soap film solution, 12 teaspoons of regular dish detergent soap and 1 1/2 liters of water were mixed together. The frame of the apparatus was made of PVC pipe. Inside this frame was strung fishing line to form a geometric shape. This was used to provide structure to the flowing flat fluid. The downward velocity, the amount of solution collected per second, and the width of the film were measured and used to calculate film thickness.

Results

Film thickness increases along with downward velocity. The fastest rate of flow had the greatest film thickness, while the slowest rate of flow had the least.

Conclusions/Discussion

The results from the experiment support the hypothesis that as the downward velocity of a flat fluid increased, the thickness of the film will also increase.

Summary Statement

The project seeks to understand the relationship between downward velocity in a flat fluid and its effect on film thickness.

Help Received

Mrs. Bosquez taught scientific procedures and corrected work, father bought needed materials and helped construct the apparatus, Dr. Brent Daniel, Ph.D. (Ohio State University) provided needed equations, pipette tips, and brainstormed possible ideas for experiments, Kinko's helped by laminating display items.

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)

Rosemary C. Jones

Project Number

J1517

Project Title

How Large Is the Earth?

Abstract

Objectives/Goals

The purpose of this experiment was to duplicate Eratosthenes' experiment in which he measured shadows at different latitudes in order to calculate the circumference of the earth.

Methods/Materials

On March 1, 2003, the shadow of a 36 inch yardstick was measured in three locations at the same longitude: Santa Barbara (measured by me), Fresno (measured by my cousin), and Yakima (measured by students at Wilson Middle School) at 9 am, noon and 3pm. I calculated the distance between the cities using a map, the mileage key and a ruler. To make sure that the yardstick was exactly perpendicular to the ground, all sites used a T-square. A level was used to make sure the surface where the shadow was measured was level. Each circumference was calculated using trigonometry to find the measurement of the angle of the yardstick and the sun's rays and then using a proportion.

Results

Using the nine different measurements at different times of day and different locations, I calculated nine different circumferences for the earth, the most accurate being 35,585 km. at noon and the least accurate being 66,927 km.

Conclusions/Discussion

My results supported my hypothesis for the noon measurements. The fact that less accurate for the 9 and 3 o'clock calculations than the noon calculations is because the equation I used only works at astronomic noon, which is not in fact when our clocks say 12:00, because of the time zones. I did some more research and found that the astronomic noon on March 1st was actually only a few minutes before or after noon in all three cities. The physicist I interviewed said it would take a more complex equation to find the circumference using the 9am and 3pm times and this is why Eratosthenes did his measurements at astronomic noon. Also, the results would be better if the measurements were done on June 21st (summer solstice) when the sun was directly overhead. I was surprised to discover that my circumference calculations were equally accurate regardless of the distance between the measurements done at noon. I would have predicted that the Santa Barbara to Yakima measurements would have been more accurate than the Fresno to Santa Barbara measurement.

Summary Statement

My project is about how to estimate to circumference of the earth using Eratosthenes method using simple materials

Help Received

My science teacher suggested the project idea. Relatives in Fresno and students in Yakima did the measurements. My uncle, a physicist, explained the equation I used to calculate the circumference from the measurements. and checked my final results. My mom helped contact the school in Yakima.

Name(s)

Stevi J. Kuhn

Project Number

J1518

Project Title

Which Color of Felt Fabric Will Absorb the Most Heat from a Heat Lamp?

Abstract

Objectives/Goals

The objective is to determine which color of felt would absorb the most heat from a heat lamp.

Methods/Materials

The colors of felt used were red, orange, yellow, green, blue, indigo, violet, black and white. An experimental light box was constructed from 6 pieces of wood (1 foot x 1 foot). As a control, the box's interior was painted grey. Each color of fabric was wrapped evenly around a thermometer and placed into the experimental light box for 5 minutes. An average between 3 separate trials was calculated.

Results

The color blue had the highest amount of heat absorbed. The color indigo had the least amount of heat absorbed. The color black absorbed less than indigo. The color white absorbed slightly higher than yellow, which absorbed the least amount of heat.

Conclusions/Discussion

My data does not support my hypothesis. This data suggests that blue, not black felt fabric absorbs the most heat from a heat lamp. The data also seems to be inconclusive, however, suggests that dark colors absorb more heat than light colors.

Summary Statement

My project is an effort to discover if the color black absorbs more heat than other colors.

Help Received

Ms. Regan Rostain helped me understand the experimental process; Father helped build light box.

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)

Sahana N. Kumar

Project Number

J1519

Project Title

Oily Pipes: The Impact of Viscosity on Clogging of Drainage Pipes

Abstract

Objectives/Goals

The purpose of my project was to examine if the viscosity of liquids affects the level of clogging in drainage pipes. It is my hypothesis that liquids that have high viscosity will clog drainage pipes more than liquids that have low viscosity.

Methods/Materials

I assembled three pipes, labeled them as A, B, and C and then clamped them to a wooden board. I placed a 500ml beaker under each pipe to collect the liquids that I poured through the pipes. In each trial, I poured 50ml of water in Pipe A, 50ml of Canola Oil in Pipe B, and 50ml of Corn Oil in Pipe C. To provide some solid particles, in each trial I also poured 20ml of orange juice with pulp, in each pipe. I performed 24 trials and after every 8 trials, recorded the amount of liquids collected in each beaker. At the end of 24 trials, calculated the total amount of liquids poured through each pipe and the total amount of liquids collected in each beaker. The difference between the amount poured and the amount collected was calculated and that indicated the level of clogging.

