# CALIFORNIA STATE SCIENCE FAIR
## 2013 PROJECT SUMMARY

**Name(s)**

**Claire Abele; Julia Cable**

**Project Number**

**J0101**

**Project Title**

# Saving Raptors, One Windmill at a Time

**Abstract**

**Objectives/Goals**

Many birds are dying in the Altamont pass from the wind turbines. Wind turbines are getting so large that birds must fly very high to pass by them without being injured. Our goal was to generate the same amount of power with a smaller blade set.

**Methods/Materials**

Using simulations of vortexes created by the windmill we designed our own blade set. Our design has blades on different planes instead of just one plane. Three blade designs are currently used because the vortex created by one blade can cause the following blade to slow if it is too close. By setting the blades in different planes, we believe that the vortexes will then help the blades spin faster instead of slowing the rotation of the windmill. And, by using many smaller blades, the area that the birds may hit is decreased.

**Results**

Our new blade design generated almost three times what the traditional blade set generated.

**Conclusions/Discussion**

The distance between the layers of blades in the design still needs to be optimized, but based on the initial results we believe that the design is superior to that which is currently in use. With good placement of these windmills the deaths of birds might be reduced.

**Summary Statement**

We designed a new blade set that is smaller (killing less birds) than the three blade style and generated triple the amount of electricity.

**Help Received**

Dad helped us with the use of power tools; GE sent us model windmills.

# CALIFORNIA STATE SCIENCE FAIR
# 2013 PROJECT SUMMARY

**Name(s)**

Grace Baker; Julia Hwang

**Project Number**

**J0102**

**Project Title**

## How Do the Sail Angle, Sail Width, and the Wind Speed Affect the Force of a Sail?


**Abstract**

**Objectives/Goals**

How do the sail angle, sail width, and the wind speed affect the force on a sail? Our hypothesis is that the largest sail at the highest wind speed will produce the greatest force. We think this because the bigger the area of the sail, the more wind can blow on it. We think if the sail is turned at a 30 degree angle, the Bernoulli effect will be greatest.

**Methods/Materials**

We bought sail material and sewed sails with different widths of 3", 5", and 7". We gained approval from Dr. Kevin Jones with the help of Jim Paul to use the Monterey Naval Postgraduate School's wind tunnel. Before we tested the sails we calculated the "zero" of the drag and lift of each sail using different amount weights. We measured the lift and drag of each sail and boat base or the sting, at multiple wind speeds, and angles in millivolts. We repeated these steps for all the sails while recording the data. Jim Paul helped us convert the millivolts into grams. With the data we made graphs showing the lift and drag of each sail compared to the sail angle and wind speed.

**Results**

-Speed increased the force on the sails by the square of the wind.
-The 7" sail without battens had the most force on it at 15 degrees and 30 degrees, out of all the sails we tested.
-For all the sails except the 7" sail with battens there was an optimal yaw angle, past which the force on the sail decreased.
-At 30 degrees, the 7" sail with battens had not yet reached its full force, so had we been able to test it at a greater yaw angle, we could have found the optimum angle for the sail.
-The 7" sail without battens was the most efficient sail based on the lift and drag ratio.

**Conclusions/Discussion**

Hypothesis appears to be partially correct.
Conclusion 1: As the wind speed increased, the forward force on the sails increased.
Conclusion 2: The sail that had the most force applied to it had a greater wind speed.
Conclusion 3: The sail with the greatest area and width had the most force applied to it.
Conclusion 4: For three of the four sails, the most force was applied on the sail at a 15 degree yaw angle.
Conclusion 5: Even though the 7" sail without battens was the most efficient, it was not the most adequate sail that would move the boat with the most force. This was because compared to all of the other sails, the 7" sail with battens had reached its peak, even at a 30 degree yaw angle.

**Summary Statement**

Our project discovered how the sail area, angle, and wind speed affected the force on the sail, and which sail was the most effective based on the research.



**Help Received**

Grace's mother taught us to sew sails; Mother drove us to the Naval Postgraduate School; Jim Paul helped us gain access to the Naval Postgraduate School equipment; Dr. Kevin Jones showed us how to work the equipment, helped us use it, and allowed us the use the equipment;Jim Paul helped us convert the

# CALIFORNIA STATE SCIENCE FAIR
## 2013 PROJECT SUMMARY

**Name(s)**
Anson E. Baker-Berry

**Project Number**
**J0103**

**Project Title**
## High Performance Sail Design


**Abstract**

**Objectives/Goals**
This science fair project determined the best mainsail design for racing, cruising, and racer-cruiser sailboats. I experimented with three sail designs: the Marconi sail (shaped like a right triangle); the high roach mainsail (shaped like the Marconi sail, except the hypotenuse is curved aft, giving the sail more area high up); and the flat-head mainsail (shaped like a rectangle). My hypothesis is that the flat#head mainsail will produce too much sideways force to be effective, the Marconi sail will not be effective enough at the head or top, and the high-roach sail will produce the most effective force for racers and cruisers. By effective force I mean that the sail will produce the largest amount of forward thrust, and the sideways force will be less than or equal to the forward drive.

**Methods/Materials**
I designed a two-layer, non-friction force-testing device to measure the forces generated by the sails. Two layers of wood, separated by three marbles encaged in plastic rings, were used to support the boat and enable the measurement of sideways and forward force by two strain gauges. I designed a flat-head mainsail and a high-roach mainsail on a piece of graph paper, copied the designs onto sail cloth, cut out and stitched them (the Marconi came with the sailboat). I rigged one sail on the model boat, positioned it in the testing device, and used a fan to control for wind angle and speed. I released the top board, let it settle, and recorded the numbers shown on the strain gauges. I repeated the process 100 times for each sail, generating 300 data points.

**Results**
The flat-head mainsail preformed the best with an average forward thrust of .36 Newtons (N) and an average sideways force of .32N. The Marconi mainsail#s forward thrust average was .28N and the sideways force average was .28N, while the high roach had a forward thrust average of .26N and a sideways force average of .34N.

**Conclusions/Discussion**
The high roach mainsail performed the worst: the sideways thrust exceeded the forward drive, opposite of what I hypothesized. The Marconi sail performed second best as predicted. The flat-head mainsail was the most efficient; it has the optimal width from top to bottom, producing drive while minimizing drag. More sail area up high affects the amount of heeling less than I predicted. The flat-head is best for racers, but impractical for others due to the need for running backstays.


**Summary Statement**
This project determined which of three mainsail designs (high roach, flat-head, and Marconi) would work the best for racer, racer-cruiser, and cruiser sailboats.

**Help Received**
Peter Berry helped me with the design of the testing device and the application of battens on the sails; Mark Baker helped me build the testing device; Louise Berry instructed me on how to use the sewing machine; Kim Berry taught me Microsoft Publisher for designing the backboard.

# CALIFORNIA STATE SCIENCE FAIR
## 2013 PROJECT SUMMARY

**Name(s)**

Annie C. Benedict

**Project Number**

**J0104**

**Project Title**

## Effect of Interior Cavern Angle & Spout Diameter on Water Ejection & Power Collection from a Simulated Oceanic Blowhole

**Abstract**

**Objectives/Goals**

In Year I of my project, I tested how changing the depth of a blowhole assembly in a wave generation tank affected the amount of water ejected from the blowhole spout, which is a measure of how much energy was collected. In this year's project, I tested two independent variables, angle of board inside the blowhole cavern and blowhole spout diameter, to find an optimum configuration for maximum power collection in a simulated oceanic blowhole. I hypothesized the most water would be ejected and most power would be collected when the board was at its greatest angle and the spout had a medium-sized diameter.

**Methods/Materials**

I used the simulated blowhole wave tank I built previously, along with a new water collection system that I designed and built. In addition, I modified my blowhole cavern by adding slant boards to create the internal angle and by developing a system to change spout sizes while still achieving an airtight seal between the spout and cavern. The waves entered the cavern and ejected water through the spout, which was then collected at different heights for a given time. I weighed the lifted water and then calculated its potential energy and power. Using five different board levels and eight different spout diameters, testing each combination for a minimum of five trials, I completed more than 200 total tests.

**Results**

My hypotheses were rejected. The cavern angle did not have much effect on the amount of water output and power collected because the wave motion is primarily at the water's surface, not the tank's bottom. In addition, the largest blowhole spout allowed the most power collection; smaller tubes did not allow for sufficient air flow. The maximum amount of power collected by my setup was 63 milliwatts.

**Conclusions/Discussion**

In this year's project, I was able to increase power collection by more than 21 times that collected previously. The finding that interior angle does not affect its output is actually beneficial to real world application since sand and other debris collected in the blowhole would not affect performance. Based upon my research, I believe blowholes, natural or artificial, could potentially be used as a novel renewable energy source in the future.

