# CALIFORNIA STATE SCIENCE FAIR
# 2010 PROJECT SUMMARY

**Name(s)**
Caylin Canales; Daniel Godinez

**Project Number**
**J1901**

**Project Title**
## Aging the Stars

**Abstract**

**Objectives/Goals**
We wanted to know how old is Monoceros R2, a little-researched start cluster in the Unicorn Constellation. We took images of Monoceros R2 using the Faulkes Telescope in Australia. We took them in two different filters, red and infrared. Using the programs SalsaJ and DS9, we analyzed the intensity of the stars and made a color-magnitude diagram. Once we got the color-magnitude of Monoceros R2, we compared it to other clusters with a known age. We then determined that Monoceros R2 could be around 100 million years old, but very likely is no more than 2.6 billion years old.

**Methods/Materials**
#A good computer with internet access
#The computer programs SalsaJ, DS9, GIMP 2, Microsoft Excel & Word
#Access to time on a high-quality telescope (we used the 2-meter Faulkes Telescope in Siding Springs, Australia)
#The coordinates of a star cluster you wish to study.
#Instructions and downloads from the Faulkes Telescope website on the following:
oPhotometry with SalsaJ
oScaling Images with DS9
oGIMPShop
#An Excel file called Color Magnitude Diagram (CMD) Plotter from Faulkes Telescope website.
#Most importantly, a good supporting science teacher. :)

**Results**
We were correct about Monoceros R2 being a young cluster. All of its stars still appear to be burning up their hydrogen and helium and therefore they're still in the main sequence. There seems to be some sort of turnoff happening, but we don't have enough data to predict that some of the stars are about to evolve into Red Giants. But it is reasonable to say that Monoceros R2 open cluster is a young cluster that might be about 100 million years old, but probably no more than 2.6 billion years old.

**Conclusions/Discussion**
In conclusion, the data support the hypothesis. We conclude that Monoceros R2 is a young cluster. All of its stars are still fusing their hydrogen into helium. Therefore, they are nowhere near evolving into the Red Giant Branch (RGB). Our data seems reasonable because Dr. Rachel Street used the same images to make her own color-magnitude diagram and got identical results.

**Summary Statement**
We found the age of a recently discovered star cluster, Monoceros R2.

**Help Received**
Science teacher supported us in every way she could since October. Such as giving up her own time to discuss information with us.

# CALIFORNIA STATE SCIENCE FAIR
## 2010 PROJECT SUMMARY

**Name(s)**
Caleb J. Brown

**Project Number**
**J1902**

**Project Title**
# Where in the World? Finding Your Location Using Gravity, the Earth's Magnetic Field, and a Sundial

**Abstract**

**Objectives/Goals**
Determine if one can find his/her location on the earth using a Foucault's pendulum, a compass and a sundial to triangulate their position.

**Methods/Materials**
I used the shortest shadow of a home-made sundial to determine true north and a compass pointing to magnetic north to determine the angle of declination in three different geographic locations (Irvine, CA; Riviera, TX; Cabo San Lucas). I set up a Foucault's pendulum in these three locations and based upon the speed of rotation, calculated the latitude by sin(latitude)=(rotation in degrees per hour)/15. Four of the five pendulum trials for each location used this formula (one was considered an outlier and not used) and then they were averaged.

**Results**
Irvine, CA has an actual latitude of 34.0 and longitude of 118. I calculated a latitude of 35.03 and a longitude of 117.
Cabo San Lucas has an actual latitude of 22.5 and longitude of 109.5. I calculated 24.33 and 109.
Riviera, TX has an actual latitude of 27 and longitude of 98. I calculated 25.6 and 97.5.

**Conclusions/Discussion**
One can calculate his/her position on the globe using a compass and a sundial to get the degrees of declination and using a Foucault pendulum to find one's latitude. Of the three measurements needed to determine one's position, magnetic north and true north are more easily measured than the rotation of a pendulum. A more accurate determine of one's location could be made with a much larger and heavier pendulum. (Foucault's original pendulum was 67 meters tall and weighed 28 kilograms.) While this method of finding your location could have been used for centuries, I could find no evidence that this has been done before.

**Summary Statement**
My project was to see if you can determine your location on the globe using only a sundial, a compass and a Foucault's pendulum.

**Help Received**
A friend helped me build the pendulum; Dad & my brother helped set up the pendulum in each location, Mom helped with typing for report and board.

# CALIFORNIA STATE SCIENCE FAIR
## 2010 PROJECT SUMMARY

**Name(s)**
Gaurav A. Budkule

**Project Number**
**J1903**

**Project Title**
## Thermoelectric Effect

**Abstract**

**Objectives/Goals**
The objective of my project is to determine how does a change in temperature affect the voltage being generated due to the Thermoelectric Effect. The Thermoelectric Effect is a phenomenon that generates voltage due to a temperature difference between two connected metals. I believe that more of a temperature difference generates more voltage.

**Methods/Materials**
The final experiment was conducted using a Seebeck device connected to a multi-meter. A lamp, ice cubes, and room temperature in 6 different combinations were used to create a temperature difference on both sides of the device. An infrared thermometer was used to record the temperature on both sides of the device and generated output voltage was recorded using multi-meter. Before using a Seebeck device, conventional metals like copper and aluminum were used to attempt to replace the device but the experiment did not produce measureable voltage.

**Results**
The results matched my hypothesis where more voltage was consistently being generated when the temperature difference was higher.