Results

The beaker in which Corn Oil was collected (Pipe C) had the least amount of liquid while the beaker in which Water was collected (Pipe A) had the highest amount of liquid.

Conclusions/Discussion

Corn oil has the highest viscosity (100 centipoise) among the three liquids and that clogged the most. Water, which was the least viscous (1.5 centipoise) among the three liquids, clogged the least. My conclusion is that the higher the viscosity, the slower the particles travel and therefore increase the level of clogging. Hence, pouring cooking oils, down the drain can over a period of time cause clogging and become harmful to health.

Summary Statement

My project evaluates the impact of the viscosity of liquids such as cooking oils on the level of clogging in drainage pipes.

Help Received

Dad helped me obtain the pipe materials. Mom helped me select the cooking oils and held the pipes when I clamped them to the board.

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)

Audrey A. Lee

Project Number

J1520

Project Title

Can the Index of Refraction Determine the Concentration of Sugar in Water?

Abstract

Objectives/Goals

This project's purpose was to see if sugar concentrations in water can be found using the index of refraction

Methods/Materials

The aquarium was made using two sheets of 1/8" thick 16" by 14" Lexan plastic, silicone adhesive caulk, a piece of half inch plywood 30.5" long and 16" tall, nails, a 12" piece of 2" by 4" pine, screws and washers, screwdriver, two pieces of 2" by 6" lumber, a jigsaw, a hammer, a Bosch Digital protractor, a digital multimeter with a thermometer, a laser pointer, a wooden bracket for the laser, and household glue.

The sugar water was made by pouring the correct amounts of sugar into 3000 cc of distilled water. There were five different concentrations: 1%, 2.5%, 5%, 10% and 20%. Each one was poured into the aquarium using a funnel, and it was filled until a marked point. Then the laser pointer moved with the digital protractor until it hit the nails with its beam. It needs to hit the nails, because they mark the compliment to the angle of refraction, so it is known every time. When the laser beam hit the nails the angle was recorded, as it was the compliment to the angle of incidence. The averages of the angles was found, and these averages were subtracted by 90 because they were complementary to the angle of incidence and the angle of refraction, which are needed in the equation for the refractive index which is n(index of refraction)=sin i (angle of incidence) / sin r (angle of refraction). Then all the tests' index of refraction for each concentration of sugar water was averaged out so there was only one answer for 1%, one answer for 2.5%, etc.

Results

For the averaged index of refraction, the refractive index for the control was 1.326. The refractive index for 1% was 1.334. The refractive index for 2.5% was 1.338. The refractive index for 5% was 1.342. The refractive index for 10% was 1.345. The refractive index for 20% was 1.357.

Conclusions/Discussion

The results showed that the index of refraction increased as the sugar concentration increased. This means that the light was bent more as more sugar was added. This happened because the higher the sugar concentration, the denser it was so it slowed the light down so it had to bend more. This shows that the hypothesis was correct. The concentration of sugar water can be determined by the index of refraction because the index of refraction increases in proportion to the sugar concentration.

Summary Statement

This project determined if the index of refraction can measure the concentration of sugar in water.

Help Received

My dad helped construct the apparatus.

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)	Project Number
Connie J. Lee	J1521

Project Title

Heat: It's Everywhere, and It's Watching You!

Abstract

Objectives/Goals

My objective was to discover the factor that affects heat transfer the most as well as the materials that are the best conductor and insulator.

Methods/Materials

For my experiment, I used 62 materials that varied in their abilities to transfer heat. They were the shaggy carpet, netting type 1, foam type 1, woven carpet, unwoven carpet, suede paper, netting type 2, foam type 2, Astroturf, soft green fabric, leather, minigolf material, silk, ceramic tile, cork, foam and styrofoam, cotton, pine, vinyl, cardboard, nylon, wool, sponge, velcro, towel, styrofoam, shade type 1, paper type 1, paper type 2, shade type 2, wallpaper, denim, copper, nickel, wall panel, kitchen floor sample, gypsum, wax, bubble wrap, dried cement, plastic, rubber, latex, gold enclosed in plastic, magnet, brass, silver, clay, cement, coal, stone, fir, brick, fiberwood, redwood, spruce, cedar, poplar, aluminum, glass, tissue, rubber with cloth, and fiberglass. But for the experiment, I separated these materials into different categories. I also utilized the triple beam balance to measure the mass of each substance. While testing, I observed these in the sun for an hour and a half and measured their temperature every thirty minutes. I also retested many times using different equipment and procedures. To find the biggest factor in heat transfer, I calculated the data in different terms of mass, volume, and density.

Results

By using the idea that a greater density equals a higher conductivity, I established that density is a prime factor that influences heat transfer. I also discovered silver to be the best conductor while the unwoven carpet as the greatest insulator. The following are the best to the worst conductor categories: metals, building materials, miscellaneous, wood, carpet, cloth, paper, foam and rubber.

Conclusions/Discussion

My hypothesis proved untrue. Copper, although widely distributed around the world as a generic conductor, was not the best heat absorber. Wood was also not a good insulator. Silver ultimately proved to be the best conductor, and the unwoven carpet the worst. Also, density was a necessary factor in heat transfer, because electrons carry heat. However, the information from this experiment is vital to society. By controlling heat transfer, one can save energy and further technology. Also, the knowledge of conductors and insulators may prevent future injuries by having equipment made of appropriate substance.

