CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)

Benjamin I. Antin

Project Number

J0101

Project Title

How Airplanes Fly

Abstract

Objectives/Goals

This experiment was designed to determine which aspect of airfoils should be changed in order to increase the amount of lift that a wing can produce when being tested in a wind tunnel.

Methods/Materials

The two aspects of airfoils that were being tested were the camber and the thickness. A control wing was tested in a wind tunnel and a weight scale was used to record the amount of lift that it produced. The scale measured the lift produced by recording the amount of force exerted the scale. Then two other wings, one with two percent more camber, and one with two percent more thickness were measured for how much lift they could produce. This would determine which aspect is more important when designing an airfoil. The airfoils were made from craft-grade styrofoam. The wind tunnel was created with household materials. Large Sparkletts# bottles were press fitted together to create an airtight seal. A household fan was then placed in the end of the tunnel. Paint sticks were then cut into small, rectangular squares. These were hot-glued in a grid formation. This grid was designed to break up any turbulence that could come off of the fan and insure that the airflow was laminar.

Results

The wing with an increased camber, which was known as Airfoil Number 2, produced 9.09 more grams of lift than the airfoil with an increased thickness, which was known as Airfoil Number 1. The Allstar Network explains this occurrence by saying, #The camber affects the speed of the air, and therefore the lift# (http://www.allstar.fiu.edu/aero/airfly13.htm). Airfoil Number 1 produced 3.81 less lift than the control airfoil.

Conclusions/Discussion

This information would most likely be used by amateur builders making remote control planes, because these airfoil builders may not have access to computer simulations to help shape the airfoils. Testing the needed airfoils in remote control planes may prove costly if the airfoils do not perform well enough, and this cost can be avoided by using the results of this experiment.

Summary Statement

Testing different shapes of airfoils in order to increase the lift that they produce

Help Received

My dad helped supervise me with the use of power tools

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)

Kennedy J. Bingham

Project Number

J0102

Project Title

Which Windmill Is Better?

Abstract

Objectives/Goals

My family and I were driving through the desert and I saw a windmill farm. I noticed that all the windmills had three blades. I wondered why there were not more blades on a windmill. At the time I thought more blades would produce more power. My research question is; how does the number of blades affect the amount of electrical power generated by a windmill? In order to answer the question, I tested a five bladed and three bladed windmills in different wind speeds and temperatures. I measured the power generated by each windmill and compared the data.

Methods/Materials

Materials List: - Pen (1), - Pencil (1), - Lined and Graph Paper, - Science Fair Journal, - 5-Bladed Windmill (Computer Cooling Fan), - 3-Bladed Windmill (Computer Cooling, Fan), - Series II Multi-meter, - Wind Generation Device (Multi-speed/Multi-temp Hair Dryer), - Superglue (1 tube), - Velcro Strips, - Electrical Wire (included with multi-meter), - Alligator Clips (included with multi-meter), - Electrical Tape (1 roll), - Plywood (16# X 9#).

Using the blow dryer to simulate the wind will ensure the same wind-speed and temperature for each data point. The fan will turn like a windmill. The turning of the fan will produce some amount of electrical power which will be measured by the multi-meter. I will then remove two blades from the windmill and repeat the experiment. I will use every temperature and wind speed combination available and do each test run twice for each windmill.

Results

A 3-Bladed windmill produced more VDC on average.

Conclusions/Discussion

This project has a major practical application. I found that a 3-bladed windmill in a hot windy environment would produce the most power. Therefore, building 3-bladed windmills in hot windy climates would be the efficient use of wind power.

Summary Statement

Is a 3-bladed or 5-bladed windmill better?

Help Received

Father helped construct and run experiment. Father helped type.

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)

Matteo Busalacchi; Noa Garcia-Brown

Project Number

J0103

Project Title

How Wing Design Affects Lift across Different Angles of Attack

Abstract

Objectives/Goals

Objective:
The objective of the project was to see if a regular upper cambered wing (traditional wing) could produce more lift than the following six wings: Symmetrical Curved, Brick, Barn Door, Car-Foil, Right Triangle, and a Sideways Figure 8.

Methods/Materials

The methods and procedures we used were as follows:
We constructed a lift scale out of K#Nex that measured lift based on angle of attack.
We built 7 wings out of different materials like paper, Styrofoam, and balsawood. We attached a K#Nex rod to each of them so we could attach them vertically to the lift scale.
We tested all the wings by attaching each of them vertically to the measurement scale and using a fan to blow air on them. We set the angle of attack and observed the lift that was generated by each wing.
We recorded the wings# lift in 3 separate trials for each angle of attack.
We averaged the three trials.
We then increased the angle of attack by 10 degrees and repeated the experiment until we reached 60 degrees.
We did this procedure for each wing. Then we compared the lift results for each wing at each angle of attack.

Results

Results
The results show that the Car-Foil Wing achieved the highest lift.

Conclusions/Discussion

Conclusion

We conclude that the Traditional Wing didn#t produce the most lift after all. Instead two of our made up wings, the Car-Foil and the Sideways Figure-8 both got high lift at 10 to 30 degrees angle of attack. However the Traditional wing achieved consistent lift over all the angle of attacks, making this wing very suitable of passenger planes.

Summary Statement

We conducted this experiment to see which of the seven different airfoils, both standard designs and made-up designs, could produce the most lift at different angles of attack.

Help Received

Interview with Jeffrey Bass, President of Hiller Aviation Museum.

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)
Justin Clausen; Riley Gaucher; Jack Morgan

Project Number
J0104

Project Title
The Science of Paper Airplane Flight

Abstract

Objectives/Goals
We wanted to determine which class of paper airplanes, Darts, or Gliders, performs better. We predicted that darts would fly farther, because their streamlined design is more adept to fly propelled by thrust. We thought that gliders would remain aloft longer, because their wings provide more lift, the force of flight that causes airplanes to rise. We defined longer and farther flights as the best performance.

Methods/Materials
We launched 6 planes, 3 darts and 3 gliders. We used a launcher, employing a rubber band pulled into tension to launch each plane 12 times in a warehouse with no wind or man-made air currents. To measure flight duration, we started a stopwatch as the plane was launched and stopped it as the plane touched the ground. We measured the distance from the launch site to the final resting place of the plane as the flight distance, regardless of whether the plane circled or looped. To maximize the performance of each class, we launched the gliders at a quarter the thrust of the darts.

Results
Our results showed that we were partly correct; darts did travel farther. Yet as it turned out, gliders did not remain aloft as long as darts. The dart's average distance was 7.5 feet longer than the glider's and the glider's average flight duration was .04 seconds shorter than the gliders.

Conclusions/Discussion
We believe the planes flew the way they flew because of the launcher we used to propel the planes into flight. The rubber band used in the launcher provided a "raw" and uncontrolled thrust the gliders could not handle. The Darts could fly with more thrust because their streamlined design eliminates drag, yet the wide winged/nosed gliders were not able to fly because of all the drag created by their wings. If we conduct further testing, we will test the flight of paper airplanes thrown versus being launched, to determine which source of power is a better way of launching paper airplanes.

Summary Statement
Our experiment tested the performance of two classes of paper airplanes, darts and gliders, to see which class functions better; has longer flight distance and flight duration.

Help Received
Feedback from local Science Fair Judges; assistance with graph creation

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)

Saya Coronado

Project Number

J0105

Project Title

Sustainability with Wind Power

Abstract

Objectives/Goals

I tested a model of a horizontal-axis wind turbine and models of vertical-axis Savonius,Darrieus,and Giromill wind turbines to see which device rotates faster to collect more electricity.