**Conclusions/Discussion**
My conclusion is that because more of a temperature difference generates more voltage this phenomenon can be used to convert excess heat/cold into usable electricity. More research is required in this area to see how much wattage we can get.

**Summary Statement**
My project studies the relation between the temperature difference of two connected metals and voltage generation due to the Thermoelectric Effect.

**Help Received**
Parents helped in typing, formatting and proofreading the report; Parents helped in purchasing materials and record some data; Parents taught how to create graphs in Excel

# CALIFORNIA STATE SCIENCE FAIR
## 2010 PROJECT SUMMARY

**Name(s)**
SavanahRose Castillo

**Project Number**
**J1904**

**Project Title**
## Determining If Temperature Affects the Tune of the Guitar

**Abstract**

**Objectives/Goals**
My project was to determine whether or not temperature has an effect on the tune of the guitar. I believe that if the temperature is warm enough the tune of the guitar will drop and if the temperature is cool enough it will go higher in tune.

**Methods/Materials**
There was one Prime Classical Quart Bass Guitar. One room set to two different temperatures,one at 16 degrees celsius and 32 degrees celsius, at different times. I also used one battery operated tuner to locate how high or low the pitch changed.

**Results**
The guitar that was set in a room of a temperature at 32 degrees celsius ended up dropping lower in pitch. After, when the guitar was set in a room at a temperature of 16 degrees celsius it raised higher in pitch.

**Conclusions/Discussion**
My conclusion is that temperature does effect the tune of the guitar.

**Summary Statement**
My project is about trying to determine whether or not temperature has an effect on the tune of the guitar.

**Help Received**

# CALIFORNIA STATE SCIENCE FAIR
## 2010 PROJECT SUMMARY

**Name(s)**
Spencer G. Ford

**Project Number**
**J1905**

**Project Title**
## Do Solar Cosmic Rays Affect the Earth's Magnetic Field?

**Abstract**

**Objectives/Goals**
I wanted to find out if there was a correlation between the number of cosmic rays I could detect and where the Earth's magnetic pole is located. The solar wind, which includes solar cosmic rays, can move the Earth's magnetic north pole. I believe that I can find a correlation between the two

**Methods/Materials**
To perform this project, I built a magnetometer from an empty 2-liter soda bottle and I built a cloud chamber out of an aquarium. Every night, I would take readings from the magnetometer and the cloud chamber. Data recorded from the cloud chamber will be in five minute sessions. After about a month of testing, I will see if there is a correlation between the number of cosmic rays I could detect and the position of the Earth's magnetic field.

**Results**
The laser beam of the magnetometer struck the wall at an average location of 16.4 cm on the ruler. The highest point was 22.9 cm and the lowest point was 8.1 cm. The average number of cosmic rays per minute I detected was 29.9. The lowest was 10.6 per minute and the highest was 56.2 per minute.

**Conclusions/Discussion**
There was no correlation between the cosmic ray counts and the magnetometer readings. The NOAA/NWS website indicated that there was very little solar activity this month, so the magnetic north pole was probably not moving much and the cosmic rays I detected were probably mostly galactic cosmic rays and anomalous cosmic rays, not solar cosmic rays.

**Summary Statement**
I wanted to see if there was a correlation between the quantity of solar cosmic rays and the location of the magnetic north pole.

**Help Received**
Dad helped me to build the equipment and handled the isopropyl alcohol. Mom helped me lay out the backboard.

# CALIFORNIA STATE SCIENCE FAIR
## 2010 PROJECT SUMMARY

**Name(s)**
Noah M. Goodman

**Project Number**
**J1906**

**Project Title**
## Moon Mass: To Wobble or Not to Wobble?

**Abstract**

**Objectives/Goals**
The objective is to determine how the mass of a moon affects its wobble. I hypothesize that if the mass of the moon increases, the moon will wobble more in its orbit.

**Methods/Materials**
1. Find a planetary simulation computer program
2. Alter it so that it can do the following:
a. Adjust the mass of the moon (this is the independent variable
b. Can record the distance of the moon from the earth
c. Has the same (starting) mass and everything else as the moon, earth, and sun (independent)
d. Allows you to see the universe centered on the earth, moon or sun
3. Run the computer program multiple times, adjusting the mass of the moon.
4. Map data into excel and graph to visualize the wobble over time.

**Results**
The wobble of the moon increased as the mass increased. When the mass of the moon exceeded the mass of the planet, the moon no longer orbited the planet, it escaped its orbit.

**Conclusions/Discussion**
As the mass of a moon increases it wobbles more. Eventually, if a moon becomes too massive, it will leave its planetary orbit completely.

**Summary Statement**
I created a planetary simulation program to discover how a moon's mass affects its wobble.

**Help Received**
My cousin, Josh Herbach, helped design the planetary simulation program.

# CALIFORNIA STATE SCIENCE FAIR
## 2010 PROJECT SUMMARY

**Name(s)**
Callista S. Hesseltine

**Project Number**
**J1907**

**Project Title**
## Year of the Sun

**Abstract**

**Objectives/Goals**

"The sun shines and warms and lights us and
we have no curiosity to know why this is so."
~Ralph Waldo Emerson

Some people have the curiosity though and I am one of them. That is why I did my experiment on solar flares. If you think the sun is a pretty orange ball warming our day, think again. If you were to go up close to the surface and watch its activities you would see violent explosions every second of every day. The explosions release energy that causes light. Some of the explosions create electromagnet storms that are carried to Earth by solar wind. When they hit Earth's magnetic field they cause anything from radio disturbances to the Auroras. About every 11 years these storms reach their maximum amount of activity. I investigated whether or not this was the year the sun had reached the height of its 11 year solar flare cycle.