Summary Statement

This project explores the various factors that influence heat transfer as well as the most efficient conductor and insulator.

Help Received

My parents helped me move the tables out into the sunlight and drove me to many places so that I could gather my materials. My teachers, Mr. Perry and Mr. Kaleikau, lent me their triple beam balance so that I could measure mass accurately.

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)

Laura F. Managan

Project Number

J1522

Project Title

Will Temperature Change the Frequency?

Abstract

Objectives/Goals

I play orchestra bells in my Junior High School band. One day, my band director was checking instruments with his tuner. I was surprised to find that my bells registered a lower pitch than they should have. Because of this experience, I decided to investigate how thermal expansion in metal pipes affect the frequency at which they vibrate when struck. Research states that at different temperatures the pipes will expand or contract, changing the initial length. Due to this length change, the frequency of their vibrations should change as well.

Methods/Materials

Ten pipes each of aluminum, stainless steel and black steel were cut to the same length. Sound wave recordings were made of five pipes of each metal at room temperature (21C) to be used as the control set. Next, the remaining five pipes of each metal were struck at different temperatures -- hot (46C in a oversized packing box heated by standard light bulbs), room temp (21C free standing in family room), and cold (-15C by placing them in an empty chest freezer); and their sound waves were recorded on sound editing software. The recordings were then converted into Fourier transforms where the frequency of each recording could be read. In order to analyze the data, part of this project required that I learn about Fourier transforms and become familiar with the computer software required to determine the frequencies.

Results

Results show that thermal expansion did take place. The pipes that were heated had a lower frequency than the room temperature ones because they expanded. The cold pipes had a higher frequency because they contracted. Also, the aluminum pipes proved to have the most regular frequencies. On the other hand, the black steel was the most random of the three types. Instead of a nice spike in the Fourier transform to clearly define the frequency, these recordings had three or four tall peaks.

Conclusions/Discussion

This project was definitely successful. The pipes did undergo thermal expansion and changed frequencies. If this project were repeated, an explanation as to why the black steel frequencies were so irregular would be desired.

Summary Statement

My project examines how thermal expansion in a metal pipe has an effect on its fundamental frequency.

Help Received

Father helped with cuttting of metal pipes and assisted in manning computer station while I struck pipes.

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)

Casey J. Mansfield

Project Number

J1523

Project Title

The Best Hot Water Heater Insulation

Abstract

Objectives/Goals

The objective of my project was to determine which of four commercially available insulating materials will keep hot water warm the longest. My dad wanted to insulate an older hot water heater, and I wanted to do an experiment to help him decide which type of insulation to use.

Methods/Materials

I used quart glass jars to simulate hot water heaters. The four insulators I used were Great Stuff Insulating Foam Sealant, Wrap-On Vinyl Backed Fiberglass, Rigid Foam sheathing, and Reflectix, a reflective bubble wrap insulation. Around each of my jars I put 2 inches of a different insulating material, except for the control jar which had nothing wrapped around it. I poured boiling water into each of the five jars, covered each jar with a metal lid, and checked the temperature of each jar and recorded the results every 20 minutes until the water cooled to below 90 degrees. I then repeated the experiment insulating the tops of the jars and wrapping aluminum foil around the insulators that did not have a reflective backing.

Results

Using the average heat loss per 20 minute interval from the 2 experiments, Reflectix came in first with 7.37 degrees, Great Stuff came in 2nd with 7.41 degrees, Rigid foam came in 3rd with 7.44 degrees, and Fiberglass came in last with 7.82 degrees, as compared with the control which lost 8.96 degrees. Reflectix, Great Stuff, and Rigid Foam were very close, and all three did better than the fiberglass in both experiments. All four insulators kept water significantly warmer than the unwrapped control.

Conclusions/Discussion

Based on my results, there wasn't a large difference between the insulating qualities of the four insulators I tested. It appears that all four insulators, each in a slightly different way, had the most important quality of an insulating material: the capacity to contain air and thus become a poor conductor of heat. Reflectix did slightly better than the others when using average heat loss as the determining measure.
Which insulator did my dad use? Based on my research, he's going to try Reflectix to insulate his hot water heater.

Summary Statement

My project is about determining which of four commercially available insulating materials will keep hot water warm the longest.

Help Received

My mom drove me to the hardware stores to buy my materials.

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)

Jonathan M. Masukawa

Project Number

J1524

Project Title

Relation between Acceleration and Angle of Inclination

Abstract

Objectives/Goals

The purpose of this project is to determine the relation between the acceleration of a rolling object and the angle of inclination of a ramp.

Methods/Materials

An inclined plane, which could change inclination from 10 degrees to 60 degrees, in intervals of 10, was constructed. A marble was rolled down the ramp while being taped on a camcorder. The time it took to travel specified distances on the ramp was calculated, and then from that acceleration was determined for each angle.

Results

The acceleration increased as the angle of inclination increased, and the velocity of the marble was found to be constantly increasing as it traveled down the ramp. The accelerations for each angle were graphed against the sine, cosine, and tangent of the corresponding angle. It was determined after analysis and comparison that the sine of the angle directly related to the acceleration of the marble.

Conclusions/Discussion

I have concluded that the relationship between the sine of the angle and the acceleration of any rolling object can be shown through the equation a = g*(sine)angle, where a = the acceleration, g = the acceleration caused by gravity (9.81), and angle = the angle of inclination. With this equation, acceleration can be calculated with just the knowledge of the angle of inclination. A computer simulation program was created to show how this equation could be used to simulate acceleration for things such as video or computer games.

