CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Konstantin Y. Batygin

Project Number
S1501

Project Title
Nonlinear Oscillations in Mechanical Systems

Abstract

Objectives/Goals
The subject of the study was a chaotic particle motion initiated by a nonlinear periodic force in a mechanical system. The appearance of chaotic dynamics in simple mechanical systems, is a fundamental classical phenomena.

Methods/Materials
Non-linear oscillations were simulated through computer modeling. The computer model was realized as a sequence of matrix multiplication. Each matrix describes linear and non-linear oscillations of a mechanical body under external forces.

Results
The result of the matrix multiplication was a chaotic motion performed by a particle in the presence of linear and non-linear forces.

Conclusions/Discussion
This type of particle action is called the "beam-beam effect." It is one of the main reasons that limits the intensity of a particle collider.

Summary Statement
The subject of the project is the study of particle motion inside a collider under external linear and nonlinear forces.

Help Received

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Michael T. Chang

Project Number
S1502

Project Title
Temperature's Effect on the Refraction of Light

Abstract

Objectives/Goals
The purpose of this project is to determine the effect of temperature on a liquid's refraction of light.

Methods/Materials
The experiment measures the change in the index of refraction of a liquid as its temperature changes.

Results
The results were inconclusive, and no trends could be demonstrated, since the changes in the indexes of refraction over temperature were very small, and hardly measurable.

Conclusions/Discussion
This suggests that the refraction of light in a liquid is only slightly affected by its temperature in the range used. The experiment could be improved if more precise measuring tools and a wider temperature range were used.

Summary Statement
The project is about finding the effect of temperature on a liquid's refraction of light.

Help Received
Mother helped create poster and provided some test liquids; Father provided a laser pointer and thermometer; Mr. Geluardi, my science teacher, helped improve my procedure.

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Jakob R. Duffin

Project Number
S1503

Project Title
Wood Business

Abstract

Objectives/Goals
I was wondering which wood gives off the most heat because wood costumers always ask which type of wood burns the best.

Methods/Materials
I used the idea of calorimetry to compare the heat energy of the three different types of wood; olive, almond, and "junk" wood (which is actually a low density wood such as cotton wood). First I took six pieces of each wood of the same volume by using "gravel displacement." I then burned the wood under the same conditions. I took 14 liters of water for each fire and measured their starting temperature and put them each on a fire. Every 15 minutes I measured the temperature of each 14 liters of water.

Results
Olive wood immediatly reached boiling so I had start another pot of water. I added the temperature change of the two pots together before calculating the heat. The almond wood and "junk" wood had pretty much the same temperature change.

Conclusions/Discussion
I came to the conclusion the olive wood definitely has more heat energy, but I was surprised almond wood did not have more heat than it did.

Summary Statement
I used calorimetry to determine which type of wood gave off the most heat.

Help Received
My mom and dad helped do the experiment. My neighbor provided the thermometers.

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)

Joanna Estrada; Stephen Hop; Craig Imazumi

Project Number

S1504

Project Title

Seebeck Effect: The Thermoelectrical Potential of Various Metal Couples

Abstract

Objectives/Goals

The Seebeck effect is the generation of electrical potential when strips of two dissimilar metals are connected to each other, where the two junctions of the metals are at different temperature. In this experiment, the potential was measured when nickel, tungsten, copper, silver, and Alumel (5% Al, 95% Ni) are paired with Chromel (10% Cr, 90% Ni) and steel at 0 and 100 deg C. It is hypothesized that metals with the largest difference in ionization energy between the metal and Chromel or steel will generate the largest potentials. Because nickel has the lowest ionization energy of the metals we measured, we expect it to generate the largest number of microvolts, and therefore to be the best thermocouple material.

Methods/Materials

The thermocouples were submerged in boiling water and ice water, and the resulting voltage was measured using a voltmeter. (Actually, a Fluke 87 Multimeter and a Fluke 80TK Thermocouple Module was used to read the #temperature# in degrees C, which we converted to voltage.)

Results

The results demonstrate that Nickel wire coupled with Chromel generated the largest potential, followed by Alumel, silver, copper, and finally tungsten.

Conclusions/Discussion

In thermoelectrics there is something called a Seebeck Coefficent. The Seebeck Coefficent is the thermoelectric sensitivity of each metal. Ionization energies are directly linked with Seebeck Coefficents. The larger the difference between the Seebeck Coefficients of the paired metals, the higher the voltage. Our results are consistent with what is predicted by Seebeck#s theory.

Summary Statement

Finding the best metal to create a voltage when paired with either steel or chromel in a thermocouple.

Help Received

Jack Parsels helped with wires and concepts. Keiko Imazumi helped with board layout. Stan Aochi helped with concepts.

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Nicholas Fung

Project Number
S1505

Project Title
Direct Solar Pool Heater

Abstract

Objectives/Goals

My objective is to demonstrate the feasibility of heating a pool using a new invention called Direct Solar Pool Heater (DSPH).

It is my first hypothesis that a pool of water with the DSPH in place will warm up to a higher temperature than the same without the DSPH because the black fabric of the DSPH absorbs more and reflects less solar energy than the light colored pool walls or bottom.

It is my second hypothesis that by suspending the DSPH closer to the surface of the water (where swimmers stay most of the time), the DSPH will heat up the surface water more than the deep water.