**Methods/Materials**

I built a magnetometer out of a soda bottle. Inside the soda bottle was a magnet and mirror glued to an index card which was attached to a string that was hanging from the cap. I had a light at angle of 45 degrees away from the bottle and the light reflected off the mirror onto a centimeter chart hanging on the wall that I made. When the solar storm came and hit the magnet, the magnet moved thus causing the light to bounce off the mirror at a different angle landing at a different spot on the chart. I observed for 30 days whether the magnetometer moved or not indicating a solar storm affecting earth's atmosphere.

**Results**

The magnetometer moved 14 times but only 1 of those times did I detect a solar storm. The rest of the times either the magnetometer was attracted to my cell phone, scissors, or a car passing by.

**Conclusions/Discussion**

Since in the height of the 11 year solar flare cycle there are normally 3 storms a month and I only detected 1, I conclude it is too early to tell whether or not this is the year the sun reached the height of its cycle.

**Summary Statement**

I recorded solar flares coming and disturbing Earth's magneticfield using a magnetometer.

**Help Received**

mother helped type; parents helped make magnetometer

# CALIFORNIA STATE SCIENCE FAIR
# 2010 PROJECT SUMMARY

**Name(s)**
Michael L. Janner

**Project Number**
**J1908**

**Project Title**
## The Effect of Ocean Acidification on the Acoustic Properties of Water

**Abstract**

**Objectives/Goals**
The objective of my experiment was to determine if the acidification of Earth's oceans would have an effect on how sounds traveled through ocean water, and if there was an effect, which frequencies of sound would be most affected.

**Methods/Materials**
A 3 inch by 10 foot drain pipe was filled with water of five different acidities (pH 5 - pH 9). Five frequencies of sound (2,500 Hz, 1,900 Hz, 1,300 Hz, 700 Hz, and 200 Hz) were generated at one end of the drain pipe with amplitudes of 95 decibels (dB). The amplitudes of the sounds were then measured in all acidities of water using a decibel meter at 5 and 10 feet away from the source. This process was repeated 10 times for a total of 500 individual tests. Using the amplitudes of the sounds at both distances, the attenuations of the sounds were calculated and compared.

**Results**
The results showed that changing the acidity of water did not cause sounds to attenuate differently. This was consistent for all of the frequencies of sound used in the project. The greatest average change for one specific frequency between two different pH levels was 0.5 dB, while most of the changes were near 0.3 dB. Both of these changes were insignificant, considering that all of the sounds were generated at 95 dB.

**Conclusions/Discussion**
This experiment was conducted because, although there were many reports regarding how ocean acidification would affect sound, few of these reports referenced a scientific investigation. The results showed that the acidity of water did not affect the attenuation of sound. This disproved my hypothesis. Most reports that claimed that ocean acidification would affect sound levels estimated that sounds would travel 60 to 70 percent farther underwater with a decrease of 1 pH unit. This experiment had a total pH decrease of 4 units. Also, five different frequencies of sound were tested, most of which were low frequency. Most reports suggested that if any sounds were affected by ocean acidification, low frequency sounds would be affected the most. Therefore, because no change in attenuation was measured with low frequency sounds, it is very unlikely for any sounds to be affected by a change in water acidity. The results of this experiment suggest that ocean acidification will not increase sound levels in the oceans.

**Summary Statement**
My experiment tested the effect of ocean acidification, caused by the oceans' absorption of carbon dioxide emissions, on the attenuation of sounds underwater.

**Help Received**
Michael Levernier, an engineer, answered questions in person, through e-mail, and over the phone.

# CALIFORNIA STATE SCIENCE FAIR
## 2010 PROJECT SUMMARY

**Name(s)**
Ronja M. Johnson

**Project Number**
**J1909**

**Project Title**
## Boiling Water: Keep Your Lid On!

**Abstract**

**Objectives/Goals**
The goal of this project is to determine whether water boils faster in a closed container than one which is open. In addition, is there a related difference in the amount of energy used and is this a method for reducing energy usage?

**Methods/Materials**
Using pre-measured bottled water, and one stainless steel pot, taking temperature readings at regular intervals, and noting the time at which boiling took place. The pot was brought back to original temperature with an ice water bath.
Stainless Steel pot w/ handle and Lid
20 x 16.9 fl oz water bottles
Thermometer (degrees F)
Gas Stove (High Heat setting 8)
Timer
Digital Camera

**Results**
The project gave results as expected. The maximum temperature reached with no lid was 212°F. With the lid on, a temperature of 213°F was the high.
According to the data, it took an average of 407 seconds or 6 minutes and 47 seconds to reach the boiling point without a lid. The average time with a lid was only 346 seconds or 5 minutes and 46 seconds. This is a 25% decrease in the time to boil the water. This reduction in time also reduced the amount of energy needed to reach the boiling point.

**Conclusions/Discussion**
The data from these experiments demonstrated my hypothesis to be accurate. Since we are almost at sea level, the pressure from the lid would force a higher boiling temperature. The boiling temperature was 212°F, regardless of the pressure due to the lid. The maximum temperature of the water exceeded the boiling point when the lid was used.
The trapped water vapor and heat caused the temperature in the water to exceed the boiling temperature. The time to reach the boiling point with a lid on the pot was reduced by an average of 25% or 1 minute and 1 second. In order to cut down boiling time and energy usage, keep your lid on#

**Summary Statement**
Does the use of a lid help reduce the time to boil water in a pot? This project looks at a simple way to reduce energy usage in everyday life.