Summary Statement

My project is about finding the relationship between the acceleration of a rolling object and the angle in which it is inclined, and then being able to accurately predict acceleration.

Help Received

Brother helped with ideas/overcoming problems; Father helped and supervised construction of the materials needed to complete project; Mathematical and physics background supplied by high school physics teacher; Inspiration and encouragement from my science teacher.

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)

Briana C. McDonald

Project Number

J1525

Project Title

The Effect of Filters on Telescopic Views of the Moon

Abstract

Objectives/Goals

Objective/Hypothesis: The objective was to determine which telescopic filter provided the clearest view of the surface of the moon. The hypothesis was: The Moon (polarized) filter would provide a clearer view of lunar surfaces than any of the other filters.

Methods/Materials

Materials and Methods: Five Orion filters were used to control the variables of shape, size, and weight and allow color as the independent variable. All the filters were made with Hoya Optical glass and coloring. One filter was polarized, the rest were red, green, blue, and yellow. A five point Likert rating scale was developed to evaluate the clarity of the view produced by each filter.

Results

Results: After numerous trials, the Moon (polarized) filter produced the clearest views of the surface of the moon when compared to the views using the red, green, blue, and yellow filters.

Conclusions/Discussion

Conclusion: When viewed through a telescope, polarized filters permit a clearer view of lunar surface features than colored filters do. The results support the hypothesis that the Moon (polarized) filter provides the clearest view of lunar surfaces.

Summary Statement

My project is about studying the surface of the moon through various filters to learn about the effects of filtered light on observation.

Help Received

Advice and consultation from Mr. Kinney, science teacher; help with layout from parents.

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)

Rebecka L. Miller

Project Number

J1526

Project Title

Which of Six Fabrics Is the Best Insulator?

Abstract

Methods/Materials

My experiment invoved boiling 21 cups of water to the temperature of 100 degrees Celsius. Then, I poured three cups of the 21 cups of boiling water into seven 750 ml jars. Each jar was covered with one of the six fabrics being tested. Every 15 minutes for two hours, my assistant and I checked the temperature of the water in each jar. The temperatures were recorded to the nearest tenth of a decimal point to make it exact. Some other materials not mentioned yet are 5 sqare inch pieces of foil, pieces of tape three inches long,sauce pans, measuring cups, pitcher's, a timer, a stove, rubber bands, thermometers, 7 jars, and six different types of white fabric.

Results

The results of my experiment did not support my hypothesis. Rather they showed that felt insulated the heated water best, preventing the lowest amount of temperature loss. My hypothesis was that the flannel fabric would be the best insulator, though it was false. In addition to felt being the best insulator, people could use the information gained from this project to now which fabric would keep them warmest in the cold.

Conclusions/Discussion

The experimental data did not support my hypothesis, indicating that it should be rejected. According to the results of this experiment, felt was the best insulator, then came flannel,acetate, rayon, cotton, polyester, and in last came the controljar which had no fabric around it.

Summary Statement

My project is to determine which of six different, white fabrics insulates heated water best.

Help Received

Teacher Mr. Scott helped with graphs; Mother edited project report

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)

Alexander K. Nunn

Project Number

J1527

Project Title

Crack vs. Ping: The Breakdown of Bat Sounds

Abstract

Objectives/Goals

The objective of this project is to determine if there is a correlation between the sound made when a ball hits a bat and the type of bat.

Methods/Materials

Methods

The experiment will be conducted as the following: a camcorder will be placed to the side of the batter to record the sound made when the ball collides with the bat. The ball will be pitched by a pitching machine at 60 mph from 50 feet away from the batter every pitch.

The variables in the experiment are three different bats are used (z-core, connexion, and a maple wood bat). Most importantly, the sound variable that will be measured.

The data I collected was recorded into my computer and segmented into different hits using a program called Sound Forge. I wrote a program in the MATLAB language that computed the frequency spectrum of the data. I then wrote a program to graph the different spectrums so I could visually analyze them.

Materials and Their Source:

1. Maple Bat, Myself
2. Z-core Bat, Myself
3. Connexion Bat, Jesse Clopper
4. 8 new baseballs, Play It Again Sports
5. Pitching Machine, I borrowed it from the SRLL
6. Camcorder, Myself
7. MATLAB, Myself

Results

The data shows that the highest amplitude peak in the frequency spectrum for each bat can be used to identify the bat type. The range for each peak for each bat is shown on the diagram. The results can be summarized by: A high-amplitude peak found between 1018 and 1283 Hz can distinguish the wood bat. A high-amplitude peak found between 1637 and 1736 Hz can distinguish the Z-Core. A high-amplitude peak found between 752 and 965 Hz can distinguish the Connexion.

Conclusions/Discussion

Summary Statement

The project is to determine whether or not you can tell what kind of baseball bat is being used by the sound it makes when it contacts a ball.

Help Received

Father help during data collection and analysis

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)

David A. Phillips

Project Number

J1528

Project Title

Which Is the Better Insulation Material?

Abstract

Objectives/Goals

The objective of my project was to see which of a variety of materials that are commonly used in home construction acts as the better insulator against heat.

Methods/Materials

I went to our local home improvement store and selected several materials that can be used in the home as insulation. I selected Extruded Polystyrene, Foamed Plastic, Bubble Pack, Fiberglass Insulation and Loose Cellulose Insulation. For controls in my study, I used plywood, air and an aluminum plate. I researched the R value (resistance to heat flow) for all of the materials and my hypothesis was that the materials with the higher R value would act as better insulators.