Methods/Materials

4 turbine models, 1 fan, 1 rpm measurer, 2 metal secures (for securing pipes, etc.), 1 shoebox cover with a hole (the size and shape of the metal secures) in the center, 1 camera.

1.After I constructed all four models, I put the Savonius model#s dowel into the metal secures, which is in the hole at the center of the shoebox, acting as the base.2.Place the base in front of the fan and secure the small rpm magnet at the tip of one of each of the model#s blades.3.Attach the sensor, so it could stand parallel and close enough to each device to register each time the magnet completes a revolution.4.Turn on the rpm measuring device.5.Turn on the fan at high speed.6.Stop the fan after one minute and record the data.7.Repeat this routine two more times, for a total of three trials per model.8.Repeat this procedure with the Darrieus, Giromill, and Wind Turbine models.9.Record observations and take pictures.

Results

I tested my four variables,models of the horizontal-axis,Savonius,Darrieus,and Giromill wind turbines.I used a fan to simulate the wind while the model,supported by a metal base,would spin around for one minute as the rpm was calculated.My results stated that the horizontal-axis wind turbine had the most rpm,followed by the Savonius,Giromill,and lastly Darrieus.My ending results differed from my hypothesis because my hypothesis was that the Darrieus would do better than the Giromill,and the Savonius would do the worst.I had to make a lot of changes not in the experiment itself,but when I was constructing my models.

Conclusions/Discussion

The results I obtained from my experiment showed that the horizontal-axis turbine is the most efficient of the turbines,while the Savonius scored better than the Giromill and Darrieus in my experiment.My empirical results were different from my expectations.This experiment taught me greatly about the different types of wind turbines there are and which are more efficient in producing electricity.In addition,it was definitely a good experience because it taught me to be creative in designing my models and the different materials I was going to use.

Summary Statement

I built models of four different types of wind turbines in an effort to find out which design would be the most efficient in producing electricity.

Help Received

Father took me to get my materials.

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)

Paul P. Daws

Project Number

J0106

Project Title

Fins, Flippers, Feet!

Abstract

Objectives/Goals

What type of webbed foot will propel a bird the fastest in the water? I predict that the foot with the most webbing between each toe will move a water fowl the fastest because it has the most surface area to create force against the water.

Methods/Materials

The first part of the procedure was the speed testing. The swimmer swam 3 laps in the lap pool using each kind of the different fins. The control used no fins, the other trials used full fins and semi fins. For each trial, timing took place when the swimmer left the wall, and it ended when the swimmer reached the wall on the other side of the pool. The second part was the force testing. Each of the different fins was tested three times. For each type of fin, a string was attached to the fin and a hanging scale. The fin was pulled through the water to measure the resistance of the fin design.

Results

The fin with the most surface area, the full fin, produced the fastest swimming time. It had the most surface area to push the water. The second fastest time was the semi fins, followed by non swimming bird fins, and lastly no fins. With the force testing, the semi fin had the most amount of resistance followed by the non swimming fin. The least amount of resistance was the full fin.

Conclusions/Discussion

The foot with the most webbing had the most surface area. In the swimming test, the full webbed foot swam the fastest. In the force test, the full webbed foot took the least force to get through the water. The foot with the most webbing produced the best result because it was able to move the most amount of water while using the least amount of force. This information helps us understand the adaptations of bird feet and what designs are best for swimming birds.

Summary Statement

Using swimming fins to simulate bird feet, test what type of fin will propel a bird the fastest in the water.

Help Received

My Dad helped by swimming laps and I timed him. I designed the experiment, the fins, and did the rest.

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)
Evan DeLano; Bryan Kronenberg

Project Number
J0107

Project Title
Air Pressure in Soccer Balls

Abstract

Objectives/Goals
The goal of our project was to find out how air pressure inside of a soccer ball affects how high it bounces if dropped and how far it goes when kicked. We also wanted to establish a relation between first, second, and third bounces. We believe that higher pressure inside of the balls will lead to higher bounce and longer kick.

Methods/Materials
In our experiment, we tested a soccer ball with 10, 9, 8, 7, 6, 5, 4, 3, and 0 PSI gauge pressure. We built a structure to kick the soccer balls for our kick test. The structure was made of ABS pipe. We designed the structure with a swinging arm and weight plates attached to kick the soccer balls. In our kick test, we lifted the kicking arm to a 90-degree angle and let it swing at the ball and #kick# it. We had spotters place beanbags where the ball landed on the first three bounces. We then repeated the test. Later, we did a drop test in which we dropped the soccer ball in front of three yardsticks from 9 feet high. We took photos of the ball dropping and used them to identify how high the ball bounced after the first three bounces.

Results
In our results, the balls inflated to higher pressure generally bounced higher and were kicked farther. The first bounce was the highest/longest bounce, and the following bounces decreased even more. However, the difference between the second bounce and third bounce was much less.

Conclusions/Discussion
Our results generally followed our hypothesis, since higher PSI led to higher/longer bounce. However, one result that we found interesting was the kick distance of the ball at 5 PSI in the kick test. The ball went farthest, but the result doesn#t make sense because of Hooke#s Law. In summary, according to Hooke#s Law, a stiff spring will apply more force than a loose spring when it is compressed. This applied to our experiment because a tight spring is like a ball at high pressure while a loose spring is like a ball at low pressure.

Summary Statement
How does air pressure in a soccer ball affect how high the ball bounces or how far it is kicked?

Help Received
Parents bought materials and drove us to test site; Dad's friend helped build kick machine;

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)

Josh S. Dhaliwal

Project Number

J0108

Project Title

How Efficient Is Your Wind Turbine?

Abstract

Objectives/Goals

The objective of my project was to determine the most efficient design of a wind turbine (based on the amount of voltage produced) using a combination of different blade materials, a different number of blades, and different speeds of the wind. My hypothesis is that the most efficient wind turbine will have three triangular balsawood blades at a pitch of 45° and a wind speed of 8 miles per hour (mph).

Methods/Materials

A model wind turbine was assembled using a KidWind Energy Kit. Triangular blades (8# long and 3# wide) were cut from balsawood, coroplast, plexiglass, and zinc metal. A 20# oscillating fan with three speed settings (high, medium, and low) was used as a source of wind. A homemade anemometer was used to measure the approximate speed of the wind in mph. The first portion of the experiment was conducted by installing two blades at a pitch of 45° at various wind speeds. The second portion of the experiment was conducted by installing three blades at a pitch of 45° at various wind speeds. The voltage produced by the wind turbine was recorded using a simple Multimeter.

Results

My hypothesis partially matched with the results. A wind turbine with three blades produced more voltage than a wind turbine with two blades when the blade material and wind speeds were identical. A wind turbine with three plexiglass blades at a pitch of 45° and at the high wind speed setting of 8 mph produced the most voltage of 3.4 volts, followed by balsawood, coroplast and zinc metal. The most voltage produced by a two-bladed plexiglass wind turbine was 3.01 volts at a speed of 8 mph.

Conclusions/Discussion

A wind turbine with three plexiglass blades at a pitch of 45° and a wind speed of 8 mph was the most efficient. For a wind turbine with two blades, the best combination was the same as a turbine with three blades. Overall, plexiglass performed the best for all experiments.

Summary Statement

How different blade materials, number of blades, and the speed of the wind impact the voltage produced by a model wind turbine?

Help Received

My parents purchased materials from the Internet and local stores; they also helped in cutting zinc and plexiglass blades and attaching them to dowels using a glue gun; proofreading my project documents; reviewing the graphs, charts, and tables; and pasting them onto the display board.