**Summary Statement**

In Year II of my project, I tested two independent variables, angle of board inside the blowhole cavern and blowhole spout diameter, to find an optimum configuration for maximum power collection in a simulated oceanic blowhole.

**Help Received**

My father assisted me with the construction/set-up of my wave generation tank and taught me how to use different tools and functions on Microsoft Excel.

**Name(s)**

Christian B. Blanco

**Project Number**

**J0105**

**Project Title**

# Prop It Up! Static Thrust and Efficiency of Small Aircraft Propellers

**Abstract**

**Objectives/Goals**

1. To construct a simple yet accurate force balance which can measure the static thrust of different types of small model aircraft propellers as a function of RPM and power.

2. To find the properties of small aircraft propellers which give the most static thrust for the least power, i.e. are most efficient under given conditions.

**Methods/Materials**

The force balance uses meter stick and fulcrum to balance the thrust of a spinning prop with a moveable weight. I used a variable voltage DC supply and motor to vary the propeller RPM, which I measured with a strobe lamp source to "freeze" the image of the spinning prop.

I investigated the effects of variables RPM, pitch, and number of blades (2 or 3) on thrust/power ratio (=efficiency). I also tested a 5-blade refrigerator fan as a demonstration, and a compact disc as a "zero thrust, minimum drag" control. I took measurements at ~16 voltage steps from 0 up to 5 Volts, and back down again to 0 Volts for validity.

**Results**

The force balance can measure steady thrust accurate to ~0.3 grams. I found that the lowest pitch propellers needed to spin at higher RPM to produce the same static thrust, but used less power to do so, i.e. they were more efficient.

Comparing 2- vs. 3-bladed propellers, at higher thrust the 2-bladed props proved more efficient (even though they operated at higher RPM). However, at low thrust, the efficiencies were similar, a result which I did not find in the literature, but makes sense since slow blades act more "independently".

**Conclusions/Discussion**

Applications of static thrust include helicopter rotors (main and tail), hovercraft, micro-UAVs and blimps. Designers of these are always looking for the most "bang for the buck", i.e. the most thrust for the least power expended. My project demonstrated that the most efficient propeller choice has 2-blades, large diameter, low pitch and operates at low RPM. However, for very low thrust applications (such as a blimp) I found that a 3-bladed prop could provide similar performance, with the advantage of lower RPM (and noise) and more compact size. More tests including 1-bladed and 4-bladed propellers, are needed to confirm and extend this conclusion.

**Summary Statement**

I constructed a force balance and strobe to measure and compare the static thrust of small propeller designs as a function of RPM, pitch, and power required.

**Help Received**

Father helped me with MS Excel formatting and chart setup; local hobby stores provided advice on propeller mounting and motor choice; Force balance parts on loan from Grossmont College; DC power supply on loan from school.

# CALIFORNIA STATE SCIENCE FAIR
## 2013 PROJECT SUMMARY

**Name(s)**

**Stephany R. Brundage**

**Project Number**

**J0106**

**Project Title**

# Water B Gone

**Abstract**

**Objectives/Goals**

My project objective was to figure out which way you could empty a bowl in the most effective way by spraying water into the bowl. (For example, you can spray water into a whirlpool.)

**Methods/Materials**

3 bowls (sm, med, lg) were one at a time filled and sprayed into, according to methods 1-5, to empty the most water out of them within a 1 minute period. A tape measure was used to measure the amount of water left, and a thermometer was used to measure the temp of the water.

**Results**

Method 1, Whirlpool, (at water surface) emptied the most water out of the bowl, and Method 2 (sprayed directly down on the water at 2# above the water surface) emptied the least amount of water.

**Conclusions/Discussion**

My conclusion is that whirlpools are the best and the most efficient way to empty water from a bowl, and spraying directly down on the water surface, breaking the meniscus is the least efficient way.

**Summary Statement**

My project was about emptying a bowl by spraying more water into it in different ways in one minute periods.

**Help Received**

Brother and Teacher corrected board. Mother did the photography.

# CALIFORNIA STATE SCIENCE FAIR
# 2013 PROJECT SUMMARY

**Name(s)**

Vivian R. Chiang

**Project Number**

**J0107**

**Project Title**

## Pulse Wave Analysis in Simulated Vascular System

**Abstract**

**Objectives/Goals**

The purpose of my experiment is to understand how doctors use blood pressure waves to diagnose the patient's sickness.

**Methods/Materials**

In my experimental setup, I have two pumps, representing the atrium and the ventricle. Check valves are located between vein and atrium, between atrium and ventricle, and between ventricle and aorta to enforce one-directional flow. Next, the aorta tube is connected to the ventricle which leads to smaller arterioles. Then, several loads are connected, representing organs. Finally, the vein takes the "blood" back to the atrium. There is a vein reservoir in between the vein tubes to emulate the property of the vein. The variables were the rate of pulses, the stiffness and length of the aorta tube, clogging in the tube, and the viscosity of the fluid.

**Results**

The pressure pulse wave traveled much slower in the Latex tube than in the Vinyl tube and the Polyethylene tube. The pressure waveforms in Polyethylene tube and Vinyl tube were similar with a slightly higher pressure with Polyethylene tube. The pressure pulse propagation delay was slightly smaller with Polyethylene tube than that with Vinyl tube.

The observed pressure was much higher with non-fat milk than that with water in Latex, Vinyl, and Polyethylene tube cases. However, the pressure pulse propagation delay was only slightly larger with non-fat milk than that with water in all three tube types.

In the cases with Latex tube, pinching aorta or the short load caused the pressure to increase slightly. However, the pressure pulse waveforms were not changed significantly. In the case with Vinyl tube, pinching aorta or the short load caused no noticeable change in both pressure and waveform.

**Conclusions/Discussion**

The pressure wave propagated faster in the stiffer Vinyl and Polyethylene tubes resulting higher systolic pressure. The pressure wave propagated slowly in more distensible Latex tube as the tube expanded and contracted resulting lower systolic pressure.

The longer the aorta is, the longer it takes for the reflected wave to reach back to the aorta/ventricle junction, resulting lower peak pressure at the junction and wider pressure pulse.

When the fluid had higher viscosity, it took much higher pressure to get the same flow through the system. However, the increase in propagation delay seemed to be not very significant.

Clogging caused flow resistance to increase but the effect was not very strong.

**Summary Statement**

Using real pumps, valves, and tubes, I investigated how stiffness and length of tubes, pulse rate, clogging in the tube, and viscosity of fluid affect the pulse wave propagation in a simulated vascular system.

**Help Received**

Dad helped to buy materials and operated power tools to build the setup.

# CALIFORNIA STATE SCIENCE FAIR
## 2013 PROJECT SUMMARY

**Name(s)**

Samuel H. Deverett

**Project Number**

**J0108**

**Project Title**

## Spin Will Win: Understanding the Dynamics of Golf Ball Spin

**Abstract**

**Objectives/Goals**

This science fair project determined how or if the angle of impact of a golf club on a golf ball affects the rate of spin. In other words, how or if ball placement in one's stance affects the distance that the ball rolls after it has hit the green.

**Methods/Materials**

A machine was built of wood, screws, springs, and turf to create a consistent swing, taking out the variable of human error. A golf club attached to the center of the machine by a spring was pulled back to the same point on every shot and therefore released at equal speeds and direction. Twelve shots from seven different impact angles were struck from the same place on the fairway to the same target on the green. The landing spots of all shots were marked and then measured to the final resting position of the golf ball, thus exhibiting the rolling distance or rate of spin of the ball.

**Results**

Golf balls placed further forward in the stance rolled significantly less than those placed behind further behind in the stance.  In the farthest forward position, the golf balls rolled an average of 284 centimeters after landing, while in the farthest back position the golf balls rolled an average of 402 centimeters.

**Conclusions/Discussion**

The results demonstrate that the further forward one places the golf ball in their stance, the more spin the ball receives and thus the less it will roll after contacting the green. With this knowledge, golfers everywhere will be able to understand and use spin affectively, putting them in control of their game and likely leading them to achieve better scores.

**Summary Statement**

This project determined how golf ball placement in one's stance affects the rate of spin on the golf ball.

**Help Received**

Father to work machine during testing while I marked the balls' landing location

# CALIFORNIA STATE SCIENCE FAIR
## 2013 PROJECT SUMMARY

**Name(s)**
Paloma J. DiMugno

**Project Number**
**J0109**

**Project Title**
## Bird Migration

**Abstract**

**Objectives/Goals**
Gazing skyward, I have always pondered why groups of birds fly the way they do. The objective of my project was to ascertain whether any formation or migratory pattern offered birds some energetic advantage, enabling them to travel farther and faster, thereby reaching their ultimate destination more efficiently, with less stress and negative effect on their bodies.