Methods/Materials

A bathtub was used to simulate the pool. Six 1300-lumen floodlights were used to simulate the sun. Three small DSPH disks were made. Each was made of black nylon fabric stretched over a steel ring and then fitted with 3 buoy sticks to allow the disk to be suspended at the desired water depth. Two temperature probes were connected to a Vernier LabPro and a TI-83 calculator to collect temperature data at 2 different depths.

Four experiments were conducted under controlled room and water temperatures. Each experiment lasted 12 hours and temperatures were recorded at 30-minute intervals. The 4 experiments were: 1)light and DSPH, 2)light but no DSPH, 3)no light but DSPH, and 4)no light and no DSPH.

Results

Experiment #1(with light on and with DSPH) yielded the biggest temperature increase (+1.071C). This confirmed my first hypothesis that a pool of water with the DSPH in place will warm up to a higher temperature than the same without the DSPH.

By comparing the data of experiments #1 and #2(with light on), it was noted that the surface water temperature was higher by 0.221C on average and the deep water temperature was higher by 0.169C on average when the DSPH was used. This confirmed my second hypothesis that the DSPH heats up the surface water more than the deep water.

Conclusions/Discussion

My project demonstrated the feasibility of DSPH. I believe DSPH has many advantages over conventional solar or natural gas pool heating systems. DSPH is cheap to make, install, and maintain. It does not require electricity or natural gas to operate. It is also highly efficient with no heat loss due to pipes or heat exchangers. If DSPH is widely used, I believe it can reduce our energy consumption and lessen the chance of another energy crisis in our future.

Summary Statement

The Direct Solar Pool Heater is a new invention designed to absorb solar energy using submerged black fabric disks and to transfer the absorbed energy directly to the pool water.

Help Received

My teacher provided useful suggestions throughout the project, kept me on schedule, and lent me the Vernier LabPro. My parents critiqued my write-ups and helped me to set up experiments and assemble the display board.

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Peiran Gao

Project Number
S1506

Project Title
Effect of Electric Fields on the Heat of Vaporization of Water

Abstract

Objectives/Goals
The objective of this project is to study the effects of an external electric field on the heat of vaporization of water through both computer simulations and experiments.

Methods/Materials
Using the molecular model of the dipolar water molecules, a program was written in Java to simulate the effect of a static electric field on the transitional and rotational movements of water molecules as well as the interactions among water molecules. The average transitional velocity, rotational velocity and kinetic energy of water molecules after each step of the simulation were plotted against time. The program was run at different strengths of electric fields from 0V/m to 1400V/m.

The heat of vaporization of water was measured using Clausius-Clapeyron equation experimentally under electric field strength from 0V/m to 1400V/m.

Results
The heat of vaporization of water increased by about 5% as the result of a static electric field. Based on the consistent results from both the simulation and the experiment, the increase of the heat of vaporization underwent exponential decay as the strength of the electric field increased.

Conclusions/Discussion
Due to the overall neutral charge of water molecules, a static electric field had no effect on the transitional movements and the transitional kinetic energies of water molecules. However, the torques created by a static electric field on water molecules tended to reorient water molecules towards the direction of the E field. The rotational movements of water molecules underwent damping oscillation in which the average rotational kinetic energy decreased. Water molecules with lower KE then needed more energy to be freed from their liquid state, thus resulting in the increase of the heat of vaporization of water in an external static electric field.

Summary Statement
Study of the effect of external electric fields on the heat of vaporization of water

Help Received
Used DC power supplies and electric thermal sensor at UCI under the supervision of Dr. Yoo; Used beakers and graduat cylinders provied by Ms. Bunch; Both parents helped make the display board

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Lynn A. Hiel

Project Number
S1507

Project Title
Effect of Color on the Characteristics of a Heat Barrier Material

Abstract

Objectives/Goals
My project determines the effect of color on characteristics of a heat barrier material. The result of this investigation will identify the effect of color on the effectiveness of this heat barrier for fire protection of utility poles and other wooden structures.

Methods/Materials
First, I drilled a hole into the center of 5 wooden boards, all the same dimensions. I coated the top of each board with a different colors of fire protection, namely white, black, green, brown, and red. I placed each board on two supports (coating up - hole down) and inserted a temperature probe into the hole. I positioned a 500-watt heat lamp above the board and recorded the temperature every second for 30 minutes. Then, I turned the lamp off and recorded the temperature every second for 60 minutes. I replaced the lamp with a gas torch and repeated the experiments for the white and black boards.

Results
Using curve fit parameters the heating and cooling curves were compared. The heating and cooling curves show a consistent sequence of the five colors: white, green, red, brown, and black. The white board reflected the most heat and released the heat most slowly. The black board absorbed the most heat and released the heat most quickly.

Conclusions/Discussion
An explanation of the observed results has been developed to explain the evolution of temperature on the surface of a fire protective coating over time.

Summary Statement
My project determines the effect of color on characteristics of a heat barrier material.

Help Received
Mom and Dad helped with gas torch test; brohter helped set up lab top computer

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Ryan J. Honda

Project Number
S1508

Project Title
Radioactive Attenuation and the Inverse Square Law

Abstract

Objectives/Goals
This project is a series of three experiments that test the effects of distance on the intensity of radioactive sources and the effects of mass absorption of beta and gamma radiation.