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)

Laurel A. Ezell

Project Number

J0109

Project Title

Hovercrafts: Winds of Movement

Abstract

Objectives/Goals

The goal was to construct a hovercraft from everyday materials. The craft was to hover 10 or more seconds, traverse at least two meters, and show measurable friction reduction.

Methods/Materials

I obtained a motor with a propeller and circular plastic cage. A circle of Styrofoam was cut to be the same size. Three smaller circles of different sizes were stacked in pyramid form, connecting the Styrofoam to the cage and providing space for airflow. A large Ziploc bag with a hole cut in the top layer was fitted over the Styrofoam and the propeller cage. A wire tie was threaded through the bottom bag layer, Styrofoam, and fan cage to connect them all together. The top layer of the Ziploc bag was secured to the fan cage. Some small airflow holes were poked in the bottom of the bag but later enlarged using scissors. Lastly a snap connecter, switch, and a battery holder were soldered in place to finish it off.

Results

After many experiments I finally found the right materials to make my hovercraft work. I also met all my design criteria. My hovercraft was able to hover 10 seconds with ease. I was hoping it would hover across the floor two meters but it was able to hover five meters when pushed. When I measured difference of friction I taped a thin elastic string to the hovercraft and measured how many centimeters the elastic stretched before the hovercraft moved. With the hovercraft turned off the elastic stretched 24 centimeters and with the hovercraft on it only stretched 6 centimeters before it moved.

Conclusions/Discussion

My results proved I was able to construct a hovercraft from everyday materials that would hover more then 10 seconds, demonstrate greatly reduced friction and travel more than 2 meters when pushed.

Summary Statement

My project was about trying to build a successful hovercraft out of everyday materials.

Help Received

Dad helped with ideas for the materials and helped look for hovercraft design examples.

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)

Mac Goldwhite

Project Number

J0110

Project Title

Stoked on Viscosity

Abstract

Objectives/Goals

The objective was to determine how changing the size of ellipsoids along one axis changes the speed at which they fall through liquids of varying viscosity and how the non-spheroid ellipsoids are inputted into Stokes' Formula for calculating viscosity. It is hypothesized that the most elongated ellipsoid (3.5 cm) will fall slowest, and that an average of the two radii of each ellipsoid will work best for inputting into Stokes' Formula.

Methods/Materials

Five spheres of an identical approximate mass were created out of Sculpey#. Each ellipsoid was rolled out along one axis longer than the last. Several sugar/water solutions of different specific proportions were prepared. Each ellipsoid was dropped five times in each solution and the time it took to reach the bottom of a graduated cylinder was recorded.

Results

All data showed a general trend of the 3.5 cm ellipsoid, the longest ellipsoid, dropping slowest in each sugar solution and the 1.5 cm sphere dropping fastest. There was an exponential jump in speed between the 50% and 70% solutions for all ellipsoids, probably due to the high number of hydrogen bonds between the sugar and water molecules. The line graphs of the 1.5 cm sphere and of the 3.5 cm ellipsoid are nearly identical in shape, suggesting that the short radius of any ellipsoid elongated along an axis will yield the most accurate results in Stokes' Formula, except in highly viscous fluids.

Conclusions/Discussion

The hypothesis was only partially supported by the results of the experiment. The longest (3.5 cm) ellipsoid did fall slowest, taking an average of 9.125 seconds in the 70% sugar solution, but the difference between the average drop speeds of the ellipsoids was small enough that using the shortest radius of an ellipsoid will work best in Stokes' Formula. It is most likely that the cause of the short radius being most accurate in Stokes' Formula is the way fluid flows around the ellipsoid. Almost none of the fluid actually goes around the long radius of the ellipsoid; it takes the short way and flows along the short radius.

Summary Statement

I explored the effect that changing the size of ellipsoids along one axis has on the speed that they fall through fluids of varying viscosity, and how the non-spheroid ellipsoids are inputted into Stokes' Formula for calculating viscosity.

Help Received

Grandpa helped me come up with the idea to use non-spheroid ellipsoids in my experiment. Dad helped me sculpt and weigh the ellipsoids. Mom procured the materials used, oversaw the cooking of the sugar solutions, and assisted with the dropping of each of the ellipsoids in the various sugar solutions.

Name(s)
Bryton A. Horner

Project Number
J0111

Project Title
Fuel Troubles: Improving Car Aerodynamics and Fuel Efficiency through Dimples

Abstract

Objectives/Goals
Objective: The objective is to determine if golf-ball style dimples can be used to improve the aerodynamics of a car.

Methods/Materials
Materials and Methods: Three versions of a 2 x 7 inch model car were compared. One had a smooth surface, one had only the bottom dimpled, and one was completely dimpled. A 5 x 5 x 16 inch wind tunnel was constructed. A 10 inch diameter circular fan and contraction cone allows 70 mile per hour wind to be drawn through the test section. A digital force gauge is used to measure and record the drag force generated. A smooth wooden ball was first compared with a dimpled wooden ball in order to ensure that the test setup was working. The models were tested and drag force results compared.

Results
Results: The dimpled ball was found to produce 27% less drag than the smooth ball showing that the test setup was working. The bottom dimpled car produced 33% less drag than the smooth car. However the completely dimpled car produced only 15 % less drag than the smooth car.

Conclusions/Discussion
Discussion: As it turns out, dimpling only the bottom of the car was the most effective aerodynamic improvement. I believe this is because dimpling the bottom reduced the vacuum gap at the back of the car. However once I dimpled the entire surface, the drag went back up. Maybe the excess dimples spoiled the airflow too much or maybe too many dimples create excess skin friction. More tests would be needed. I think a golf ball needs the entire surface dimpled because it is spinning through the air, so all sides are exposed. A car doesn't because it remains in the same position. Additional tests were performed on a tractor-trailer shape and an Aptera wheel cover and the results were similar. Partial dimpling improved the aerodynamics but too much dimpling worsened it.

Summary Statement
Can the aerodynamics of a car be improved with golf-ball style dimples.

Help Received
Dad helped with construction and dangerous cutting. I assembled it. Borrowed schools digital gauge.

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)

Evan L.R. Karow

Project Number

J0112

Project Title

Can Kites Go Low?

Abstract

Objectives/Goals

Which type of kite will fly well in low winds? My hypothesis is that the Propelled Pillow kite or the Aerodynamic Airfoil kite will be able to fly at the lowest wind speed.

Methods/Materials

Materials: Various to build the mini kites & wind tunnel; voltage rheostat; box fan.
8 different design mini kites were made & a wind tunnel constructed. A voltmeter measured voltage to the fan & was used as an indirect measurement of wind speed. A launch pad was constructed inside the wind tunnel & the kites were placed in exactly the same position for each test. A voltmeter reading was taken when the kite lifted off the launch pad. Each kite was tested 9 times. My independent variable was the design of the kite. My dependent variable was the average voltage reading of when the kite achieved lift. My controls: the construction materials, design of the wind tunnel, fan position, kite placement, & taking an average of 9 trials per kite. The measurement of voltage when the kites lifted determined which design was better at low wind speeds.

Results

The results supported one part of my hypothesis, but did not support the other. The Propelled Pillow did not perform well in low wind conditions: it had the second worst performance. The Aerodynamic Air Foil design delivered far superior performance in low wind conditions. It consistently tested at the lowest voltmeter reading, indicating the lowest wind speed required for flight.

Conclusions/Discussion

This experiment was successful in that it was able to create reliable results based on carefully controlled testing conditions. Having an indirect method (voltmeter) of collecting results had its advantages & disadvantages. The advantage was the ability to compare each kite under the same conditions, so results could be reproduced. The disadvantage was test results produced in the wind tunnel may not be an accurate indication of how kites will perform in real life. I think the next step would be to make bigger versions of each of the kites & test them on low wind days enough times to get reliable & reproducible results.

