



**CALIFORNIA STATE SCIENCE FAIR
2002 PROJECT SUMMARY**

Name(s) Tom C. Anastasio	Project Number J0101
Project Title Rocket Science	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals I originally wanted to look at the effect of fin design on model rocket performance, but when I did my research, I found out that it would be really hard to measure the effect of fin design because it affects stability, and stability is also affected by a lot of other variables. I decided to study the effect of nosecones because nosecones only generate drag, which is easier to measure. It is also easier to control because the drag variable primarily affects altitude.</p> <p>Methods/Materials I started by getting three identical model rocket kits (Estes Viking), and I built them according to the constructions, making them the same as possible. I picked four different shapes of nosecones - parabola, pointed cone, domed, and flat. Each one had a different drag coefficient that had been measured in a wind tunnel and given in a book on model rockets. I based my hypothesis on the drag coefficients.</p> <p>Results After twelve tests and several lost rockets, I found that my hypothesis was proven correct. I also found out the nosecone shape affected rocket stability more than my research said it would. I also discovered that flying model rocket is truly rocket science and is a lot harder than I thought it would be.</p> <p>Conclusions/Discussion After twelve tests and several lost rockets, I found that my hypothesis was proven correct. I also found out the nosecone shape affected rocket stability more than my research said it would. I also discovered that flying model rocket is truly rocket science and is a lot harder than I thought it would be.</p>	
Summary Statement It tested which nosecone will fly the highest under certain conditions.	
Help Received Mother helped type report, Dad Made Nosecones out of balsa.	



**CALIFORNIA STATE SCIENCE FAIR
2002 PROJECT SUMMARY**

Name(s) Phillip B. Behm	Project Number J0102
Project Title Supercavitation	
Objectives/Goals Question I'm investigating: Does supercavitation reduce the drag on a submerged streamlined object? Hypothesis: My hypothesis is that supercavitation will reduce the drag, however, only if the speed of the air coming out of the front is correct. If it is too high I believe it will increase the drag.	
Abstract Methods/Materials Procedure: Make a torpedo-looking object. Drill a series of holes into the front of the torpedo and another one in the side so air can be pushed through that hole and out the others at the front of the torpedo that you just drilled. Build an apparatus that can accommodate a water pump and a testing chamber. Attach a 2.5-Newton scale to a rolling carriage that can hold the torpedo underwater while the water runs by it. The drag is measured at this time with a 2.5-Newton scale. Next, air, at a speed of about 10-PSI, is pushed out of the front of the torpedo by an air compressor. The drag is again measured. The air speed is then increased to 20 PSI, 30 PSI, and 40 PSI. The drag is measured at these intervals. My torpedo length was about 1-1/2 inches. The test chamber was 1 inch across and 1-3/4 inches high. Materials: Aluminum, Steel, Wood, Water Pump, Air Compressor, Plastic Bottle, Plexy Glass, 1-inch wheels and axles, Outlet and Wiring, and 1/2-inch and 1-inch PVC Piping.	
Results Results: The results show that when the valve was half open or about 20 PSI, the drag was the least. Also, data shows that with the valve completely open or about 40-PSI, the drag was actually increased.	
Conclusions/Discussion Conclusion: The results of this experimentation support my hypothesis. Supercavitation does reduce the drag to a point. If the air speed is too high it creates more drag. In conclusion, supercavitation works well if used correctly.	
Summary Statement Will supercavitation, an air bubble around a submerged streamlined object, affect the drag on that object in moving water?	
Help Received Father helped build apparatus; Mother helped format report.	



**CALIFORNIA STATE SCIENCE FAIR
2002 PROJECT SUMMARY**

Name(s) Primo Catalano	Project Number J0103
Project Title A Scientific Inquiry into Air Film Crafts	
<p style="text-align: center;">Abstract</p> <p>Methods/Materials 1. First, I built the track which the crafts ride on. 2. Second, I built multiple crafts or Air Film Crafts. 3. Then out of the crafts that that I built, I timed the ones that moved. The materails I used were 1"x4"strips of balsa wood, wood glue, tape, 1"x1"x4' metal pole, stop watch, and camera.</p> <p>Results My results were, that if you put fins in the frount ack as wieghts lifting up the rear, letting more air out the back making thrust.</p> <p>Conclusions/Discussion My conclusion is that yes I could build a track that could make a film of air that the crafts could ride on.</p>	
Summary Statement I compared the speed of several crafts which were propelled on a countinuos film of air.	
Help Received	



**CALIFORNIA STATE SCIENCE FAIR
2002 PROJECT SUMMARY**

Name(s) Clayton C. Davis	Project Number J0104
Project Title Up, Up, and Away	
Abstract Objectives/Goals The goal of my project was to test what pitch of a helicopter's blade will provide the most lift. Methods/Materials I made four helicopter blades with identical shape and size, but different pitches (5, 20, 35, and 50). All blades are to be mounted on a motor. The motor and blades were placed on an envelope scale and weighed. I then turned on the motor and observed the new weight. The difference between the two numbers is how many ounces the particular unit can lift. I tested each pitch three times. Results My results from greatest to least lift were as follows: 20 degrees lifted 9.1 ounces, 35 degrees lifted 7.2 ounces, 5 degrees lifted 6.7 ounces, and 50 degrees lifted 5 ounces. Conclusions/Discussion My hypothesis was proven correct by my results. After testing, I communicated with some helicopter manufacturers and they confirmed my results by stating that my findings were just as they would have expected. Experiments such as mine have helped helicopter aviation reach goals of lifting astonishing weights. Helicopters that can lift great weights are used in forest fire fighting, army transportation, and many other ways.	
Summary Statement My project was to determine what pitch of a helicopter's blade will provide the most lift.	
Help Received My father helped me brainstorm the development of my project and assisted me in the use of power tools for building the testing unit. My teacher edited papers and assisted me in putting my board together.	