I built a testing station of glass and used two aluminum plates, one on each side of the material I was testing. Before testing, I cut each of the insulation materials to #" thickness so that my comparisons would be fair. I clamped the material being tested between the two aluminum plates to prevent any air gaps from affecting my results. I used a hair dryer to heat one of the aluminum plates for 20 minutes while I recorded the temperatures of the heated plate and the temperatures of the aluminum plate on the other side of the material being tested. I also recorded the room temperature as a control.

After I collect all of the data, I analyzed it by looking at the rate of the rise in the temperature of the aluminum plate on the side of the test fixture away from the heat of the hair dryer. The smaller the temperature rise the better the material performed as a good insulator.

Results

The experiments showed that the insulation materials tested generally followed their R values. Bubble Pack was the best insulator followed by the extruded polystyrene, fiberglass, loose cellulose, plywood, foamed plastic, air and then finally the aluminum plate. Based on the R value, the foamed plastic should have acted as a better insulator than my test results showed.

Conclusions/Discussion

Published R values are a good indication of how well a material insulates against heat, though my results showed that the foamed plastic did not act as I had expected. This could be because foamed plastic is a better insulator at lower temperatures and so has a higher published R value, but at the higher temperatures where I took my temperature slope measurements, the foamed plastic passes more heat.

Summary Statement

My project compares the insulation quality of a variety of commonly used insulation materials.

Help Received

My father helped me in buiding the test station. I borrowed the thermocouple monitor from his company.

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)

Elliot J. Porterfield

Project Number

J1529

Project Title

What Is the Effect of a Magnetic Field on the Critical Temperature of a Type II Ceramic Superconductor?

Abstract

Objectives/Goals

My project was to determine the effect of a magnetic field on the critical temperature (temperature at which a superconductor superconducts) of a type II ceramic superconductor. I believe the critical temperature of the type II superconductor (Bi(2)Sr(2)Ca(2)Cu(3)O(9)) will lower as the Gauss (strength of the magnetic field) increases.

Methods/Materials

A solenoid coil was constructed with 10,000 turns of wire wound around a cryogenic container, suspending the superconductor material in liquid nitrogen. The magnetic field of the coil was calculated from the known dimensions, number of turns, and the impressed current. Each run of the experiment was conducted with an increased strength of the magnetic field. The first and last runs were both made at 0 Gauss as a control check. The temperature of the type II ceramic material was lowered by liquid nitrogen until the ceramic superconductor material reached the state of superconductivity. As the temperature of the superconductor increased, the resistance of the superconducting material was measured at fixed intervals of temperature.

Results

In the first run, with a magnetic field of 81 Gauss, the critical temperature lowered. In the next run with 162 Gauss, the critical temperature again lowered. In the next three runs, 324 Gauss, 486 Gauss, and 648 Gauss, the critical temperature reached a plateau where it was nearly the same as the run with 162 Gauss. The control check, at the end with 0 Gauss, yielded results that were consistent with the first run at 0 Gauss.

Conclusions/Discussion

My conclusion is that a magnetic field does significantly affect the critical temperature of a superconductor. The magnetic field (within the range of the equipment) does not have a significant effect after a specific level of strength. This data indicates that within the confines of this experiment, the magnetic field distorts the lattice of the superconductor or disrupts the Cooper pairs of electrons in the ceramic superconductor, up to a certain quantum level.

Summary Statement

In my experiment I varied the strength of a magnetic field and recorded how it affected the critical temperature of a type II ceramic superconductor.

Help Received

Father mentored and helped in preforming the more dangerous parts of experiment, sister and mother proofread report, Seamar Electronics loaned equipment.

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)

Thomas J. Powelson

Project Number

J1530

Project Title

The Densities of Liquids and the Speed of Sound through Them

Abstract

Objectives/Goals

The objective is to determine whether or not density is the sole property of a liquid that determines the speed of sound through that liquid.

Methods/Materials

Each of six liquids were measured to 100ml, weighed to find its density using the formula d=m/v and then poured into six identical 7.5 cm square plastic containers. A sound wave through air was produced by placing an empty 7.5 cm square plastic container into a cushioned plastic rectangular box between a speaker and a sound meter. A speaker was wired to a function generator and a sound meter registered back to an oscilloscope. This incoming wave was used as the control. Each liquid was then placed in the apparatus and a new wave was produced. By measuring the phase shift of each new wave against the control, a calculation was made to determine the speed of sound through each test material. These tests were performed five different times with each liquid.

Results

The liquids in order from highest to lowest density are as follows: corn syrup, glycerine, water, vegetable oil, alcohol, and kerosene. The liquids in order from fastest to slowest speed of sound are as follows: glycerine, vegetable oil, kerosene, water, corn syrup and alcohol.

Conclusions/Discussion

The results showed that density is not the sole property of a liquid that determines the speed of sound through that liquid. If it were a sole factor, there would be a linear relationship between the density and the speed of sound and this was not found in this experiment.

Summary Statement

The purpose of the project was to determine whether or not density is the sole property of a liquid that determines the speed of sound through that liquid.

Help Received

Mother helped with display board. Brother provided and operated oscilloscope and function generator at my house.

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)
Ramine Ravanbakhsh

Project Number
J1531

Project Title
The Viscosity of Motor Oil

Abstract

Objectives/Goals
The viscosity of motor oil is supposed to stay the same no matter how hot the temperature gets, but could the viscosity of motor oil change at different temperatures? My goal was to disprove the theory that the viscosity of motor oil could not change.