**Methods/Materials**
Initially, I constructed two bird models with LEGO blocks, proportionately matched to a pink footed goose, a common migratory bird. I connected one bird to a lever system, connected to a scale, while the remaining bird model was movable. I configured a LEGO base plate, and inserted it into a cardboard air tunnel(a large and open cardboard box). Two feet away, I positioned a large fan. I placed the movable bird at various positions along a V-formation on the LEGO plate and blew the fan for 60 seconds, noting changes on the scale, and recorded the averages. I repeated the procedure 29 times, at different sites on the base plate.

**Results**
Each time the movable bird was on the V-formation pattern, the scale registered zero grams. In those cases where the movable bird was located at any place on the base plate, away from the V-formation, the scale registered weights of anywhere from .1 to 1.3 grams, on average.

**Conclusions/Discussion**
I concluded that the birds flying in a V-formation pattern enjoy an energetic advantage in that they utilize the draft and wing-tip vortexes provided by this formation to minimize energy expended. This enables the birds to consistently remain airborne and strong during long flights.

**Summary Statement**
My project explores the idea that birds migrate in a V-formation because it offers energetic advantages, making them stronger and faster, and enabling them to travel more efficiently to their ultimate destination.

**Help Received**
Mother and I discussed theories of bird migration and my observations; Science instructor provided ideas on how to construct Lego birds.

# CALIFORNIA STATE SCIENCE FAIR
# 2013 PROJECT SUMMARY

**Name(s)**

**Samuel P. Ferguson**

**Project Number**

**J0110**

**Project Title**

## Shape and Flow: What Makes My Derby Car Go?

**Abstract**

**Objectives/Goals**

This experiment was conducted in a full-scale, low speed wind tunnel in order to test the aerodynamic properties of a soapbox derby car and to create a racing strategy based on science. Derby cars have only gravity as their engine, so reduction in drag is critical to maximize speed. The hypotheses for this experiment is that there are four variables that have the greatest effect on the shape of the car and how air flows around it in a race; airfoils, a painted car shell, a foam lined cockpit and a driver seated as far forward as possible - and that this will be the combination that yields the lowest grams force drag on the car.

**Methods/Materials**

Two super stock soap box derby cars were tested in the San Diego Low Speed Wind Tunnel to allow for accurate calculations and data capture. A plate was made to place on top of the load cells to secure the car in the wind tunnel. The cars were loaded inside the wind tunnel and the tests were conducted at 10-35 miles per hour in 5mph increments. There were three categories of tests - car only, car and a "human analog," and car with human.

**Results**

The results of the experiment showed that airfoils attached to the axles lowered grams force drag and had the greatest impact of any variable. Lining the cockpit with foam reduced grams force drag as hypothesized. The tests regarding driver position revealed that a rear seated driver actually had a better reduction in grams force drag than a forward seated driver. The data showed that there is a benefit for a smaller driver to sit in the rear of the cockpit opening for a reduction in drag.

**Conclusions/Discussion**

The data proved the experimental hypotheses to be correct with respect to the airfoils and a foam lined cockpit yielding a lower grams force drag.  The data showed that the rear position for driving had less grams force drag contrary to my hypothesis. The experiment revealed that the painted shell and unpainted shell had similar grams force drag but it also highlighted the importance of measuring the actual frontal area of a cars shell because the smaller the shell the lower the drag. The data will be used to create a scientifically sound racing strategy and to refine slow speed computer models for the US Olympic Bobsled Team.

**Summary Statement**

This project was conducted to test the aerodynamic properties of a superstock soap box derby car in a low speed wind tunnel and to use the data to create successful racing strategies based on scientific evidence.

**Help Received**

San Diego Low Speed Wind Tunnel - ran wind tunnel. Ollie Brower - US Olympic Bobsled Team aerodynamicist helped review data and critiqued test procedure.

# CALIFORNIA STATE SCIENCE FAIR
# 2013 PROJECT SUMMARY

**Name(s)**

Julie A. Fuller

**Project Number**

**J0111**

**Project Title**

## What's the Drag with Swimming?  How Effective Are Swim Caps in Reducing Drag?


**Abstract**

**Objectives/Goals**

My objective was to determine whether a swim cap reduces drag on a swimmer, and if so, whether a swimmer with long hair or short hair would benefit most.  Similar to a cyclist wearing a helmet, I believe that it may be possible for a long haired swimmer to create a similar effect allowing water to flow smoothly over the head to the shoulders, filling in the gap in the neck area decreasing drag.

**Methods/Materials**

With my dad's help, I created a test rig (similar to a wind tunnel, for water), which was placed in our swimming pool.  I placed a plastic model of a swimmer's head and torso on a slide inside the rig.  A current was created using garden hoses, which put pressure on the swimmer ("drag").  Through a cable and lever system, pressure was applied to a scale.  I measured the amount of drag in grams which was then converted to newtons.  I did three tests for each category of swimmer, with and without a swim cap, with a short hair wig, long hair wig and no wig.

**Results**

The results showed wearing a swim cap reduced drag in all situations.  The best drag reduction occurred by a long haired swimmer with a swim cap.

**Conclusions/Discussion**

My base test was a bald swimmer without a swim cap (0 newtons).  All other tests were compared to that swimmer.  Adding a swim cap to the bald swimmer, reduced the drag to -.0196 newtons.  The short haired swimmer without a swim cap had 1.01 newtons of drag; this was reduced to -0.0785 newtons with a swim cap.  The long haired swimmer without a swim cap had .539 newtons of drag; this was reduced to -.2844 newtons with a swim cap.  The least amount of drag occurred with long hair in a swim cap, which confirmed my hypothesis.

I was correct that the long hair under a cap would perform best, but wrong because I was unable to fill in the gap at the nape of the neck as I originally thought.   The caps used were too tight to allow the hair to be positioned where I initially wanted.

By observation, it appeared that drag reduction was achieved by diverting the water around the nape of the neck.


**Summary Statement**

My project compares drag reduction utilizing a swim cap over various lengths of hair.


**Help Received**

Prostethics, Etc. helped me create the "swimmer" used for my tests.  Dad helped me build my test rig and perform the tests.  Mom helped me with my display.

# CALIFORNIA STATE SCIENCE FAIR
## 2013 PROJECT SUMMARY

**Name(s)**

Gabriel A. Garnica

**Project Number**

**J0112**

**Project Title**

# How Airfoil Angles Affect Lift

**Abstract**

**Objectives/Goals**

I'm testing whether changing the angle of an airfoil/wing affects the lift (or downward force) generated by air flowing over and under the airfoil/wing.

**Methods/Materials**

My testing consists of creating a wind-tunnel made of cardboard, which airfoils made of balsa wood and of different degree angles will be subject to wind force by a household fan placed at the front of the wind-tunnel, whose force on the airfoil will then be measured on a digital scale

**Results**

The results confirm that the degree of different angles does affect upward or downward force on the airfoil/wing.

**Conclusions/Discussion**

Since changing the angle of an airfoil affects both upward force (lift) and downward force, one can conclude that one can control the rise and speed of decent of an aircraft by changing the airfoils of an airplane wing.  One can also conclude that the same principle could be applied to turbines and other machinery using fins of differing angles, thereby increasing air and water intake and speed of the turbines and machinery.

**Summary Statement**

My project is about whether changing the degree of the angle of an airfoil on an aircraft will affect the amount of lift or decent of the aircraft as generated by the upward pressure and downward pressure of the airfoil angle.

**Help Received**

My father helped me by directing me to where I could find information on aerodynamics and explaining to me the principles I found.

# CALIFORNIA STATE SCIENCE FAIR
## 2013 PROJECT SUMMARY

**Name(s)**
Ruth J. Gillespie

**Project Number**
**J0113**

**Project Title**
## Battling Bottles: The Aerodynamics of Propulsion

**Abstract**

**Objectives/Goals**
The objective of this investigation is to determine what size and shape plastic bottle travels the farthest distance when launched from an air pressure system.

**Methods/Materials**
Each of the differently shaped 1L bottles were filled with 1.5 cups of water; the 2L bottles were filled with 3 cups of water. At time of launch each bottle was fitted with a cork that had a bike pump needle inserted through the center of the cork. The bottle was then laid on the launch ramp and connected to a bike pump. The bottle was pressurized by pumping air into it therefore making the bottle separate from the cork and launch.

**Results**
The flavored soda water bottle traveled the least amount of distance at an average of 36.74ft. The coke bottle went the farthest at an average of 57.39 ft.; its runner up, the 2L, 7-up bottle, at 55.16ft. The sparkling grapefruit soda bottle was next at 53.93ft on average. And then, the sparkling water bottle at 50.64ft. The data shows that the bottles that had a larger circumference on the bottom, as well as being 2L traveled further than those that had a much smaller bottom circumference and were 1L

**Conclusions/Discussion**
In doing this experiment it was found that the size and shape does affect how far a bottle goes when launched from an air pressure system. The size wound up being more important than the shape for this experiment, because the bigger the bottle the more room there is for pressure to build causing it to fly off faster and stronger.