**CALIFORNIA STATE SCIENCE FAIR
2002 PROJECT SUMMARY**

Name(s) Mac P. Delaney	Project Number J0105
Project Title Supreme Windmill Turbine Design	
Abstract Objectives/Goals My goal with this project was to find the best windmill turbine blade by varying the width of the blade, and the inner and outer angles. I believe that the widest blade will be th fastest; the best angles will be both angles at sixty degrees. Methods/Materials To setup my project I had to construct a windmill with special blades, I used K'nex for the base, and I made wooden blades with width attachments for one set, and angle adjustments for another set. Results I found that the medium width worked the best because it increased surface area without adding oo much weight; the fastest angles were both at sixty degrees. Conclusions/Discussion More surface area seemed best untiltoo much weight was added, the best anles were the ones facing the wind the most; next time I sould combine to test for the inner and outer angles with the width.	
Summary Statement My project tested for the best windmill blades varying the angles and widths of the blades.	
Help Received My father helped with the construction the windmill blades.	



**CALIFORNIA STATE SCIENCE FAIR
2002 PROJECT SUMMARY**

Name(s) Philip M. Dettinger	Project Number J0106
Project Title Do Liquid Objects Travel Farther than Solid Objects when Thrown?	
Abstract Objectives/Goals The success of this project depended on building a catapult, with the help of a parent. Using algebra to calculate the system of weights, and levers needed to throw a water balloon the optimum distance. Then make 28 water balloons that were the same size and weight. Freeze three of them and flung them one after the other. Methods/Materials On average, the frozen water balloon went as much as 9 feet farther than the unfrozen water balloon. Results This happened because as the liquid water balloons flew threw the air they changed into a shape with a lot of resistance. Conclusions/Discussion The intent of this science fair project is to find out whether liquids could cover a larger distance than a solid object when thrown with equal force. The success of this project depended on building a catapult, with the help of a parent. Using algebra to calculate the system of weights, and levers needed to throw a water balloon the optimum distance. Then make 28 water balloons that were the same size and weight. Freeze three of them and flung them one after the other. On average, the frozen water balloon went as much as 9 feet farther than the unfrozen water balloon. This happened because as the liquid water balloons flew threw the air they changed into a shape with a lot of resistance. The persons that helped me with this project are: Michael Dettinger and Robin Rierdan.	
Summary Statement This project was started to find out if the fact that liquids don't retain any shape makes them travel farther than solid objects when they are thrown with equal force.	
Help Received Father helped build catapult	



**CALIFORNIA STATE SCIENCE FAIR
2002 PROJECT SUMMARY**

Name(s) Allison C. Frazier	Project Number J0107
Project Title Watch Out Below	
Abstract Objectives/Goals My objective was to find out if the shape of a parachute affects the rate of its descent. I believe the shape will affect a parachute's descent rate, and that the triangle will finish first followed by the square, octagon, hexagon, and rectangle. Methods/Materials Using garbage bags, washers, a nut, string, scissors, a protractor, and a ruler I constructed different shape parachutes. I used a stopwatch to time each flight. I flew each parachute five times from 16 ft. 5 in. with a 2 oz. washer. Then changed to a 1 oz. nut and repeated. I recorded the data and averaged each shapes descent time with the different weights. I compared the different weight and shape averages. Results With the 2 ounce washer the triangle fell the fastest with an average of 1.56 seconds, followed by the rectangle with an average of 1.63 sec., the square at 1.86 sec., the hexagon at 2.29 sec., and the octagon at 2.56 sec. With the 1-ounce nut the results stayed pretty much the same. The triangle finished first with an average of 2.17 seconds., the rectangle was next at 2.46 sec., then the square at 2.75 sec., the octagon at 2.75 sec., and the hexagon at 2.94 sec. Conclusions/Discussion My hypothesis wasn't supported by my results. From this experiment I learned that for the same area, the more corners something has the slower its descent. Through my research I learned about the terminal velocity of an object, and that the weight and shape of an object affect its velocity. Therefore, if I were to further experiment on this project I would test at taller heights to be sure the parachutes had reached a terminal velocity.	
Summary Statement Does the shape of a parachute affect its descent rate?	
Help Received Ms. Brown with format. My mom and dad in building and testing. My dad some typing.	