**Help Received**
My mother helped me with the the organization of my display, and my Dad helped me with graphing the data and helped with the tests themselves.

# CALIFORNIA STATE SCIENCE FAIR
# 2010 PROJECT SUMMARY

**Name(s)**
Vikram Kalahasthi

**Project Number**
**J1910**

**Project Title**
## Orbits and Objects: The Influence of Gravitational Pull on Celestial Objects

**Abstract**

**Objectives/Goals**
The objective of my project is to see if a star's gravitational field strength would have any effect on the elliptical path of the comet that orbits the star.

**Methods/Materials**
I used an iron bolt, fish hook weighing scale, stand (desk lamp), disk magnets, a pushpin, floss/string, and a flat iron wrench. First, I made an oscillating pendulum using the desk lamp, floss, and iron bolt. Then, I found the magnetic field strength of each magnet. Next, I made a measuring chart using 21 concentric circles. Finally, I rotated the bolt in the influence of magnets and traced its path using 4 groups - 4 magnets, 8 magnets, 12 magnets, and no magnets.

**Results**
I found out that the most elliptical orbit was caused by the strongest magnet, and the least elliptical path was caused by no magnets.

**Conclusions/Discussion**
The strongest magnet caused the most elliptical path. The results mean that if the star has a strong gravitational pull, the comet that orbits the star will have a very elliptical path and vice versa.
By creating a model, a prediction can be made on when a comet will hit Earth.

**Summary Statement**
The central focus is how stars of different gravitational pulls affect the path of the comet that orbits the star.

**Help Received**
Father helped buy materials.

# CALIFORNIA STATE SCIENCE FAIR
## 2010 PROJECT SUMMARY

**Name(s)**
Janelle V. L'Heureux

**Project Number**
**J1911**

**Project Title**
## Experimenting with Surface Tension

**Abstract**

**Objectives/Goals**
Although many do not know about it, surface tension has many important impacts on life. For example, it is essential for the transfer of energy from wind to water to create waves, as well as creating a habitat for some insects to walk on water. In this experiment, the question that was tested is whether the surface tension of a liquid will increase due to cold or hot water. The objective was to prove my hypothesis correct, which was that the surface tension would increase as the liquid's temperature decreased.

**Methods/Materials**
A single-beam balance made of wood was built with a hanging needle on one end, and a small rectangular piece of foil suspended at the other end. The needle was placed extremely carefully on the surface of the water, and water drops on the foil acted as weights on the other end to pull the needle off. By using a thermometer, seven different temperatures ranging from 10 to 49 degrees Celsius were used, and various amounts of water drops were required to break the surface tension. There were two different liquids tested, including water and water with detergent.

**Results**
The results remained similar for both liquids used. When the temperature of the liquid increased, the surface tension decreased. Even though detergent greatly decreases the surface tension of water, the change in temperature still had a measureable effect.

**Conclusions/Discussion**
While executing the procedures, there were a few questions that came up. For example, what is the maximum surface tension before water freezes, and what is the highest temperature in which surface tension could be measured. Due to limits of study, certain temperatures could not be reached, and the counterweights were not completely accurate. However, the overall experiment was definitely a success, and there were many significant and fascinating concepts learned throughout the process.

**Summary Statement**
In my experiment, different temperatures were used as independent variables in order to increase and decrease the surface tension of water.

**Help Received**
Dad helped perform the experiment

# CALIFORNIA STATE SCIENCE FAIR
# 2010 PROJECT SUMMARY

**Name(s)**
David R. Lester

**Project Number**
**J1912**

**Project Title**
## Synthesis of Piano Notes

**Abstract**

**Objectives/Goals**

I was curious about the sound of piano and wondered if it was possible to create notes that sounded as realistic as the piano notes and better than my electronic keyboard. Since a keyboard uses electronics rather than strings to generate sound, I wondered how close the electronic keyboard actually comes to correctly reproducing the sound of piano notes.

By studying the properties of piano sounds and reproducing these sounds using MATLAB, the notes of the piano can be synthesized with greater precision than is achieved by an electronic keyboard.

**Methods/Materials**

I learned how to progam in MATLAB, a mathematical/engineering program. Using MATLAB I created a fundamental frequency to mimic a "c" note. I recorded the sound of seven "c" notes on the computer and found that each note not only has harmonics but also inharmonics. I duplicated the harmonics and inharmonics of the piano using MATLAB. I also recorded the electronic keyboard notes and found that my synthesized notes sounded more like a piano than the keyboard.

Materials- Samick upright piano/ Yamaha Midi keyboard/ Microsoft Sound Recorder/ MATLAB computer program/ Cyber Acoustics microphone/ Dell laptop computer.

**Results**

After matching up the fundamental frequency, harmonics, and inharmonics, I found that my note sounded more like a piano then the keyboard. I learned that the sound of piano notes decays exponentially. Once all these terms (harmonics and inharmonics) were programmed, it was hard to tell the difference between the actual piano note and the synthesized note. The results showed that as the notes increased in frequency, less harmonics were evidenced both in the piano spectrum and the keyboard spectrum. As the frequency increased, the recorded piano notes showed a shorter time duration, whereas the keyboard notes showed a nearly constant duration. The keyboard notes sound more artificial at the higher frequencies than at the lower frequencies. My synthesized notes sound more like a piano than the keyboard.