**Summary Statement**
This project is about determining what shape and size plastic bottle travels the farthest distance when launched from a pressurized air system.

**Help Received**
Mother helped do graphs; Family helped determine where bottles landed.

# CALIFORNIA STATE SCIENCE FAIR
# 2013 PROJECT SUMMARY

**Name(s)**

Evan M. Green

**Project Number**

**J0114**

**Project Title**

## Just Wright for Flight

**Abstract**

**Objectives/Goals**

The goal for this project was to find out if golf ball dimpling on the top surface of delta wing glider can increase its aerodynamics efficiency to a point which affects measurable performance. I defined performance as flight distance and time aloft.

**Methods/Materials**

I used 1" thick R-Max foam insulation as the raw material to build a delta wing glider of my own design. I ran 50 indoor trials with the glider as my control group. Next, I used a 1/2" drill bit to create standard concave dimples on the top surface of the glider. I then repeated 50 more trials according to protocol for my experimental group.

**Results**

The data showed that the dimpled glider had a 23.9% increase in average flight distance; however, the average time aloft decreased by 5.5%.

**Conclusions/Discussion**

I had expected an increase in flight distance due to what physicists refer to as the "golf ball dimpling effect'. In simple terms, dimpling decreases turbulent airflow and therefore reduces air friction, enabling a golf ball and my glider to fly farther. The unexpected decrease in time aloft is most likely due to a human variable. The short flight times were difficult to measure accurately with a stopwatch.

**Summary Statement**

I experimented to determine the effects of golf ball dimpling on the performance of a delta wing glider.

**Help Received**

Mother assisted with timing of flight trials, Father helped with constructing launcher( that was not used)

# CALIFORNIA STATE SCIENCE FAIR
## 2013 PROJECT SUMMARY


**Name(s)**

Cameron A. Kalantar


**Project Number**

**J0115**

**Project Title**

# Wind Turbine


**Abstract**

**Objectives/Goals**

The blade angles of wind turbines affect the amount of electricity generated. My research proved that the blades least tilted at an angle of 15 degrees will generate the most electricity out of the three options.

**Methods/Materials**

Methods: Assemble a miniature wind turbine.Create snap on blades made from various materials. Put the blades at an angle of 15 degrees for the 1st set, 45 for the 2nd and 75 for the 3rd. Remember to repeat each set 5 times. Snap in your blades to the wind mill. Attach the DC Motor copper wires to the multi meter.Set the multimeter to the right setting. Then set up a table fan. Turn on the multimeter. Turn on the fan.Once the multi meter Is stabilized,record the voltage on your paper. For every test mark down the voltage. To Calculate average, Add all the trial results, Divide by five. Compare between the three angles results. Then record the answer in your science journal. Materials: 1 mini D.C Motor. 1 Digital AC/DC Multi meter. 3 full pieces of construction paper.1 long plastic pipe.1 connection piece. 4 screws.1 table-top fan. 3 ft of copper wire. 1 power drill or any other tools I might need.1 large-thin piece of wood. 4 patches of foam paper.5 inch of duct tape. 15 sticks hot glue. 1 hot glue gun. 1 metal fastener. Green Paint. 5 large pieces of duct-tape.1 light bulb holder

**Results**

My experiment results were; 15 degree angle blades came in 1st with an average of 12.80 mV. The 45 deg blades came in 2nd with an average of 9.02 mV. Lastly, 75 deg blades came in 3rd with an average of 4.66 mV. These results confirm my hypothesis and show that the angle of wind turbines# blades does affect the resulting outcome of generated electricity.

**Conclusions/Discussion**

After completing my project I conclude that the angles of the blades are important. The main reasons are related to aerodynamic forces of Lift and Drag. For example,when the fan was blowing on the 15 degree angled blades, the wind impact on the slightly tilted blades would slide off resulting in the blades moving in a circular motion. These aerodynamic forces apply to many real situations. Some key examples are airplanes or jets. Since the wings of an air plane are the correct angle,it is able to lift off and stay in the air.


**Summary Statement**

Blade angles of a wind turbine affect the amount of generated electricty


**Help Received**

Mom helped me buy materials, Dad explained about DC motors and teacher taught me about Wind Turbines

# CALIFORNIA STATE SCIENCE FAIR
## 2013 PROJECT SUMMARY

**Name(s)**

Michael Kao

**Project Number**

**J0116**

**Project Title**

# The Effects of Vibrational Force on Dilatants

**Abstract**

**Objectives/Goals**

The goal of this experiment is to see how vibrational force affects the properties of dilatant fluids and how the effects can be implicated in new technology.

**Methods/Materials**

This experiment will be testing two dilatant fluids called oobleck and ethylene glycol by inducing vibrations into the fluids. The proposed experiment begins by making oobleck out of cornstarch and water and obtaining 1 1/2 cup of ethylene glycol. A speaker will be connected to a TV amplifier and a frequency change kit. Pour the fluid into the speaker, and make sure that all variables are kept controlled except the frequency of the vibration. Using the frequency kit, measure how long a ruler takes to sink to the bottom of the speaker (4 inches) at every 300 Hz all the way to a maximum of 1800 Hz. The time it takes for the ruler to sink is indirectly measuring the viscosity of the fluid at each frequency level. Test each frequency several times from 300-1800 Hz for the fluid, and repeat procedure for the second fluid. Record and graph all measurements taken.

**Results**

An analysis of the results shows a positive correlation between the the frequency of the vibration and the time of the ruler. As the frequency was moved higher and higher, the viscosity of the fluid increased to the point where the ruler took almost 13 seconds to sink in a four-inch depth. Faraday waves were present during the experiment and a viscosity change could clearly be seen. The viscosity of the fluid stopped increasing after 1800 Hz, and results recorded with a frequency of below 300 Hz were not valid enough to be recorded.

**Conclusions/Discussion**

It can be concluded that vibrational force does increase a dilatant fluid's viscosity, as the time of the ruler shows. Between 0 and 1800 Hz, there was an 8 second increase in time, a huge increase compared to the small change in the frequency. From analyzing, dilatants probably form hydro-clusters from the vibrations as resistance, so the clusters increase the viscosity. This unique property can be widely used in modern industry development, such as an inliner for pipes to resist pressure, shock resistance for a variety of vehicles, hydraulic pressure buffers, and even as possible bulletproof resistance armor for combat. Uses of dilatant fluids are still hypothetical but are being widely experiment by industrial companies.

**Summary Statement**

Dilatant fluids have previously almost no use in the industry; this project will see how vibrational force affects dilatants and how this concept can be used.

**Help Received**

Awknowledgements go to my father for providing the right supplies and assistance for constructing the frequency kit.

# CALIFORNIA STATE SCIENCE FAIR
## 2013 PROJECT SUMMARY

**Name(s)**

Daniel H. Kass

**Project Number**

**J0117**

**Project Title**

# Rocket Components Affect Rocket Flight

**Abstract**

**Objectives/Goals**

The objective is to learn about the effect of rocket component on rocket flight and test these things.

**Methods/Materials**

Main Rocketry Components

1 model rocket kit, 15 Model rocket engines (B6-6 model), 4 Alternate type model rocket engines (B6-4 model) , Rocket launch pad, Pennies (for weighting),

Measuring and Assembly Tools

Stopwatch, Meter stick, Scissors, Duct tape (For attaching weights and modifying fin size).

Assembly Phase

In this phase, I built the rocket as in the standard instructions.

Launch and Measurement Phase

In this phase, I launched and recorded things about the rocket's flight. I fired the rocket, using the stopwatch to measure the flights duration. When the rocket landed, I recorded distance from launchpad to landing point. I then recorded the statistics in my book. After that, I recovered the rocket, and inserted a new engine. I repeated the Launch and Measurement Phase 2 more times.

Modification Phase

In this phase, I modified the rocket in several ways. The first modification involved taping weights on to the rocket. The second modification involved using duct tape to expand the fins. The third modification involved using a different engine. After each modification, I repeated the launch and measurement phase to record data about the effect of the modification.

Analysis Phase

Finally, I created averages from the flight time and stability data, and then compared the averages to determine the effects of the modification.. I determined which rocket flew the longest. I also decided which rocket landed farthest away from the launchpad.

**Results**

Results: Each modification had an effect on the flight: They all decreased the stability and the flight

**Summary Statement**

This project is about the effect that various changes to a rocket can have on its flight characteristics.

**Help Received**

got advice about writing this application from my dad, and my parents drove me to the park where we launched the rockets, and my parents bought the rockets for me.

# CALIFORNIA STATE SCIENCE FAIR
## 2013 PROJECT SUMMARY

**Name(s)**
Kelby B. Kramer

**Project Number**
J0118

**Project Title**
# Ocean Current Energy: Angling for the Future

**Abstract**

**Objectives/Goals**
The objective of my experiment was to determine the optimal blade angle for an ocean current turbine in different current speeds. I suspected that a 45° blade angle would produce the most volts because it had an ample surface area and still had a gap for the water to flow through.