Summary Statement

My experiment is to find out which types of kites will fly best in low wind conditions.

Help Received

Mother & tutor helped with editing; father assisted in wind tunnel construction, under Evan's direction; mother recorded results while Evan controlled voltmeter.

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)
Andrew V. Kelleghan

Project Number
J0113

Project Title
Falling Faster: The Effect of Area on Terminal Velocity

Abstract

Objectives/Goals
The purpose of my project was to determine whether the area of an object has an effect on its terminal velocity.

Methods/Materials
To test this, I built a wind tunnel out of wood, plumbing parts, and a plastic tube. Then I created shapes out of foam board so that I could test if the area was a variable in determining the terminal velocity of an object. I created three pairs of shapes. For two of the three pairs, the objects had the same weight but different areas. This allowed me to prove whether or not the area was influencing the object's terminal velocity. For the third pair of shapes, I decided to test whether objects with the same weight and area but different shape would have different terminal velocities. For each test, I would select two shapes that I had cut out, and, one by one, drop them into my wind tunnel. I would then adjust the ball valve to increase or decrease the wind speed to match the object's terminal velocity. Once I found the terminal velocity, I recorded the object's weight, shape, terminal velocity, and area in my logbook. For each test, I did three trials to ensure that the result had not been a fluke or a mistake. After conducting my experiments, I used the equation of a line to develop an equation that would allow me to predict the terminal velocity of a shape with a constant weight. Once I found this equation, I tested it by creating two new shapes and I used my equation to predict the terminal velocity of each shape. Then I tested the shape in the wind tunnel to make sure that the predicted terminal velocity was the same as the real one.

Results
The shape with the lowest area, the triangle weighing 3.5 grams with an area of 1 square inch, had the highest terminal velocity, 17 mph, because it encountered the least wind resistance. I also found from my data that I could create an equation with which I can predict the terminal velocity of an object with constant weight.

Conclusions/Discussion
The predicted terminal velocity was the same as the terminal velocity when i tested it in my wind tunnel. This proved that my equation was indeed correct. From my research and experiments, I can conclude that the larger an object's area is, the lower the terminal velocity will be. I also proved that an object's shape does not have an effect on its terminal velocity.

Summary Statement
My project demonstrates that the area of an object has an effect on its terminal velocity.

Help Received
My dad took me to buy the needed parts to build my wind tunnel.

Name(s)
Muzammil A. Khan

Project Number
J0114

Project Title
WHRRR! The Effect of the Angle of a Blade on the Voltage Output of a Wind Turbine

Abstract

Objectives/Goals
Today we are running out of Fossil Fuels. The environment is being harmed and we need another green source of energy. One of these sources of energy is a wind turbine. A wind turbine is a machine that converts the kinetic energy in wind into mechanical energy. This mechanical energy can be used to create electricity! The purpose of this project is to find out if changing the angle of blades of a wind turbine will change its voltage output. By finding the best angle we can increase the voltage produced by a wind turbine improving the wind turbine. Based on my research, the hypothesis I formed is that the 30° blade will produce the most voltage. The 30° blade has best angle of attack meaning, more lift will be produced compared to the angles of the other blades, producing more electricity.

Methods/Materials
First I constructed a wind turbine out of wood. Then I marked five different degrees on the wind turbine, 15°, 30°, 45°, 60°, and 75°. Then I placed the turbine 30.5cm away from a high velocity fan. Then I turned the fan on with the angle of the blades at 15° and left it on for 30 seconds. I observed the voltage the whole time and recorded the highest voltage produced. Then I changed the angle and repeated. I repeated the whole testing four times to make sure my results were accurate.

Results
The results were that the 15°blade produced an average of 2.75 mV. The 30° blade produced an average of 4.14 mV. The 45° blade produced an average of 2.68 mV. The 60° blade produced an average of 2.08 mV. The 75° blade produced an average of 2.01 mV.

Conclusions/Discussion
My hypothesis of the 30° blade producing the most voltage was supported. The reason for the 30° blade producing the most voltage was that its angle was the highest it could get before the amount of lift produced started to decline. In the other blades the lift produced was not as much as the angle of this blade meaning they rotated slower. This in turn had the magnet rotate slower, producing less electricity. Since there was more lift the 30° blade rotated faster the magnet rotated faster. Since the magnet rotated faster, more energy was produced. With this information wind turbines can be improved to produce more energy more energy more efficiently. At the same time, by doing this, we are a step closer to green energy and a step farther from fossil fuels!

Summary Statement
My project is about investigating the effect of the angle of a blade on the voltage output of a wind turbine.

Help Received
Grandfather helped me build the wind turbine.

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)

David K. Knittel

Project Number

J0115

Project Title

Pick-Up the Pace: A Study in Truck Body Shapes and Drag

Abstract

Objectives/Goals

The purpose of this experiment is to see which truck style is the most aerodynamic.

Methods/Materials

To test which truck and camper bodies were the most aerodynamic, different boxes and camper styles were cut from wood and then attached to a standard pinewood derby truck cab design. The truck with the different shapes was then put in a wind tunnel, where drag was measured and recorded at different speeds. The test was run with wind speed increasing and decreasing to reduce the effects of hysteresis. To find the actual drag at each speed, the values were averaged.

Results

After reviewing the data, the hypothesis was neither proved nor disproved because all the data sets were very similar. This was unexpected because internet research studies indicated that driving with the tail gate up was better than leaving it down, and that long, smooth shapes had much lower drag.

Conclusions/Discussion

Since the body styles were tested at low Reynolds Numbers, the flow was mostly laminar for all shapes and the drag was mostly due to friction. The streamlined shape had more surface area than the other shapes, so their increased friction reduced their overall performance. Reynolds Numbers need to match to create accurate scale testing. For my model, the 40 mph air speed only equated to about 1.4 mph for the actual truck. For my small model to simulate the same conditions that the full-scale truck would encounter at 40 mph, the model would need to be tested at air speeds of 1130 mph.

Summary Statement

With higher gas prices, I wanted to determine the most fuel efficient truck body style.

Help Received

Dad helped build, test and analyze the truck shapes; Mom helped with report and display; Mrs. Hornnes allowed access to wind tunnel.

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)

Michael J. Lawler

Project Number

J0116

Project Title

Maximum Angle of Attack Before Stalling

Abstract

Objectives/Goals

I wanted to find out the angle of attack that would stall an airplane wing. I thought of this idea watching my dad fly and wanted to learn more about how wings create lift and when they stop lifting or #stall#.

Methods/Materials

To measure a wings stall angle can be done either mathematically or experimentally I chose the experimental method. To test a wing I had to build a wind tunnel. I made the wind tunnel out of 1x2 lumber and wax panel boards. I chose wax boards inside the tunnel to minimize turbulence of the airflow. I installed a viewing port in the area where I attached my wing and marked angles on the opposite wall of the wind tunnel to visually measure the angle of the wing. I attached strings of yarn to the wing to tell whether the airflow over the wing was laminar or turbulent. Laminar flow indicates that the wing is creating lift and the strings of yarn would lay flat on the wing. Turbulent flow is indicated by the yarn fluttering above the wing and indicates a stalled condition.

Results

I found the maximum angle of attack to stall my wing was 45 degrees with a wind velocity of 4.5 MPH. I extended my experiment by increasing wind speed to see if the stall angle would change. I increased the wind speed to 6.5, 10.2 and 17 MPH. The wing stalled at the same angle for all wind speeds.

Conclusions/Discussion

An airplane wing will stall at the same angle of attack regardless of wind speed. This angle is approximately 45 degrees.

