CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY

Name(s)
Kurtis Abato-Earwood; Kannan Aravagiri

Project Number
J0101

Project Title
Project Pine Car: Mass and Propeller Variations on Vehicle Efficiency

Abstract

Objectives/Goals

The objective of the experiment was to know which variables such as mass and propeller pitch create an efficient air propulsion system on land. The experiment was to find a good combination between mass and propeller pitch that would create the most efficient propulsion system.

Methods/Materials

The experiment included 3 pine cars, 6 plastic wheels, 3 metal axles, 9 9-volt batteries, 1 205.11 cm long track, insulated wire, hobby motors, varied propellers, duct tape, stop watch, ruler, spray paints, clay, toothpicks, square wooden rods, tape measure, switches, hot glue, drill, Dremel tool, 9 washers, and a protractor. The experiment is first done by making the track with a narrower piece down the middle with a bumper on one side and a start on the other, pine cars are fitted with identical motors and varied propellers and weights to be tested. Afterwards, the cars are moved through the track, while being timed, testing weight sets and propeller pitch variations. Afterwards, the times were recorded, and the testing was completed. The independent variables were the weight sets, the propellers (size and pitch), the 25 degree uphill, and 25 degree downhill tracks. The controlled variables were the track length, the motor used, the car type, the material used in the car, and the kind of battery used. The dependent variable was the speed of the car.

Results

Propeller one with a 75 - 45 degree propeller proved to be the fastest at the straight track with no variation at 92.4 cm/s on the track average. Propeller one with no added weight went uphill fastest at 83.7 cm/s. On the downhill track however, the control propeller seemed to move the fastest 89.2 cm/s. When testing propellers with different weight sets, the fastest proved to be weight set one(6.9 g) with propeller two at 85.8 cm/s. On the downhill track, variation of weight set 1 and propeller 1 gave the fastest speed at 102.6 cm/s. On the uphill track, the variation with the fastest speed was 91.2 cm/s.

Conclusions/Discussion

When all of the testing was completed, it was concluded that the cars with a higher degree of pitch (75 - 45 degree pitch), larger size of propeller, and with few added weights can produce the most efficient air propulsion.

Summary Statement

The objective of the experiment was to know which variables such as mass and propeller pitch create an efficient air propulsion system on land.

Help Received

Mr. Vanegas, and Mr. & Mrs. Abato-Earwood helped in tool use. Mr. Saramosing advised us on the project.

CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY

Name(s)

Patrick D. Adelstein; Grayson C. Kopperud

Project Number

J0102

Project Title

Need for Speed

Abstract

Objectives/Goals

The experiment is "How will the shape of a car effect its speed down a straightaway track" and "How will the addition of a spoiler on the back of the car effect its speed down a track." It is hypothesized that the streamlined shape would move faster. This is thought to be true as it produces the smallest drag coefficient and has a smaller frontal area than the other shapes.

Methods/Materials

In short the experiment starts with cutting five differently shaped cars as noted in the procedure, and one spoiler. The first half of the experiment starts with sending each car with no spoiler down the track. The time is recorded after each run in seconds and the speed is calculated in meters per second, and then the average of both is found for each car. The second half is repeating the first but adding a spoiler for each run. Every car should have a total of five trials with and without the spoiler.

Results

After calculating the average speeds of all the cars with and without the spoiler we observed a few results. First of all the wedge shaped car never finished a run. Disregarding the wedge from fastest to slowest was the oval, followed by the rounded, then the streamline, and then the rectangular. When we attached a spoiler and tested the cars the oval, rounded, and rectangular cars all experienced a slight increase in speed while staying in relation to each other. The streamline car although experienced an unexpected decrease in speed due to it's weights hitting the floor and slowing it down.

Conclusions/Discussion

The ending result is inconclusive. No conclusion could be made because the wedge never finished a run and the streamline experienced difficulties in maintaining a consistent friction with the track. This made the collected data incorrect.

Summary Statement

My project deals with how the shape of a car and the presence of a spoiler effects it's speed.

Help Received

Mother drove to get materials; Carpenter helped shape and cut cars; Neighbor loaned track

CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY

Name(s)

Henry D. Alkire

Project Number

J0103

Project Title

The Effect of a Propeller's Design (Manufacturer) on Its Static Thrust

Abstract

Objectives/Goals

I designed this experiment to test the static thrust of three designs of 8x4 model aircraft propellers (figure 1) and determine if there is a difference

Methods/Materials

Materials: Three 8x4 propellers of different manufacturers' design (GWS, APC, Master Airscrew); E-flite 480 outrunner brushless motor; Spring scale (measures newtons); Coat hanger; 20 amp electronic speed control; 7.2 volt 1000mah Nicd battery; Five thin sticks of wood and one plywood sheet.

Methods: Preliminary:

The stand was assembled from the wood and coat hangar listed in materials.

-Experiment:

The motor was then run at full throttle using each of the three propellers. The motor's thrust pulled the stand forward on its pivot point and moved the spring scale. A reading of the motor's thrust was taken on the spring scale after 10 seconds of run time. Each propeller was tested 7 times. The results were graphed and the median thrusts were compared.

Results

The APC propeller's median thrust was 2.4 newtons, the GWS prop's median thrust was 2.3 newtons, and the Master Air Screw's median thrust was 2.0 newtons.

Conclusions/Discussion

Conclusion: My hypothesis was disproved, each design generated a different level of static thrust. The APC prop generated the most thrust.

Discussion: This test proved that the propeller's design makes a difference in the the props performance. In aircraft flight, higher static thrust means more performance during aerobatics and at low airspeeds. I believe that the APC propeller's wider, but thinner airfoil allowed it to move more air. The fact that it utilized carbon fiber in its construction, may have allowed its manufacturer to design a broader airfoil without gaining in thickness and weight. Ironically, the Gws propeller, which was the only propeller that didn't have an advertising claim, outperformed the Master Airscrew, which had a paragraph of advertising and self promotion. The Gws propeller had a straightforward design with thin, semi-rounded blades. The master airscrew had a thicker square shaped airfoil.

Summary Statement

This project was a test of the static thrust of different designs of 8x4 model propellers

Help Received

Catherine Alkire (parent) helped design board and type. Randy Oliver (science teacher) helped in design of stand Harry Stewart (friend) helped with equipment questions

CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY

Name(s)

Allison Aoun

Project Number

J0104

Project Title

On the Wings of Mission Piggyback Ride: Winglet and Canard Analysis for Transported Craft Aerodynamics, Phase 2

Abstract

Objectives/Goals

Phase 1 determined the best configuration for transporting space aircraft by using larger planes. Attaching the small ship on the bottom of the large ship, facing forward, right side up, was best, followed very closely by bottom and forward, but upside down. Winglets are being added to increase aerodynamics and reduce fuel usage. I wanted to find out if the addition of winglets to the space shuttle would improve the aerodynamics of transporting it. My hypothesis was that the triangle winglet would do the best. After my winglet tests, I decided to experiment further and retested with the addition of canards to see if they would improve the performance of the winglet additions.