**CALIFORNIA STATE SCIENCE FAIR
2002 PROJECT SUMMARY**

Name(s) Evan M. Gates	Project Number J0108
Project Title The Effects of Spin Stabilization in Amateur Rocketry	
Abstract Objectives/Goals The purpose of this experiment was to research the effects of spin stabilization on the altitude of an amateur rocket. The hypothesis was that while spin is beneficial for stabilization purposes, excessive spin could result in a decrease in altitude. Methods/Materials Six Aerotech Airspike rocket kits were used for this project. Five of the rockets included the addition of fin tabs at different angles to induce various amounts of spin. A payload section was also added to house electronics used to record flight data. For recording flight data, a Rocket Data Acquisition System, or RDAS, unit was used. The RDAS is equipped with an altimeter, accelerometer, and six analog-to-digital channels for recording additional data. A photo cell circuit, wired to the RDAS unit, was used to determine roll rate. Each rocket was flown an average of three times to gather data. All flights used an Aerotech Econojet F20-7 rocket motor. Results The data from the flights was recorded on the RDAS unit and then downloaded onto a computer and graphed for analysis. The results proved the hypothesis. The faster a rocket was spinning, the lower the altitude achieved. Conclusions/Discussion The energy taken to spin the rocket decreased the altitude achieved. The final results plotted on a graph as altitude versus roll rate, shows a second order equation. This was found to be caused by the amount of drag produced by the spinning of the fins, with this drag being proportional to the square of the angular velocity.	
Summary Statement This project researched the effects of spinning on the altitude of a rocket, and showed that the altitude decreased proportionally to the square of the roll rate.	
Help Received Mentor helped refine experiment plan; Father supervised construction and launch of rockets; Parents helped format and proofread.	



**CALIFORNIA STATE SCIENCE FAIR
2002 PROJECT SUMMARY**

Name(s) Chelsea B. Green	Project Number J0109
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Project Title
The Effects of Blade Size and Shape on the Electrical Output of a Generator

Abstract

Objectives/Goals
My objective was to determine what effects windmill blade size, shape and angle placement has on the generation of electrical energy. I hypothesized that the small trapezoidal blade would be the best energy producer.

Methods/Materials
Materials: One windmill-wooden base with triangular shaped sides, One Amp Meter, One Fan, One Tape Measure, One Electrical Motor, 24 Square Blades(3 sizes), 24 Rectangular Blades(3 sizes), 24 Trapezoidal Blades(3 sizes)& 24 Triangular Blades(3 sizes).

Experimentation Methods:

- a) Build the windmill
- b) Attach the motor & amp meter to the windmill
- c) Cut out 96 blades(4 shapes-3 sizes for each shape)
- d) Place the fan one meter from the blades of the windmill
- e) Set the angle of the blades on the windmill hub to 75 degrees
- f) Turn the fan on medium
- g) Read the voltmeter and record the amount of electricity produced
- h) Repeat steps D-G using the different sizes and shapes of blades
- i) Repeat steps D-G but setting the angle on the windmill hub to 45 degrees and 60 degrees
- j) Use the recorded data to prepare graphs to display results

Results
I observed that the smaller, lightweight blades placed at a 45 degree angle produced more energy. Blades placed at a 75 degree angle consistently produced less energy.

Conclusions/Discussion
In conclusion, I found my original hypothesis to be incorrect in that the Square and Rectangular shaped blades were more efficient energy producers rather than the trapezoid that I had originally theorized. Of the four shaped blades, the Triangle was the lowest producer followed by the Trapezoid. The Square and Rectangle were higher producers and had very similar test results. My final results show that the small Square and Rectangular shaped blades placed at a 45 degree angle were the most efficient producers of electrical energy.

Summary Statement
My project is about measuring electrical output when using various sizes, shapes and angle placement of windmill blades.

Help Received
Father-Collected/organized materials & assisted with testing. Wilson Wang-Assisted in buiding windmill. Kevin Sill-Technical advisor/assisted with testing. Antone Natale-Provided motor. Christine Voe-Cut out blades. Vanessa-Cut out blades. Mother-Assisted in collecting data, reports & display board.



**CALIFORNIA STATE SCIENCE FAIR
2002 PROJECT SUMMARY**

Name(s) John A. Hawkins	Project Number J0110
Project Title How Does the Shape of a Wing Affect Its Lift and Drag?	
Abstract Objectives/Goals The purpose of the project was to conduct wind tunnel studies to determine how the shape of an airplane wing affects the lift and drag of that wing. It was hypothesized that the wing with the biggest curvature or camber would generate the most lift and the wing with the most streamlined body would generate the least drag. It was also hypothesized that larger angles of attack would create larger lift and drag forces because of the greater surface area exposed. Methods/Materials A wind tunnel was constructed according to plans on a NASA web site, along with four balsa wood wings and one balsa wood control surface to test their lift and drag forces. Five angles of attack were tested for each of the five wings plus control to determine which gave the best results. Each wing was setup in the wind tunnel with the desired angle of attack, the power was engaged and the measurements were taken using a spring scale. Then the lift and drag forces were calculated for each wing. There were twenty total trials for each wing with four trials for each angle of attack. The variables were controlled by the test set up. Results The mean lift and drag forces were calculated for each of five wings and each of five angles of attack. Wing D (high camber and surface area, least weight) generated the most lift force and Wing C (most streamlined) generated the least drag force. Conclusions/Discussion It is concluded that the shape of a wing does affect the lift and drag of an airplane. The results supported the experimenter's hypothesis. It is also concluded that higher angles of attack produce the most lift and the most drag because there is more surface area opposing the air. The lower angles of attack produce the least drag because there is less surface area being exposed to the airflow. The findings proved that wind tunnel studies can be used to design more efficient aircraft, saving fossil fuels and improving transportation.	
Summary Statement Using wind tunnel studies to determine how the shape of an airplane wing affects the lift and drag forces of that wing.	
Help Received Father helped in construction of wind tunnel and supervised testing.	