Methods/Materials
First I gathered all of my materials. Then I got the size 5w-30 motor oil. I put 900 mL of that type of motor oil in a clear plastic container. Then I dropped a ball, about 1-inch in diameter, in the container. I timed how long it took the ball to reach the bottom of the container to measure the viscosity of the motor oils. I took the ball out and warmed up the oil 40 degrees F. If the viscosity did not change, I warmed it up 20 degrees higher. Then I did the same thing with the 5w-30 motor oil except I did it using the 10w-40 motor oil and the 20w-50 motor oil. I followed the same procedure for all three types of motor oil under different temperatures.

Results
The results showed that the viscosity of the motor oil began to change at 90 degrees F, and as the temperature got higher, the ball that I dropped in the motor oil sank more quickly to the bottom of the container. The results supported the conclusion.

Conclusions/Discussion
After I conducted my experiment, the data supported that my hypothesis was correct. As the oil was heated to higher temperatures, each type of motor oil became thinner and thinner, making it quicker for the ball to fall through and hit the bottom of the plastic container.

Summary Statement
The point of my project is to disprove the theory that the viscosity of motor oil cannot change.

Help Received
My father supervised my experiments; my mother showed me how to mat the paper on my board; my sisters gave me tips on the format of my board and how to make graphs on the computer.

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)

Jacob J. Rucker

Project Number

J1532

Project Title

Quantifying the Effect of Skyglow on the Visibility of Stars

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 impact of skyglow can be predicted based on a site's distance from an urban center.

Methods/Materials

A total of 120 photographs of the zenith (and controls) were taken with a 35mm camera using 100ASA color film for 30-second time exposures in similar weather and moonlight conditions between August 2002 and January 2003 from sites around San Diego County at 30, 60, 75, and 124 kilometers from the urban center. The pictures were developed and scanned into over 500 computerized bitmap files. I developed a custom computer program to convert the bitmap files into 600x600 pixel arrays with pixel intensity values from 0 to 767 and to calculate the number of pixels at each intensity level for each image. Resulting intensity intervals for each site were averaged, graphed, and compared to known functions to determine a best-fit mathematical correlation to the change in intensity (brightness) as a function of a site's distance from the urban center.

Results

The average number of "bright value" pixels in the photographs varied greatly at the four sites, from 68.4% of all pixels at 30 km from the urban center to 18.9% at 60 km, 8.4% at 75 km, and only 1.6% of all pixels at 124 km. A formula for the brightness value, "B", as an indication of skyglow varying with distance, "d", was derived: B = 4.4 X 10^8 X d^-2.2.

Conclusions/Discussion

The effect of skyglow, as measured by the brightness of the photographs at the sites (B), decreased inversely with the distance (d) from the urban center. The rate of change in brightness also diminished for increasing distances, as approximated by the equation I developed: B = 4.4 X 10^8 X d^-2.2. Applying the formula reveals that observable visible light from stars remains below 50% until nearly 35 km from a city the size of San Diego and does not improve to 90% visibility until over 70 km from the urban center, indicating an increasing threat to astronomical observations at the nearby Mt. Laguna and Mt. Palomar Observatories.

Summary Statement

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

Help Received

Thanks to my dad for driving me to the sites in the middle of the night and helping me write the custom "Countpixels" computer program, to Dr. Tony Ratcliffe for the Canon scanner, and especially to John Hoot, astronomer and computer scientist, for the photography equipment and recommendations.

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)

Amy R. Shipley

Project Number

J1533

Project Title

Wavelength Absorption in Liquids

Abstract

Objectives/Goals

My goal was to use a spectrometer to observe the absorption of the visible wavelengths of light in liquids. My goal was also to determine the amount of light absorption in liquids by building a simple colorimeter and quantifying the amount of light being absorbed. Using this method I was able to determine the amount of food dye in other liquids such as Kool-Aid and Gatorade. I believe that liquids do absorb light depending on what chemicals, elements, or dyes are present in the liquid.

Methods/Materials

I placed a glass jar filled with a household liquid and set it between a 100-watt halogen bulb and a spectrometer. I was able to observe and compare the spectrum of the light bulb against the spectrum that made it through the liquid. In order to further study the light absorption, I devised a more advanced setup. I built a simple colorimeter using RGB light-to-voltage Sensors. It was important that I used white LED's for my light source in this setup. I placed an acrylic container filled with a dyed liquid between the white LED's and the RGB Colorimeter. Using Beer's law I was able to determine the absorbance of particular wavelengths. As a result of using Beer's law I observed a linear relationship between the light absorbance and dye concentration in the liquid.

Results

Olive Oil and Pink Car Wash Gel were the two with the most interesting absorption characteristics. In the Car Gel's spectrum all the green wavelengths were missing and in the Olive oil, some single wavelengths were missing. When I tried to quantify the absorption of the dyed liquids, all the liquids had linear relationships between concentration and absorbance. I was able to determine the amount of dye in the Kool-Aid and the Blue Gatorade but because the blue Gatorade's linear line did not go straight through zero, I was only able to estimate the concentration of dye in the liquid.

Conclusions/Discussion

Most colored liquids do absorb light in the visible spectrum because they are dyed. The dye acts as a filter and only lets particular wavelengths get through the liquid. Using the relationship of Beer's Law, I was able to find out how much light was being absorbed and compare that to how much dye was in a liquid. The reason why the Blue Gatorade's linear line didn't go through zero was because the substances in the liquid were cloudier and these particles scatter some of the light.