Methods/Materials
The materials used in this project include:
1. Spectrum Techniques ST-360 Counter with GM Tube (Power supply, stand, clamp, USB cable, source holder, and 20 shields of varying mass thickness.)
2. Sony Notebook Computer
3. Radioactive Sources: Beta Sr-90 & Gamma Co-60
The procedure for the Inverse Square Law experiment is to place the detector on the clamp of the ruler stand. Then, place the radioactive source on the surface of a table. Record 10 readings at 60 second intervals for each source from 2cm to 24cm at 1cm intervals.
The procedures for the Beta and Gamma experiments are to place the source in the source holder inside the shelf stand 3cm away from the detector. Next, place a shield 2cm away from the detector. Record 10 readings at 60 second intervals for each source and each shield.

Results
The results for The Inverse Square Law experiment and the Beta and Gamma experiments are:
Graphs A and C describe intensity as inversely proportional to the square of the distance and plot as a hyperbola.
Graphs B and D describe intensity as proportional to the reciprocal of the square of the distance and plot as a straight line.
Graphs E and G graph as a decrease in intensity as the mass thickness of the absorbers is increased.
Graphs F and H graph intensity logarithmically verses the increasing shield numbers. The beta graph begins as a straight line but intensity decreases rapidly by aluminum shield M. Graph H plots as a straight line with a downward slope as the mass thickness of the shield numbers increase until the thickest lead absorber T is used. Gamma radiation is more penetrating than beta radiation, and lead is a better absorber of aluminum when one compares their mass thickness. The half thickness was calculated to be 6553 mg/cm^2 for gamma.

Conclusions/Discussion
Experimentation partially supports my objectives, goals, and results of the Inverse Square Law and the Beta and Gamma Absorption experiments.

Summary Statement
This project states the intensity of radiation decreases proportionally as the inverse square of the distance, and the effectiveness of radioactive shielding improves with materials of increasing density and linear thickness.

Help Received
No

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Lara A. Injeyan

Project Number
S1509

Project Title
The Doppler Effect and the Fiber Gyroscope

Abstract

Objectives/Goals
My project relates to the Doppler Effect and how it is used to measure rotation in a fiber gyroscope. This Doppler effect introduces a frequency shift on a beam that can be measured by using a Sangnac interferometer. I used a turntable as my rotating platform. My rotation speed (measured by number of turns/ second) is my independent variable and the number of fringes shifted is my dependent variable.

Methods/Materials
I used a HeNe laser to assemble a Sagnac interferometer where two beams propagate in opposite direction on a rotating platform. The interferometer used a long fiber as the beam carrier for the two counter propagating beams to enhance the Doppler effect. A turntable served as the rotating platform. I used a beamsplitter to produce the two beams that were injected into the fiber, and observed the fringe pattern created by the return beams on a screen. We then observed the change in fringe patterns as the spool of fiber rotated on the turntable. We observed the fringe motion at three different rotation speeds corresponding to 17, 33 and 45 rpm.

Results
My hypothesis was correct; we were able to build a basic Fiber Optic Gyroscope and measure the Doppler shift introduced by a rotating platform. We measured the Doppler shift for three rotational speeds of a turntable and the number of fringes observed by the Sagnac interferometer were within 5% of that predicted by theory.

Conclusions/Discussion
The simple fiber optic gyrsoscope that we assembled was able to measure roataion with surprising accuracy (5%). There were two possible sources of error; the poor contrast ratio of the fringes and the ability to only count the fringe shift with limited accuracy (half a fringe). Reasons for the poor contrast included the use of a non-polarization maintaining fiber and difficulty in balancing the intensities of the two beams. These issues were overcome by doing multiple trials (at least 10) for each rotational speed. This enabled us to reduce the standard deviation to approximately 10% of the average value at the higher speed (45 rpm) and less than 25% of the average value at the lowest speed (17 rpm).

Summary Statement
Measuring rotational speeds using the Doppler Shift in a fiber optic gyroscope.

Help Received
Father helped identify project and collect data.

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Jennifer N-J. Lawler

Project Number
S1511

Project Title
How Accurate Is Parallax?

Abstract

Objectives/Goals
The purpose of this experiment was to find out how accurate parallax is when determining the distance of stars from the earth. My hypothesis is the further away the star is to the earth, the less accurate the calculation will be. My independent variable is the distance, and my dependent variables are the stars.

Methods/Materials
I used candles to represent stars, and balls to represent the earth and sun. I placed the candles 0.9398, 2.921, 4.9276, and 5.5372 meters away from the earth. I utilized a pole to represent the relative star. I obtained the degree of angles for each star, when the earth is in the January and July position. The baseline was 1.8288 meters. I used the parallax equation: ½ baseline divided by the tangent of the average angles. I did the experiment in inches, but then converted the numbers to meters.

Results
The first star, which was the closest to the earth, measured to be 0.9398 meters; however, when I used the parallax equation the answer was 0.87122 meters. The second star I measured, which was the fourth star, had an exact measurement of 2.921, but the parallax calculation occurred to be 3.302 meters. The seventh star was precisely 4.9276 meters away from the earth; nonetheless, the response came about 4.28752 meters, when doing the parallax equation. The last star I measured was 5.5372 meters. When I calculated the star with the parallax equation the result was 3.556.

Conclusions/Discussion
The experiment supported my hypothesis, even though I did not come up with the correct answers. The first star had the smallest difference in numbers with 0.06858 meters. The difference of the measurements grew as I measured each star further and further away. The eighth star had the biggest difference of 1.9812 meters.