**Methods/Materials**
I created a gravity fed pipe system to run my tests. I tested 5 different angles: 15°, 30°, 45°, 60°, and 75°. The different angled blades were placed into the pipe system which was then filled with water. The cap at the bottom was pulled and I would measure the peak output of the blade. This process was repeated five times before a new blade of a different angle was placed into the pipe. Once all five blade angles had been tested in this manner I changed the outflow size to increase the current speed and repeated the experiment.

**Results**
For the smaller one inch outflow, the 30° blade angle proved to be the most productive (3.5V). However, all the different blade angles hardly twitched when running them in the smaller outflow size. The water flow may have been so slow that the blade rotation could not overcome the friction on the shaft. In my second test with a larger two inch outflow there was a consistent trend that the lower angles produced more energy with the 15° blade being the most productive (15+V).

**Conclusions/Discussion**
Contrary to my original hypothesis a 45° blade angle was not the best. In fact lower angle blades worked better. The optimal blade angle is either 15°or 30° depending on the velocity of the water flow. My data was inconclusive. At the faster water rate, the 15° blade was optimal perhaps because the greater surface area of the blade allowed more water to hit it and thus spin faster. The 30° blade was best at a slower water rate. I do not know if this is caused by my apparatus#s limitations (friction, etc.) or if it is actually correct that 30° was better. Therefore to understand if the optimal blade angle varies depending on water flow speed, I would have needed to do a third experimental run at a different current speed.

**Summary Statement**
My ocean current energy experiment uses a gravity fed water system at two different current speeds to test for the optimal turbine blade angle that generates the most power.

**Help Received**
My dad supervised me when using power tools and drove me to get supplies. I went to the California Academy of Science#s naturalist desk and they gave me a contact in Oregon. I emailed some questions to Noah Weaverdyck in Portland who was my main scientific support.

# CALIFORNIA STATE SCIENCE FAIR
# 2013 PROJECT SUMMARY

**Name(s)**

David A. Lipman

**Project Number**

**J0119**

**Project Title**

## Science in the Sink

**Abstract**

**Objectives/Goals**

The purpose of this project was to determine what factors affect the radius of the ring that forms in a sink when a stream of water from the faucet hits it. This ring is called the hydraulic jump.

**Methods/Materials**

The effect of varying flow rates was tested by running water through a nozzle at a fixed height with 10 different flow rates, measuring the size of the ring for each rate. The effect of a fixed flow rate from varying heights was tested by using a constant head device to create a fixed flow rate and measuring the ring size at 11 different heights.

**Results**

It was determined that one of the main factors affecting the radius of the hydraulic jump is the flow rate. As the flow rate increases the radius of the hydraulic jump increases in a linear relationship. As the height of the nozzle is increased, the jump radius increases roughly in proportion to the square-root of the nozzle height. Both of these relationships can be explained using simple mathematical models that were developed in analyzing the experimental results.

**Conclusions/Discussion**

From my research I learned about the energy of the jump and what causes the water to stop at the jump edge. I found it interesting that by using a simple mathematical model of the hydraulic jump, scientists can understand real-world phenomena such as the white hole and the solar wind terminal shock.

**Summary Statement**

Studying the factors affecting the shape of the hydraulic jump that forms when a stream of water from a kitchen faucet hits the sink.

**Help Received**

I had some assistance from my Dad. He helped me set up the equipment and he helped me understand some of the math.

# CALIFORNIA STATE SCIENCE FAIR
# 2013 PROJECT SUMMARY

**Name(s)**
Raul Lopez

**Project Number**
**J0120**

**Project Title**
## Effects of Altitude on Drones

**Abstract**

**Objectives/Goals**
After designing a capsule to carry an RC (Radio Control) drone into the stratosphere, I compared the affects of different altitudes on the signal, power and stability of drone planes.

**Methods/Materials**
. I constructed a capsule using balsa wood, foam board and wood glue. I then modified a RC plane. On both, the capsule and plane I mounted a camera and FPV system which allowed me to have live video feed on screen. I also constructed an antenna system for the long range of my experiment. To get the airplane and capsule into the stratosphere, I tied a weather balloon to the capsule that took my airplane into the stratosphere. I used telemetry to get all my data. I conducted two tests. One test went horribly wrong, the capsule came crashing down. After I constructed and innovated my capsule I conducted my test.

**Results**
All my results were compared. My plane started losing power at 116,160 feet which was my max altitude. My signal was also really weak at 116,160 feet. However my stability was good and the drone was flying great. After reviewing my results I found out that high altitudes do in fact effect drones power, signal and stability. My results strongly support my hypothesis.

**Conclusions/Discussion**
I learned many things from this project. I learned how the atmosphere affects major components in a drone. I was able to fly a model UAV drone 116,160 feet into the atmosphere. My hypothesis was correct because I said drones start to have problems at about 100,000 feet. I believe this may help real world applications. If I could do this again I would try using different airplane designs.

**Summary Statement**
I took a predator RC model plane into the stratosphere to test the effects of high altitude.

**Help Received**
my mom helped me complete my display board.

# CALIFORNIA STATE SCIENCE FAIR
## 2013 PROJECT SUMMARY

**Name(s)**

Tithi Mandal

**Project Number**

**J0121**

**Project Title**

## Airfoils and Winglets

**Abstract**

**Objectives/Goals**

To find out if airfoils become more aerodynamic when a winglet is attached. I believe winglets will make a wing more aerodynamic.

**Methods/Materials**

For my experiment I made three airfoils with various camber styles and made three winglets, which can be attached at the tip of the airfoils to turn them into airfoils with winglets. I placed the each airfoil without attaching the winglet inside a wind tunnel one at a time and measured lift and drag force by two sensitive spring scales. Then I attached the winglets to the tip of the airfoils and again placed them inside the wind tunnel and took the same measurements. I kept the speed of the wind in wind tunnel and the angle of attack same.

**Results**

The wings did become more aerodynamic with winglets. For low camber and deep camber airfoils, the lift to drag ratio was 300% higher when the winglet was attached to them compared to the case when the winglet was not attached. For symmetric camber it was 200% higher! Also the lift force generated by airfoils with winglets was 200-300% higher! Planes need to fly at a safe altitude above all weather, so the lift force must be pretty high. To get a high lift force, the angle of attack has to be high, which again generates high drag as well. As the airfoil with winglet generates higher lift for a given angle of attack, a plane with winglet will need lower angle of attack hence less drag for the same lift compared to a plane without winglet.

**Conclusions/Discussion**

I concluded that wings with winglets are the most aerodynamic. All three types of wings have higher (200 - 300%) lift to drag ratio when a winglet is attached. This means that for the same lift the drag will be lower for a wing with winglet attached to it.

For getting higher lift the angle of attack needs to be high, which generates higher drag. In case of a wing with winglet, a lower angle of attack will be needed to generate the same amount of lift as the wing without winglet. And due to lower angle of attack lower drag will be generated.

**Summary Statement**

To find out if airfoils become more aerodynamic and efficient when a winglet is attached.

**Help Received**

My parents helped me in making the airfoil and wind tunnel and preparing the board

# CALIFORNIA STATE SCIENCE FAIR
# 2013 PROJECT SUMMARY

| Name(s) | Project Number |
|---|---|
| Patrick R. Mullen | J0122 |

**Project Title**

## Ship Shape Hulls


**Abstract**

**Objectives/Goals**

My objective was to see how a boats hull shape can affect its speed and to show the more displaced water by the hull or the hull that is more submerged will go faster.

**Methods/Materials**

Materials: Styrofoam, Fishing line, Fishing weight, Photo Gate EA-24, Rain gutter, Timer ET-36, Industrial Washers, # inch PCV pipe, Pulleys.

I carved uniquely different boats out of styrofoam and ran them through a gutter filled with water and measured the speed with a photo stop timer.

**Results**

Boat 1 A rectangular,block of Styrofoam,had the second fastest times averaging 5.065 seconds. This boat had the most amount of displacement and submerged hull but had problems nose diving and therefore causing drag.

Boat 2 was the fastest boat of all because it had a steep bow slant. It had the least amount of Styrofoam carved out to shape it#s form. The slant prevented it from nose diving and while keeping most of its hull submerged. Although it had slightly less displacement than boat 1, it had an average time of 4.382 seconds.

Boat 3, which had the symmetric and ideal hull shape of a speed boat with bow and forward side slants. This boat didn#t perform as well as expected because and had the slowest times with an average of 5.337 seconds. It had the least area of submerged hull so it displaced the least amount of water, but it had a bow shape the prevented it from nose diving.