**Conclusions/Discussion**

My hypothesis stated that the notes of a piano can be synthesized with greater precision than that produced by an electronic keyboard. After doing my project and spending time analyzing the results, I came to the conclusion that it is possible to create your own synthesized notes which sound better than the notes of a keyboard.

**Summary Statement**

Using MATLAB, a mathematical/engineering program, I was able to generate a fuller sounding piano note than one produced by an electronic keyboard.

**Help Received**

Grandfather and uncle helped understand MATLAB and helped record notes; Mother helped type report

# CALIFORNIA STATE SCIENCE FAIR
## 2010 PROJECT SUMMARY

**Name(s)**
Kieran S. Mital

**Project Number**
**J1913**

**Project Title**
# Measuring the Effect of Sugar Concentration on the Refractive Index of Water Using a Home-made Laser Refractometer

**Abstract**

**Objectives/Goals**
The objective was to measure the affect of sugar concentration on the refractive index of water as measured using a homemade laser refractometer. The hypothesis was that the refractive index of sugar solution increases as the concentration of sugar increases.

**Methods/Materials**
Materials: Laser pointer with built-in level,hollow, plexiglass prism that is 45mm eq. x 45mm, organic cane sugar, precision weighing scale that measures from .1 grams - 100 grams, distilled water, aluminum level ruler that is 1220mm, styrofoam block (320 x 145 x 65mm), cast iron stands (4" x 3"), steel, adjustable clamps (0-160mm), a plastic funnel (Dia30x5mm, depth40mm), glass graduated cylinder (100ml), wooden metric ruler (300mm).
Method: Pass the laser light through the hollow prism that has a sugar solution and record where this hits on a vertical metric scale and calculate the refraction distance. Repeat this 3 times for each concentration. In addition, the whole experiment set was repeated a total of three times to get the right resolution for low concentrations.

**Results**
1. In the first experiment set , concentrations <1g/100ml had negligible differences in refraction distance but for concentrations >1g/100ml, the higher the sugar concentration, the higher the refraction distance but the difference between readings was small (about 2mm for every 5g/100ml).
2. In the second experiment set, the higher the concentration, the higher the refraction distance. Also higher resolution was obtained(about 8mm for every 5g/100ml compared to 2mm in Exp Set 1).
5. In the third experiment set, the higher the concentration, the higher the refraction distance even for <1g/100ml with significantly higher resolution (about 8mm for every 1g/100ml)

**Conclusions/Discussion**
1. The higher the sugar concentration, the more light bends (higher refractive index). The refractive index is increasing because the solution is getting #thicker# creating a denser medium with a higher refractive index.
2. The resolution of the refractometer increases with Projection Distance.
The relevance of these conclusions is that this kind of setup could be used in mass production of soft drinks and other liquids with dissolved sugar. Such a refractometer could be part of the pipes that the liquid flows through and measures the amount of sugar continuously. If there is too much, it signals to add more water, if there is too little, it signals to add more sugar.

**Summary Statement**
The refractive index of light was shown to increase with sugar concentration using a home-made laser refractometer which has important industrial applications.

**Help Received**
My Mother helped with my board and my Father helped with the apparatus setup and using Excel for graphs

# CALIFORNIA STATE SCIENCE FAIR
## 2010 PROJECT SUMMARY

**Name(s)**
Gathenji B. Njoroge

**Project Number**
**J1914**

**Project Title**
## Reflection Detection

**Abstract**

**Objectives/Goals**

To determine which airplane will reflect the least amount of light. The three airplane models are the B-2 spirit airplane model, the Boeing 767 model and the F-35 joint strike fighter.

I believe that the B-2 spirit airplane model will reflect the least amount of light. I believe that the Boeing 767 model will be in second place, while the F-35 joint strike fighter will reflect the most light.

**Methods/Materials**

Using Titebond wood glue, scissors, paper, and a ruler make three of each type of plane. Get a large box and cut a hole in it, to fit the LED flashlight. Fit the flashlight into hole in box. Underneath the flashlight, tape the sensor of the Lux meter. Tape LCD of the Lux meter outside the box. Build a stand for the planes to be on during the testing. The bottom should be made of a square piece of Styrofoam that is glued to the bottom of the box. Sticking up from the Styrofoam are four straws, one in each corner. Use a laser level to make sure the straws are all straight. Paint inside of box black using Asphalt undercoat spray paint. Place plane being tested on the stand. Turn on Lux meter and close box. Turn on flashlight and record reading that is observed on the Lux meter. Test all nine planes and record all the observed readings.

**Results**

I conducted the experiment a total of twenty-seven times and in all these experiments, the B-2 spirit airplane models reflected the least amount of light. On average, it reflected 10 lx. The Boeing 767 reflected an average of 15 lx. The F-35 Joint Strike fighter plane reflected an average of 30 lx. The experiment was fair. All planes were tested under the same conditions.

**Conclusions/Discussion**

My hypothesis was proven correct. The B-2 spirit airplane model reflected the least amount of light because it has a slim body and very few angles for the light to bounce off. The Boeing 767 model was second because it only has one vertical stabilizer. The Boeing 767 also does not have a big engine on the back. The F-35 joint strike fighter reflected the most light because it has two vertical stabilizers, two air intakes, and a large engine at the back. If I did this experiment again, I would use a different colored light, so that I could determine whether it would reflect light differently.