Summary Statement
My project is about the calculation of parallax, and how accurate it is when determining the distance from the earth to the stars.

Help Received
Father helped set up equipment.

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Scott Levine; Michael Zasadzinski

Project Number
S1512

Project Title
Brass Instruments & Artificial Lips

Abstract

Objectives/Goals
Our main project goal was to find out how different variations of brass horns and mouthpieces affect the sound ultimately produced by a brass instrument.

Methods/Materials
5 Different mouthpieces, which have different attributes.
3 Different "Low Brass" horns: 1) Kanstul Silver Baritone, 2) Horn Conn Brass Baritone Horn, 3) Conn Director 18H Trombone
A Wooden, hermetically sealed, box, containing artificial lips made out of latex tubes filled primarily with water.
Procedure:
1.To determine the frequency of the mouthpiece as played by the lips, we created a box containing Artificial Lips (See display). Copper tubing is inserted to the back and is connected to an air supply via sturdy tubing.
2.Compressed air travels into the box, which is pressurized, and vibrates the latex tubing against the mouthpiece, creating a buzzing sound.
3.Frequencies and pitches of four different mouthpieces are recorded using computer equipment and a Korg Orchestral Tuner.

Results
--Our data shows no apparent correlation between mass and frequency. There is a fairly significant correlation between rim size and frequency, as shown by the graph. This agrees with the widely held belief that rim mass plays a significant factor in the ability to play in the high register.
--There seems to be a slight correlation between outer cup diameter and frequency, being that a smaller outer cup size apparently means a higher frequency.
--There is an apparent direct correlation between inner cup size and frequency, being that a smaller inner cup diameter (diameter of interior cup at the top) and frequency.

Conclusions/Discussion
Our conclusion is that the size of the rim directly determines the frequency (pitch) produced by a mouthpiece, the pressure of air does not affect the pitch, and mass does not necessarily affect the pitch emitted from a mouthpiece.

Summary Statement
How do variations of brass horns and mouthpieces affect the sound ultimately produced by a brass instrument?

Help Received
Used lab equpment at UCSB (compressed air); carpenter helped with the building of the box

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Albert G. Linden

Project Number
S1513

Project Title
The Effect of Ammonia Gas on Copper Nanowire Sensors

Abstract

Objectives/Goals
The objective of this experiment was to expose copper nanowire arrays to ammonia gas and measure the change in resistance of the arrays upon exposure and for some time thereafter.

Methods/Materials
Materials: CuSO(4) H(2)SO(4) H(2)O Na(2)SO(4) Fume hood Sterile glass slides Electrochemistry array Pressurized tanks of ammonia and nitrogen HOPG Graphite Silver paste Cyanoacrylate glue Current amplifier Multimeter system Computer with a multimeter program 50 mL vial
Methods: I grew copper nanowire arrays from a solution and tested their change in resistance when exposed to ammonia for 5 seconds. With no ammonia, the resistance of copper nanowires does not change, while the presence of ammonia causes an increase in the resistance of the arrays. I used 2 different copper nanowire arrays and took 7 sample readings from each one. I measured the resistance of the nanowire arrays before, during, and after their exposure to ammonia and compared this to the initial resistance of the array with a ratio.

Results
My data had a mean resistance increase of 35.5% and were highly variable with a minimum of 8% and a maximum of 105% increases in resistance, excluding one outlier of 301%.

Conclusions/Discussion
The presence of ammonia causes a significant increase in the resistance of copper nanowire arrays. This effect is always noticeable but the magnitude of the change is subject to large variation.

Summary Statement
My project measured the change in resistance of copper nanowire arrays when exposed to ammonia gas for future application as ultrasensitive gas sensors.

Help Received
My mother helped make the backboard and I used lab equipment at the University of California, Irvine under the supervision of Dr. Reginald Penner.

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Andre Maranhao

Project Number
S1514

Project Title
Chemiluminescence: Determining the Efficiency of Light Production by Luminol

Abstract

Objectives/Goals
In my experiment, I will determine efficiency of light production by luminol in an aqueous solution with hydrogen peroxide as the oxygen donor and iron as a catalyst in the form of potassium ferricyanide.

Methods/Materials
METHOD:
I produced luminol in my high school lab. Then I divided the luminol into 2 equal amounts for two separate reactions. The first reaction took place in a calorimeter and measured the total energy evolved. The second reaction took place in a glass beaker in a totally dark room and measured the illuminescence of the reaction. Once illuminescence was converted to light energy, the light energy was divided by the total energy evolved by luminol resulting in the efficiency of light production.

MATERIALS:
3-nitrophthalic anhydride Hydrazine sulfate Hydrated sodium acetate Glycerol Boiling chip Thermometer NaOH (10% solution) Sodium hydrosulfate Glacial acetic acid Potassium ferricyanide [K3Fe(CN)6] Hydrogen peroxide (3%) (commonly obtained) HCl Laptop Vernier Lab Equipment (Lab Pro, digital thermometer, light meter)

Results
According to my results approximately .0180% of the energy generated by luminol will escape the system as light. There may be more light created, but it will only heat the solution of the system or be absorbed or transformed into heat somehow.