Methods/Materials

I built a wind tunnel and flew a small plane attached to a larger one in 8 different configurations. To confirm, I retested my original experiment and also tested 4 different winglet designs: wedge, cylinder, triangle, and rectangle. Tested configurations included combinations of top, bottom, forward, backward, upside down, and right-side-up positions for each wing configuration. I tested each configuration and wing type 5 times for a total of 200 tests. I then tested each configuration and wing type with the same canard 5 times, 200 tests, for a total of 400 tests altogether.

Results

The addition of a wedge-shaped winglet improved performance in all positions, and the wedge shaped winglet improved the top scoring position from Phase 1. However, all of the other winglets (cylinder, triangle, and rectangle) performed worse than if there was no addition. The addition of a canard improved aerodynamic performance overall.

Conclusions/Discussion

My hypothesis was completely incorrect with regards to the triangle winglet, as the position I thought would be the best ranked near the bottom of test scores. The best winglet was the wedge. Commercial planes are adding winglets; my project indicates that this is a good idea since the addition of one of the winglets was an improvement over no winglet. However, most of the winglets resulted in less aerodynamic performance, which would translate into higher fuel costs. It would be better to add no winglet if the design is not a good one. Since space travel will soon be commonplace, the fuel economy resulting from using aerodynamic science is important. The addition of a canard generally improved performance and could be added for relatively little cost.

Summary Statement

My study uses a homemade wind tunnel to determine the best, most aerodynamic winglet, or wing addition and whether a canard improves the aerodynamic performance of that winglet.

Help Received

None.

CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY

Name(s)

Andy J. Bligh

Project Number

J0105

Project Title

I Believe I Can Fly

Abstract

Objectives/Goals

The objective of my project was to determine which propeller pitch produced the most thrust in a static setting, and I believed that the steepest pitch would produce the most thrust.

Methods/Materials

Five propellers of identical brand and length, were obtained. The propellers were identical except for the pitch which varied sequentially from four to eight inch pitch. Each propeller was attached to an electric motor and the thrust was measured. This process was repeated four times for each propeller, and the results were averaged. Due to the low thrust output of the propeller, and the limited sensitivity of the scale, a test apparatus was designed to leverage up the thrust and counterbalance the weight of the motor.

Results

The propeller with the five inch pitch produced the most thrust by a large margin, while the propeller with the eight inch pitch had the lowest thrust.

Conclusions/Discussion

Propeller pitch has a great impact on thrust, and the largest pitch does not necessarily produce the most thrust. My research indicated that thrust from a propeller of a given pitch will vary with the speed of the surrounding air. Therefore, the pitch that produced the most thrust in this static test would not necessarily produce the most thrust on a moving airplane.

Summary Statement

My project is about measuring thrust of identical propellers with varying degrees of pitch.

Help Received

My grandpa sent some sources, my dad helped me interpret these sources and helped to design the apparatus.

CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY

Name(s)

Alison R. Boaz

Project Number

J0106

Project Title

Rocket Fins

Abstract

Objectives/Goals

My objective is to learn if rockets with larger or smaller fins fly the highest and are the most stable.

Methods/Materials

The materials I used were:
Balsa Wood, 8 Viking Rocket Kits, Wood Glue, Sandpaper, Scissors, Spray Paint, Spray-On Primer, Gorilla Glue, Tape Measure, X-Acto Knife,
Short Piece of Wood, 2 Small Pieces of ABS Pipe, Protractor, String, Heavy Washer, Double-Sided Tape, Tri-Pod, A8-3 ESTES Engines.

My procedure was:
1) Cut out seven sets of three's of right angled fins from balsa wood that are .5, 1, 2, 3, 4, 5, and 8 inches in height. 2) Read all of the directions for making the Viking rocket. 3) Glue the hook to tie the shock cord on to the bottom of each nose cone. 4) Mark the three places for the fins on seven of the rockets because the first one does not have fins. 5) Glue the engine stopper 6.35 cm into each rocket on the same end that the fins are marked. 6) Glue the fins on each rocket. 7) Spray primer on the rockets, and let them dry for a couple days. 8) Sand all the nose cones to make sure they are smooth all the way around. 9) Spray primer on the nose cones, and let them dry for a couple days. 10) Glue the shock cord at least one inch into each rocket. 11) Put the streamer in each rocket. 12) Spray paint on both the rockets and the nose cones, and let it dry. 13) Load all rockets with the engines and three sheets of wadding. 14) Weigh all eight of the rockets at least twice for an accurate weight. 15) Determine the center of gravity of each rocket by balancing it on the point of two large nails hammered close together into a piece of wood. 16) Measure thirty meters out from the launch pad and place the measuring device there. 17) Fly all of the rockets at least 3 times and measure the height of each rocket. 18) Record results.

Results

My results were that rocket number 5 flew the highest and was the most stable.

Conclusions/Discussion

My conclusion is that rockets with more fin surface area below the center of gravity and little or no fin surface area above the center of gravity were the most stable and flew the highest. My hypothesis was that rocket number five would fly the highest and was correct.

Summary Statement

My objective is to learn if rockets with larger or smaller fins fly the highest and are the most stable.

Help Received

Father helped me build the measuring device; Sister helped take pictures; Mother helped take pictures

CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY

Name(s)
Krishna Choudhary

Project Number
J0107

Project Title
Twinkle, Twinkle, Little Star: Turbulence in the Kitchen

Abstract

Objectives/Goals
The objective of my project is to investigate the nature of turbulence produced in heated air. The goal is to measure the properties of time variability of the refractive index distribution over the source of heat.

Methods/Materials
The turbulence was produced by a heated stove in the kitchen. The laser beam propagated through the turbulent air before focusing on a sheet of graph paper. Because of the turbulent motion of the heated air above the stoves, the laser point on the graph sheet moved from my control point. The control point was determined by the point the laser on the graph sheet, when it travelled in a straight line. I took ten second videos for each heat level with a commercial Kodak dogital camera and I reapeated the experiment three times. I determined the distance the of the laser beam from the control point on every fifth frame. The time of each frame was determined from a clock in the field of view.

Results
The distance between the laser beam and the control point increased as a function of the heat level. Within the measured range of heat, the beam displacement was nearly liner.