**CALIFORNIA STATE SCIENCE FAIR
2002 PROJECT SUMMARY**

Name(s) Emily M. Helbig; Julia C. Strumpell	Project Number J0111
Project Title 5...4...3...2...1... Blast Off!	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals Objective: To find out what fin design flies the highest and what fin design is in flight for the longest time. We think the triangular fin will fly higher because it will fly straighter.</p> <p>Methods/Materials Materials and Methods: We had flown five rockets that are the same weight. The only thing different about each rocket is the fin design. We have flown each rocket three times and we then average the three heights and the three lengths of time the rocket was in the air. We used materials such as cardboard, model paints, string, plastic, model glue, balsa wood, and model rocket engines.</p> <p>Results Results: Our results show that the circular fins fly better then triangular fins. The circular shapes fin consistently had a higher altitude.</p> <p>Conclusions/Discussion Conclusion: My conclusion is that the more the fin sticks out the higher it goes because there is more stability so it will fly straighter.</p>	
Summary Statement We made five different fin designs for rockets to see what shape caused the rocket to fly the highest.	
Help Received Mother helped re-type report, Dad helped build rocket and drive us places	



**CALIFORNIA STATE SCIENCE FAIR
2002 PROJECT SUMMARY**

Name(s) Adam G. Hendry	Project Number J0112
Project Title Pro-Newton vs. Pro-Bernoulli: Which Theory Is Misconceived?	
Abstract Objectives/Goals The objective is to determine if wing-shape is the sole factor to creating lift on airfoils. Methods/Materials A NACA 0019 and NACA 4219 airfoil were each made out of poster board and foam core. An open circuit wind tunnel was made out of the materials suggested and figures and directions given from the Baals company website in conjunction with NASA kids' curriculum (http://Idaps.arc.nasa.gov/Curriculum/tunnel.html#test_section). Each airfoil was tested in the wind tunnel from a zero-degree to a twenty-degree angle of attack. Lift and drag were measured using two force probs from Vernier Instruments. Results At a zero degree angle of attack, the symmetrical airfoil, NACA airfoil 0019, was not able to lift at all, while the cambered airfoil, NACA airfoil 4219, was able to lift a little amount at a zero degree angle of attack. Finally, between a four-and-five-degree angle of attack, both airfoils lifted the same amounts. Finally, although lift was the main measurement in this project, when both airfoil's drag were measured, the symmetrical airfoil had less drag than the cambered airfoil. Conclusions/Discussion Symmetrical airfoils are most commonly used with high-speed aircraft because they create less drag since they have equal surface area at their stagnation points at a zero-degree angle of attack. Although airfoils increase their surface areas, and therefore their lift, at higher angles of attack, too high an angle can cause the air on a wing to trail off and create drag. This is why some airplanes need to have cambered airfoils, so that they can create better lift at lower angles of attack. This is needed for short runways or carrying heavy loads. Because cambered (shaped) and non-cambered airfoils can fly, but better in different conditions, we should use this knowledge to our advantage by creating each for performing different tasks.	
Summary Statement The purpose of this experiment is to see if wing shape is the limiting factor to creating lift.	
Help Received First Pilot Mr. Kooistra helped me with explaining the math and calculations associated with lift, my dad helped me build my wind tunnel, and my mom got me the supplies I needed for my display board.	



**CALIFORNIA STATE SCIENCE FAIR
2002 PROJECT SUMMARY**

Name(s) Brett Isakovic; Chris Warren	Project Number J0113
Project Title The Battle of Aerodynamics: Shapes vs. Wind	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals Our objective was to show how the amount of air resistance on an object would be affected by its shape. Our hypothesis was that the most streamlined shape, a bullet shape, would have the least amount of air resistance.</p> <p>Methods/Materials In this experiment, we suspended four different shapes (bullet, wedge, sphere, and cube) in front of a high powered fan. We then measured the amount of movement caused by the wind to determine air resistance. We repeated the experiment five times, and then calculated an average measurement for each shape.</p> <p>Results The wedge shape consistently showed the least amount of air resistance with an average of 7.8 degrees, followed by the bullet with 9.0 degrees, the sphere with 12.6 degrees, and finally the cube with 13.1 degrees.</p> <p>Conclusions/Discussion Our hypothesis was only partially correct. Our test results did show that streamlined shapes have lower air resistance. However, our prediction that the bullet shape would have the least amount of air resistance was incorrect. We believe that the greater surface area of the bullet shape affected the amount of air resistance measured; therefore, it affected our results.</p>	
Summary Statement This project shows how air resistance is affected by the shape of an object.	
Help Received For this project, we received help from several people: Chris's mother helped shop for supplies, Chris's dad helped with the project assembly, and my mom help to type the final report.	