Boat 4 was the boat that performed the least consistent of all the boats. It had a range of times from 4.438 seconds to 5.664,Its shape was a blunt bow with cut out chimes running down the sides of the boat. It nose dived and displaced a medium amount of water in comparison with the other boats.

**Conclusions/Discussion**

This lab tested how a boat#s hull shape and design affects its speed due to water displacement. I conclude that the more of a boat#s hull that is submerged will cause a boat to move faster through the water by creating a bow wave that propels the boat through water.Also, an example of fluid friction was shown through boat 2 having less displacement then boat 1, yet moving faster because its bow shape allowed it to over come the bow waves. The chime of boat 4 worked at a pro and con level because the chimes took


**Summary Statement**

How the different shaped hulls affect speed through the water and the other factors that comtribute or inpeed its speed

**Help Received**

Father helped design and set up rig and helped compose graphs on power point.

# CALIFORNIA STATE SCIENCE FAIR
## 2013 PROJECT SUMMARY

**Name(s)**

**Payton Nance; Sameer Sundrani**

**Project Number**

**J0123**

**Project Title**

# The Flight Path of a Boomerang

**Abstract**

**Objectives/Goals**

The objective of our project is to determine how launching a two # winged boomerang at different angles affect the boomerangs flight path. We hypothesize that the boomerang will land farthest away from the point of origin, the skeet shooter, when the boomerang is launched at zero degrees, horizontal. When launched at forty degrees, the boomerang will land closest to the point of origin.

**Methods/Materials**

A skeet shooter was used to launch the boomerang at different angles ranging from 0 degrees horizontal up to 40 degrees. This skeet shooter was modified so that it was able to launch the boomerang at the correct strength and speed for it to fly in the correct manner. The boomerangs flight path and the distance it landed from the point of origin was recorded. In order to measure these distances, markers and a tape measure were used. Every time the boomerang landed, the tape measure was used to measure the distance away from the point of origin in meters.

**Results**

When launched at 0 degrees, the boomerang landed at an average of 34 meters away from the point of origin. The boomerang landed at an average of 37 meters away from the point of origin when it was launched at 10 degrees. When launched at 20 degrees, the boomerang landed at an average of 31 meters away from the point of origin. The boomerang landed at an average of 29 meters away from the point of origin. Finally, when launched at 40 degrees, the boomerang landed at an average of 27 meters away from the point of origin.

**Conclusions/Discussion**

In conclusion, these values support our hypothesis because our results showed that the boomerang landed closest to the point or origin when launched at 40 degrees, because the boomerang is not able to spin when launched at horizontal, and therefore will not get lift or the returning motion. When launched at 40 degrees, the boomerang is able to spin, creating lift and the returning motion needed for it to come back. It took many trials and four different modifications to determine the proper placement of the bolts on the skeet shooter to enable it to shoot boomerangs. We are planning to conduct additional trials and will have those results to present at the state science fair. Other variables, such as wind resistance, moisture, and the strength at which the boomerang is launched can be used in future investigations.

**Summary Statement**

Our project is about #How does changing the angle a boomerang is thrown at affect its flight path?#

**Help Received**

My parents helped glue material on the board, they helped to modify the skeet shooter, and they helped us use the skeet shooter.

# CALIFORNIA STATE SCIENCE FAIR
# 2013 PROJECT SUMMARY

**Name(s)**

Jason S. Provol

**Project Number**

**J0124**

**Project Title**

## Analysis of Airfoil Performance in a Micro-Scale Wind Tunnel

**Abstract**

**Objectives/Goals**

The first objective of this study was to build a home-made wind tunnel and to perform meaningful quantitative analysis of the lift and drag performance of airfoils. Also, to evaluate the impacts of modifications to the airfoils including adding dimples and protrusions to the surface, and changing the length (#chord#) of the airfoils. The changes in lift and drag were measured at different air velocities.

**Methods/Materials**

A #Pendulum Technique# was applied to measure horizontal drag force. The airfoils were suspended from a 602 mm fishing line and the airfoil moved horizontally as it experienced drag. A Drag Calibration Device was built to calibrate the horizontal displacement measurements taken in the wind tunnel. A #Spring Technique# was used to measure lift force. As air flow was introduced to the front of airfoils, they lightened due to lift and the springs condensed. A Lift Calibration Device (LCD) was built to calibrate this vertical displacement. The vertical displacement in the LCD related to the spring constant and the amount of lift force.

**Results**

Results showed that the Base Airfoil mosly had the most lift. L/D#s were ~1.6-2.9. Airfoil A5 had longer chord which resulted in less lift but also less drag. L/D#s for A5 were ~2.0#3.4, better than A1. Airfoils A6#A8 included protrusions on top of the airfoil. Protrusions reduced lift and increased drag, resulting in L/D#s of 0.6-2.4. Airfoil A9 had dimples on top. Dimples reduced lift and increased drag. L/D#s for A9 were ~0.9#0.6.

**Conclusions/Discussion**

Dimples added to an airfoil (A9) mostly resulted in the most reduction to the L/D for all of the airfoils tested. Protrusions (A6-A8) resulted in lower lift and higher drag. This supported the hypothesis that modifications would inhibit performance of A1, though in some tests the results were less dramatic than the 4:1 change in L/D that was hypothesized. A5 had similar dimensions to A1, but a longer chord. A5 had substantially less drag than the other airfoils. A5 has the highest L/D of all airfoils tested. An extremely interesting observation occurred during lift testing. When air was allowed to leak through the side of the wind tunnel from under the airfoil but not from above it, the amount of lift displacement observed was substantially greater. This is a key finding for further study that the experimenter would like to pursue as it offers promise to improve wing performance of aircraft wings.

**Summary Statement**

A micro-scale wind tunnel was built economically in the garage to test and observe the lift and drag of six different airfoil designs at six different velocities inside of the wind tunnel.

**Help Received**

Mr. Kurtis Long helped with consultation on airfoil design, wind tunnel design, experimental apparatus, and ongoing discussion on results and conclusions.

# CALIFORNIA STATE SCIENCE FAIR
## 2013 PROJECT SUMMARY

**Name(s)**

**Sampson B. Reynolds**

**Project Number**

**J0125**

**Project Title**

# Winglets on the Water

**Abstract**

**Objectives/Goals**

To determine if attaching a winglet to a rigid wing sail on an Americas Cup 72 would affect the amount of drag on the rigid wing sail. I think that the winglet will decrease the amount of overall drag on the rigid wing sail. As far as i know this hypothesis has never been tested before.

**Methods/Materials**

1. Design and build a wind tunnel out of plywood.
2. Build an Americas Cup style rigid wing sail and a winglet out of Styrafoam
3. Mount the sail on a linear bearing and mount the bearing on the floor of the wind tunnel
4. Hold the winglet at the front of the bearing then time how long it takes to be blown the length of the bearing
5. Repeat this 49 more times and then put the winglet on and repeat it another 50 times

**Results**

The final results of my experiment where that winglet wing had more drag than the regular wing. The winglet time ranged from 1.9 to 2.4 seconds with an average of 2.132 and the normal wing ranged from 2.1 to 2.5 seconds and had an average time of 2.332. The higher the number the lower the drag because it had less wind resistance so it took longer. This means that the winglet wing created more of a wind barrier the wind pushed it faster making it have the lower number

**Conclusions/Discussion**

The results did not support my hypothesis. In the future I would like to refined the method used to measure the amount of drag to create a more sensitive measure if possible. I would also like to try putting one winglet in the center of the wing and maybe change the shape of the winglet. I believe there is a strong possibility that this hypothesis could be proven true with the correct modifications. If winglets do actually decrease the drag on a rigid wing sail then they may appear on the next Americas cup boats.

**Summary Statement**

To use a wind tunnel to determine if attaching a winglet to the rigid wing sail of an Americas cup 72 will affect the amount of drag on the wing.

**Help Received**

Dad helped use table saw and nail gun; Dad held other side of hot wire knife; Friend held smoke bomb

# CALIFORNIA STATE SCIENCE FAIR
## 2013 PROJECT SUMMARY

**Name(s)**
Monet G. Scullin

**Project Number**
**J0126**

**Project Title**
## Paper Airplane and Flight Distance

**Abstract**

**Objectives/Goals**
A paper airplane is a simple, yet fun and creative toy. After reading my brother's paper airplane book, I learned that there are a wide variety of paper airplane designs. While going through the different designs, I was curious to find which paper airplane design would fly farthest? I conducted a scientific experiment using 8 different designs of paper airplanes to see which design would fly farthest. My hypothesis was a plane with a wider wing span would fly farthest because a real airplane has wider wing span to fly a longer distance.

**Methods/Materials**
For my experiment, I used the 8.5 x 11 inches plain copy paper to make paper airplanes, made two original designs, and picked six designs from www.origami-kids.com. I conducted my experiment inside the gym to avoid the effects of wind. I used the electric launcher in the first part of my experiment and hand throw in the second part. I threw one type of planes ten times and measured the distance from the starting point to nose of the plane for each throw. I repeated this procedure for the rest of designs.