Conclusions/Discussion
The results of the experiment show that as the heat level increases, the refractive index of the air pockets increase. This is because the laser beam bends due to the refraction caused by heated air. Understanding the nature of air turbulence and refraction is a vital part in designing "adaptive optics" for obtaining sharp images through turbulent medium. The application of adaptive optics benifits astronomical imaging and remote sensing of earth resources from space. Such studies through turbulent water would help underground photography.

Summary Statement
My project investigates the Twinkling of Stars

Help Received
Mother helped glue the Board

CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY

Name(s)

Sophia Cooper; Nisha Husain; Haley Zarrin

Project Number

J0108

Project Title

Effect of Fins on Water Rocket Stability

Abstract

Objectives/Goals

To see what effects water rocket stability while the rocket is flying. Fins, weight, air pressure, and water-to-air ratio were examined in 3 ways: 1) using a rocket simulator from the Internet, 2)using a homemade wind tunnel, and 3) launching 76 water rockets.

Methods/Materials

First, we used an Internet water rocket simulator to launch 57, 0.5-liter water rockets. We changed the amount of water for 20 trials. Then we changed the air pressure for 20 trials. We also experimented with different gravitational forces. We determined the optimal amount of water for maximum speed and height from this experiment.

Second, we used a homemade wind tunnel to find the effect of the number of fins on a rocket's stability. We hung rockets with different numbers of fins in the wind tunnel and videotaped their movement from underneath each rocket. Then we analyzed the videotape frame-by-frame and recorded the effect of the number of fins on a rocket's stability under constant airflow.

Third, we built 22 water rockets with different numbers of fins. We launched the rockets a total of 76 times and videotaped each launch. We placed a 4.87- meter reference pole in the background of the launch field. The videotape was analyzed frame-by-frame. The reference pole in the background was used to determine the maximum speed and height of each rocket. The tape also recorded the travel pattern of each rocket.

Results

- Rockets with 50% water reached maximum velocity.
- With 50% water and 50% air, there is just enough air and water to push the rocket straight up to maximum height.
- 95.4% of rockets with higher velocity remained on flight path.
- Number of fins of rockets did not affect the rocket stability.
- Rockets with 90 PSI air pressure traveled 12m/s faster than those with 15 PSI air pressure.
- Fins have no effect at low velocity near maximum height.

Conclusions/Discussion

Fins are an important ingredient in building rockets. Because fins give rockets stability, it is important to understand the effect of fins on rocket stability. From our experimenting, we found that fins are more effective at higher velocities, and when a rocket is filled with 50% water and 50% air.

Summary Statement

The central focus of our project is to find the effect of fins on rocket stability.

Help Received

Mr. Simon Zarrin helped with the dangerous elements of our project (ei. hot glue gun, pressurizing rocket with air.)

CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY

Name(s)
Katie G. Eberle

Project Number
J0109

Project Title
The Study of Sails

Abstract

Objectives/Goals
The objective is to determine, for a fixed surface area, what sail shape, a triangle, square, rectangle or trapezoid will produce the fastest run for a "Land Yacht."

Methods/Materials
A Land Yacht was constructed using a common skateboard, a PVC mast, a wood-dowel boom and window cord. Four sails, all with areas of 400-square inches were cut out of 2-mil plastic. A 7-foot long test course was set up on a smooth concrete floor inside an enclosed building. A fixed fan was used to produce a constant wind. The yacht was run 5 times with each sail shape and each run was timed. The high and low times were dropped and the remaining 3 were averaged.

Results
The yacht with the trapezoid shaped sail travelled across the test course in the fastest time.

Conclusions/Discussion
I concluded that the shape of a sail affects the speed of a vessel going down wind. However, I wondered why most sail boats have triangular sails. I think that a triangular sail must be easier to handle than a trapezoid sail. Also, a triangular sail must make it easier to maneuver a boat in real life where there are cross winds and head winds. An optimum sail is one that gives a vessel both speed and maneuverability.

Summary Statement
My project is about determining if sail shape affects a vessel's speed.

Help Received
My mother helped me buy material, build the yacht, run the fan during the testing and type the report.

CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY

Name(s)
Bryan Faber; Colin Mackenzie

Project Number
J0110

Project Title
Streamer Dimensions and Their Effect on a Rocket's Descent

Abstract

Objectives/Goals
Our question was: How do the different dimensions of rectangular streamers all with the same area affect how long it takes for the rocket to fall?
We thought that if a streamer was longer, there would be a longer line of streamer to slap the air, therefore slowing the rocket down effectively.

Methods/Materials
First, we made (out of regular garbage bag plastic) 5 different streamers (40cm x 40cm, 200cm x 8cm, 320cm x 5cm, 400cm x 4cm, 800cm x 2cm). All of the streamers had an area of 1600 square centimeters. Then we put the 40 x 40 streamer into the rocket and launched the rocket THREE times in a row. We recorded how long it took for the rocket to fall once the streamer had deployed. Then we repeated step 2 and 3 with the 200 x 8, 320 x 5, 400x 4, and 800 x 2 streamers. We then analyzed the data to determine which streamer slowed the rocket down the most.

Results
Here are the times (in seconds) with the streamer dimensions (in centimeters): 160x10 took 18.96, 18.75, 18.96 (average time = 18.89), 80x20 took 19.24, 19.43, 20.18 (average time = 19.62), 64x25 took 20.54, 24.36, 23.93 (average time = 22.94), 50x32 took 22.65, 22.35, 20.34 (average time = 21.78), and 40x40 took 19.06, 25.45, and 19.38 (average time = 21.3).

Conclusions/Discussion
We found that as the streamers became shorter and wider, overall they slowed down the rocket more effectively, but they also became more unstable and unpredictable, and the range in falling times varied immensely. These results were the opposite of what we predicted in our hypothesis, in which we thought the long and skinny streamers would be the most effective in slowing down a rocket.

Summary Statement
We investigated how the different dimensions of rectangular streamers, all with the same area, affected how long it took for a rocket to fall.

Help Received
Parent assisted by paying for materials, taking photographs, and supervising safety.

Name(s)

Stewart Farley; Greg Kahn

Project Number

J0111

Project Title

Laminar vs. Turbulent

Abstract

Objectives/Goals

This experiment tests whether wind turbines should be placed in laminar or turbulent flow. Laminar flow is a straight, sequenced type of wind while turbulent flow moves erratically.

Methods/Materials

To test this, a wind tunnel was built to provide a controlled environment for a miniature wind turbine to test how much energy it produces in laminar and turbulent flows.

Results

During the experiment, the wind turbine produced more energy in laminar flow than in turbulent flow. There was a significant difference between them: 8.7%. This experiment supports the idea that wind turbines should be put in level, flat places that produce laminar flow.