Summary Statement

Measure wind speed and air flow over a wing to physically observe (yarn tufts) detach at wing stall angle.

Help Received

Father used table saw

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)
Ethan D. Maahs

Project Number
J0117

Project Title
Spin It to the Limit

Abstract

Objectives/Goals
The objective is to determine if the rotation speed of a football affects drag on the football

Methods/Materials
Materials:
Home-made wind tunnel - Football Suspension and rotation apparatus - Home-made anemometer - Force Gauge - Nike 1000 Spiral Tech Football - 18V DC Motor (2)-TORO Leaf blowers - 12 VDC Power Supply -Variable Autotransformer
Methods:
1. Calibrate the wind tunnel at various wind speeds a. Place the anemometer in the center of the exit to the wind tunnel b. Turn one leaf blower to setting I c. Set the multi-meter to 200 mV. d. Record the output from the multi-meter. e. Set both leaf blowers to setting I and repeat steps c and d. f. Turn both leaf blowers to setting II and repeat steps c and d. g. Use the graph generated by using vehicle speeds and determine the wind speeds at the leaf blower settings. 2. Mount the rotation apparatus so the football is centered in the wind tunnel 3. Confirm the wire on top of the rotation apparatus contacts the force gauge 4. Zero the force gauge. 5. Turn one leaf blower to setting I. 6. Record the gram force. 7. Turn the DC motor on and set variable auto transformer to 10%(485 RPM). 8. Record the gram force. 9. Change the setting on the auto transformer to 15%(622 RPM). 10. Record the gram force. 11. Change the setting on the auto transformer to 20%(780 RPM). 12. Record the gram force. 13. Change the setting on the auto transformer to 25%(1020 RPM) 14. Record the gram force15. Turn the leaf blower and the auto transformer off16. Turn on both leaf blowers to setting I17. Repeat steps 6-15 with both leaf blowers on setting I18. Repeat steps 6-15 with both leaf blowers on setting II19. Repeat the procedure to collect 3 data sets at each wind speed. 20. Calculate the average gram force for each rotation and wind speed.

Results
The drag on the football reduced with increases in rotation speed for all wind speeds up to 780 RPM, but increases in rotation speed beyond this point increased drag.

Conclusions/Discussion
The drag force on a football seems to be inversely proportional, with the exception of the highest rotation speed where the drag on the football increases with increased rotation speed. Based on the test data the optimum rotation speed to minimize drag on the football is between 622 RPM and 780 RPM.

Summary Statement
My project was to study the affects of the rotation speed of a football on the drag of a football at various velocities.

Help Received
My father helped build the wind tunnel, suspension apparatus and suggested improvements that helped my experiment.; Mr. Hobbs for making sure I knew what I was doing before I started the experiment, checking my report and helping me practice my presentation .

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)
Nicholas A. Maggio

Project Number
J0118

Project Title
The Effect of Water Level on the Altitude of a 2-Liter Water Rocket

Abstract

Objectives/Goals
My objective was to determine what level of water would cause a 2-liter bottle rocket to reach its highest altitude. I believe that a 2-liter water bottle rocket will reach its highest altitude when filled with 1,000mL of water.

Methods/Materials
I built a rocket launcher out of PVC pipe and fittings, a bicycle pump, and a string. My rocket was a 2-liter soda bottle. I placed an empty bottle on the launcher and pumped the bicycle pump until it reached 60 psi. I pulled the string to launch the rocket and measured the altitude with an angle finder. I launched the empty rocket 5 times and then added 200 mL of water after every 5 launches until the rocket was at full capacity (2,000 mL). For every launch, I maintained 60 psi as a constant.

Results
My results were that the rocket reached its highest altitude (average of 88.62 feet) with 1,200 mL of water.

Conclusions/Discussion
I concluded that my hypothesis that the rocket would reach its highest altitude with 1,000 mL of water was incorrect. The experiment was related to Isaac Newton's laws of motion. Newton's laws of motion are: Inertia, momentum, and action-reaction. This is how the water rocket works. The rocket is at rest on the launch pad (inertia). When air is pumped into the rocket, it gains momentum. When the rocket is launched, the force of the air pressure pushes water downwards, which means that the water pushes the rocket upwards so hard that it overcomes gravity and will fly. The amount of water in the rocket will determine the reaction. It should still launch without water because the air in the bottle has a mass. Because air is light, the bottle will empty itself but the force will not last long. That is the reaction. When the bottle is almost filled with water, it is heavy and the extra weight means that because there is less room for air, not enough pressure exists to push the heavy water out and the rocket will not reach a very high altitude. My hypothesis was that the rocket would reach its highest altitude with 1,000 mL of water because there would be an equal amount of water and air. My experiment taught me that slightly more water causes the rocket to reach a higher altitude. This combination of slightly more water than air causes the greatest action-reaction.

Summary Statement
My project was about determining what level of water would cause a two liter water bottle rocket to reach its highest altitude.

Help Received
My mother helped type the report. My father helped build the rocket launcher. My teacher helped organize the report.

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)

Diego McDonald

Project Number

J0119

Project Title

Determining the Relationship between Lift and Wind Speed to Induce Flight in a Sample Aircraft

Abstract

Objectives/Goals

To determin the relationship between added weight and wind velocity on an airplane.

Methods/Materials

A wind tunnel was built to simulate the effects of wind. A model airplane was suspended at one end of the wind tunnel, and the fan was installed on the opposite end. The wind speed was calibrated using an aeronometer designed for the project. The aeronometer consisted of a dial controlling wind speed in degrees, from zero to 360. The minimal amount of counterweight needed to suspend the plane was determined and set. The counterbalance weight was increased in increments of 2.5 grams (one penny dated after 1985), and the wind speed was adjusted using the increments on the aeronometer. Tests were performed at 21 different wind speed settings.

Materials used included an aerodynamically Correct Model Airplane (has the ability to fly, a Wind Tunnel, Weight Set (I used pennies dated after 1985, each weighs 2.5 grams, Aeronometer (I found relative wind speed using circle graph on dimmer switch) and a Counter Weight (Used water to keep airplane suspended).

Results

When the weight of the plane was increased by 2.5 grams, the wind speed would need to be increase by about 5o on the dial. Each time we added weight, we had to increase the wind velocity for the plane to rise. We started at 300 grams of water to emulate the plane hovering in air. We found the minimal wind velocity needed for the plane to fly without added weight, 170 degrees.

Conclusions/Discussion

I discovered the weight added and the amount of wind speed required to lift the plane varied directly with each other. When added weight is increased, the wind velocity must be increased for the plane to rise. Using linear regression, the equation for the relationship between the wind speed and the added weight was determined to be:

$$y = 2.17x + 172.32$$

Where:
y = wind speed needed lift the plane, as represented by degrees on
the circle (aeronometer)

Summary Statement

Testing the relationship between wind velocity and added weight on an airplane.

Help Received

Father helped build wind tunnel; Mother helped paste elements of exhibit board.

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)

Miles J. McGinley

Project Number

J0120

Project Title

Hovercraft Mania

Abstract

Objectives/Goals

The goal of my project, Hovercraft Mania, was to discover the maximum payloads, or maximum weight, of different sizes of self-constructed hovercrafts. When I tested the payloads I would record the maximum height of the hovercraft. Then, add weights to the hovercraft and when the maximum height of the hovercraft started to decrease then I recorded that weight on the hovercraft and run the test two times with two speeds of the electric leaf blower used to create the lift in the hovercraft and then average the weights of both test runs.