Conclusions/Discussion
I feel that I learned a lot from this experiment not only about chemiluminescence and light conversion, but also about how to do a better experiment. I was able to pull together information from many different sources and devise a method for measuring an abstract value. Even though there were many variables associated with this project, I feel that for future experiments I now have the knowledge needed to properly access such variables.

Summary Statement
I determined the percent of total energy released by luminol that is converted into visible light.

Help Received
I would like to acknowledge Mr. Ferazzi for his aid in steering me toward chemiluminescence, providing me with the procedure on how to render luminol, and for giving me all the necessary lab equipment and time. I would like to thank Dr. Biessmann of the UCI Developmental Biology Center for providing me

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Ashley N. Muirheid

Project Number
S1515

Project Title
How Do Various Nonwoven Medical Gowns Compare as Barriers Against UV Radiation?

Abstract

Objectives/Goals
The objective of my project was to compare nonwoven medical gowns as barriers against UV radiation. The long-range application of my experiment would be to use the protective characteristics of medical gowns, in both UV and bacterial resistance, as a model for the design of new, UV-protective fabrics suitable for everyday clothing.

Methods/Materials
Seventeen nonwoven medical gown fabrics were tested for transmission and absorbance of UV radiation using a Spectronic 20+ spectrophotometer. Each sample, along with the control (an empty frame), was sandwiched between homemade frames and penetrated with UV radiation inside the testing chamber. The samples were also observed under a scanning electron microscope to determine surface characteristics of the samples.

Results
The higher-ranking fabrics were composed of threads that allowed for a closer entanglement of fibers, such as the best performer, a 55/45 woodpulp/polyester mix. Fabrics with a looser weave and a larger area of holes ranked lower, such as the worst performer, a light 100% polyester fabric.

Conclusions/Discussion
On average, when compared to other samples of the same composition, thicker and heavier fabrics performed better than the lighter and thinner types. However, the most significant factor in determining the rank of all tested samples was the area of air spaces. Larger holes permitted more UV radiation to pass through, which resulted in lower performance.

Summary Statement
Nonwoven medical fabrics with closer weaves perform better at blocking UV radiation because the porosity, which permits transmission of UV rays, is less.

Help Received
DuPont# and my science advisor graciously supplied the materials and equipment that I needed to conduct my experiment. Dr. D. B. from the Graduate Laboratory at Fresno State trained me on how to use a scanning electron microscope. My father helped me with the digital photographs.

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Anthony T. Nguyen

Project Number
S1516

Project Title
Thermoacoustics: Creating Sound with Heat

Abstract

Objectives/Goals
The objective is to understand and demonstrate the thermoacoustic phenomenon, which uses heat to initiate the oscillation of gas without moving parts. The second objective is to characterize the properties of a thermoacoustic engine. The third objective is to use solar energy to power the engine and to test different engine designs. My hypothesis is that the sound intensity, pitch and sound onset depend on the size of the resonant cavity and the power applied.

Methods/Materials
The engine is made of a thermoacoustic stack inside a Pyrex tube. Electrical power is applied at one end of the stack to create a steep temperature gradient along its length. When the temperature gradient exceeds a critical value, noise is generated. The stack is a solid matrix with flow channels. I studied three stack designs: a ceramic cube with flow channels, rolled metal foils with parallel channels and a wire mesh of random flow paths. I also used a parabolic solar concentrator to create the temperature gradient across the stack. I varied the stack position and the power levels to study the generated sound. Data collected include the applied power, time of sound onset, the temperature of the hot end, and the sound intensity and frequency.

Results
The results of my tests are divided into two sections. First, I fixed the stack position and plotted the hot temperature, the sound intensity, and time of onset as a function of the applied power. The temperature at the hot end and sound onset time decrease and the sound intensity increases as the applied power is increased. Second, I plotted the time of sound onset, the hot temperature and the applied energy as a function of the stack position. The time of onset, the temperature at the hot end, and applied energy are minimized when the stack is at the middle of the test tube. The frequency of the generated noise depends on the length of the test tube because the engine produces a standing wave with a wavelength that is four times the length of the test tube.

Conclusions/Discussion
The thermoacoustic engine can generate sound using only heat and without moving parts. It is environmentally friendly because it also uses inert gases as the working fluid and can be powered with solar energy or rejected heat. As the applied power to the stack is increased, the intensity of the generated sound is increased. The optimal position of the stack is near the middle of the test tube.

Summary Statement
I studied and tested different types of solar powered thermoacoustic engines to demonstrate that it is possible to generate sound by using applied heat and to determine the optimal working conditions of the engine.

Help Received
My mother helped format various materials. My father helped build the apparatus and edit the report.

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Tammy E. Prado

Project Number
S1517

Project Title
Swing, Pendulum, Swing!

Abstract

Objectives/Goals
In my project I intended to find out whether the length, amplitude, or weight of a pendulum affected its period of motion. Through research I hypothesized that the length, weight, and amplitude would affect the period of motion.

Methods/Materials
Procedures: 1. Assemble the pendulum frame using the diagram in appendix 1-3 as a reference. Attach the screw hook to the center of the upper wood frame. 2. According to the size of your pendulum frame, chose five different measurements for your independent variables, length (L), amplitude, and weight (W). 3. Attach your largest weight to the largest piece of fishing line that you can use. 4. When step 3 is completed attach the opposite end of the fishing line to the screw hook. 5. At this point you will bring the weight to the amplitude of (A) degrees, then release the pendulum. With a stopwatch measure the time period (P). Measure the period for twenty times. 6. After you have collected the data of the time periods, compute the average time period. 7. Repeat steps 3-6 using all different independent variables. 8. Compare and contrast all results. Ask yourself: were my hypotheses correct or incorrect?