Conclusions/Discussion

This could greatly increase the efficiency of wind turbines. Since current wind turbines have only a 40 to 60 percent energy efficiency rate right now, this result could have a large impact on wind turbine placement and use.

Summary Statement

This project tests whether wind turbines should be put in laminar or turbulent flow for maximum energy output.

Help Received

Father helped with some ideas and handy work on the wind tunnel.

CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY

Name(s)

David K. Fleming

Project Number

J0112

Project Title

Stoked about Stokes

Abstract

Objectives/Goals

The objective of my project is to determine which liquid, corn syrup or glycerin, is the most viscous. I also want to see how temperature affects the viscosity of these liquids. Lastly, I want to see, using my experimental method and data, if Stokes Law can be computed to determine the viscosity of glycerin.

Methods/Materials

My experimental method was to drop 10 steel marbles, of 2 different diameters and weights, into two 61-cm high tubes containing 1100ml. of each of the 2 liquids: corn syrup and glycerin. Testing at 3 different temperatures, 14, 19, and 30 degrees Celcius, I timed the descent of the marbles as they dropped 40 cm through the liquids.

Results

My results clearly show that corn syrup was more viscous than glycerin because both sizes of steel marbles had a lower velocity in corn syrup than in glycerin. As the temperature became cooler, each of the liquids became more viscous. The velocity of the marbles increased in the higher temperature and decreased in the lower temperature. Lastle, I was able to compute the viscosity of glycerin, using my experimental method and data, and a modified version of Stokes Law.

Conclusions/Discussion

My results show that corn syrup is more viscous than glycerin because the steel marbles had a lower velocity in corn syrup than in glycerin at all 3 temperatures tested. Also, modifying the temperature did affect viscosity as the velocity of the marbles decreased as the temperature became cooler, showing an increase in viscosity. Lastly, using my experimental method and data, I saw that Stokes Law could be computed to determine the viscosity of glycerin. My result differed slightly from the known viscosity of glycerin at 20 degrees Celcius, possibly due to the fact that I used my data which was tested at 19 degrees Celcius.

Summary Statement

This project is a comparison of the viscosity of corn syrup and glycerin, evaluating the variation in velocity, using 3 different temperatures, of 2 different sizes of steel marbles as they are dropped through the liquids in a cylinder.

Help Received

Dad helped me with Stokes Law, Mom helped me to edit my writing, and my brothers and sister helped with graphs and glueing.

CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY

Name(s)

Lindsay Gilliland; Allison Martin

Project Number

J0113

Project Title

Measuring the Effect of Aerodynamic Design on Vehicular Drag

Abstract

Objectives/Goals

Measure and compare the effect of wind drag at three different speeds on model cars with three different shapes. In addition, to design a wind tunnel which would be able to precisely measure that drag without adding any more factors due to the testing method itself.

Methods/Materials

Create a verticle windtunnel using a 5'4" apparatus to hold it in place. You can use two vinyle flower pots to funnel the wind from the 5 bladed house fan to the tunnel. On the shelf over the opening of the tunnel, we put the scale, and attatched a string tied to the vehicles to under the plate. As we turned on the wind, the vehicle would get lighter and then we subtracted the new weight from the original weight and this will give you the drag of that velosity of wind. Repete untill you are through with the different velosities.

Results

The Viper, our most streamlined vehicle, as expected, did have the least amount of drag of all three vehicles. Next, the Ford pickup truck that we used to test if the bed was a factor, and last, the Jeep Cherokee which was indeed our most air resistant vehicle.

Conclusions/Discussion

Just as we hypothesized, there was a significant difference between the vehicles, with the more streamed vehicle, the Viper, having the least amount of drag. The percentage of drag increased (Pickup +80%, and Jeep +120%) as the vehicle design was less aerodynamic. Drag is becoming an increasingly important factor in getting better mileage, especially with today's rising cost of fuel.

Summary Statement

We measured the effect of aerodynamic design on vehicular drag using a unique way to isolate drag from other forces and to eliminate most other error factors.

Help Received

Allison's dad helped us obtain certain materials and advised us on how we could apply the wind source to the vehicles in an upright position. He also helped us with the tools to build our wind tunnel system.

CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY

Name(s)

James R. Hepler

Project Number

J0114

Project Title

"Arrow"dynamics

Abstract

Objectives/Goals

I undertook this project to determine which combination of fletch and arrowhead provides the most stability to the arrow, thus making it the most accurate.

Methods/Materials

I made 8 arrows for each of the following 4 fletch types: 12.5 cm Pope and Young, 12.5 cm shield, 10.0 cm parabolic, and 7.5 cm parabolic. The 8 arrows of each fletch type were fitted with 6.5 g arrowheads (which were later removed and replaced with 11.3 g arrowheads). The arrows of each fletch type were then randomly divided into 2 groups of 4. Each group was fired from a 15.9 kg (35 lb.) draw weight longbow at a 40 cm-wide target from a distance of 18.3 m. The group sizes (distances between the 2 widest shots) were measured individually with a cm ruler. The two groups of four arrows were then mixed and again randomly divided into 2 groups of four. This process was the same for every combination of fletch and arrowhead. Twenty-five groups of four arrows each, and therefore a total of 100 arrows, were fired, measured, and recorded for each of the 8 combinations of fletch and arrow type (a total of 800 arrows).

Results

The results of my experiment were as follows: the 12.5 cm Pope and Young fletches, with both types of arrowheads, had smaller group sizes than all the other combinations. The 12.5 cm shield fletches had the next smallest group sizes, then the 10 cm parabolic fletches, which were followed closely by the 7.5 cm parabolic fletches.

Conclusions/Discussion

I conclude that Pope and Young fletches, the largest, provided the optimum in stability and precision, most noticeably with the lightweight 6.5 g arrowheads. The smaller fletches did not do nearly as well as the Pope and Young, although the difference was less pronounced with the heavier arrowheads. The Pope and Young type of fletch is not commonly used today; I believe that this is so because its shape, with its setback rear, makes a whirring sound as it rotates in flight, making it less desirable for hunting. Target archers do not commonly use this fletch, but I believe they should. As a result of my findings in this experiment, I will use my arrows with 6.5 g arrowheads with Pope and Young fletches in my future archery tournaments.

Summary Statement

I tested 8 different types of arrows to determine which is the most accurate.

Help Received

Father provided transportation to the archery range and supervised the shooting. Mother helped set up display board.

Name(s)

Robert C. Hollar

Project Number

J0115

Project Title

Hovercraft Design

Abstract

Objectives/Goals

The objective of the project was to design and build a hovercraft capable of carrying a load of 10 kg (22 lbs.)