**CALIFORNIA STATE SCIENCE FAIR
2002 PROJECT SUMMARY**

Name(s) Zachary N. Johnson	Project Number J0114
Project Title Length for Lift	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals My question was "How does the length of a wing help keep the wing in the air?" My goal was to find out which wing generated more lift, large or small. I guessed that the long wings would be able to generate more lift because the longer the wing gets, the more surface area it has.</p> <p>Methods/Materials One sheet of Lucite, Electric fan, Two 2 1/2 inch Styrofoam wings, Two 4 1/4 inch Styrofoam wings, Four 13 inch metal rods, 2 bungee cords, 4 chain clamps, 2 small screws, 10 three and four tenths gram washers, 1 eyebolt, 1 nut, 2 square metal bars, Stopwatch, Dremel drill, Epoxy glue, Silicone sealer, Razor blade, Pliers, Hammer</p> <p>Results I hypothesized that the large wing would carry more weight. My results agreed with my hypothesis. The two large wings lifted much more than the two smaller wings. The large wings lifted all ten washers on all but two for wing four, where it lifted nine. The two smaller wings averaged two and three washers.</p> <p>Conclusions/Discussion The long wings lifted more than the short wings. I think this happened because the large wings had more surface area than the small wings. It expands my knowledge of the subject by letting me know that length does effect how much lift is generated by the wing.</p>	
Summary Statement My project is about how much lift a longer and shorter wing generates.	
Help Received H. T. Johnson, the Assistant Secretary of the Navy, helped me build my wind tunnel.	



**CALIFORNIA STATE SCIENCE FAIR
2002 PROJECT SUMMARY**

Name(s) Thomas Keiffer	Project Number J0115
Project Title Does Ball Speed Increase the Effect of Spin?	
Abstract Objectives/Goals To determine if the speed that a ball is traveling will increase or decrease the effect of spin. Methods/Materials I have constructed a wind tunnel that I have used to blow high speed winds past a spinning ball. During this process I have recorded the data to see if I have proven my hypothesis correct. Results Results showed that the greater the spin the greater the effect on the movement of the ball. Conclusions/Discussion Increasing ball speed will increase the effect of spin on the ball. The greater the speed, the greater the spin. When spinning with top-spin at 5mph, the average degrees of movement was 16.2 at 30 mph the average was 23.2 degrees and the average at 60 mph was 26.5 degrees.	
Summary Statement Understanding windspeed effects on ball spin	
Help Received father helped build wind tunnel	



**CALIFORNIA STATE SCIENCE FAIR
2002 PROJECT SUMMARY**

Name(s) Natalya Kostandova	Project Number J0116
Project Title What Affects the Windmill Power?	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals The objective of my project was to determine what factors have the affect on the power produced by a windmill. My hypothesis is that the speed and the angle of the wind, the mass, the length, and the amount of the blades, and the presence of the hole between the central support beam and the blades will affect the windmill power.</p> <p>Methods/Materials First the research was done on the given subject. Then 11 different windmill models which differed one from another with one property were built. The block was built, and the strings of the same length were attached to each windmill and led through the block. One of two objects was attached to the end of the string. As the fan was turned on, the windmill began to spin and the object was lifted up. As it reached the top of the block, the time it took to get to the top was measured and the experiment was repeated 5 times with each model and each object. Then one time was dropped, and the average was found. The average time of two windmills were compared, and if they differed, the characteristic which was different in the compared windmills (ex: different masses) did affect the windmill power.</p> <p>Results From the experiment I found out that the mass, amount, angle of the wind, and the presence of the wind do have an affect on the power produced by the windmill.</p> <p>Conclusions/Discussion The power that the windmill produces depends on the air density, speed and the angle of the wind, amount, mass, shape, and the length of the windmill blades, the height of the windmill tower, type of windmill, and the presence of the hole between the center of the windmill and its blades. The conclusion supported my hypothesis, but the hypothesis wasn't full.</p>	
Summary Statement My project was about the different factors which affect the windmill power.	
Help Received My mother helped me to measure the amount of time it took the windmill to lift the object up; my brother explained how each tool I need to build my models worked; my teacher advised.	