**Summary Statement**

The purpose of this experiment was understand how airplane shape affects the way it reflects light.

**Help Received**

My Mom bought me the Lux Meter, took me to the library, and proof read my project. My dad helped to spray paint the box and hold the box cover down as I took the readings.

# CALIFORNIA STATE SCIENCE FAIR
## 2010 PROJECT SUMMARY

**Name(s)**
Betsy V. Roy

**Project Number**
**J1915**

**Project Title**
## The Pendulum Snake

**Abstract**

**Objectives/Goals**
Objective: If I construct a pendulum snake then my model will provide a visual demonstration of the time keeping properties of pendulums, and of wave movement.

**Methods/Materials**
Materials and Methods: I used hex nuts for my pendulums, because they were easy to find and have a fairly consistent weight and a convenient hole in the middle. I used construction layout line because it is strong and was at the hardware store. I originally used a foam core support that had cuts in it like a staircase, but I made a new one out of wood, for more strength.

**Results**
Results: My research shows that yes, there is a visual way to show the time keeping properties of pendulums in a visually pleasing manner using a pendulum snake. From my table, and further research, I verified that the frequency of the pendulums = the inverse of the square root of their length. The frequency of my experiment is the number of swings in thirty seconds.

**Conclusions/Discussion**
Conclusion: My hypothesis is correct because by watching the pendulum snake you can see the different speed of the pendulums. I learned from this experiment that it is possible to understand the speed of pendulums by making a pendulum snake. By making a pendulum snake you can show people waves, and gain a deeper understanding of pendulums.

**Summary Statement**
A visual demonstration of the time-keeping properties of pendulums, showing a mesmerizing snake pattern.

**Help Received**
Father constructed support frame

# CALIFORNIA STATE SCIENCE FAIR
# 2010 PROJECT SUMMARY

**Name(s)**
Adam J. Shartle

**Project Number**
**J1916**

**Project Title**
## Snell's Law, Refractive Index, and the Speed of Light in Water

**Abstract**

**Objectives/Goals**
Measuring the speed of light in air is pretty difficult. It took Albert Michelson years to make an accurate measurement. Measuring the speed of light in water might be easier, using Snell's Law and the definition of refractive index. The goal of this study was to measure the speed of light in water, and to compare it to the speed of light in air.

**Methods/Materials**
To measure the speed of light in water, I used Snell's Law and the definition of refractive index. Using the CRC Handbook of Chemistry and Physics, I found values for the refractive index of air, and the speed of light in a vacuum.

Using a .8 mW diode laser, I measured the change in angle of the laser beam as it moved from air into water. To visualize the beam in water, I added a drop of Elmer's Glue to the water. Using a drafting program, I made protractors to measure the angle of the laser in air and in water. Measurements were made using angles in air of 30, 45, and 60 degrees.

**Results**
At an angle in air of 30 degrees, the angle in water was 22 degrees. At an angle in air of 45 degrees, the angle in water was 32 degrees. At an angle in air of 60 degrees, the angle in water was 40 degrees. Using Snell's Law and the definition of refractive index, the speed of light in water was found to be 225,000,000 meters/sec, 225,000,000 meters/sec, and 222,000,000 meters/sec. These values were off by 0.23%, 0.20%, and 1.17%, according to the handbook.

**Conclusions/Discussion**
This method was both precise and accurate. When measuring the angles in water, I repeated the measurements 5 times and got the same value each time. It really helped printing out the protractors. The speed of light in air is 299,705,543 meters/second, so light travels about 25% slower in water than in air. Even in water, light travels really fast, making it around the earth more than 5 times in a single second. It's amazing that I could measure the speed of light in water so accurately using a laser, a drop of Elmer's Glue, and some water!

**Summary Statement**
Using Snell's Law and the definition of refractive index, the speed of light in water was measured.

**Help Received**
Experimentation was performed at home, with my parent's supervision.

# CALIFORNIA STATE SCIENCE FAIR
## 2010 PROJECT SUMMARY

**Name(s)**
Kaitlin R. Spencer

**Project Number**
**J1917**

**Project Title**
## Music in Motion

**Abstract**

**Objectives/Goals**
My goal of this experiment was to test the frequency, amplitude, and magnitude of nine different clarinet notes as they pass through different mediums. These mediums consisted of air, glass, and velvet.

**Methods/Materials**
The experiment was conducted using a personal computer. Nine clarinet notes (found online), were played through air, velvet, and glass into a personal computer recording microphone. The frequency, amplitude, and magnitude of the notes were processed using MATLAB software.

**Results**
The amplitudes of all the notes decreased after traveling through any of the three mediums. The amplitude of the sound wave decreased the most when going through the velvet, and the least when going through the air. The glass medium#s amplitude was slightly higher than velvet. Most notes had about four main frequency points. Almost all of the trials performed produced consistent data, with little change. Most notes consistently showed that the medium did not affect the notes# frequency.

**Conclusions/Discussion**
All of the tested notes produced different frequencies, the highest notes and octaves of notes showing higher frequencies. Almost every notes# frequency did not change, even after traveling through different mediums. This may have been due to the mediums I tested. If mediums such as water or lead were tested, differences in frequencies may have been observed. The notes that did change were probably outliers and did not show logical patterns, and were most likely due to measurement or calculation errors. The amplitudes decreased the most when going through the velvet medium, followed by glass, and then air.

**Summary Statement**
The frequency, amplitude, and magnitude of nine different clarinet notes after traveling through three different mediums were tested.