Methods/Materials

Materials:
Electric Model Aircraft motor with propeller and radio controller, gel cell battery, pvc plastice sheets, abs plastic pipe, rubber adapter boot, bicycle inner tube, anemometer, hand-built mamometer, and tachometer.

Method:
1) Build test apperatus using the abs pipe, manometer, and anemometer;
2) Build engine assemby with motor, propeller, and rubber boot;
3) Conduct design tests measuring air pressure and speed at specific combinations of motor speeds and flow constrictions;
4) Tabulate and plot results of design tests;
5) Design and construct a hovercraft based on the results of the design test;
6) Conduct initial test flight;
7) Modify hovercraft design based on initial test flight; and
8) Conduct final flight test.

Results

The design test suggested that a hovercraft with a body 52 cm in diameter would carry a load of 10 kg using the model aircraft motor and propeller. Therefore a hovercraft body was built to these specifications and tested with the design load.

Conclusions/Discussion

The hovercraft successfully lifted the design load of 10 kg. However, significant force was required to move the hovercraft horizontally. It appears that air escaping from under the hovercraft acts as a lubricant and is necessary for it to move easily. The motor could create sufficient pressure to lift the load when only a small volume of air was escaping. Better results could have been optained if the hovercraft had not been designed near its maximum capabilites.

Summary Statement

The purpose of the project was to design and build a hovercraft using engineering data.

Help Received

My father discussed various aspects of the project and supervised the testing and construction.

CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY

Name(s)

Hannah Ann Jack

Project Number

J0116

Project Title

Moving Weight and Airplane Flight

Abstract

Objectives/Goals

Determine if adding weight and moving it along the fuselage will change an airplane's flight distance and stall height.

Methods/Materials

METHODS: Prepare test area without wind currents(garage), test equipment - launch pad, glider, paper clip, rubber band, tape measure. Conduct flights with weight at different places on fuselage. Measure where each flight ended. Test each weight position three times and record data.

MATERIALS: Balsa wood glider, rubber bands, measuring tape, ply wood launching pad, foot stool under launching pad, garage with no wind, paper clip for weight, pencil, note paper, marker, two nails, hammer, clamp.

Results

Position of weight on fuselage (flight in cm)

Mean Median Range

X 270 272 19

A 240 246 52

B 254 251 40

C 242 252 60

D 231 234 32

E 209 211 29

F 205 200 14

Conclusions/Discussion

I found out:

1. Adding weight to an airplane changes the way it flies.
2. More weight caused airplane to fly shorter distances and not as high.
3. When we had weight on the nose, plane flew longest distances. When weight was toward the tail, airplane flew shorter distances.

My data showed:

1. The plane flew the farthest when there was no weight on the plane. The mean distance was 270 inches.
2. As we moved the weight from the nose to the tail, the plane flew shorter distances. Mean distance when the weight was on the nose was 240 inches. Mean distance with the weight toward the tail was 205 inches.

Summary Statement

What effect does weight (its placement along the length of the fuselage) have on an airplane's flight distance and stall height?

Help Received

My dad helped me type, find information, take pictures, set up and test.

Name(s)

Zachary B. Jones

Project Number

J0117

Project Title

Does Barometric Pressure Affect the Velocity of a Lacrosse Ball?

Abstract

Objectives/Goals

The purpose of this experiment is to learn if a lacrosse ball will go faster at a higher altitude due to the low barometric pressure. The experimenter also might be able to increase the velocity of the lacrosse ball in some way to help improve lacrosse players throw. One other great reason to look into this area is if you love lacrosse or weather. If the reader enjoys lacrosse this experiment can be a fun activity that can be done on free time. This experiment can be fun, exciting, and can help the experimenter#s understanding of the sport and barometric pressure. This is why this experiment is such a wonderful topic.

Methods/Materials

This experiment required a machine that would launch the lacrosse balls. The lacrosse balls were launched 150 times and the hang-time and distance each lacrosse ball had was recorded. The lacrosse balls were launched at three different test locations approximately 3 inHg more than the next. Using the hang-time and distance the experimenter found out their speeds. The speeds were compared to see which location the lacrosse ball traveled the fastest.

Results

Two different measurements were used to calculate the velocity of the lacrosse ball. The two measurements were time and distance. In the Red-Tailed Roost Volunteer Center parking lot the lacrosse ball traveled in the air for an average of 1.65 seconds. In Dudley#s Bakery parking lot the ball traveled an average of 1.49 seconds in the air. At the Red-Tailed Roost Volunteer Center parking lot the lacrosse ball traveled an average distance of 89 feet. In the Dudley#s Bakery parking lot the lacrosse ball traveled an average of 85 feet. The average velocity at the Red-Tailed Roost Volunteer Center parking lot was 54.4 feet per second. At the Dudley#s Bakery parking lot the average velocity was 56.9 feet per second.

Conclusions/Discussion

This experiment did not support the hypothesis. The hypothesis for this experiment was that the lacrosse ball will travel three feet per seconds faster in three inches less of barometric pressure. The data shows that the lacrosse ball traveled an average of 2.5 feet per seconds faster at the higher barometric pressure of 26.96 inches. Although the lacrosse ball traveled faster at the high barometric pressure level, the lacrosse ball had more hang-time and distance at the low barometric pressure level.

Summary Statement

This project is on how a lacrosse ball flying through the air is affected by barometric pressure.

Help Received

Father helped with dangerous tools and launching; Mother helped with layout of board

CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY

Name(s)
E. McKenzie Kipe

Project Number
J0118

Project Title
Any Way the Wind Blows!

Abstract

Objectives/Goals
The objective of my project was to determine which degree of pitch combined with which number of blades on a propeller is optimum for producing the maximum power from a model wind turbine.

Methods/Materials
In total, nine model propellers were obtained, three two-bladed propellers, three three-bladed propellers, and three four-bladed propellers. Each set of the two, three, and four bladed propellers had three different angles of pitch, 4#, 6#, and 8#. A wind tunnel was constructed out of Plexiglas and wood, and a model turbine was constructed to fit inside the tunnel. Each of the combinations of pitch and blade number were bolted onto the model apparatus one at a time and tested for maximum energy production from wind using an industrial fan as the source. The highest number of amps were then recorded and all reached their highest number of amps within ten seconds. This process was repeated until all of the propellers were tested. Each propeller was tested two or three times in order to insure that each propeller had consistent results.

Results
The three-bladed propeller combined with the 4# pitch produced the highest amount of amps and therefore produced the most energy.

Conclusions/Discussion
My conclusion is that a three-bladed propeller combined with a pitch close to 4# will produce the most energy if applied to backyard wind turbines today and will ultimately lower the electricity prices of most electrical bills for families.