**CALIFORNIA STATE SCIENCE FAIR
2002 PROJECT SUMMARY**

Name(s) Daniel S. McDermott	Project Number J0117
Project Title Blade Testing for Best Windmill Performance	
Objectives/Goals The goal of my project was a to discover the best windmill blade angle which would create the fastest rotation speed. I also evaluated the width of the windmill blades and its effect on rotation speed.	
Abstract A windmill that spins the fastest will produce the most energy. I made the body of the windmill from a K-nex set and made the windmill blades from balsa wood, same in length (12") but at different widths. For a wind source, I used a floor fan placed 2 feet and 6 inches away from the actual windmill. The fan was operated at various speeds. I measured the blade angles using a protractor. I measured the blade speed using the cadence feature from a bicycle cyclometer and attached that to the body of the mill. The blade rotation measurements were in RPM (Rotations Per Minute). My hypothesis is that the thin, 75-degree angle blade design will spin the fastest. My hypothesis was based upon my assumption that the 75-degree angle would push the blade more into the direction of the rotation creating a faster spin. The thin blade will be lighter so it would be easier to turn.	
Methods/Materials K-nex set for the windmill structure Sets of four balsa wood strips 12# long at different widths for the windmill blades 1 floor fan Cyclometer - cadence function (used for bikes) Washers (to counterweigh the cadence meter weight)	
Results The 5-degree thin blade produced the fastest spin; however, under high wind conditions, the 5-degree wide blade toppled the entire windmill structure. Larger angles were able to withstand higher wind speeds without toppling over.	
Conclusions/Discussion I was way off! The 5-degree blade angle produced the fastest spin under low and moderate wind conditions. The 5-degree angle had the largest surface area to catch incoming wind and had the least wind resistance in the direction the blades were rotating. However, the 5-degree wide blade caught too much wind and caused the structure to fall. The thin blade spun slightly faster than the wider blade because it was lighter and had a smaller cross section for wind resistance. I recommend further study to testing see if a windmill could be invented which automatically adjust to the best blade angle for the wind speed at that time.	
Summary Statement To discover the best windmill blade angle which would create the fastest rotation speed.	
Help Received Mom and Dad for editing my papers, Dad for helping with display board, Dad for advanced computer help, Dad for help measuring blade angles, Mom for taking photos	



**CALIFORNIA STATE SCIENCE FAIR
2002 PROJECT SUMMARY**

Name(s) Jymette J. Meyer	Project Number J0118
Project Title Lift, Applied: Optimizing the Lift of a Glider	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals The objective is to find the lifting capacity of a certain airfoil within the testing conditions of a self-constructed wind tunnel. With the results obtained a flying machine will be designed and fabricated.</p> <p>Methods/Materials A wind tunnel was built of lightweight materials, using the general design principles from my 2001 science fair project. From the results of last year's project, a certain airfoil shape was selected and its lifting capacity was measured using the wind tunnel. The data was applied to the design of the glider.</p> <p>Results Due to measurement difficulties (excessive friction on the guide wires for the airfoil), the angle of attack that was chosen for the wings of the glider resulted in an excess of lift from the forward wing. Adjustments were made to lessen the angle of attack of the forward wing, resulting in successful flight. Modifications to the lift measurement mechanism are in progress, and will be displayed at the State Science Fair.</p> <p>Conclusions/Discussion This project shows that it is practical to use test data to build a functioning machine, in this case, a glider.</p>	
Summary Statement In a continuing project, test data was gathered, then utilized to design a successful flying machine.	
Help Received Father helped in design of wind tunnel, the using of power tools, and explaining procedure. Mother helped in gathering resources, proof reading, and presentation.	



**CALIFORNIA STATE SCIENCE FAIR
2002 PROJECT SUMMARY**

Name(s) David J. Michon	Project Number J0119
Project Title Put a Spin on It: Measuring the Magnus Force Generated by a Spinning Tennis Ball	
Objectives/Goals The objective was to measure the Magnus force generated by a spinning tennis ball in a moving air flow at various spin rates and in both directions.	
Abstract Methods/Materials A conventional fan-powered wind tunnel was assembled from melamine coated hardboard, glue, duct tape, egg-crate light panels, and a household fan. The wind tunnel simulated a tennis ball flying through the air. A tennis ball mounted on a shaft driven by two slightly geared down motors provided the source of the Magnus force. A variable voltage supply set the speed of the motors. A slotted opto coupler connected to a frequency meter measured the spin rate. The motor mechanism built from various LEGO elements permitted the shaft to pivot about an axle mounted on top of the test chamber. The Magnus force pushed the spinning shaft sideways, moving the ball upwards against the force of gravity until the Magnus force and force of gravity were equal. This angle was recorded for each spin rate. To calibrate the mechanism, the shaft was rotated to the horizontal position and a postal scale was placed under the tennis ball. The weight measurement represented the net downward force of gravity on the ball at 90 degrees. To obtain the force at other angles, this value was multiplied by the sine of those angles. This gave the Magnus force. Three trials each consisting of 19 angle measurements taken at 83 RPM intervals ranging from 0 to 1500 RPM in both clockwise and counter-clockwise spin directions were made.	
Results For spin rates ranging from 0 to 1500 RPM in 83 RPM increments, the Magnus force increased continually from 100 dynes to 7,700 dynes. At 0 RPM, the ball fluctuated wildly. Balls spinning clockwise (as viewed from the top) tilted to the right (as viewed from the exhausting fan). Balls spinning counter-clockwise way tilted to the left.	
Conclusions/Discussion The principle observation confirms the hypothesis that the greater the spin rate, the greater the Magnus force. In addition, a zero spin rate produced great instability, which probably accounts for the erratic behavior of knuckle ball pitches in baseball. Finally, when the ball was spun in one direction, the ball always swung to the same side. When the ball spin was reversed, the ball swung in the opposite direction but to the same degree for the same spin rate.	
Summary Statement This project measured the Magnus force of a spinning tennis ball in a moving air flow at various spin rates and in both directions.	
Help Received Father helped design and construct wind tunnel, explain unit conversions, and record measurements. Mother helped create backboard and record measurements. Brother helped assemble wind tunnel and record measurements.	