**Help Received**
My father programmed MATLAB software in order for me to produce readable graphs showing the frequency, amplitude, and magnitude of the notes. My mother assisted in organizing the science fair board. My teachers gave advice and guidance concerning my experiment.

# CALIFORNIA STATE SCIENCE FAIR
## 2010 PROJECT SUMMARY

**Name(s)**
Brian M. Sussex

**Project Number**
**J1918**

**Project Title**
# What Are You Following? Will Following a Car with LED Brake Lights Attract the Attention of a Following Driver Quicker?

**Abstract**

**Objectives/Goals**
Can a car equipped with quicker illuminating LED brake lights, as opposed to incandescent brake lights, attract the attention of a following driver quicker thus reducing the stopping distance in an emergency breaking situation?

**Methods/Materials**
An electronic apparatus was constructed to test how quickly people react to the illumination of LED and incandescent lights. Several people were tested and the reaction times were compared.

**Results**
The test subjects reacted an average of .067 seconds quicker to the LED light as opposed to the incandescent light. This translates to 6.89 feet in stopping distance traveling at 70mph.

**Conclusions/Discussion**
One could conclude that drivers do react quicker to LED brake lights as opposed to incandescent brake lights, therefore making the LED lights safer.

**Summary Statement**
LED brake lights on cars attract the attention of a following driver quicker than incandescent brake lights.

**Help Received**
Dad helped with overall project; Dr. Dunn (teacher) gave me advice about how to do the project.

# CALIFORNIA STATE SCIENCE FAIR
## 2010 PROJECT SUMMARY

**Name(s)**
Adam E. Torres

**Project Number**
**J1919**

**Project Title**
## Can You Turn Down the Noise?

**Abstract**

**Objectives/Goals**
My goal was to produce two sound waves and switch one 180 degrees out of phase to counter and canel the other.

**Methods/Materials**
I used a circut board (dual opamp, resistors, capasitors, potentiometers) project box, barbed fitting, vinyle tubing, acrylic pipe, decibel meter, two eight ohm speakers, oscilloscope, four feet of speaker wire, plugs, connectors and two nine volt batteries.

**Results**
I was able to produce two audible sine waves at a set frequency and amplitude and by switching one of the sine waves 180 degrees out of phase within the acrylic pipe I was able to produce and measure sound cancelation with a decibel meter.

**Conclusions/Discussion**
By creating two sond waves at the same frequency 180 degrees out of phase they completely opposed each other and canceled each other out. Sound has the characteristics of wavelength, frequency, amplitude and volocity in matter. If you can create the opposite wave you can cencel out the original. This can be very useful to cacel out unwanted sound vibration that could be destructive to human hearing, machines and equipment and silent running such as in a submarine bearing noise. They are many useful applications for sound cacellation.

**Summary Statement**
My project proves that you can cancel sound by producing a second exact sound 180 degrees out of phase.

**Help Received**
My father helped build the circut board and borrowed the test equipment from his work.

# CALIFORNIA STATE SCIENCE FAIR
# 2010 PROJECT SUMMARY

**Name(s)**
James T. Uejio

**Project Number**
**J1920**

**Project Title**
## The Effect of the Shape and Symmetry of a Guitar on the Amplitude and Decay of Its Sound

**Abstract**

**Objectives/Goals**
My goal is to determine how the shape and symmetry of a guitar affects the amplitude and decay of the sound produced by the instrument.

**Methods/Materials**
I built four different shaped guitars: a square, rectangle, equilateral triangle, and a right triangle and controlled for volume. I built a reusable guitar neck with a single string of fixed length and tension. I placed the reusable neck on the guitars and plucked ten times displacing the string the same distance each time. Using a computer program, I measured the amplitude, in relative dB readings, from 0-1, and the decay, in seconds.

**Results**
The equilateral triangle guitar had the highest amplitude and decay, then the square guitar, then the right triangle guitar, and the rectangle guitar had the lowest amplitude and decay.

**Conclusions/Discussion**
When two waves travel at the same frequency and same distance and they interfere with each other, they produce a wave twice the height of the original waves. This is called constructive interference. All waves of the same pitch travel at the same frequency, so the waves radiate from the center of the hole throughout the guitar. If the distance from the hole to the side of the guitar is the same all around, it takes the same amount of time, and distance, to hit the side of the guitar and bounce back towards the middle. And if multiple waves do this, then when they collide, they will cause constructive interference. However, where the distance from the hole differs in each direction, such as in the rectangle, most of the waves take different time to bounce back from each side, and they all reach the hole at different times causing deconstructive interference. Also, each pluck of the string has the potential to give its highest amplitude and longest decay through constructive interference unless acted upon by another force. If there is more constructive interference, then the amplitude would be higher and the decay would be longer because it takes longer for a larger amplitude to decrease. My conclusion from my research and experiment is that it isn#t necessarily the symmetry that affects the amplitude and decay, but constructive, and deconstructive interference and the distance from the hole to the side of the guitar.

**Summary Statement**
To investigate how the shape and symmetry of a guitar affects the amplitude and decay of the sound produced by the instrument.

**Help Received**
Carpenter helped build guitars.

# CALIFORNIA STATE SCIENCE FAIR
# 2010 PROJECT SUMMARY

**Name(s)**
Gordon D. Williams

**Project Number**
**J1921**

**Project Title**
## Can Water Boil at Room Temperature?

**Abstract**

**Objectives/Goals**
The objective of this project is to measure the boiling pressure of water as the temperature is varied and see whether water can boil at room temperature.