Summary Statement
My project is about determining the most efficient blade construction for a wind turbine.

Help Received
Father helped build the apparatus

CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY

Name(s)

Nicole L. Larsen

Project Number

J0119

Project Title

Aerodynamics of Projectiles Through a Liquid Medium

Abstract

Objectives/Goals

The purpose of this project was to see which shape (circle, triangle, or square) would travel the farthest distance when propelled through water.

Methods/Materials

The procedure included making a 121.92 centimeter long box lined with plastic to hold the water. Two holes were drilled on one side of the box and one on the other to attach two hooks and plastic tubing. The plastic tubing was fastened to an air compressor that launched the projectile through the water. The three shapes of the projectiles were a circle, labeled S1, a triangle, labeled S2, and a square, labeled S3. Each projectile was propelled through water using the air compressor six times and measurements of the distance were taken after each test.

Results

The average measurement for the circular projectile, S1, was 95.9 centimeters. The average measurement for the triangular projectile, S2, was 79.8 centimeters. The average measurement for the square projectile, S3, was 80.6 centimeters.

Conclusions/Discussion

It was concluded that the circular projectile traveled the farthest, which supports the hypothesis.

Summary Statement

This project is testing whether the shape of an object will affect how far it traveled in water.

Help Received

Mom helped proofread report; Dad helped perform procedure; Uncle helped with research; Teacher gave ideas to improve project.

Name(s)

James P. McClean

Project Number

J0120

Project Title

Propelling Numbers

Abstract

Objectives/Goals

To show that by increasing the pitch of a propeller it will generate more thrust, while at the same time less RPM, and draw more power.

Methods/Materials

I used four different 9-inch propellers, an electric motor, tachometer, watt meter and I built a test stand for measuring thrust.

Results

I found that everything had gone according to my hypothesis. As the pitch of the propeller was increased, the thrust generated increased, maximum RPM achieved dropped and power drawn from the battery increased.

Conclusions/Discussion

Through my experiment I learned that the reason thrust goes up and RPM goes down as pitch is increased is because the high, or course-pitched propeller has to push more air. This also causes the motor to work harder which in turn pulls more power from the battery.

Summary Statement

My project is about how changing pitch effects propeller performance.

Help Received

My dad helped me cut the wood for my test stand and supervised the tests.

Name(s)

Daniel C. Moyer

Project Number

J0121

Project Title

Winging It: A Study of Wind-Powered Nautical Propulsion Systems

Abstract

Objectives/Goals

This research paper, experiment and analysis is on the efficiency of an airfoil being employed to push a boat using lift compared to that of a lateen sail. It#s purpose is to prove whether or not a wing employed as a way of propelling a boat across the wind is more efficient than using a traditional lateen sail. The researcher's hypothesis is that the wing will be at least 10% better than the lateen sail.

Methods/Materials

Basic construction materials were obtained and a 10x1x1-foot trough capable of holding upwards of 500 pounds of water was built. A 1-foot long balsa wood boat was constructed and also from those same materials was built a wing and a sail to test on the model boat that was built. After 20 trials each it was determined that another wing and sail set would have to be built and the boat given a larger keel and rudder to keep it on course. 20 more trials were made for all four wings and sails at a higher wind speed using the modified boat.

Results

The second wing was proven more effective by 11% over the second sail and by 20% over the first sail. The first wing was within the standard deviation for the second sail but was more effective than the first sail at the higher windspeed.

Conclusions/Discussion

The researcher's hypothesis was proven correct with a wide margin for the 2nd wing and, to a lesser extent, because of standard deviation, the original wing.

Summary Statement

This is a comparison between the efficiency of an air foil and a traditional lateen sail while sailing across the wind.

Help Received

Former Science Teacher taught how to make model boats in his class and loaned his laser timer. Father helped build the trough.

CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY

Name(s)

Michael A. Raynis

Project Number

J0122

Project Title

Extreme Frisbee: Thrust, Angle, and Rate of Spin vs. Frisbee Flight Tendencies

Abstract

Objectives/Goals

The purpose of this experiment was to determine the effect of rate of spin, thrust, and launch angle on a Frisbee's flight tendencies.

Methods/Materials

This experiment requires the construction of two launchers. One that will launch Frisbees at several variable rates and another that can launch Frisbees at two different angle, thrusts, and spin rates. Besides the materials used in the construction of the launcher, the materials for this experiment include a 150g Frisbee, an electric Dremel, 12 inch (366 cm) tape measure, masking tape, fluorescent tape, chalk, a stopwatch, a metric measuring wheel, and a metric spring scale.

The first part of this experiment involves the use of Launcher A to launch the Frisbees at these different variable spin rates: 0, 5, 10, 30, 60, 100, 300, 600, 1000 RPMs. For each rate of spin, Launch the Frisbees 5 times and record each distance from the Launcher. The second part of this experiment involves the use of Launcher B to launch the Frisbees at a 9.58 kg or 16.75 kg of thrust, a 10 or 20 degree angle, and any fast or slow spin rate. Launch the Frisbees twelve times to test the effect of each of these variable pairs while controlling the other variables. Record each distance from the Launcher and analyze the data.

Results

When the Frisbees were launched at different angles, a 10 degree angle would make it go farther than a 25 degree angle (44.3m vs 34.6m). When the effect of thrust was tested a 16.75 kg thrust made Frisbees go farther than a 9.58 kg thrust (48.3m vs 34.7m). When the effect of spin rate was tested, a fast spin rate made Frisbees go farther than a slow spin rate (47.9m vs 23.9m).

Conclusions/Discussion

The experiment demonstrates that if either the rate of spin or thrust of a Frisbee is increased, it will fly farther, but if the launch angle is increased it will not fly farther. Aside from the data gathered from this experiment, research provided valuable information about the significance of the design of a Frisbee. Using both research and data, a new, more effective Frisbee design can be proposed. It involves a light-weight Frisbee with a heavy metal ring along its inner rim. This would direct all the force of a launch or throw to the Frisbee's angular momentum, making it go farther than a normal Frisbee.

Summary Statement

The project demonstrates the effects of thrust, angle, and spin rate on a Frisbee's flight characteristics.

Help Received

Father assisted when using power tools; Instructor, Mr. Saramosing assisted with editing and revision; Younger brother assisted with gathering data.

CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY

Name(s)
Annie M. Robison

Project Number
J0123

Project Title
A Weir-d Project

Abstract

Objectives/Goals
The purpose of my project was to confirm that the weir equation that relates water height or stage above an obstruction to stream flow in a rectangular stream channel is adequate. Furthermore, I wanted to find out just how accurate the weir coefficient of 0.465 is.