Materials: To construct the pendulum frame: Wood (View the dimensions in the diagram in appendix 1-3); About a pound of nails to make the pendulum frame; Tools to build the pendulum; Saw blade, nail gun, wood glue, hammer; Screw hook; Protractor (measure the amplitude); Small weights: 20g-100g; Fishing line; Ruler; To measure the variables: Stopwatch.

Results
The results were that as I increased the length and amplitude the period of motion would also increase in duration. The effect that the weight had on the period of motion is inconclusive.

Conclusions/Discussion
My data showed two of my hypotheses to be correct. The period of motion was affected by the length and amplitude. Unfortunately one of my hypotheses was incorrect the weight didn't necessarily affect the period of motion.

Summary Statement
My project focuses on the period of motion of a pendulum and the factors that may affect its duration.

Help Received
Mr. Jerod Moore, Mr. Steve Haskell, Mr. Hampton, Mr. Johnson, Mr. Demunnik, Dr. Lutz, Jose Calderon, Dr. Scott

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Ray Ramirez

Project Number
S1518

Project Title
Wavelength Controlled Holographic Polarization

Abstract

Objectives/Goals
The project had two objectives. The primary objective was to design an optical system that polarized light based on the selective subtraction theory. The optical system would be designed in such a way as to serve as a platform to record polarizing holographic optical elements. The second objective was to chemically manipulate the holographic optical element in such a way as to selectively polarize specific wavelengths of light, while scattering or absorbing all others.

Methods/Materials
To accomplish the first objective, a glass-plate polarizer was constructed. The optical system consisted of standard holographic recording materials, including an isolated platform, optical mounts, a helium-neon laser, processing chemistry and a high resolution silver-halide holographic emulsion on polymer and glass substrates.

Results
The desired optical system was designed using a method known as selective subtraction via a glass-plate polarizer. Based on Brewsters theory of reflection, this polarizer systematically eliminated light of undesired polarization. The second objective was achieved by preswelling the holographic emulsion in a process known as presensitization. This technique utilizes the chemical triethanolomine (TEA), which is absorbed into the emulsion and later determines the reconstruction frequency of the holographic optical element.

Conclusions/Discussion
It was determined that the experimental methods utilized were an innovative and effective way to selectively polarize light, based on its initial wavelength and state of polarization. The polarizing holographic optical elements performed comparably with current polarizing technology.

Summary Statement
A holographic polarizer was produced that selectivley polarizes light based on its initial state of polarization and wavelength.

Help Received
Mr. Fred Unterseher, Columbia Career Center, Columbia Missouri.

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Ronalynn A. Ramos

Project Number
S1519

Project Title
Color vs. Heat Absorption: Comparing the Emissivity of Light for Different Colors

Abstract

Objectives/Goals
The objective was to see which colored jars had the highest emissivity (or absorbed heat the fastest) & which colors radiate heat the fastest by performing independent tests for heating & cooling the colored jars.

Methods/Materials
Nine of the 10 small jars were painted on the outside with different colors of enamel paint. The 10th jar was used as the control variable. For the heating testing, the colored jars were divided into 3 groups. Group 1: red, blue, yellow; Group 2: gold, silver, black; Group 3: white, green, purple. Each jar started with 80 mL of 24 degree C tap water. The worklight had 2 high-powered lights of 500 watts each and 4 jars were tested at a time (each group was tested 1 at a time; one jar always being the control) for a total of 3 tests for 1 heating trial. There were 2 jars per light, both 20 cm from the light and 3 cm from each other. The 4 jars each had calibrated glass thermometers in them to monitor the water temps. A foil wall was put between the 2 lights to keep light & heat from affecting the other light's jars. The temps were checked every 10 min. for a 100-min. period and recorded. For the cooling trial, 59 degree C water was poured into the 10 jars. The temps were checked and recorded the same way as the heating trial.

Results
The green jar heated the fastest with its temp rising to 63 degrees C at the end of the period. Blue followed with 59 degrees C. Black was near average, with 52 degrees C. Gold stayed coolest with 41 degrees C. All colors cooled at almost the same rate but Black always had the coolest temp compared to the other jars.

Conclusions/Discussion
The hypothesis was incorrect in the heating trial, but was supported in the cooling trial. During research a picture of the visible spectrum was found, showing blue and green with the thickest bonds. Maybe that's why the blue and green jars heated the fastest & appeared to have the highest emissivity. The black jar cooled the quickest maybe because it's color had the jar absorb the heat from the water. Green appeared to have the highest emissivity. It may be linked to why chlorophyll is green.

Summary Statement
If the colored jars were placed under a light source, the darkest color of the set would heat the fastest (or have the highest emissivity); if all colored jars were cooled from the same temperature, the darkest would cool the fastest.

Help Received
Mother helped glue pieces to board and assisted in boiling/heating the water.

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Jessica J. Rucker

Project Number
S1520

Project Title
Quantifying the Effect of Tungsten Illumination on Color Rendering of Low-Pressure Sodium

Abstract

Objectives/Goals
Low-pressure sodium vapor (LPS) is efficient and astronomer-friendly lighting, but its narrow band of emissions results in poor color rendering of illuminated objects. This experiment determines whether a model can be developed to predict the amount of broader-spectrum incandescent illumination required to supplement LPS in order to render near normal color perception.