**Methods/Materials**
A test system was built that had two subsystems: a heating subsystem and a vacuum subsystem. The heating subsystem consisted of an aluminum bowl that holds water, a heater and thermocouple in the bowl, and a temperature controller. The vacuum subsystem was made from a vacuum chamber, vacuum pump, pressure gauge, and valves.
The water was heated from 25 to 100 degrees C in 5-degree steps. The vacuum chamber was slowly pumped down at each temperature until the water boiled. The boiling pressure was recorded. Tests were repeated twice at each temperature.
Average boiling pressures were calculated and plotted as a function of temperature.

**Results**
The lowest temperature that water boiled at in this setup was 30 deg C, at 0.03 bar absolute pressure. The highest temperature was 98 deg C, at 0.99 bar absolute pressure (atmospheric pressure on the day of the tests).

**Conclusions/Discussion**
The boiling pressure was fairly repeatable for each temperature. The boiling pressure increased with the temperature in an upward curve. If the curve is extended to a lower temperature, it shows that water should boil at room temperature (20 deg C).

**Summary Statement**
The boiling temperature of water decreases as the pressure decreases below normal atmospheric pressure.

**Help Received**
My dad explained how to assemble the vacuum and electrical systems. I drew diagrams and put everything together except for epoxying in the wires. My neighbor showed me how to use his mill. My dad read the pressure off the gauge while the system pumped down.

# CALIFORNIA STATE SCIENCE FAIR
## 2010 PROJECT SUMMARY

**Name(s)**
Cynthia L. Yin

**Project Number**
**J1922**

**Project Title**
# How Is Friction Affected by Properties of the Inclined Surface and the Contact Object?

**Abstract**

**Objectives/Goals**
The objective of this project is to determine the effects on friction by the independent variables: incline material, incline angle, contact area, and contact object mass. I analyzed how each independent variable affected the following dependent variables: force applied to the contact object to produce motion, maximum static friction force, and static friction coefficient. I hypothesized that friction would be reduced by a smoother incline material, a flatter incline, a smaller contact area, and a lesser contact object mass.

**Methods/Materials**
With various incline materials, incline angles, contact areas, and contact object masses, I constructed inclines and contact objects. For each configuration of incline material, incline angle, contact area, and contact object mass, I gradually applied force to the contact object until the object started to move. Immediately, I measured the force at this instant using a spring scale. I then calculated the maximum static friction force and static friction coefficient.

**Results**
After I collected data, I analyzed the effects of incline material, incline angle, contact area, and contact object mass on friction. Furthermore, I statistically analyzed the relationships between the independent variables (incline material, incline angle, contact area, and contact object mass) and the dependent variables (force applied to the contact object, maximum static friction force, and static friction coefficient).

**Conclusions/Discussion**
The results suggest that friction is affected by incline material, incline angle, and contact object mass, but not by contact area. The validity of my hypotheses was checked by the findings below:
(1) smoother incline materials reduce force applied to the contact object, maximum static friction force, and static friction coefficient;
(2) a flatter incline results in less force applied to the contact object, greater maximum static friction force, and greater static friction coefficient;
(3) no relationship exists between contact area and each of the dependent variables;
(4) less contact object mass reduces force applied to the contact object and maximum static friction force; and
(5) static friction coefficient is independent of contact object mass.

**Summary Statement**
My project analyzes how incline material, incline angle, contact area, and contact object mass affect applied force, maximum static friction force, and static friction coefficient.

**Help Received**
My thanks go to Ms. Agapoff for her scales to measure mass and force, and my parents for assisting in building the setup, and checking data and formulae.

# CALIFORNIA STATE SCIENCE FAIR
## 2010 PROJECT SUMMARY

**Name(s)**
Philip S. Zehnder

**Project Number**
**J1923**

**Project Title**
# Tune-A-Car: An Investigation into Car Window Buffeting

**Abstract**

**Objectives/Goals**
Car window buffeting is known as Helmholtz oscillation. The sound made could be considered musical. Based on a model of this phenomenon, I wanted to see how this "note" could be manipulated. The objectives were to observe how the window opening and speed affect the frequency and amplitude of car window buffeting.

**Methods/Materials**
A test rig was constructed consisting of a latex membrane stretched over a cooking pot. A pointer was attached to the membrane and a 60 frame per second digital video camera was positioned so that the pointer, a scale and a stopwatch (located behind the pointer) were visible. The rig was placed in two cars (Honda Odyssey and Toyota Camry) and the cars were accelerated to 50, 60, or 70 mph. The window was rolled down to intervals of 1/3, 2/3 and 3/3 open with a control of 0/3 open. When the window was rolled down, the resulting pressure waves caused the membrane to move in and out. These movements were filmed. The footage was slowed down, and oscillations were measured and timed by looking at the stopwatch and scale.

**Results**
When the car window opening is increased, the amplitude of the resulting sound increases, and the frequency decreases. When the car is accelerated, both the amplitude and frequency of the resulting sound increase.

**Conclusions/Discussion**
By creating an accurate method of measurement, I attained my objectives. I confirmed that the amount of the window opening and the car speed caused a response that matched my understanding of Helmholtz oscillation.

**Summary Statement**
This project investigated the effects of window opening and speed on car window buffeting.

**Help Received**
My father drove the car during my tests and bought me the camera. My mother taught me how to use excel. I participated in a mentoring program at my school, which helped greatly. My father also showed me where to buy the latex membrane and he gave my advice.