Methods/Materials
A stream model was constructed. To find the amount of discharge for different undetermined flow settings on my pump, I operated eight runs in which I measured the volume of water coming from the stream and divided it by the amount of time it took. I then substituted values in the weir equation for each of the eight runs I did to find the discharge according to that equation. The different flow measurements of the model and the equation were compared. I then back calculated my results for each run to find what the coefficient would be if my results were without error.

Results
The difference between the calculated discharge using the timed bucket method and using the weir equation ranged from 0.3 # 25.6 cubic centimeters per second. The timed bucket flows ranged from 114.4 # 376.1 and the calculated discharges of the equation ranged from 114.1 # 351.5. Furthermore the relationship between the weir equation and the timed bucket almost fit a one to one relationship with regression analysis giving an equation of $y = 0.9533x$ with an r squared of 0.9986. If the calculated discharges of the model were exact, the coefficient would range from 0.466 # 0.497, but, as I said, my calculated model discharges were slightly off.

Conclusions/Discussion
My results show that this weir equation is a sufficient representation of the discharge of a stream and the weir coefficient 0.465 is accurate. Because I was unable to take absolutely precise measurements of the water in each of the runs, the calculated discharge of the model was slightly different than that of the equation and the weir coefficient altered somewhat when I back calculated. However, it was an insubstantial variation and it is obvious that the weir equation can be relied on to take accurate flow measurements and the weir coefficient of 0.465 is adequate.

Summary Statement
In my project, I tested a weir equation for its accuracy measuring stream flow.

Help Received
My dad helped me learn the statistics; My mom helped me build the model.

CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY

Name(s)

Corinne Rockoff

Project Number

J0124

Project Title

Which Type of Roof Survives Hurricane Winds Best?

Abstract

Objectives/Goals

My objective in this project was to find out how roofs of different types react to winds of hurricane caliber. Mainly, in doing this project, I hoped to find a solution to one of the problems that arose in recent hurricanes, that of roofs acting almost like airplane wings and lifting straight off the houses, causing unparalleled destruction.

Methods/Materials

To test this project, I constructed an elliptical tank with a center divider from wood, plastic sheeting, and plexi-glass, and installed a pond pump, creating a circular flow. In this flow, I placed five model roofs. I placed oatmeal in the water and recorded the flow of the oatmeal around the houses, observing apparent areas of high and low pressure.

Results

I quantified my data by counting the number of pieces of oatmeal in certain areas prone to low pressure observed in frames of video taken of the experiment. These results averaged with the shed roof being best with an average of 71/3, then Mansard roof with 9 1/3, Gambrel roof with 12, Gable roof with 12 1/2, and finally Hip roof with 15 2/3 average. These results correlate with my observations of eddies and whorls in the tank, suggesting that the shed roof, if correctly oriented, may be the best at surviving hurricane strength winds.

Conclusions/Discussion

Although other factors such as its structural strength must be taken into consideration, I concluded that due to its low number of surfaces and lack of a curve that might invoke Bernoulli's priniciple to create low pressure, the shed roof is, if properly oriented, the best at withstanding hurricane winds.

Summary Statement

My project explores which type of roof best withstands hurricane winds, using hydrodynamics to illustrate aerodynamic properties.

Help Received

My father and Steve Wasserman helped operate power tools used in building tank; Mother assisted with videography; The Anchor boat shop, Reseda bike shop and Margy Rockoff all donated materials.

CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY

Name(s)

Madigan J. Stehly

Project Number

J0125

Project Title

Bubbles or Buoyancy

Abstract

Objectives/Goals

My project was designed to test the effect of gas bubbles on the density of water. I obtained my idea from a television show I watched about the Bermuda Triangle. One of the theories of how ships sank in the Bermuda Triangle is methane hydrates, or methane gas eruptions, decrease the density of water so that a once buoyant ship becomes a sinking metal rock. By the time the bubbles are gone, the boat is too deep to surface. I wanted to see if other gases, besides methane, could also cause an object to sink.

Methods/Materials

Methods: I built a bubble manifold out of PVC pipe to fit on the bottom of a fish tank. I then connected different gas tanks to a valve system connected to the manifold. After I filled the tank with 30L of water, I placed a full 237mL water bottle in the tank. I let the gas flow at 600 kilopascals (kPa) for 15 seconds and recorded the depth.

Materials: fish tank;safety goggles;one tank each of carbon dioxide, welding grade oxygen,acetylene,and propane;air compressor;water bottles;air hoses;pieces to make bubble manifold;pieces to make valve system.

Results

The water bottle did not stay at any certain depth for very long; therefore I did the best I could to accurately measure how deep the bottle sank after 15 seconds. In my experiment, compressed air bubbles, my control, caused the bottle to sink to an average depth of 13cm. Carbon dioxide bubbles caused the bottle to sink to an average depth 11cm. Oxygen bubbles caused the bottle to sink to an average depth of 14cm. Acetylene bubbles caused the bottle to sink to an average depth of 9cm. The propane gas did not produce enough bubbles to cause the bottle to sink.

Conclusions/Discussion

From the data, it is evident that the oxygen caused the bottle to sink the deepest. It sank to an average depth of 14cm. Compressed air caused the bottle to sink to an average depth of 13cm. These two show it is hard to tell whether it was a specific type of gas bubble that affected the density of the water, or if gas bubbles, in general, contributed to the sinking of the bottle. If this project had been done in a more condensed container, the bubbles would have less area to disperse in, and the cloud of bubbles would therefore become denser. It would also increase the pressure of bubbles coming from the PVC pipe at the bottom. With less area of pipe, the gas can generate more pressure and force out more bubbles to create an even denser cloud of bubbles.

Summary Statement

Based on one of the theories about the Bermuda Triangle, my project is about how different types of gas bubble eruptions in water affect the buoyancy of an object.

Help Received

My dad helped me purchase the right parts, build the correct valve system and supplied me with the gases I needed; My mom edited my writing and also helped me with converting my measurements from standard to metric form.

CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY

Name(s)

Hanna M. Vincent

Project Number

J0126

Project Title

Forces on the Sails of a Club Flying Junior

Abstract

Objectives/Goals

To compare the forces on the Main sail and Jib sail of a CFJ sail boat in different wind conditions and directions to see if the forces are consistently proportionally to the difference in the surface area of the two sails.

Methods/Materials

A CFJ One-Design Sail Boat, with standard rigging: mainsail, jib, and sheets.
-Force Meter (SHIMPO digital force meter, Model #FGE-20X)
-Wind Speed Meter (Skymate Speedtech SM-18, digital wind speed gauge)
-Open space in Santa Barbara harbor for data collection, with adequate wind.