**CALIFORNIA STATE SCIENCE FAIR
2002 PROJECT SUMMARY**

Name(s) Connor L. Mosley	Project Number J0120
Project Title Taming Tidal Waves	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals My objective was to test man-made methods to reduce tidal wave run-up of a tsunami generated by an underwater landslide. I used the possibility of an earthquake induced underwater landslide occurring off the coast of Santa Barbara as a "conceptual model" and basis for my experiment.</p> <p>Methods/Materials I built a "doe-boy style" pool 5m x 1.2m x .6m from wood/plastic sheathing, with plywood at opposing ends, one at a 60* angle to simulate the "slide zone" and one at 15* angle simulating the "beach". I released a 27kg pea-gravel bag just underwater simulating the slide, and recorded max wave heights at the beach. After establishing my control, I tested 3 methods of reducing wave run-up: 1)"Filling" the area at the base of the slide zone (extra plywood @ 30* angle to simulate land fill) to reduce the slide angle; 2)"Obstructing" the slide path(16p nails in the slide zone to simulate surplus objects like oil derricks, bridge girders/trestles, ships, railcars, airplanes) to break up slide speed and energy; 3)create an "Opposing" force between slide zone and beach (width wise nylon bladder, inflated by rubber tube-attached exterior "air-rocket footstomper" to simulate explosive charges that would ring the slide zone and be auto-activated by zone sensors during a slide) to defuse tidal energy. All methods were tested 50 times each and results averaged.</p> <p>Results The averaged wave heights (in mm)were: the control-37; the "Fill" method-29; the "Obstruct" method-21; the "Oppose" method-34. In comparing the variable method wave heights with the control, all 3 methods showed a height reduction: "Obstruct" - 47.2%; "Fill" - 22.6%; "Oppose" - 8.6%.</p> <p>Conclusions/Discussion The "Obstruction" method was the most efective way of reducing wave run-up, but also had the largest fluctuation in recorded results. I believe this was due to the difficulty in consistantly "modeling" the landslide. The model I built was not intended to duplicate any actual topographical location, or simulate any actual scale, but rather to generate results for these 3 methods strictly for comparison with each other. I gave no consideration to any "real-life" cost, safety, environmental, or engineering impacts or problems that any of these methods might envolve, and I can not claim that the scale or accuracy of any of these methods would result in a "real-life" solution. All of these factors would have to be considered in order to explore any real solutions.</p>	
Summary Statement Exploring man-made methods of reducing tidal wave run-up for tsunamis generated by underwater landslides.	
Help Received My father helped with the building of the wave pool, and "air stomper" mechanism.	



**CALIFORNIA STATE SCIENCE FAIR
2002 PROJECT SUMMARY**

Name(s) Elizabeth D. Roteman	Project Number J0121
Project Title Sailing into the Future: The Racer's Edge	
Abstract Objectives/Goals My objective was to get my boat to be able to go its fastest up wind. To do this, I needed to find what wind condition and sail position , of several made each sail shape move the boat with the most forward force. Methods/Materials Aluminum for the sails, non-stick pan for the water, wood shaped as a boat, a big drier for the wind. Rigged the pan with rubberbands so that the boat could move in all directions. I put different wind shapes in wind channels that were at certain angles, to see which sail worked best at these angles. The boat and pan never changed. The drier that we used was the same for all the sails. If one gets a slightly different reading it may be because of the lining up of the drier with the angles. Results Sail number 1 was best overall in all of the wind conditions, that I set. Sail number 2 was second. Sail number 3 was third and sail number 4 was last, in the conditions that I had chosen. Sail number one was best for up wind. Sail number 2 is not a sail you usually want to have. You might use it in when the wind changes direction a lot and you don't know where the wind is going to be coming from. Sail number 3 is used when it is really windy and you can't keep the boat flat. The sail lets air spill out. Sail number 4 is what a sail might look like going down wind. Conclusions/Discussion My data supported my hypothesis for four out of four of the sails. To improve my project I would make the boat and sails bigger and make sure that they are built to scale. In doing this I would get more accurate readings. I would also make different wind conditions. I could try the sails down wind and on reaches. It helps me to choose which shape to put my sail in at what times.	
Summary Statement My project is about how I can make my boat go as fast as possible.	
Help Received Grandfather helped me make my set up and hold the wind at the angles so I could take the readings.	



**CALIFORNIA STATE SCIENCE FAIR
2002 PROJECT SUMMARY**

Name(s) D. Ziva Shulaker	Project Number J0122
Project Title Sail Away: Air, What a Drag!	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals To see what effect the surface area of an object, such as a vehicle, has on the amount of air resistance produced as it travels down a slope.</p> <p>Methods/Materials MATERIALS: 1 wooden ramp (set at a constant angle); 1 toy car; 2 wooden dowels; rectangular 'sails' of different sizes cut from posterboard; stop watch; marking tape to show "Start" and "Finish" lines on the ramp. METHOD: A sloped ramp was set up at a 12 degree angle - a Start line was marked at the top of the ramp, and a Finish line at the bottom. A toy truck was fitted with two wooden dowels, and cardboard sails of various sizes were threaded onto the dowels. The toy vehicle was timed going down the ramp, using a stop watch. Five trials for each sail were recorded. The highest and lowest scores for each sail were discarded, and the average of the remaining three was calculated. The results were plotted on a graph - Sail Area vs Time for Vehicle to travel down ramp.</p> <p>Results The results showed that the larger the area of the 'sail' attached to the car, the slower the car traveled down the ramp.</p> <p>Conclusions/Discussion The vehicle speed plotted against the area of the sail gave a straight line graph. I concluded that the larger the area of the sail, the greater the air resistance produced, and so the slower the vehicle went. However, the results also showed that with sails of the same area, but of different shapes, the vehicle speed was a little different, so I also conclude that air resistance is affected by the shape of the object travelling through the air, as well as by the surface area.</p> <p>From my research, I learned that air resistance is important in the 'real world'. For example, in the design of automobiles, the less air resistance, or drag, that a vehicle produces, the less energy is wasted as it goes through the air, and so, the more fuel efficient it is.</p>	
Summary Statement This project is about air resistance - the larger the area of an object, the greater the air resistance	
Help Received None.	