Methods/Materials
Using a digital camera, I took over 1600 images of six Newtonian color targets illuminated by 4300 lux from an 18-watt LPS lamp and variable lux from a 100-watt tungsten lamp, ranging from 0 to 3080 lux regulated by a dimmer and measured photometrically. I developed a C++ computer program to convert RGB pixel data of each CCD image into CIE L*a*b values and to calculate delta E color differences against a 100% tungsten color reference. I established a "Color Rendering Value (CRV)" from 0-100 for each sample, based on a weighted average of the delta Es of the Newtonian spectrum. CRVs of samples were averaged and graphed to determine a best-fit mathematical correlation to CRV as a function of tungsten percentage.

Results
The CRV for illumination with 2.5% tungsten was 2.3, 3.4 with 15.0%, 13.7 with 26.0%, 30.1 with 35.9%, and 41.2 with 42.7% tungsten illumination. A model correlating tungsten percentage, "W", to color perception as indexed by CRV was derived: CRV = 38 arctan(.07 W - 3.2) + 49.5, with acceptable color rendition at CRV > 13.

Conclusions/Discussion
The results of this experiment indicate that LPS lighting augmented by approximately 26% tungsten illumination may render near normal color perception, with higher standards achievable with higher amounts of tungsten illumination. Applications of LPS combined with broader-spectrum illumination may present an alternative for outdoor lighting that is both color-acceptable as well as cost-efficient and environmentally responsible.

Summary Statement
This project examines the effect of tungsten illumination on color rendering of low-pressure sodium vapor light using computer analysis of CCD pixel data and derives a model correlating color perception to percentage of tungsten.

Help Received
Thanks to: Christian Luginbuhl at the US Naval Observatory for access to archives. John Hoot, computer scientist/astronomer, for information about CCDs. My dad for teaching me C++. Bruce Lindbloom, color scientist, for color analysis tutorials and encouraging my pursuit of LPS photometric research.

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Garrett J. Thompson

Project Number
S1521

Project Title
The Bigger They Are, the Higher They Fly: How Mass & Size Are Directly Related to Thrust in a Positively Charged Ion Fie

Abstract

Objectives/Goals
To determine if the current Internet "antigravity" technology craze, as exemplified by a device known as the "lifter" is in fact an unexplained antigravitational force or another known electronic force.

Methods/Materials
Xxtremely lightweight airframes of varying sizes was contstructed out of balsa wood and aluminum foil. Construction was designed, according to specifications available on the Internet, to create lift through corona discharge in an ion field (known as the Bifield-Brown Effect). The airframe was then hooked up to a high-voltage, low amperage power source. The thrust of the craft was measured with payloads of different masses, and compared with the thrust predicted by mathemathical models.

Results
Larger airframes could lift more mass, a result that was consistent with the thrust predicted by "ion breeze."

Conclusions/Discussion
The observed thrust coudl be accounted for by known electrical phenomena, and are not evidence of a previously unknown antigravitational effect.

Summary Statement
To explore the physical and electronic principles behind so-called "anti-gravity" devices.

Help Received
Dad helped print color pictures, mom helped design layout. Friend of dad's supervised wiring of high-voltgage components.

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Karina Torres

Project Number
S1522

Project Title
Specific Heat in Materials

Abstract

Objectives/Goals
My project was done to see what material would stay with the most heat after being heated and cooled. By konwing this, one could see how the climate in different places is effected by the materials around them.

Methods/Materials
The materials that were tested were water, salt and tap, sand, soil, and oil, corn and car. I placed the material in a container and situated the two thermometers, one in 2 cm. deep and the other on the surface. The lamp was put a couple of centimeters over the material and turned on for 1 hour. Every 5 minutes the temperature was checked for each thermometer. After hour was over the light was turned off and again the temperature was recorded every 5 minutes. This was done 3 times to every material for the 3 trials.

Results
After testing the result was the that sand and soil did not absorb so much heat and when it did it was released easily. The oils absorbed a lot of heat and ended up losing a lot of it but not as fast as the Earth materials. The waters absorbed little heat but kept it in. The end result was that the oils ended up with the most heat since it accumulated so much but did not release it all. The water was the second with the most heat since it did not release it. Last was the Earth materials which released all their heat.

Conclusions/Discussion
My project shows how heat is absorbed and released by different materials. This project ties in with the climate by showing how you may be able to predict how the climate is in one place by knowing what is around. If a city is by the beach, like Oxnard, it will have nice weather because the ocean will keep in the heat. It will not be so hot or so cold. Other places that do not have a body of water around them get hotter since the soil does not contain the heat.

Summary Statement
My project shows how different materials relate with heat to effect the climate.

Help Received
My brother, Juan, helped by typing somethings for my board and Mr. Callaway gave me thermometers and other equipment to use.

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Matthew L. Ward

Project Number
S1523

Project Title
The Focalization of Sound

Abstract

Objectives/Goals
Scientists have been able to focus sound waves by transmitting an ultrasonic wave in a straight line that can give off audible sound in its path. The only disadvantage to this is the high cost. This project was designed to develop a low-cost process of focusing sound using a parabolic dish and sound-absorbent material.