Methods/Materials

The materials used in my project consist of: Polyplastic (6mil), JT staple gun, JT 1/2 inch staples, duct tape, 3 pieces of 1/2 inch plywood, three coffee can lids, three 2 1/2 bolts, six washers, three nuts, electric leafblower, weights, tape measure, electric drill, electric saw, hobby knife, safety gloves, safety goggles (for cutting wood), plastic screw-top bottle cap, and a pen.

Results

For my results, the size 122 by 122 centimeter hovercraft would work the best if it was used on speed two of the electric leaf blower used. The power and the size of the hovercraft is believed to create more lift, enabling it to float on the largest cushion of air. I did support my hypthesis because my hypothesis was that thelargest size hovercraft (122x122cm) on speed two would work the best if it was used in everyday life.

Conclusions/Discussion

My science fair experiment has taught me a lot. It has also improved my construction skills. For my experiment I was testing to see which design of hovercraft would work the best if it was used in everyday life. My hypothesis was that the largest hovercraft, 122 by 122 centimeters on speed 2, would work the best over all. I did support my hypothesis because the lift average on both speeds, was slightly increased from the other two designs. The maximum payload was also greatly increased from the other two designs.

Summary Statement

My project is about testing the maximum weights on different sized hovercrafts, if used in everyday life.

Help Received

My father helped me construct the hovercrafts because he is a contractor.

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)

Kaycee C. Miller

Project Number

J0121

Project Title

Rotating into the Future of Flight

Abstract

Objectives/Goals

The purpose of my project is to demonstrate that a coaxial contra-rotating proprotor can outperform a single proprotor used on current rotor aircraft today. History, designs, concepts, advantages and disadvantages will be experimented and discussed throughout my project.

Methods/Materials

I used a wind tunnel to test free spinning proprotors to validate my hypothesis. I installed single and coaxial proprotor models in my wind tunnel and looked for any changes to thrust, pitch, or roll performance characteristics.

Key materials include: concrete form tube, cardboard separator, fan, camera, paper, pencil, computer/printer, cutting tools, glue, fishing line, wooden dowels and spoons, woodworking tools, tape measure, and screws.

Results

I noticed the single proprotor experienced characteristics of roll, while the coaxial proprotor maintained smooth performance when both propellers were contra-rotating at effectively the same rate. Additionally, the coaxial proprotor exhibited greater thrust characteristics.

Conclusions/Discussion

I concluded that the coaxial proprotor performed with more significant overall flight characteristics versus the single proprotor because of the torque affecting the single propeller along with the aerodynamic affect of retreating blade stall (RBS), whereby the advancing blade on a propeller outperforms the retreating blade. The coaxial contra-rotating propellers equal out both the effects of torque and RBS.

Summary Statement

My project resolves the question of whether a coaxial contra-rotating proprotor propulsion system can outperform more popular modern single proprotor systems.

Help Received

My father helped me build my wind tunnel and proprotor models, drove me around to collect materials, and assisted with organizing my notebook and display board.

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)

Loren J. Newton

Project Number

J0122

Project Title

Fly Like an Eagle: Ornithopter Dynamics

Abstract

Objectives/Goals

To investigate & determine which shape & angle of attack of an ornithopter's wings would produce the best thrust performance.

Methods/Materials

Based on proven laws of physics, use of Algebra, and Geometry theory, I derived a formula with factors I could work with to design my experiment.

An onithopter test rig & platform were then constructed. Three sets of mylar wings of varying shapes, but with equal area were crafted.

With each set of wings mounted, nine angles of attack were set respectively.

The distance traveled by each flapping wing configuration in 15 seconds were recorded.

Results

Least thrust was generated at 0 degree angle of attack, while negative angles of attack caused braking drag.

The larger the positive angle of attack, the more thrust was generated, to cause the further the distance traveled.

The curved shape wings had the least wing tip area to cause the least drag, and therefore had the greatest distance traveled.

Conclusions/Discussion

Ornithopters with flapping wings at a larger positive angle of attack, generated more thrust. Flapping wings with the least tip area (curved wings) caused the least drag.

In practice, there is a need to actively control each individual wing's amplitude and angle of attack in order to generate different combinations of thrust & lift forces for different flight functions.

Summary Statement

To examine the design factors contributing to the thrust performance in ornithopter dynamics. (F= P*(l*w*cosine A) + (D/t) + f)

Help Received

My Dad helped in purchasing the material, and help construct the test fixture. The Onithopter Society web site provided technical reference.

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)
Samuel C. Nobles

Project Number
J0123

Project Title
Does the Size of the Waterwheel Paddle Affect Speed and Performance?

Abstract

Objectives/Goals
The purpose of this experiment is to find out if adding more paddles or changing the width of the paddle fold will affect the speed and performance.

Methods/Materials
1. Create a template using a pie chart in Microsoft Excel.
2. Use the waterwheel template to create a nine-inch waterwheel out of a pie tin.
3. Make three waterwheels with five equal paddles. One wheel should have paddles with two-inch folds, another with three-inch folds, and a third with four-inch folds.
4. Repeat step four creating a waterwheel with six, seven, eight, and nine equal paddles.
5. Place a bucket with a hole drilled on each side in a sink with a faucet.
6. Place a wooden dowel through the holes of the bucket.
7. Use 50 cm of string and tie one end to the middle of the dowel.
8. Tie the other end to a fishing weight.
9. After placing a waterwheel on the dowel, run water on the wheel and time how long it takes the fishing weight to reach the top of the dowel.
10. Repeat step nine two more times making sure to record times in the logbook.
11. Repeat experiment steps nine and ten for each waterwheel design recording times in the logbook.

Results
The paddles with the four-inch folds proved to be most consistent because the water remained on the paddle due to the larger fold size.

Conclusions/Discussion
The waterwheel with the four-inch folds worked the best and was more consistent because the water hit a larger area across the paddle of the wheel

Summary Statement
This experiment is to find out if adding more paddles or changing the width of the paddle fold will affect the speed and performance.

Help Received

Name(s)

Justo Padron, III

Project Number

J0124

Project Title

Does Wing Affect the Amount of Kinetic Energy Produced by the Different Wind Blade Designs

Abstract

Objectives/Goals

The objective of my project was to test different turbine blade designs and the effect it will have on the amount of kinetic energy produce.

Methods/Materials

The following materials were used to construct a homemade wind turbine machine. A 3 geared PVC wind turbine, volt meter, fan, bossial wood, plastic, wood dowels and digital volt meter. The blades were designed and mounted onto the geared turbine and the blades were rotated to various degrees.

Results

My results confirmed my Hypothesis that a curved blade will produce more kinetic energy than the other blade designs. The different blades designs consisted of the square, round and curved (semi-round), each blade was rotated to three different degree settings. The final results showed that the curved wood blade set at 30 degrees produced the most kinetic energy.

Conclusions/Discussion

My theroy that the curved wood blade was correct. After all the blade designs were tested for each degree rotation and the different blade materials the averages fore each test was calculated which then determined the final results. Although my testing was limited due to the complexity of the wind turbine systems being used today, I can honestly say that my home made system was able to illustrate that wind is and can be an effective use of mother nature to produce an alternative and clean energy source. The way of the future for alternative energy is wind. It cheap and there is lots of it.

Summary Statement

Does a blade design of a wind turbine effect the amount of kinetic energy produced.

Help Received

My father helped with the construction of the wind turbine machine

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)

Nikita Patel

Project Number

J0125

Project Title

Gone with the Wind

Abstract

Objectives/Goals

My project will analyze which blade angle is the most efficient for generating electrical power using wind turbines. The blade angles I am testing are 15, 30, 45, 60, and 75 degrees. I will have three different wind speeds, 5, 10, and 15 mph, blowing at the wind turbine.