CALIFORNIA STATE SCIENCE FAIR 2002 PROJECT SUMMARY

Name(s) Madison P. Stanford	Project Number J0123
Project Title Which Wing Generates the Most Lift?	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals My objective was to determine which of five wing shapes (rectangular, elliptical, delta, swept, and round) generated the most lift, by testing them individually in a simple, home-built, open-loop wind tunnel. I hypothesized that the rectangular wing shape would generate the most lift, due to the equal distance between the leading edge and trailing edge in all areas of the wing.</p> <p>Methods/Materials In order to conduct my experiment, a wind tunnel was constructed out of Plexiglas, kitchen lighting grid, and a 4# x 4# box fan. A test stand was then built out of vinyl and a wooden dowel, and fastened with Velcro to a 3 1/2# diameter scale. Five different wing shapes were constructed of the same vinyl. They had equal areas, so that everything would be kept constant except coefficient of lift, the variable being tested. There were ten separate trials in which each of the five wing shapes were tested. Each trial consisted of attaching a wing shape to the test stand, at an equal angle of attack, and placing the test stand, wing, and scale in the test section while the fan was blowing. The scale was then zeroed, and the lid was placed on the top. The scale read negative as the wing lifted up on it. The data was recorded, and this process was repeated for each of the wing shapes.</p> <p>Results My results indicate that my hypothesis was correct. The rectangular wing generated the most lift, followed by the elliptical, delta, swept and round, respectively. The data was significant with a p-value of less than 0.05.</p> <p>Conclusions/Discussion My conclusion is that wing shape does affect lift. However, lift is not merely a function of wing shape, as many other variables such as airspeed, altitude, humidity, air pressure, turbulence, and aspect ratio affect the performance of a particular wing. While my experiment was conducted carefully and precisely, my results cannot necessarily be generalized as all the other variables were held constant.</p>	
Summary Statement Five different wing shapes were tested in a wind tunnel to prove my hypothesis that the rectangular wing would generate the most lift, which was correct.	
Help Received My dad helped glue the wind tunnel together. My mom helped with the backboard.	



**CALIFORNIA STATE SCIENCE FAIR
2002 PROJECT SUMMARY**

Name(s) Daniel A. Stenavich	Project Number J0124
Project Title 5...4...3...2 Liter Blast Off	
Abstract Objectives/Goals The purpose of this project is to determine what water amount in a two-liter bottle rocket will make the rocket go to the highest altitude. Methods/Materials Bottle Rocket, Rocket launcher, Measuring Cup, Water, Angle finder, Tape measure, Back-up supplies Results In the launches, at 1250 ml. The rocket went the highest altitude. So, at about half water and not too much weight the rocket reached the highest altitude. At 62.5% of the rocket filled with water it reached the highest altitude. Conclusions/Discussion The results of the experiment were not as predicted. The rocket reached the highest altitude when it was filled with 62.5% of the total amount of water. This proves the hypothesis incorrect.	
Summary Statement Trying to see at what water level would a bottle rocket reach the highest altitude.	
Help Received Father helped find angle, grandfather helped carry water, Mr. Johnson helped supply pieces	



**CALIFORNIA STATE SCIENCE FAIR
2002 PROJECT SUMMARY**

Name(s) Kevin T. Yamazaki	Project Number J0125
Project Title Hovercraft Skirts	
Objectives/Goals ABSTRACT	Abstract <p>The Hovercraft is a modern invention, which glides on a cushion of air. A fan pushes down the cushion of air into a rubber #skirt#. A skirt surrounds the hovercraft to provide air supply and to balance the cushion of air. Obviously, everything has some type of drag/resistance, it is just a matter of controlling these setbacks. Which hovercraft skirt works best? I will test the main skirt types. Construct 3 identical hovercraft bodies. Mount the fan on a hovercraft. Launch it from a rubber band pulled back to a certain mark on the floor. Repeat 5 times for each hovercraft and measure where it comes to a complete stop. The finger skirt was the most frictionless and was able to glide the furthest on the ground. Each finger was able to get the most hover-height. The bag skirt had the least amount of peripheral jet stream. The bag skirt with splitter had the same contacts points, but a better peripheral jet stream. To succeed in creating the best type of hovercraft skirt, use a finger skirt to minimize contact points and maximize peripheral jet streams (increasing hover-height).</p>
Summary Statement My project is about the comparison of different skirt's hoverheights when applied to a hovercraft.	
Help Received	