Summary Statement

The study of wavelength absorption in liquids, and the use Beer's Law to quantify the concentration of dye in liquids.

Help Received

My dad helped me obtain my RGB sensors. Set Engineering provided the Data Acquisition Card used to gather the sensor voltages. Dave Sasscer at the Santa Cruz Public Works Department helped explain the practical applications of colorimeters.

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)

Maia Singhal

Project Number

J1534

Project Title

Seeing Red: How Different Are the Colors of Red Laser Pointers?

Abstract

Objectives/Goals

I noticed that the colors of some red laser pointers were slightly different when I aimed them at a wall. However, other family members did not see any difference, so I wanted to know who was right. My experiment was to find out exactly how different the colors were by measuring the wavelength of each pointer.

Methods/Materials

I used 3 red laser pointers (wavelengths marked between 630 and 680nm on the label) and one green laser pointer (wavelength 532nm). The green pointer was my control. I used a diffraction grating to disperse the laser beam from each pointer onto a screen. By measuring the distance between the grating and the screen, as well as the distance between the dots of diffracted light on the screen, I calculated the wavelength of light from each laser pointer. For each pointer, I repeated the experiment with three gratings and three different distances between the grating and screen.

Results

The measured wavelength of the green laser pointer was withing 2 nanometers of the wavelength marked on its label. That showed that my measurements were accurate. The results for the red laser pointers showed that their average wavelengths were very close--within 7 nanometers of one another.

Conclusions/Discussion

At first, I thought that because the wavelengths were so close, the colors of the red laser pointers were really the same. I found out, though, that the human eye can see differences in color when the wavelengths are only 2-4 nanometers apart. Therefore, I concluded that although the wavelengths were only 7 nm apart, that difference could be seen.

Because I am the youngest in my family, as a future experiment I think it would be interesting to find out if the ability to see small changes in color decreases with age.

Summary Statement

For my experiment I measured the color difference in 3 red laser pointers by measuring the wavelengths of their light beams.

Help Received

My dad lent me his laser pointers for the experiment and bought the meter stick and diffraction grating for me. He showed me how to use Microsoft Powerpoint and Microsoft Excel so I could do my diagrams and graphs on the computer. My mom gave suggestions on how I could make my poster clearer.

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)

Alysse G. Stewart

Project Number

J1535

Project Title

Transferring the Sun

Abstract

Objectives/Goals

My project was to se which heat transfer fluid (HTF) would get the hottest. I used what I had learned in prior years solar projects to make three concentrating solar heaters exactly the same. The only difference was the liquid to be heated inside. I used salt water, olive oil, and plain water (to serve as my control). I guessed that salt water would get the hottest because salt is added to water to make it's boiling point hotter.

Methods/Materials

I used a shop light fixture as my solar concentrating shape. I had mirrors cut to the shape of the inside of the light fixtures and glued them in. I also glued a glass plate over each fixture to keep the wind out. The heat transfer fluids were held inside a simple copper tube cut to size. I then aimed them at the sun and gook hourly temperature readings with a meat thermometer. I was careful to keep moving the solar panels to keep them tracking with the sun during the day.

Results

The averge temperatures of the heat transfer fluids were: Salt Water 158 degrees farenheit; Olive Oil 153 degrees; Plane Water 149 degrees; Outside Air Temperature 70 degrees. One of my readings had the salt water at 196 degrees in the afternoon on a very sunny day and I was able to heat the solution over 88 degrees above the outside air temperature.

Conclusions/Discussion

My hypothesis was correct. The salt water transfer fluid got the hottest. I was surprised how hot the solutions got with my little home made concentrating solar panels. I was able to tour the solar plant in our area and learned they used a unique heat transfer fluid that reaches temperatures of over 750 degrees farenheit. My research found there are many ways to capture the sun's energy and that it happens naturally every day with no negative impact on the environment.

Summary Statement

My project was about trying to find out which heat transfer fluid would get the hottest while inside three identical concentrating solar panels.

Help Received

My mother glued the cut mirrors and my dad helped me with the computer input and graphs.

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)

Erich W. Strub, II

Project Number

J1536

Project Title

Can Fire Survive in a Microgravity Environment?

Abstract

Objectives/Goals

The purpose of my experiment is to answer one question. Can fire survive in a micro-gravity environment?

Methods/Materials

By spinning a fire in the center of a sealed drum, centrifugal force will pull the most dense particles away from the fire. This will change the direction of buoyancy keeping the heated oxygen depleted gases around fire, thereby extinguishing the fire.

Results

After running several failed tests, I determined the test was not faulty but the conditions. I changed the RPM and pre-run time, and ran more tests. With the proper speed and pre-run the fire self extinguished as I expected, and also left a smoke cylinder in the center of the drum.

Conclusions/Discussion

After igniting the wick electronically, the oxygen depleted gases stayed toward the center of the drum completely surrounding the fire and choking it to death, thus proving my theory to be correct. Fire does need gravity in order to sustain its life. The reason for this, is that with gravity, the oxygen depleted gases are pushed away from the fire, bringing new oxygen rich air to the fire, thus leaving the fire to burn.

Based on the results of my experiments, my hypothesis is deemed correct. Can fire survive in a micro-gravity environment? No, it needs gravity.

Summary Statement

My project was to show the relevancy of gravity to fire.

Help Received

Mother helped type, Father helped build machine, Fire Chief William Kevin Clark supervised demonstrations

Name(s)

Henry P. Tung

Project Number

J1537

Project Title

Can You Resist the Heat?