Methods/Materials

Materials: Anemometer, Ammeter measuring mA, Wind turbine kit with six blades that can change angles, Multimeter measuring mV and mA, Motor for load

1.Build the wind turbine from the kit
2.Connect Ammeter in series to the turbine and motor and Voltmeter across motor
3.Set the blade angles of all blades at a right angle to the wind and then set the blades to 15 degrees. Repeat for 30,45,60,75 degrees
4.Turn the fan on and use the anemometer moving forward or away from the fan until the speed is reached 5 mi/hr. Repeat for 10 and 15 mi/hr
5.Turn fan on and measure the voltage from the Voltmeter and the current from the ammeter
6.Record the voltage and the current, wind speed and blade angle

Results

I predicted that 45 degrees would generate the most energy but it generated only a few mW. The angle of the blade that generated the most energy varied depnding on the wind speed. At 10 and 15 m/hr wind, the maximum power was generated at 15 degrees blade angle. However at 5 m/hr wind, 30 degrees blade angle obtained the most power. This may be because the angle of the turbine blades is inversely proportional to the wind speed for maximum power. Even at very slow speeds, you could set the angle high enough to generate any energy.

Conclusions/Discussion

My conclusion is that the optimum turbine angle for maximum power depends on the wind speed. Currently wind turbines have fixed blade angles meaning that at very low speeds, the turbine either shuts off or generates a few MW of power. I am proposing wind turbines to have actively variable blade angles that constantly change according to the speed of winds.

Summary Statement

Which blade angle is the most efficient for generating electrical power using wind turbines?

Help Received

Dad helped in assembling the wind turbine and in purchasing the materials.

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)
Rylan T. Pickett

Project Number
J0126

Project Title
Water Wheelin': The Effects of Turbine Blade Size on Power Produced by a Micro-Hydro Water Turbine

Abstract

Objectives/Goals
The goal of this project was to investigate the effect of turbine blade size on power produced by a micro-hydro water turbine. I hypothesized that the smallest blade size would produce the most power.

Methods/Materials
I assembled a micro-hydro water turbine out of an antifreeze bottle, magnets, copper wiring, paperboard, duct tape, wood, cork, vinyl, and acrylic. I assembled the machine so that the hubs that held the blades were interchangeable so as to test the different blade sizes (6.3 square cm., 9.4 square cm., 12.5 square cm., and 15.6 square cm). I ran a fixed flow of water through the opening at the top and recorded the output at three different intervals in millivolts, which is proportional to power.

Results
The smallest blade size produced the largest output in millivolts while the largest produced the lowest voltage.

Conclusions/Discussion
I concluded that when building a water turbine, optimizing blade size is a very important part of the process, and that in this case, the smaller sizes proved to be the best.

Summary Statement
To determine which blade size produces the most power in a micro-hydro water turbine.

Help Received
Dad gave me building and electrical concept advice.

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)

Omkar S. Savant

Project Number

J0127

Project Title

The Lean Mean Green Machine: Finding the Optimum Parameters for an Efficient Windmill

Abstract

Objectives/Goals

The goal of this project is to find the most efficient way to build a windmill.The different areas of investigation are the blade length, blade angle, and gear ratio.My hypothesis for this experiment are the longest blades(31cm) will produce the most voltage because it will have the most torque, the blade angle of 30 degrees will have the highest voltage, and the gear ratio of 7 will produce the most voltage. If successful, this experiment can provide a great help to home owners who decide to harvest the power of wind as a guideline on how to build the windmill.

Methods/Materials

To conduct this experiment, I used a birdhouse as the base and mounted the shaft and generator on the inside of it. Attached to the shaft was the blade set which had either 31cm, 20cm, or 10cm blades which were mounted in 15, 30, 45 or 60 degrees.The birdhouse held the gear ratios of 1,3,5, or 7. When the fan started spinning, the blades would also spin, in turn causing the generator inside the birdhouse to generate electricity, which was measured by a multimeter.

Results

The average results for the gears were 0.31V for a ratio of 1. For the ratio of 3, the voltage was 0.69V. The gear ratio of 5 produced 1.59 volts and the gear ratio of 7 produced 1.9V. The average results for the blade lengths were 1.9V for the 10cm blade, 0.91V for the 20cm blade, and 0.47V for the 31cm blade. The average results for the blade angles were 1.42V for the 15 degree angle, 1.93V for the 30 degree angle, 1.12V for the 45 degree angle, and 1.45V for the 60 degree angle.

Conclusions/Discussion

The results prove two out of three of my hypotheses correct.The best angle was 30 degrees, the most effective length was 10cm, and the most productive gear ratio was 7.The 31cm blade might not have produced high voltage because of its heavy weight.The 45 degree angle had the least output because it cuts the airflow whereas, the 30 degree angle allows the air to slide and push the blade faster.

Summary Statement

My project's goal is to find the most efficient way to build a windmill.

Help Received

Father helped me bulid the windmill.

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)

Amber J. Schisler

Project Number

J0128

Project Title

Which Airfoil Design Generates the Most Lift?

Abstract

Objectives/Goals

The purpose of this experiment was to determine which of four airfoil designs would generate the greatest lift. Airfoil One was the most similarly shaped to common aircraft wings. Airfoil Two was shaped in a triangular fashion with the same height and peak position as Airfoil One. The peak of Airfoil Three was moved to the center of the wing with an oval arced shaped top. Airfoil Four was rectangular. The hypothesis states that if airfoil models One through Four are all tested in a wind tunnel with a 0º angle of attack, Airfoil One will generate the most lift.

Methods/Materials

On December 23, 2008 four different airfoil models with equal bottom areas and varying only the top shapes, were tested in a 20.9 m/sec (approx. 46 mph) speed wind tunnel constructed for this experiment. Each airfoil was leveled at a 0° angle of attack before each test. Before each test, the scale was zeroed. The electric powered blower was then turned on and permitted to reach full speed. The grams of lift were then measured in negative to show the amount of lift. The blower was unplugged and allowed to stop. Each wing was tested 20 times.

Results

It was concluded that Airfoil Three generated the most lift, with an average 72 grams of lift. Airfoil One generated the second most lift with an average of 35 grams. Airfoil Two was third with an average of 29 grams of lift. Airfoil Four generated no lift, (0 grams).

Conclusions/Discussion

The hypothesis was proven incorrect. Airfoil One did not generate the most lift. Airfoil Three generated the most lift due to the oval arc shape. Lift is caused by the faster movement of air on the top side of an airfoil. Having the peak of Airfoil Three in the center of the top span of the wing provided a greater surface area for the air pressure to build up as the air moved over the wing, thus creating a more concentrated area of low pressure in back of the peak. Airfoil Four was rectangular, and this was the reason it did not generate any lift with a 0º angle of attack. This airfoil is symmetrical (top to bottom) and at a 0º angle of attack, there was equal pressure on the top and bottom side of the wing; therefore, no lift was generated. It was noticed that airfoils Three and Four needed to be anchored to the scale to prevent them from blowing backwards. Presumably, these two designs had the most drag.

Summary Statement

The focus of this project was to test the amount of lift generated by differently designed airfoils.

Help Received

My mother helped me proof-read my report, and a family friend, Paul Lechner, built the wind tunnel for me.

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)

Ryan C. Segervall

Project Number

J0129

Project Title

The Amazing Hovercraft

Abstract

Objectives/Goals

The objective of my project was to build a hovercraft, to determine if different surfaces affect how much weight it will hold and how well it will hover, and to have fun.

Methods/Materials

Materials:
Plywood, leaf blower, vinyl, 2" PVC pipe, bicycle tire, lawn chair, screws, bolts, and clamps.