**Results**
My data contained outliers, so I decided to use median. This way, I could avoid influencing central tendency of my test results. Based on the median, Wide Fenix got the first place for using the electric launcher. The second was X-Glider; the third Original; the forth Mouse; the fifth FF2; the sixth X-Hunter; the seventh Fly; the eighth Needle. For the hand throw, Original got the first place. The second was Wide Fenix; the third X-Hunter; the forth Needle; the fifth Fly; the sixth X-Glider; the seventh FF2; the eighth Mouse.

**Conclusions/Discussion**
Since the results of launcher depended on the fold on the bottom of the planes, the hand throw was more reliable way to test my hypothesis. Therefore, I only use the results by hand for my conclusion.Overall, my test results did not support my hypothesis. The winner, the Original, did not have a wide wing span. The second place, Wide Fenix, did have a wide wing span, but the third and fourth place did not have a wide wing span. Therefore, a wider wing span was not a key factor for longer travel distant.

For the future experiment, I will test the winner of this experiment (the Original) using different size of papers to see which paper size of papers would fly farther. This way, I can tell whether a wing span would affect a travel distance.

**Summary Statement**
This project is about the correlation between wingspan and flight distance of paper airplanes.

**Help Received**
Father showed me how to fold paper airplanes. He also helped to make my graphs. Parents and brother helped measure the flight distances and record the results.

# CALIFORNIA STATE SCIENCE FAIR
## 2013 PROJECT SUMMARY

**Name(s)**

**Ryan D. Sloane**

**Project Number**

**J0127**

**Project Title**

# Going with the Wind

**Abstract**

**Objectives/Goals**

To determine which factor of a wind turbine blade is responsible for effiency, surface area or the shape of the blade. I tested eight different shaped blades that had equal surface area. My hypothesis was that if surface area was the deciding factor then all blade sets would have approximately the same output. But if shape turned out to be the most important factor then there would be different outputs produced by each blade. I started my project believing that shape would be the factor that influenced effiency. I worked hard to design an experiment that had only a single variable of blade shape.

**Methods/Materials**

I constucted a wind turbine out of recycled printer parts that had an adjustable mandrel that could be used to test each blade shape at seven different angles. Using an electric meter I was able to measure the electrical output of each blade type in volts DC.Each blade type was tested at three different wind speeds created by a box fan array. The blades were made from thin scrap plywood and all different shapes had an equal surface area of 96 square inches. Each blade set created a power curve that could be compared to the others. I defined efficiency as the average output for each blade set at the three tested speeds.

**Results**

I was expecting the blade sets to have different outputs, but I was very surprised when the half circle shaped blade(#8) far outperformed the others. Of the eight tested shapes, one outperformed the group, six were fairly close in outputs, and one lagged the group. This experiment created a large amount of data that clearly defined the results.

**Conclusions/Discussion**

The half circle blade set(#8) far outperformed the rest of the test group. Shape was the factor that influenced output the most. My analysis is that the half circle when tested at 75 degrees formed a simple airfoil that increased efficiency by creating lift. I base this obsevation on the idea that most airfoils in aviation have a curved upper surface over a lower straight surface. If I continued this experiment I would examine blades with curved surfaces that would influence effiency.

**Summary Statement**

Testing which factor influences wind turbine blade efficiency, shape or surface area?

**Help Received**

Father help construct the wind turbine.(Table saw and power tool operation.)

# CALIFORNIA STATE SCIENCE FAIR
## 2013 PROJECT SUMMARY


**Name(s)**

Phoenix A. Spoor


**Project Number**

**J0128**

**Project Title**

# How Buoyant Is a Plastic Bottle Kayak?


**Abstract**

**Objectives/Goals**

Problem - Safebottles.co.nz has reported that more than 100 million plastic water bottles end up in landfills and waterways worldwide each day # that is approximately 1500 every second. There is a need to find ways to reuse these bottles. (http://www.safebottles.co.nz/News/Plastics+and+the+Environment.html ).

Objective/goal # My object was to determine is plastic bottles would be buoyant enough to be reused for the construction of a kayak.

**Methods/Materials**

Methods - researched plastic bottles and the effects on our environment; researched plastic bottle boat and kayak designs; calculated Archimedes Principle; determine which bottles to use; collected materials; designed and built initial prototype for the kayak construction; tested and modified design; final test with person in the boat

Materials - Scale, tub with overflow valve, fresh water, measuring cup, 1# weight, calculator , plastic bottles, glue, caulk, tape, scissors, rope, camera, lifejacket, paddle, wetsuit, bathing suit

**Results**

The experiment was a success. It produced a kayak that was water tight, floated, and could bear the weight of the experimenter. There was a need to adjust the design three times and there is still room for improvement.

**Conclusions/Discussion**

Conclusions/discussion - One 24-ounce empty plastic bottle can support 16 ounces or 1 pound of person weight; the lightweight boat was comfortable and sea worthy for a person weighing 100 pounds or less using the 60% rule (www.sansa.org.sa/content/buoyancy-small-vessels); the stern of the boat needs to be expanded to increase stability and change the center of gravity; consider a second row of bottles under the deck or around the gunwales, or redesign the keel and stabilizers to increase stability; the lightweight boat was comfortable and sea worthy for a person weighing 100 pounds or less; the stern of the boat needs to be expanded to increase stability and change the center of gravity; consider a second row of bottles under the deck or around the gunwales, or redesign the keel and stabilizers to increase stability
Recommendations - Although the project was a success, there is a need to adjust the design and construction of the boat.


**Summary Statement**

This experiment has shown that with some design modifications this project can be replicated by many people allowing for the reuse of plastic bottles that will no longer go into the oceans or landfills.


**Help Received**

Parents and sister helped collect bottles and with the construction of the boat. Mother helped with typing and graphs. Guidance and support received from Paul Pakus and Norman Negus

# CALIFORNIA STATE SCIENCE FAIR
# 2013 PROJECT SUMMARY

**Name(s)**
Priya Valentina

**Project Number**
**J0129**

**Project Title**
## Viscosity Challenge: Milk, Oil, or Pancake Syrup?

**Abstract**

**Objectives/Goals**
The purpose of this project was to find which one of the liquids (milk,oil, or pancake syrup) has the highest viscosity.

**Methods/Materials**
I will be testing the viscosity of each liquid by using the "dropped-sphere" method where a marble is dropped down into each graduated cylinder with each liquid inside and the time it takes to get through each liquid is recorded. Then the results from this method will then be inserted to the viscosity equation. Identify each term of the equation for each liquid and then calcualte the math.

**Results**
When calculated, the results were pretty evident at the end. The marble that went through the pancake syrup had the slowest average time(8.18 sec).The marble in the milk had the highest average time(0.67sec). Oil's average time was close to the milk's time (0.96 sec).When these results were inserted into the equation, the syrup had the highest and number and the milk had the lowest number.

**Conclusions/Discussion**
My conclusion was that the results do support my hypothesis. The pancake syrup did have the highest viscosity and the milk had the lowest viscosity. Milk and Oil maintained similar results throughout the experiment, however, the syrup's results remained high.This project helped me analyze the different components of each liquid. If this project was to be repeated I would suggest using the dropped-sphere method in differnt temperatures. Would the pancake syrup still have the highest viscosity even in different temperatures?

**Summary Statement**
Finding the viscosity of each liquid by using a sphere(marble).

**Help Received**
Mom helped me by getting all the materials and gluing information on the display board.

# CALIFORNIA STATE SCIENCE FAIR
## 2013 PROJECT SUMMARY

**Name(s)**

Jonathan M. Wahl

**Project Number**

**J0130**

**Project Title**

# Air Conditioning vs. Windows: How to Cool Down Your Car Fast

**Abstract**

**Objectives/Goals**

The goal of this project is to find out if opening windows before activating the A/C system helps cool down the automobile's interior faster than a baseline of A/C only. Measurements were obtained at different vehicle speeds to characterize the convective mixing of air inside the vehicle. A simple temperature model was used to optimize the window open time for fastest cool down.

**Methods/Materials**

The temperature inside the car was measured simultaneously at four strategic locations to obtain a representative average temperature. The car interior was heated up to about 50C before each test. The temperature was recorded for four sensors at 1 sample/sec as the effect of different operating conditions was explored. The baseline consisted of only using A/C to reach the target temperature (typically 25C). This was compared to using only open windows (A/C off) while varying the vehicle speed (0, 35 and 65 mph). The experimental data was normalized and curve fit to characterize the convective mixing of air inside the car. This was later used in a model for predicting the temperature inside the car. This model was exercised to find the optimal window open time (before switching to A/C) to achieve the shortest overall time for cooling down the car.