Abstract

Objectives/Goals

This project examines the relationship between the temperature of a sodium chloride solution and the solution's electrical resistance. I carried out this project to learn about solutions, how electricity conducts through them, and how outside influences like temperature affect the process.

Methods/Materials

To find the relationship between the temperature and the resistance, an apparatus was constructed consisting of a sealed plastic container containing a salt solution, copper electrodes, a thermometer, a power source, and an ammeter.

For each trial, the container was placed in an ice water bath to cool it below 16ºC. It was then removed and allowed to warm up in the air. At 16ºC, and at 2º intervals after that, readings were taken of the amount of electrical current flowing through the solution. The resulting data was entered into multiple formulas to calculate the actual resistance values of the solution itself. These values were then examined in an attempt to find a suitable mathematical relationship associating them with their corresponding temperatures.

Results

The sets of data obtained were all very similar, confirming their accuracy. An inverse variation between the resistance and the 0.32 power of the temperature was approximated with the aid of a calculator.

Conclusions/Discussion

Thus, it can be concluded that the electrical resistance of a salt solution decreases with an increase in temperature.

Summary Statement

This project examines the relationship between the temperature of a sodium chloride solution and the solution's electrical resistance.

Help Received

Father supervised apparatus construction; Family members helped to proofread parts of report.

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)

Katie D. Walker

Project Number

J1538

Project Title

Is Your Insulation Best? The Effect of Insulation on the Spread of Heat from a Flame inside a Typical House Wall

Abstract

Objectives/Goals

The purpose of my project is to determine if different kinds of insulation minimize the spread of heat from a flame running through a vent pipe inside a wall. I predicted that the blown-in insulation would contain heat the best.

Methods/Materials

I constructed a three-section mock wall with a vent pipe in each section. The wall had one section with no insulation, one with fiberglass insulation, and a third section with blown-in insulation. In each section, initial temperatures were recorded prior to testing. A flame from a propane torch was inserted into the bottom of the vent pipe and run for five minutes. Then, final temperatures were recorded. Three trials with four tests each were completed.

Results

The fiberglass batted insulation did the best at keeping the spread of heat minimal inside the wall. In the section with the blown-in insulation, the vent pipe got so hot that it ignited the insulation surrounding it, causing the insulation to smolder.

Conclusions/Discussion

My hypothesis was incorrect, the blown-in insulation did not do the best at minimizing the spread of heat inside the wall. The fiberglass insulation contained the heat inside the vent pipe without allowing it to spread throughout the wall section. The blown-in insulation got very hot around the pipe, ignited and smoldered. I expected the blown-in insulation to contain the heat without catching fire.

Summary Statement

My project is to determine if different kinds of insulation minimize the spread of heat from a flame running through a vent pipe inside a wall.

Help Received

My father helped me build the mock wall. Mr. Duerr helped with the graphs and charts.

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)

Adam A.J. Whipple

Project Number

J1539

Project Title

Which Material Operates Most Efficiently as a CPU Heatsink?

Abstract

Objectives/Goals

The purpose of this experiment is to determine which of the four materials, aluminum, copper, bronze, and galvanized steel, conducts heat from a CPU most effectively.

Methods/Materials

Four metal heatsinks (aluminum, brass, copper, and galvanized steel) simulating a CPU were attached to a thermal plate that provided a constant heat source. A thermocouple was used to measure the maximum temperature reached by the thermal plate during a 13-minute period for each metal heatsink. The results for each metal were compared and graphed.

Results

The copper heatsink was the most thermally conductive and therefore transferred heat most efficiently. Aluminum was the second most thermally conductive.

Conclusions/Discussion

Copper was the most thermally conductive of all the metals, but was most expensive. Aluminum was the second most thermally conductive, but was the cheapest. I believe aluminum is the most commonly used metal because of its low cost and high thermal conductivity.

Summary Statement

The project was testing four different metals' thermal conductivity to be used as potential CPU heatsinks.

Help Received

Dad helped me cut & shape the metals and provided thermocouple. Mom helped with presentation board and editing report. Resistor idea from http://www.anandtech.com/showdoc.html?i=1136. Friend provided powering advice.

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)

Eric S. Wilder

Project Number

J1540

Project Title

Fishy Vision

Abstract

Objectives/Goals

My objective is to determine if the type of water -- fresh water, ocean water, and pool water -- affects refraction in a way noticable to the human eye. I believe that ocean water and pool water will be more refractive than fresh water.

Methods/Materials

My experimental set-up included a tank filled to the brim with various water types, with a protractor standing vertically at the bottom. One foot away, a vertical yardstick was used to measure the height of a laser beam as it shone through the water to the protractor. As I moved the laser pointer, I recorded the angles and heights to measure the refraction effects.

Results

I made measurements of the laser height for every 5 degrees on the protractor (in water), for each different water type. I took 5 different trial readings at each angle, and averaged them in order to reduce experimental error. The pool water trial results were slightly different than the other two waters, so I tested again with 100% chlorine bleach, and got results similar to the fresh and ocean water.

Conclusions/Discussion

I found that the type of water solution does not make a noticable difference in refraction. All three waters in my experiment had approximately the same refraction effects. So, my hypothesis was not supported by this data, and the type of water will not change refraction in a way noticable to the human eye.

Summary Statement

My project compares refraction effects of different water solutions.

Help Received

Friend helped make the Excel graph, after I entered the data