Methods/Materials
The project began with the building of a sound box to test different materials in. The box (20.75 in. x 15 in. x 16 in.),made of particleboard,had one open end and served as a confined space to test the sound characteristics in. A speaker was suspended in a cradle and was capable of moving inward and outward 1 in. A constant sound frequency was transmitted at a level of 105 dB through the speaker. The project consisted of 3 small tests and 1 final test. The 1st test was to determine if the material of the parabolic dish affected its sound focusing capabilities. Measurements were taken from many locations around each parabolic dish (inside the box) using a decibel meter. The 2nd test determined if the position of the speaker affected how sound was focused. Measurements were taken with the decibel meter at many different locations to determine if the speaker directed sound best from 2,3,or 4 in. from the back of each dish. The 3rd test was to determine whether sheet rock,styrofoam,or fiberglass insulation absorbed the most sound. These materials were cut to line the walls of the sound box. For each material,sound measurements were taken 1 ft. from the outside of the box. The final test combined the results of the previous 3 tests to determine if it is possible to focus sound.

Results
The 1st test indicated that the glass dish was the most capable of focusing sound. The 2nd test yielded that sound waves were more focused when the speaker was placed 2 in. from the rear of the dish. The 3rd test showed that fiberglass insulation was the most capable of absorbing sound. Thus, the final test consisted of a measuring of the sound with the speaker 2 in. from the back of the glass dish that was situated inside the fiberglass insulation-coated walls of the box. The sound was able to be focused 3-5 ft. in front of the dish,while the spread of sound was limited in other directions.

Conclusions/Discussion
The data collected supported the hypothesis that sound could be focused using a parabolic dish and sound-absorbent material. Also,this process of focusing sound is very cost-effective.

Summary Statement
My project utilizes a parabolic dish and sound-absorbent material to focus sound, generated from a speaker, in a certain direction without the spread of audible sound waves in all directions.

Help Received

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
David A. Woodbury

Project Number
S1524

Project Title
Shielding of Neutron Emission Ratio Observer from Neutrons Produced by Cosmic Rays

Abstract

Objectives/Goals
To investigate the cosmic ray neutron attenuation effects of passive and active shielding on the neutron emission ratio observer (NERO), a low-energy neutron detector.

Methods/Materials
Passive shielding consisted of water, boron carbide, and a combination of the two materials. Active shielding consisted of a VETO gate using the inputs of the neutron detector and a coincidental signal from two plastic scintillators.

Results
Boron carbide absorbed 13% of neutrons, water 42%, and a combination of the two, 48%. Active shielding was shown to reject NERO signals, and the rejected signals were shown to have been confined to the neutron-specific energy ranges.

Conclusions/Discussion
Both boron carbide, water, and a combination of the two were shown to be effective neutron attenuators. Active shielding was shown to be effective, but because of a short time window in which NERO signals were rejected, only about 0.7% of the total neutrons were rejected. This problem could be fixed by using a longer time window to account for the difference in processing speed between the scintillators and neutron detector.

Summary Statement
My project tests the effectiveness of shielding a low-energy neutron detector from neutrons produced by cosmic rays.

Help Received
Participant in Michigan State University High School Honors Science Program. Used lab equipment at National Superconducting Cyclotron Laboratory at Michigan State University under the supervision of Dr. Hendrik Schatz. NERO is sponsored by the Joint Institute for Nuclear Astrophysics.

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Tom Yang

Project Number
S1525

Project Title
The Effect of Temp. on the Voltage of Potassium Sodium Tartrate (Rochelle Salt) Crystals by the Piezoelectric Effect

Abstract

Objectives/Goals
My objective was to determine the effect of temperature on the piezoelectric effect of Rochelle salt crystals. My hypothesis was that higher temperatures would yield higher voltage values, and that lower temperatures would yield lower voltage values, based on the fact that resistance decreases as temperature increases.

Methods/Materials
The materials used were a three-beam balance, burner, computer, aluminum foil, voltmeter, cardboard, refrigerator, hammer, water, and potassium sodium tartrate (Rochelle salt).

Crystals of Rochelle salt were grown, under identical conditions. Then the crystals were taken out and struck with a hammer various times in order to measure the piezoelectric effect (the voltage produced). The temperatures of the crystals tested were altered to test the hypothesis. There were about 4 to 5 crystals tested and about 100 measurements for each temperature range. There were three temperature ranges: -5 degrees C; 20-25 degrees C; 40-50 degrees C. The measurements taken were voltage levels produced when crystals were struck.

Results
In the low temperature range (-5 degrees C), the mean voltage displacement was 0.053 volts. In the room temperature range (20-25 degrees C), the mean voltage displacement was 0.23 volts. In the high temperature range (40-50 degrees C), the mean voltage displacement was 0.060 volts. These show that temperature does effect the piezoelectric effect.

Conclusions/Discussion
The results showed that my hypothesis was partly correct and partly wrong. The lowest temperature range did have the lowest voltage displacement, but the room temperature range, not the highest temperature range, had the highest voltage displacement. The results show that the piezoelectricity of Rochelle salt crystals are not proportional to temperature, and is most efficient at room temperature.

Summary Statement
My project is about determining the effect of temperature on the piezoelectric effect of Rochelle salt crystals.

Help Received
Mom helped clean up project; Mr. Antrim lent me equipment; Mr. Nakaue gave me advice.