**Results**

At 0 mph, opening windows does not help the car cool faster than with A/C only. Although the results suggest that the mixing of air at 0 mph is better compared to A/C only, the air from the A/C is so much colder compared to the outside temperature that the A/C cools the car down faster. The situation changes once the windows come down when the vehicle is moving at which point the air mixing overwhelms the A/C#s capabilities, provided the outside temperature is not too high.

**Conclusions/Discussion**

The key finding of this project is that opening windows at any speed is better as long as the outside temperature is not too high. Reason being the fan rushing the air through the A/C system is not powerful enough to compete with the jet stream coming through the windows. The temperature model established as part of this project can predict the window open time for any given vehicle speed and outside temperature and can be possibly used in a Smartphone application to provide guidance or it could be programmed into the car's computer to do the same thing as the Smartphone but controls the components automatically to achieve the fastest cool-down.

**Summary Statement**

This project investigates and quantifies which approach cools down the interior of a car the quickest: using only A/C or opening windows first followed by A/C.

**Help Received**

Father derived advanced mathematical equations and set up the temperature model in an MS Excel spreadsheet. See student notebook for further details.

# CALIFORNIA STATE SCIENCE FAIR
## 2013 PROJECT SUMMARY

**Name(s)**
Christopher H. Yip

**Project Number**
**J0131**

**Project Title**
## Wind Turbines

**Abstract**

**Objectives/Goals**
How does the number of blades and blade shape, size, angle, and curve affect the efficiency of a wind turbine?

**Methods/Materials**
Materials:
Styrofoam,Balsa Wood,Wooden Rods,Lego NXT Set,Cup (For the Tower),Fan,Craft Knife,Hot Glue Gun and Glue,Drill and Drill Bits,Styrofoam Cutter,Art Tools (Ruler, Compass, Pen, Scissors, Protractor)
I tested the number of rotations per minute by using an NXT to count the number of rotations per minute.

**Results**
The short-bladed wind turbine rotated the fastest. 20o angles also worked well. The wind turbine with the convex head moved in the opposite direction of the other wind turbines. With more blades, the number of rotations increased. As the angle increased, the number of rotations decreased. 0o and 90o angles, as well as the one-bladed turbine, didn#t move.

**Conclusions/Discussion**
If there are more rotations, more kinetic energy is being converted into electrical energy by the wind turbine. My hypothesis is that more blades will generate more energy because there is more surface area for the wind to act on, the blades should be medium sized and rectangle shaped, and the blades should be at 30 degrees so that the wind can still move past but the blades will be moved relatively quickly. My hypothesis was partially correct. Some incorrect parts are that 20o angles and shorter blades worked better. The shorter, medium-width, flat, rectangular and the 20o angle blade moved faster.
The ratio of the rotations to the blade area was not always proportional and constant. If blade area is the only factor that influences the number of rotation, the blade area would be constant. Therefore, other factors also influenced the number of rotations. The best conditions were more lift, a better tip-speed ratio, and more power applied to the turbine. I achieved this by using more blades, shorter, wider, and relatively flat blades, and a lower angle.

**Summary Statement**
My project tested the effects of blade design on a wind turbine's effiency.

**Help Received**
Mom and Dad helped me get materials and took me to the library for research. Sister helped me build wind turbines. Dad's coworker lent me Styrofoam Cutter.

# CALIFORNIA STATE SCIENCE FAIR
# 2013 PROJECT SUMMARY

**Name(s)**

Ziv H. Batscha

**Project Number**

**J0197**

**Project Title**

## Testing the Efficiency of Wingtip Devices on Aircraft Wings

**Abstract**

**Objectives/Goals**

My goal was to check if wingtip devices improve the flight performance of an aircraft and which wingtip device (90 degree winglet, 45 degree winglet, and wingtip fence) will result in the highest efficiency in terms of the greatest amount of lift and the least amount of drag. My hypothesis was that the wing with wingtip fences would be the most efficient, and then by decreasing order: 90 degree winglet, 45 degree winglet and then the wing with no winglets.

**Methods/Materials**

In my study, I built four wings which were all exactly the same. The only difference between the wings was the winglet found at the end of the wing (90 degree winglet, wingtip fence, 45 degree winglet and one without winglet). I built a wind tunnel. Each wing was tested five times using 2 force sensors to measure the lift and drag forces.

**Results**

Lift- The wing with the wingtip fences came in 1st place and the wing with 90 degree winglets came in 2nd exactly according to my hypothesis. However, the 45 degree winglets came in 4th after the one without winglets. When I considered that the span of the wing is small and the 45 degree winglets take 1/3 of the span, I figured out that this wing has a smaller horizontal surface for creating lift and that is why it had the least lift. This effect will disappear if the span was larger with the same size winglet.

Drag- The results were opposite to my hypothesis: 1st the wing with no winglets, then the 45 degree winglets, then the 90 degree winglets and last was the wingtip fences. However, when accounting that the parasitic drag is proportional to the frontal surface area, and calculating the drag force/in2, the wing with 90 degree winglets came in 1st, then the wingtip fences, then the 45 degree winglets and the wing with no winglets came last, which directly matches my hypothesis.

**Conclusions/Discussion**

I can conclude that the wingtip fence is the best design to reach the greatest lift. The 90 degree winglet came in 2nd. As for drag, when you take the frontal surface area of each wing into account, then the wing with 90 degree winglets is the best design if you want the least amount of drag and the wingtip fence design had results very close to it. Therefore the best design if you want to increase the lift and decrease the drag of an aircraft is either the wingtip fence or the 90 winglets. My study proved that my hypothesis was correct in that the wingtip fences are the most efficient.

**Summary Statement**

My project tests whether wingtip devices improve the flight performance of an aircraft and which wingtip device results in the highest efficiency while maintaining all other aspects of the aircraft the same.

**Help Received**

Father helped build wind tunnel.

# CALIFORNIA STATE SCIENCE FAIR
# 2013 PROJECT SUMMARY


**Name(s)**

Jaelan E. Phillips


**Project Number**

**J0198**

**Project Title**

## How Does Elevation Affect the Break of a Curveball?


**Abstract**

**Objectives/Goals**

The purpose of my project was to find out if and how elevation affects the break of a curveball. I predict that a curveball thrown at higher elevation will travel farther and break less.

**Methods/Materials**

8 Nike brand baseballs and one JUGS pitching machine. Two tests were made; one at 194 feet above sea level, the other at 1,712 feet above sea level. The balls were thrown a total of 40 times at the curveball setting. Small plastic spikes and a yardstick were used to mark and measure where each ball landed.

**Results**

The balls pitched at an elevation of 1,712 feet on average traveled significantly farther and had less break then the curveballs thrown at 194 feet above sea level.

**Conclusions/Discussion**

In conclusion, my hypothesis was proven correct. At higher elevations a curveball travels farther and breaks less. I believe that pitchers should take elevation into account when pitching, because elevation drastically affects the break of a curveball.


**Summary Statement**

My project tested how elevation affects the break of a curveball.


**Help Received**

My father helped me conduct the tests by either operating the pitching machine or marking/measuring where the balls landed. He also helped me edit my report.

# CALIFORNIA STATE SCIENCE FAIR
## 2013 PROJECT SUMMARY

**Name(s)**
Austin W. Peters

**Project Number**
J0199

**Project Title**
# Up, Up, & Away

**Abstract**

**Objectives/Goals**
My problem for the experiment was, "Do winglets increase the amount of lift created by a wing?" My hypothesis was that winglets do increase lift because they decrease wasted energy around the wingtip.

**Methods/Materials**
First I built the wind tunnel to house my plane by taping four large plexiglass panels together. Then I cut and attached the wing in the box and attached guy wires. After that, I glued together a wind stabilizer of three-hundred and seventy-five 2" PVC pipes to make sure there was even airflow. Then I turned on the fan and measured how high the wing got. I used four plexiglass panels, eleven wooden sticks, fishing wire, suction cups, a fan, three-hundred seventy-five 2# PVC pipes, metal L brackets, one straw, heavy duty packaging tape and a wing.

**Results**
Out of all of the data collected the two highest amounts of lift were winglet E which is what I designed with an average of 29.4 cm and the winglet D with an average of 27.1 cm of lift. The two lowest were Winglet A with an average of 23.9 cm of lift and winglet B with an average of 20.5. When I had no winglet on the wing, it had 24.2 cm of lift.

**Conclusions/Discussion**
My hypothesis was supported to an extent where some winglets did increase lift and some decreased it. This connects to the real world because the use of winglets to increase lift on newer airplanes. That allows planes to carry more weight and can also have shorter runways.

**Summary Statement**
My project tests if winglets not only reduce drag, but also increase lift on an airplane wing.

**Help Received**
Dad helped me construct some pieces and helped to keep the box steady; Ms. Fisher kept me on track for getting my science fair done in time; Mrs. Diaz helped me put together the research report; Mom helped me make my papers to be easily read and sensible.