Wind speed was measured and recorded just before each run. The force meter was connected to the end of the Main Sheet (line) or Jib Sheet and the force in pounds was recorded for each reading, as many times as possible before running out of room in the harbor.

Results

Force on the main remained constantly more than that on the jib and there was always more force on both sails when there was more wind. The main sail had about 7.4 times more force than the jib when going downwind at about 6.5 knots. The mainsail had about 3.3 times more force than the jib when going upwind at about 6 knots. Therefore, the difference in force between the mainsail and jib is not proportional to their surface areas, and differs in different conditions.

Conclusions/Discussion

Upwind forces were always considerably larger than downwind. This is because when a sailboat is going straight downwind, it cannot go faster than the wind because the wind is pushing it. As the boat goes faster, and closer to the speed of the wind, the pressure on the sail from the wind begins to diminish because the forward and backward forces begin to equal each other. This, along with friction between blocks, may have resulted in an inaccuracy of testing. Downwind testing was surely influenced by many variables (oscillating and shifty winds, swells, currents, and measurement variables with the line and force gauge). However, under the circumstances, testing was as accurate as possible. Future testing should include collecting more data in many different conditions. This would help reduce at least the wind variable. Otherwise, testing would have to be conducted in a more controlled way, perhaps with a model sailboat in an indoor pool with fans to create winds at constant speeds.

Summary Statement

Does the Main or Jib sail of a Club Flying Junior sail boat produce more force, and are the forces proportional to their size in different sailing conditions?

Help Received

Father helped collect data in the boat, took pictures, and helped me format the data tables and graph.

CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY

Name(s)

Ian N. Zell

Project Number

J0127

Project Title

Egg Survival: Optimizing the Blade Camber of a Free-Falling Rotor

Abstract

Objectives/Goals

My objective for this project was to see if I could slow a free-falling object safely to the ground using only drag, by optimizing the blade camber of propellor wings. I believe that there is a blade camber that will maximize the descent time and number of propellor spins.

Methods/Materials

I dropped a 4-bladed rotor device from two different heights, multiple times. This device had blades that could be folded at different angles. The diameter of the propellor wings, the weight, the number of blades, the dropping method, the air humidity and wind were all kept constant. I took data on how blade fold angle changes the descent time and the number of spins. The descent time was measured with a stopwatch and the number of spins was measured by slow motion playback of video.

Results

The blade fold angle of 45 degrees always maximized the descent time and the number of spins. All of the other angles resulted in faster descents and less spins.

Conclusions/Discussion

My conclusion is that the blade camber can change the descent time and number of spins of a carefully constructed device. My hypothesis of an optimimum blade camber was supported by the data.

Summary Statement

My project is about optimizing the blade camber of a free-falling rotor.

Help Received

Dad helped me gather materials and conduct the drop test. I also received information from interviews of two NASA engineers.

CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY

Name(s)

Zachary R. Zuniga

Project Number

J0128

Project Title

Cylinder vs. Blade: An Experiment Using Rotating Cylinders and Stationary Blades to Generate Lift

Abstract

Objectives/Goals

The objective of my project is to determine how much lift a rotating cylinder generates when compared to an airplane propeller and a helicopter blade. I predict that the rotating cylinder will generate as much lift as the blade and the propeller, but do better at low wind speeds.

Methods/Materials

To test this, I built an apparatus that rotated a cylinder in an air stream. The amount of lift was measured with a load cell, the angular velocity of the cylinder was measured with a tachometer and the wind speed was measured with an anemometer. The wind was generated by a leaf blower. For comparison, I tested a toy helicopter blade and radio-controlled airplane propeller using the same apparatus, except they were stationary.

Results

I found that the cylinder generated significantly more lift than the propeller or blade per unit length. Despite this, the cylinder did not generate as much lift as predicted by the Magnus Effect equations.

Conclusions/Discussion

In conclusion, a rotating cylinder is a potential mechanism for generating lift, and future projects could look into making wind turbines with cylindrical blades.

Summary Statement

My project tests the lift generated by a rotating cylinder in an air flow when compared to a stationary blade and a stationary propeller.

Help Received

Mother helped edit my report; Father helped edit report, obtain parts and troubleshoot apparatus; Thomas Zimmerman helped think of ideas; Lisé Whitfield helped edit report and fromat project

CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY

Name(s)

Laurel A. Kroo

Project Number

J0199

Project Title

A Fuel Cell Powered Underwater Glider for Marine Exploration

Abstract

Objectives/Goals

Underwater gliders are used for subsurface mapping, underwater scanning for the Navy, and other environmental purposes. Currently, these gliders are propelled by buoyancy engines that expand and compress air. The glider moves forward as it sinks and when the buoyancy is increased, it glides forward as it floats upward. The main problem with these gliders is that they have poor efficiency - about 12%. My goal is to radically improve the efficiency of underwater gliders by replacing the typical buoyancy engine with a reversible hydrogen and oxygen fuel cell, and changing the external design to minimize drag, and to accommodate this new engine. Other advantages of using a fuel cell are that it has no moving parts, and water for the fuel cell is always available.

Methods/Materials

The first step in the design of a new glider was to develop a new fuel cell buoyancy engine. I started with a fuel cell and modified it by capturing the gases using the electrolysis process. The fuel cell changes the water into oxygen and hydrogen gases (using energy from the batteries), making the craft more buoyant. Once the device reaches the surface, the fuel cell switches directions, combining the hydrogen and oxygen and making the craft sink. The process is repeated. I designed, built and tested several versions of this new buoyancy engine. The second step was designing an underwater glider. I designed a glider to work with my buoyancy engine, calculated the required buoyancy for the craft to go at different speeds, and compared the drag of this craft to three current gliders (Spray, Seaglider, and Slocum). In this process I learned many things about aerodynamics like drag area, skin friction coefficients, Reynolds numbers, and laminar versus turbulent flow.

Results

I calculated the efficiency of my new buoyancy engine, and the needed buoyancy for specific speeds of the craft. Current gliders are 12-15% efficient, where the fuel cell is about 75% efficient in electrolysis, and 51% efficient when producing water and electricity. Because of the new buoyancy engine, and of the new external design this glider could double or triple the time underwater gliders can stay at sea.

Conclusions/Discussion

Fuel cell powered underwater gliders could greatly contribute to ocean exploration and provide new research opportunities. My project could lead to a powerful tool to make advances into the ocean's vast unexplored depths.

Summary Statement

In summary, I have built a fuel cell buoyancy engine, designed and analyzed an underwater glider, and demonstrated that fuel cells would greatly benefit these highly efficient aquatic vehicles.

Help Received

My mother helped me paste together my board. My father told me about underwater gliders, helped with the assembly of prototypes in situations with dangerous tools and/or substances, and talked with me about my design ideas.