



CALIFORNIA STATE SCIENCE FAIR 2006 PROJECT SUMMARY

Name(s) Maliha S. Ahmed	Project Number S0201
Project Title Investigating Resonance and Analyzing the Effects of Tension in a Multi-Pendulum System	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals The objective of this project was to examine the properties of resonance and the effects of tension in multi-pendulum system. The independent variable was the amount of tension in the system and the dependent variable was the displacement of the pendulums. The collected data (1) showed the relative amounts of energy transfer during the oscillations at various tensions and (2) showed when resonance could be achieved. The hypothesis was that if the tension between the pendulums increases, less energy will transfer between the pendulums but resonance patterns will only be seen at lower tensions.</p> <p>Methods/Materials Three pendulums were used to simulate a multi-pendulum system. Each pendulum was first built by attaching a 1-ounce fishing weight to a 14.5-inch fishing wire. These fishing wires were then placed equidistantly from one another on a longer fishing line (base string) that ran the entire length of a wooden bar. Hooks were attached to both ends of this base string. Predetermined weights were then added to these hooks (500 grams and 1 kg). Changing the weights changed the amount of tension in the base string, and thus, changed the amount of tension in the system. To simulate infinite tension in the base string, the pendulums were hung from hooks that were directly attached to the wooden bar. Ten combinations of released and non-released pendulums were examined at different tensions.</p> <p>Results In almost every case, the oscillations of the released pendulum transferred energy to the non-released pendulums. This caused the non-released pendulums to start oscillating, which increased the number of oscillations in the system. In most situations, as the tension increased, less energy was transferred from the released pendulum to the non-released pendulums. When the base string tension was infinity, no energy was transferred.</p> <p>Conclusions/Discussion When analyzing the non-released pendulums, there was less energy transfer with increasing tensions (proving the hypothesis correct). When analyzing the released pendulums, there was less energy transfer at infinite tension and the "Control + 10 Newton" tension (proving the hypothesis correct). However, at the "Control + 5 Newton" tension, there appeared to be greater energy transfer than at "Control" tension (proving the hypothesis incorrect). Also, resonance was observed in all tension scenarios except for the infinite tension case.</p>	
Summary Statement This project examined the properties of resonance and the effects of varying tension on a system containing multiple pendulums by measuring the displacements of the released and non-released pendulums.	
Help Received Mother helped with board and obtaining materials; brothers helped with conducting experiments and understanding basic laws of physics	



**CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY**

Name(s) Andrew Bagdasarian; Rory Matthews	Project Number S0202
Project Title Bottle Rocket Blast-Off	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals To demonstrate Newton's third law of motion: That every action has an equal and opposite reaction. Pressurized water & air creates a non-polluting source of transportation by expelling from the vessel they are in and creating powerful propulsion.</p> <p>Methods/Materials 1.Fill a 1liter soda bottle 1/5 (a 1:4 ratio of water to air) full of water. 2.Fit onto quick release. 3.Pressurize with bike pump to 35 Pounds Per Square Inch (PSI). 4.Release using string tied to quick release. 5.Monitor height on scale. 6.Repeat with different ratios of water to air & PSIs of 50 & 70.</p> <p>1.1liter soda bottle; 2.Quick release fittings; 3.5 foot rubber hose; 4.Bike valve; 5.Masonite; 6.PVC pipe; 7.Metal bracket; 8.String; 9.Drill; 10.Screws; 11.Screw driver; 12.Tool bench; 13.Pressure fittings; 14.2 in. by 4 in. wood.</p> <p>Results At 35 PSI, a 1:4 water to air ratio launched the rocket the highest, at 4.88 meters. At 50 PSI, a 0:1 water to air ratio launched the rocket the highest, at 5.79 meters. At 70 PSI, a 1:4 water to air ratio launched the rocket the highest, at 8.23 meters. Our hypothesis, that a 1:2 ratio of water to air would launch the rocket highest, was inaccurate. It actually took less water and more air.</p> <p>Conclusions/Discussion This data shows us that pressurized water and air, varied amounts suitable to the vessel, can propel the vessel a long distance. It is important to have enough water to propel the vessel with enough force while not having too much water that will weigh the vessel down. The objects of this project were met. We discovered that the best water to air ratio to propel the rocket highest is 1:4. Further experiments could be done by increasing the size of the vessel or the weight being propelled. In order to discover if this method could be used as a means of transportation, the experiments should use a heavier, larger vessel and larger amounts of water. The speed of the vessel should also be observed. If we were to improve the validity of our project, we would use a more precise measuring device, such as launching the rocket at a ninety-degree angle next to a vertical board labeled every meter. Also, video-taping the launch would let us review the experiment and slow it down so we could see the exact height the rocket reached.</p>	
Summary Statement To show how to propel a vessel using fuel and other controls such as size and the amount of fuel and pressure	
Help Received Father helped with materials and construction	



**CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY**

Name(s) Gregory Bailey; Wayne Karim	Project Number S0203
Project Title Magnetic Attraction Can Cause Hot Situations	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals Our experiment will hope to uncover which adjustment to the heat motor will make it work more efficiently. We will be experimenting with what factor, pendulum wire length or heat source strength, will make the motor run most efficiently.</p> <p>Methods/Materials We will be using a regular ceramic magnet to swing in the pendulum, and an electro-magnet to attract this ceramic magnet. The magnet will dangle on a pendulum and hover over a candle while being over a candle while being attracted to a large electro-magnet. Once the heat dissipates the magnetic properties of the element, the pendulum will swing. Ultimately it will regain its strength and continue this pendulum motion.</p> <p>Results We uncovered from our experiments that the heat source intensity was the factor that made the heat motor run most efficiently.</p> <p>Conclusions/Discussion As the heat source became more intense, the suspended magnet's period on the pendulum became significantly shorter. on the contrary, the increase of the wire length caused the magnetic attraction between the suspended and stationary magnets to become stronger, so that eventually the motor did not move at all.</p>	
Summary Statement Which factor, pendulum wire length or heat source strength, will make a heat motor run most efficiently.	
Help Received we recieved no help during the project	



**CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY**

Name(s) Andrea C. Collins	Project Number S0204
Project Title Aviation Circuitry: How Protected Are They to the Ever-Changing Environment?	
Abstract Objectives/Goals The circuit breaker is a necessity in any electronic device. It is the basic piece of equipment, which provides a continuous supply of power. Circuit breakers in airplanes and space shuttles are being modernized to prevent malfunctions. This project was designed to test what affect the varying atmospheric temperatures have on circuit breakers used in modern flight. If the environment#s temperature increases then the circuit breaker will pop at a lower current rating than at ambient temperature; if the environment#s temperature decreases then the circuit breaker will pop at a higher current rating than ambient temperature.	
Methods/Materials This project began five months ago with the assistance of a mechanical engineer. He explained how and why a circuit breaker pops with a certain amount of current. The information helped develop the procedure to test a 1A aircraft circuit breaker in two diverse temperatures, with respect to the ambient temperature#s breaking point. Three configurations were tested five times each. Dry ice and an embossing heat gun were used to simulate two diverse temperatures. A multi meter was used to measure and maintain temperature by a thermal couple, and to measure the total current in the circuit produced by eight light bulbs (two 40 watt and six 25 watt bulbs). This experiment concluded change in temperature impacts the time it takes a circuit breaker with a certain current rating to disengage.	
Results Temperature does have an effect on a circuit breakers breaking point. When a 1A circuit breaker was placed at ambient temperature of 80°F, it disengaged at an average time of 1 second with a current of 1.87Amps(A). The circuit breaker disengaged at an average time of 1.5 seconds with 1.65A and 8.3 seconds with 1.46A when a temperature of 139°F was applied to a circuit breaker. Finally, a temperature of -65°F was applied to a circuit breaker. The circuit breaker disengaged in an average 19.83 seconds with 1.87A.	
Conclusions/Discussion The hypothesis of this project was supported by data throughout the experiment. Environmental temperatures do affect the amount of time a circuit breaker can support a particular amount of current before breaking. An assumption can be made from the results that an aircraft#s circuit breaker may fail depending on the environmental temperature it is exposed to.	
Summary Statement This project was formed to see if environmental temperatures affect the amount of current a circuit breaker can support before it pops.	
Help Received Dad helped wire circuit box; Mechanical engineer helped gather aircraft circuit breaker information and supplies	



**CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY**

Name(s) Andreas Pena Doll	Project Number S0205
Project Title Effects of Agitation on Black and White Film Developing	
Abstract Objectives/Goals To design a mechanism that allows one to test how the frequency of agitation and stroke length affect a print's contrast, thoroughness of development and overall quality, and to conduct the related tests. Methods/Materials I designed and built a mechanical film agitator that performs the agitation duty cycle with an adjustable stroke length and frequency regulator. I tested four combinations of frequency and stroke length for contrast, thoroughness of development and overall quality using the device. Results Fast frequency and large stroke length gave the greatest contrast, thoroughness of development and therefore, greatest overall quality. The developing process with slow frequency and large stroke length gave the worst contrast, development and overall quality. Fast frequency and short stroke length resulted in fair contrast, development and overall quality. The experiment with slow frequency and short stroke length resulted in poor contrast, thoroughness of development and overall quality. Conclusions/Discussion In order to obtain maximum contrast, thoroughness of development and overall quality, the mechanical developer must be set at a fast frequency of agitation (seven strokes per five seconds) and a large stroke length (three centimeters long).	
Summary Statement Inventing a mechanical film developer and using it to test the effects of frequency of agitation and stroke length on black and white film developing.	
Help Received	



**CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY**

Name(s) Vivien Y. Fang	Project Number S0206
Project Title Controlling the Dynamic Behavior of Structures with Active Dampers	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals The purpose of this experiment was to determine the dynamic behavior of a structure when excited at its natural frequency, and how active damping could be used to control the vibrations.</p> <p>Methods/Materials A structure was first constructed out of plexiglass, and its natural frequency was experimentally determined. Then the structure was excited under different excitation frequencies, which were close to the natural frequency, to observe the responding magnitude of the structure at these frequencies. The active damper was then applied to the structure and the structure was excited at the same excitation frequencies to find the responding magnitudes. Then the ratio between the damped and un-damped magnitude was found to view the efficiency of the damper at each tested frequencies.</p> <p>Results The ratio of the response magnitude of the natural frequency, 9.3Hz was 0.421660. The ratios of responding magnitudes for 8.3Hz, 8.8Hz, 9.8Hz, and 10.3Hz were 0.814891, 0.593268, 0.485263, and 0.532439 respectively. These results were relatively precise with 2.00% deviation. The ratio of the response vibration magnitude for 9.3 Hz was the lowest.</p> <p>Conclusions/Discussion The hypothesis, the damper should be most efficient when the structure was vibrated at its natural frequency was supported. Since the responding magnitude was the lowest at the structure's natural frequency and hence the less stress and possible damages. These results occurred because when the damper was added to the structure, it increased the degree of freedom to the structure and shifted the natural frequency of the structure; therefore, the structure no longer experienced the same resonant effect.</p>	
Summary Statement This experiment was conducted in order to determine the dynamic behavior of a structure when vibrated at the natural frequency, and how active damping could be used to control the vibrations.	
Help Received Dad helped during the construction of the structures, and provided the apparatuses and materials	



**CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY**

Name(s) Betty C. Huang	Project Number S0207
Project Title Measurement of CD Deviations	
Abstract Objectives/Goals The purpose of this project is to see if all manufactured CDs have the exact same area and perimeter. If not, which brands have more deviations in their manufactured production and which ones have less? My objective is to measure the deviations of each brand through image processing with images of 50 CDs of each brand of CD, and putting the image through my written program that will then measure the area and perimeter of both the actual CD and the hole in the middle of the CD. Methods/Materials 50 Philips blank CDs, 50 Memorex blank CDs, 50 Imation blank CDs, 1 Matlab Program, 1 Adobe Photoshop Program, 1 Sony Cyber-shot Camera (5.0 Mega Pixels), 1 Camera stand, 1 CD lid Results The CD that cost the least (Imation) had the highest deviations in manufacturing. The CD brand that cost the most (Philips) had the least deviations in manufacturing. The Matlab program was successful in determining the area and perimeter of both the CD and its inner hole accurately. Conclusions/Discussion The higher the deviations in manufacturing per brand, the cheaper the price for a CD of that brand. Image processing that is run through the Matlab program is an effective way to verify the accuracy of measurements of certain objects and to determine the amount of deviation that occurs between two compared objects.	
Summary Statement Image processing is effectively used to determine accuracy & deviations in manufacturing per brand of CD; the cheapest brand, Imation, had the most deviations, while the most expensive, Philips, had the least deviations in manufacturing.	
Help Received Dr. Kung-Shiuh Huang	



**CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY**

Name(s) Ummon P. Karpe	Project Number S0208
Project Title Designing an Efficient Home Thermostat (Temperature Controller)	
Abstract	
Objectives/Goals My objective was to develop a home thermostat that anticipated temperature fluctuations in advance to control the heater and to test if it was more efficient than a conventional thermostat when used for a radiant heating system.	
Methods/Materials To read the temperature of the subject house, a thermocouple was connected to my computer using an analog to digital/digital to analog converter (ADC/DAC). A program was created to record readings on 5 minute intervals. These readings were used to model the house's temperature. Another program was written that downloaded temperature readings and forecasts from the National Weather Service and took indoor temperature readings. It uses these data to estimate the indoor temperature to turn the heater on or off. To compare the new thermostat with the old, they were run under similar conditions and the standard deviations of the temperatures were calculated.	
Results The designed thermostat created a more stable environment when compared to the original one. It controlled the evening and night temperature very well even though there wasn't much improvement in the stability of the morning temperature with the new thermostat as opposed to the older thermostat . The standard deviation of the old thermostat was 3.14 F. The standard deviation of the new thermostat was 2.44 F or 2.37 F not considering extreme outliers.	
Conclusions/Discussion Anticipating the temperature was highly effective because radiant heating systems take 4 to 6 hours after they are turned on to start heating at there maximum rate. The designed thermostat creates a more stable and therefore comfortable temperature. There are many possible improvements to the designed thermostat that could be implemented in the future. A commercial product utilizing this idea is plausible.	
Summary Statement Developed a thermostat that anticipates temperature fluctuations with the help of downloaded readings and forecasts for improved performance.	
Help Received Conocophillips engineer Jeff Ruzler provided used equipment. Mother implemented computer's instructions to turn off or turn on the heater at night. Father insulated high voltage connection.	



**CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY**

Name(s) Simon Lebsekal	Project Number S0209
Project Title Interfacing the Bionic Eye via the Retinal Matrix	
Abstract Objectives/Goals Due to pressure caused by a retinal tack that is used to attach the current micro-electrode prosthesis to the surface of the retina, vascular leakage and retinal folding are becoming more and more apparent. This is defeating the purpose of restoring vision to victims with Retinitis Pigmentosa. The goal of my project is to develop a biological adhesive that will allow the attachment of the silicone prosthesis to the retina, which should significantly reduce the negative affects of pressure on the retinal surface. Methods/Materials Silicone with lasered points to ensure the free electrons will be ascertained in order to allow for good adherence to the Contotrostatin protein. Once we receive this as well as the snake venom protein (Contortrostatin) we begin to remove the retinal samples from the porcine eyes and place them on aluminum cylinders. We will place the protein on the lasered Silicone and allow it to dry. Once we have the experiment ready we use a Bose pressure sensor to find a precise amount adherence to the retina by the Contortrostatin covered Silicone. This adherence will be read on the computer by the amount load in mN. Results We found that the protein Contortrostatin had a load of 340mN and the Silicone without the protein had a load of 10mN. This shows that this protein is a good candidate for further more thorough and extensive testing. Conclusions/Discussion The problem with many bio-adhesives is that they can be neurotoxic and non biocompatible, etc. The data we have received is only preliminary data and will only lead to many more experiments such as temperature tests, animal testing, and histology for further understanding of the protein; maybe even a way to remove protein with the help of enzymes. The advent of this new technology can be applicable to many other fields and will be very beneficial to field of medicine and biomedical engineering.	
Summary Statement The goal of my project is to develop a biological adhesive that is not neuro-toxic and will allow the attachment of a Silicone retinal prosthesis with ease.	
Help Received STAR program, USC Lab mentor Dr. Adrian Rowley, Program supervisor Dr. Coccozza, Bravo Med. Mag.	



**CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY**

Name(s) Alex J. McFarlin	Project Number S0210
Project Title Gasoline vs. Ethanol	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals To determine whether ethanol is a more efficient fuel than gasoline. Hypothesis- I think that ethanol is a more efficient fuel than gasoline because it is an oxygenate, which means it has a cleaner and more complete burn.</p> <p>Methods/Materials single cylinder gasoline engine,dynamometer,2-2 liter gas cans,2 liters regular,unleaded gasoline,2 liters 200 proof auto grade ethanol/ethyl alcohol,500 ml. brake fluid,complete wrench and screwdriver set,pyrex widemouth measure beaker (200 ml.),calculator,shop table, large, heavy-duty C-clamps,notebook and pencil I ran the engine on gasoline at 4000 rpm's and then added a load on the dynamometer to determine horsepower output. The dynamometer indicates pounds of torque, which is converted to engine horsepower. The experiment was repeat numerous times to get the average horsepower with gasoline. I then did a burn test to check efficiency. I ran the engine on 50 ml of gasoline while timing to see how long it ran. This test was also repeated to obtain an average run time. I had to change the engine timing to account for the different speed of burn for the ethanol and then repeated the same tests with this fuel.</p> <p>Results On my first series of tests the average horsepower for the gasoline was 1.3 hp. When I tested ethanol the average horsepower was 3.1. The results of the second series of tests/burn tests were exactly the same for gasoline and ethanol- 1 minute 58 seconds.</p> <p>Conclusions/Discussion Ethanol has more than double the power of gasoline. This is because ethanol is an oxygenate (a compound containing oxygen), which means it has a more complete burn than gasoline. Since oxygen is required for fire, having more oxygen during a burn insures all the fuel being used. Also, ethanol is a much slower burning fuel; it has an octane rating of 110, where as regular unleaded gasoline has a rating of 87. The results of the burn tests, or the rate at which the engine consumed the fuel were exactly the same because I never altered the carburator. Since the carburator meters or controls fuel flow the results would have to be the same. From the results I learned that ethanol has double the power of gasoline and that oxygen is a big factor in engine performance. Through my experiments I proved my hypothesis correct because ethanol has a more powerful burn, so that means half the amount of fuel can be used to substitute gasoline and have no loss of power.</p>	
Summary Statement The project was to determine which fuel was more efficient- gasoline or ethanol.	
Help Received My father, who teaches shop classes at Carmel High, provided me with the engine, the workspace, dynamometer,tools, and his expertise. Information was aquired from Dotseth Specialty auto parts in Salinas, CA.	



**CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY**

Name(s) Brian Orser; Dylan Vandenberg	Project Number S0211
Project Title From Grains to Grease, to Gallons of Gas: A Search for Efficient Biofuel	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals Our purpose was to discover the most efficient crop to use in the creation of biodiesel. We asked: "Of the various crops commonly used in the manufacturing of biodiesel (corn, soybean, peanut, flax), which yields the most pure biodiesel per acre? In other words, which of these crops is the most efficient for the biodiesel creation process?" We hypothesized that peanut would be more efficient for the production of biodiesel than corn, flax and soy, due to the purity and amount of oil extracted from each plant, the large number of plants per acre, and the existing agricultural infrastructure centered around the growth of peanuts. Peanut plants yield one hundred thirteen gallons per acre, more than twice the amount of the highest yield of the other three.</p> <p>Methods/Materials We made four batches of biodiesel from each type of oil, starting with 200 ml of oil for each. This way, we would find how much biodiesel each oil yields relative to the others. We first heated the oil, added methoxide, blended it and poured it into a settling container. The methoxide broke apart the triglycerides, allowing the glycerin to settle out of the mixture. We then siphoned off the biodiesel, leaving the glycerin, and washed it with 100 ml of water which removed any remaining glycerin, water or other contaminants. We then siphoned off the purified biodiesel and measured the yield. We repeated this process four times for each oil, and compared the yields.</p> <p>Results The peanut oil coagulated, such that we couldn't test it. The remaining oils; Soy, Flax and Corn; had 89.75, 89.00 and 86.50 percentage yields respectively, meaning the volume of the final Soy biodiesel was 89.75% of the beginning volume of oil, and so on. However, what we were testing was yield per acre. The yields per acre (in gallons) for Soy, Flax and Corn are, respectively, 43.08, 45.39, and 15.57.</p> <p>Conclusions/Discussion We can not be certain whether or not our hypothesis was correct, as the peanut oil coagulated to a point at which it was useless. However, we can still discern which of the remaining three crops yields the most biodiesel per acre. We hypothesized that flax would have the second largest yield which turned out to be true. Despite the fact that soy yields more biodiesel per gallon of oil, flax yields enough more oil per acre to offset this, and to allow flax to be the most efficient, followed closely by soy, and then by corn.</p>	
Summary Statement We made biodeisel from several commonly used plant oils to discern which yields the most biodeisel per acre of crop.	
Help Received Father supplied some materials.	



**CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY**

Name(s) Brian M. Smith	Project Number S0212
Project Title Don't Be Swayed: A Study of the Dampening Abilities of Viscous Dampers in Buildings	
Abstract Objectives/Goals Will the replacement of stiff cross-members by viscous dampers decrease the amount of acceleration that a building undergoes during an earthquake? My objective is to test two model buildings, one with stiff cross-members, and one with viscous dampers to determine the amount of acceleration that they are subjected to. Methods/Materials Materials: Wood of various sizes; balsa wood; MDF board; AC motor; drill; fax paper; screws; custom made measuring transparency; custom made drill bit Methods: 1) Create shake table and data tower to apply the same amount of shaking to the buildings. 2) Create two identical buildings with three floors. One will have stiff cross members one floor one, while the other will have viscous dampers on floor one. 3) Attach building to shake table and set the paper in place. 4) Turn on the shake table and the paper roller for exactly five seconds, then turn off. 5) Repeat procedure number four 200 times (100 per building). 6) Measure the period with the highest total displacement and count the number of periods. 7) Record data and use it for the necessary calculations. Results The building with the viscous damper had a much lower acceleration and displacement(1.10mm/s; 5.77mm) than the building with the stiff cross-member(1.29mm/s; 8.9mm). The calculations and results also proved to be extremely accurate with a standard deviation of 0.086. These results prove how well viscous dampers help to dissipate the effects of the seismic energy on a building's response during an earthquake. Conclusions/Discussion Viscous dampers substantially help to reduce the mount of displacement and acceleration that a building undergoes during an earthquake. By reducing the amount of displacement and acceleration, the building will have less stress on its structure and therefore is less likely to collapse.	
Summary Statement I tested viscous dampers vs. stiff cross members to measure the reduction of the amount of acceleration that a building undergoes during an earthquake.	
Help Received Mother helped for ideas on backboard display; Brother helped soulder wires; Father helped give tips on building the apparatus.	



**CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY**

Name(s) Jacob L. Smith	Project Number S0213
Project Title Comparison of the Distance a Ball Is Thrown from a Catapult Compared to a Formula's Accuracy When Arm Length Is Changed	
Abstract Objectives/Goals To compare the distance a golf ball could be launched compared to the distance predicted by a mathematical equation. Methods/Materials Research began one month ago by researching catapult design as well as existing formulas to compare the catapult projectile distance to. A wooden compound catapult was constructed to determine the distance of a golf ball being launched and provide a comparison for mathematical formula. The variable for the catapult was a changing launching arm length that could be changed to 15, 20, 25, 30, 35, and 40 inches long, measuring from the arms pivot point and the cup at the end of the arm that holds the golf ball. At each arm length the ball was launched 20 times and measured. Results The mathematical formula distance prediction did not match the results that were given by the actual launching of the golf ball until the arm weight was calculated into the formula. The results then became more accurate and closer to the actual projectile range. The outcomes from launching the golf ball became increasingly more accurate as the arm length increased. Conclusions/Discussion The longer arm lengths, 30,35, and 40, were closer to the prediction given by the math equation used. The prediction was less accurate for the 15,20, and 25 inch arms based on the data and did support the hypothesis.	
Summary Statement Comparison of the actual distance of a golf ball launched from a compound catapult compared to a mathematical formula's accuracy when arm length is changed.	
Help Received Science teacher helped with excel and research the project; mother helped to collect data; father helped collect data and photograph project	



**CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY**

Name(s) Luke E. Stagner	Project Number S0214
Project Title House of Flying Daggers: The Physics of Knife Throwing	
Abstract Objectives/Goals The purpose of this experiment is to find the most efficient way to throw a knife and to see which factors affect thereof. Methods/Materials The way the project was performed was by find the best angle of entry of the knife and measuring how much the knife penetrated the target. I did this by throwing the knife 100 times for every fifth angle and taking the average penetration all the while throwing at the same angular and linear velocity and filming myself. I controlled the angle of entry by adjusting the distance from the target in order to allow the knife to rotate less or more in accordance with the physics of the knife while its traveling through the air. I then calculated the total kinetic energy, the velocities and the penetrations using the data collected from the video and from the throwing process. After all the data was collected for this particular velocity I repeated the experiment with 2 different velocities. To prevent errors I did not accept data that was flawed in a way that it shouldn't have been such as the angle of entry and the velocities. The materials needed to do this experiment were a center-balanced knife, a target made of Trex Board (a plastic sawdust compound that has uniform density), a video camera, and video editing software. Results My results show that 90°, 85°, and in between 85° and 90° penetrated the deepest. The data cooresponds with my hypothesis that the best angle would be the inverse tangent of the vectors. Conclusions/Discussion I have concluded that the best angle of entry would be the inverse tangent of the vectors because the knife utilizes the linear kinetic energy to the fullest effect. It was also concluded that as the kinetic energy of the knife is increased, the closer the best angle would be to being orthogonal.	
Summary Statement This project is a study of the physics of knife throwing and the factors that affect thereof.	
Help Received My friend filmed me throwing the knife.	



**CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY**

Name(s) Lilian Tran	Project Number S0215
Project Title Characterizing Oxygen Plasma and Acid Treated Polydimethylsiloxane Bonds	
Objectives/Goals Drug delivery devices are constructed entirely from polydimethylsiloxane (PDMS). The objective is to attach the three separate layers of the device by employing oxygen plasma or acid treatment and to optimize the bond strength. Sturdy drug delivery devices will treat eye diseases such as glaucoma, macular degeneration, and retinitis pigmentosa.	
Abstract Methods/Materials Exposure to oxygen plasma alters the surface chemistry of polydimethylsiloxane, enabling covalent bonds to form between two contacting surfaces. In an acid treatment, PDMS structures are immersed in a solution of 1.2mM hydrochloric acid to increase its hydrophobicity and enable bonding to occur when two surfaces contact. For both treatments, the PDMS structures are then baked to accelerate bond formation. A pressure test is conducted to determine the bond strengths. The variables being investigated for the effects on the bond strengths are the treatment duration, use of polar solution during assembly, baking duration, plasma machine power and pressure, acid concentration, and weighing down of the structures. Another interesting variable is the preparation of polydimethylsiloxane.	
Results For PDMS structures exposed to oxygen plasma, the baking period of 30-45mins is optimal for the temperatures of 50°C, 80°C, and 95°C. Assembling PDMS structures in ethanol bonded the structures more effectively than assembling in water or in no polar solution. Acid treated structures with longer durations of baking resulted in stronger bonds: 1.22psi for 30mins, 1.97psi for 60mins, and 2.62psi for 1440mins. Structures cured passively (overnight at room temperature) and assembled without any method of treatment can withstand an average pressure of 15.49psi, more than structures cured actively (1hr baking at 80°C).	
Conclusions/Discussion Adhesives used in attaching separate layers of drug delivery devices can clog drug channels and bring difficulty in alignment of the layers; both lead to device failure. Oxygen plasma and acid treatments are viable alternatives to adhesives. PDMS structures assembled under ethanol increases bond strengths. Bonding passively cured PDMS layers is also an alternative technique for strong layer attachments. An optimal strength between PDMS layers provides durability which will allow drug delivery devices to be refilled, reused, and leak resistant. Patients can receive targeted delivery and sufficient dosages of drugs to treat eye diseases.	
Summary Statement Drug delivery devices used for treating eye diseases are designed to reduce the negative effects that prevail in current drug delivery methods, and the performance and durability depend upon the bonding strength between the device layers.	
Help Received Mentors assisted in oxygen plasma treatment; Used lab equipment at the University of Southern California under the supervision of Dr. Meng and PhD student Ronalee Lo	



**CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY**

Name(s) Geoffrey H. Woo	Project Number S0216
Project Title Detection of Metal Fatigue and Defects by Electron Work Function Topography and Gradient	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals I explore the electron work function (EWF) and its relationship with metal fatigue and defects. All materials fatigue, deteriorate and eventually fail, disrupting everyday use of vehicles, machines, and structures. Since no method currently exists to actively monitor deformation, my objectives are (1) to develop an original real-time monitoring method for fatigue, (2) to detect surface and internal defects, and (3) to propose a parallel dislocation mechanism for both exo-electron emission of metals and deformation luminescence of ionic crystals, which was studied previously.</p> <p>Methods/Materials Compressive and three-point bending tests on hardened aluminum were conducted to determine the effects of plastic deformation and flaws on exo-electronic emission. Because low-energy exo-electrons dissipate quickly in the atmosphere, the Kelvin method, measuring the EWF gradient, was utilized to measure the increased surface electric potential resulting from exo-electron emission. Mathematical modeling and analysis were done from stress-strain data taken by a material testing system and EWF data from a Kelvin probe</p> <p>Results The results show that the EWF gradient is (1) a clear real-time indicator for metal fatigue, (2) useful for determining cumulative deformation in the lifetime of a metal through derived mathematical modeling. EWF topographies, taken from Kelvin probe mounted on a three-dimensional stage, were found to be effective in (1) identifying and pinpointing the locations of both surface and internal flaws, and (2) visualizing the stress distributions of a metal under load.</p> <p>Conclusions/Discussion I observed novel phenomena with implications for an original non-destructive, non-contact, on-site, real-time monitoring method. The EWF is an intrinsic attribute of the lattice structure of a metal, and therefore provides accurate characterization of overall metal health. These findings may lead to safer use of vehicles, machines, and structures.</p>	
Summary Statement My study presents an original real-time metal monitoring method, which is effective in indicating fatigue, pinpointing flaws, visualizing stress distributions, and determining cumulative deformation.	
Help Received Used lab equipment at UCLA under supervision of graduate student, Mr. Juan Escobar.	