Method:
1. Build hovercraft according to the instructions in the "Ultra Simple Hovercraft" document
2. Test to see if it works
3. Test on each of the 6 surfaces by putting weights on it until it wouldn#t hover. I defined hover as "if you push it, it will move easily".

Results

The hovercraft held more weight on the hardwood floor than any other surface. It held 731 pounds compared to 596 lbs on cement, 553 lbs on hard sand, 503.5 lbs on asphalt, 173 lbs on soft sand, and 86 lbs on grass. It lifted 731 pounds on the hardwood floor by creating a calculated 0.5 lbs/in^2 of pressure. It lifted the most on hardwood floors because it created the best seal and less air leaked out the sides creating more lift.

Conclusions/Discussion

My conclusion supported my hypothesis that the hovercraft would work best on the smoother surface (hardwood floor). It really surprised me on how much it could lift. This study showed me that hovercrafts are fun but not very useful because they can only do well on certain surfaces and they are really noisy and use a lot of gas.

Summary Statement

My project is about building a hovercraft and understanding how well it works on different surfaces.

Help Received

My Dad helped me get materials, helped me put weights on the hovercraft during testing, and he also sat on it so I could have more weight on it.

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)

Isabelle L.P. Swing

Project Number

J0130

Project Title

How Does Parachute Material Affect Speed?

Abstract

Objectives/Goals

My obhjective was to determine which parachute made from a common household material would have the closest drop speed to a zero porosity, real parachute material.

Methods/Materials

Five parachutes were made of identical size and shape. The first was made of 0 porosity material similar to a real parachute, one was of newspaper, one plastic, one from a t-shirt, and one from a pillowcase. Each was dropped from 10 feet, 5 trials each. The drop was timed from when it was released to when it hit the ground. Using the distance and the average time in the velocity formula, I determined the speed per second.

Results

The plastic bag parachute had the closest drop time to the control. the newspaper and pillowcase parachutes were the next closest, leaving the t-shirt parachute with the largest difference of seconds per foot to the control.

Conclusions/Discussion

I concluded the plastic bags probably have 0 porosity like the control parachute. It is important to know the porosity of a parachute material because it affects its drop speed.

Summary Statement

My project determined which parachute made from household materials would have the closest drop speed to a real parachute.

Help Received

Mother, Susan Swing, helped edit the report. Grandpa, Howard Swing, helped design and assemble the parachute hanger. Southside School, Dr. Forbush, reviewed project and made recommendations.

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)

Brian J. Vallelunga

Project Number

J0131

Project Title

Levitation: Applied Electrohydrodynamics

Abstract

Objectives/Goals

The scientific exploration of unconventional flight is exciting and full of surprises. This science project explorers the relationship between thrust and voltage of an asymmetric capacitor as a means of generating thrust. The Biefeld-Brown effect also referred to as electrohydrodynamics (EHD) provides the primary theoretical foundation for the project in conjunction with Newton#s 1st, 2nd, 3rd laws of motion and Coulombs law. The core objective of this year#s project is to apply directional control to a lifter using a joystick.

Methods/Materials

The craft is made of balsa wood, aluminum foil, super glue, sewing thread, scotch tape, 30 gauge enameled copper magnet wire and 0.0028# stainless wire. The GRA10 circuit board powered by a RPS1220 power supply provides the voltage and current to the lifter that generates thrust. The lifter levitates using only EHD; it has no wings or conventional propulsion.

Results

The result was a lifter that can achieve sustained levitation using only EHD using direction control.

Conclusions/Discussion

The innovating new way to use a lifter is through a joystick. The joysticks gives the new and improved lifter a application for direction control. There has been four designs manufactured in this report for lifter trials. Wire Mess Lifter, Original Triangle Lifter, Original Square Lifter, Square Lifter 2 are all trialled to see which design will be chosen for a controllable lifter. The lifter uses five circuit boards as a application of power for directional control. The first circuit board is a function for lift, and the other four circuit boards are for Forward, Reverse, Left and Right.

My conclusion is that with careful construction and attention to detail, a lifter can be controlled using a joystick and five circuit boards.

Throughout the scientific discovery, there were many failures along the road to success. With patience, lots of hard work, study, sacrifice, trial and error, attention to detail, analysis and a relentless pursuit of success, I present to you #Levitation#.

Summary Statement

Levitation - Electrohydrodnamics as a sole means of propulsion.

Help Received

Father helped construct apparatus

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)

Nicholas M. Willy

Project Number

J0132

Project Title

Which Pitch to Ditch? How Propeller Pitch Affects the Thrust and Speed of an Underwater Motor

Abstract

Objectives/Goals

The purpose of this project is to determine how propeller pitch affects the thrust and speed of an underwater motor. The blade angle, defined by pitch, of an underwater propeller is one important design variable affecting the propeller#s performance. Each year M.A.T.E. holds an Underwater Robotics contest with remotely operated vehicles (ROVs). These ROVs are maneuvered using thrusters constructed of propellers attached to underwater motors. Next year I will compete in the MATE contest and I want to ensure my ROV will have the best thrust and speed combination providing an enormous advantage in the competition.

Methods/Materials

In doing this project learned how to measure propeller performance and select the most effective ROV propellers. To conduct the experiment, I designed and constructed two devices: one to measure thrust and the other to measure speed across an above ground pool. I also modified a motor so that I could easily interchange propellers during testing without compromising the design of the testing devices or motor performance. I tested three propellers each having a different pitch: 2.50 inch pitch, 2.75 inch pitch, 3.0 inch pitch.

Results

Multiple runs for each test were performed and I was able to observe different performance with the pitch variations. Speed and thrust were measured in both forward and reverse directions. After testing,the results did not match my hypothesis directly.

Conclusions/Discussion

In a future experiment I would like to conduct experiments related to the other parts of propeller design such as diameter and blade area. This experiment was fun and I know it will help me next year on the ROV team.

Summary Statement

I tested how the pitch of a propeller affects the thrust and speed of an underwater Remotely Operated Vehicle (ROV) motor.

Help Received

My dad helped me construct measuring devices, and helped me collect data, and taught me Microsoft Excel. My mom helped me design and assemble my poster board. My teacher Mr. Alexandrov supported and guided me.

Name(s)

Matthew Wong

Project Number

J0133

Project Title

Looking for Lift!

Abstract

Objectives/Goals

The objective of my project was to see if more wing curvature generated more lift.

Methods/Materials

Four airfoils (wings) were designed and constructed, each with differing heights of 0 cm, 2.0 cm, 3.5 cm, and 5.0 cm. The 0 cm wing had no curvature. As the heights increased, the amount of wing curvature was also increased, with the 5.0 cm wing having the most curvature. A 10 in. desk fan facing the leading edge of each wing was used as a wind source. Each wing was tested at least three times, and the amount of lift generated was measured and recorded.

Results

The wing with the most curvature (5.0 cm) did not lift the highest of all the wings, but it was the most stable. This wing also took longer to achieve consistent lift and had the smallest angle of attack.
The wing with the least amount of curvature (0 cm) lifted the highest, yet was the most unstable and turbulent.

Conclusions/Discussion

My conclusion is that more wing curvature increases stability but not lift. Some factors that may have affected the outcome: Weight of each airfoil, wing shape and dimension, type of materials used, and wind and weather conditions (experiments were conducted outdoors).

Summary Statement

My project was to determine if more wing curvature increases the amount of lift generated.

Help Received

Attendance at Hiller Aviation (San Carlos, CA) summer aviation camps over the last three summers helped me gain a deeper understanding of aviation and inspired me to investigate further into some ideas I had. Mother helped purchase the desk fan, cut/slice some materials, and anchor desk fan to the display.