CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)

Andrew A. Asper

Project Number

J0101

Project Title

What Variables Are Needed to Efficiently Produce the Most Electrical Output from a Darrieus Vertical Axis Wind Turbine?

Abstract

Objectives/Goals

My objective was to determine which design and angle of blades produces the most electrical output from a Darrieus vertical axis wind turbine, using 2, 3, or 4 blades. I believe that blade style #4 rounded front edge tapering to a thin point, at an angle of 90 degrees with 4 blades, will produce the most electricity.

Methods/Materials

First, I designed and built my own Darrieus vertical axis model. Then I made hubs for the blade mounts and made sure the mounts were drilled at 15, 45, and 90 degrees (the angles being tested). Next, I made a template of 4 different blade designs in order to shape my balsa wood blades to the specific design. The blades were then sanded and weighed. After that, I designed and built my own wind tunnel for testing the turbine. I tested using a fan for the wind power. I recorded the amount of electricity produced by using a voltmeter wired to a motor on the tower of the wind turbine, and I also tested the RPM. I ran 3 trials for each blade style, angle and number of blades to insure accuracy of results.

Results

The 2 blade, style #2-rounded front edge with a concave underside, tapering to a thin point, at an angle of 90 degrees was the most efficient at producing electricity. Blade style #4 (described in my objective) produced the most electricity overall (between all tests involving that style). The unmodified blade style #3 was the worst overall at producing electricity.

Conclusions/Discussion

My conclusion is that blade style needs to be aerodynamic in order to produce the greatest amount of lift, which is necessary to generate electricity. Also, the data suggests that engineers need to find the best combination of variables that work together to produce the most amount of lift and the least amount of drag, in order to efficiently produce the most electricity. Perhaps engineers/scientists should investigate my #2 blade design as well. The answer to the energy crisis isn't blowing in the wind. It is the wind.

Summary Statement

My project is about trying to determine which variables will efficiently produce the most electrical output from a Darrieus vertical axis wind turbine in an effort to harness the wind's power.

Help Received

My dad let me use his equipment , mom proofread my report , and my sister took the photographs. I also had an engineering student from Dolhousie University give me a few suggestions by e-mail. Finally, I had the encouragement and support of two middle school science teachers.

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)

Matthew J.H. Brokate

Project Number

J0102

Project Title

Ready... Aim... Fire!

Abstract

Objectives/Goals

My objective was to determine which mortar design would launch a tennis ball the farthest; a mortar with one baffle or a mortar with two baffles.

Methods/Materials

Naphtha, tennis balls, pringles containers, fireplace matches, duct tape, 4inch thin-walled PVC pipe, drill, tape measure, teaspoon and hair dryer.

I built two tennis ball mortars from three Pringles potato chip containers. One of them had a single baffle made in the bottom of the top can. The other one had a baffle in the middle can also. I heated each mortar with a hair dryer for two minutes before each firing. I poured one teaspoon naphtha down the barrel being careful to get passed the baffles into the base. I put the tennis ball in the barrel and it rested on the baffle. I held the ball in place and shook the mortar to vaporize the naphtha. I put the mortar into the firing tube and leaned it against a chair with a slight angle and lit the fuel air mixture through the firing hole in the base. Then I measured the distance that the ball traveled. I did the final trial six times with each mortar.

Results

My results were very different for each mortar. The mortar with two baffles fired the tennis ball as far as 101' while the mortar with one baffle only went 13'8" at the same angle. In all six of the final trials the mortar with two baffles fired the ball farthest and made the biggest bang.

Conclusions/Discussion

I thought that the mortar with one baffle would shoot the farthest because there would be more room for the naphtha to expand and mix with oxygen and make a lot of the fuel mixture. I learned that having the fuel mixture in a more confined area made it burn more efficiently and quickly which caused a bigger explosion. The baffle on top held the ball in place and the baffle on the bottom kept the fuel contained.

Summary Statement

My project is to find out which tennis ball mortar is more efficient at firing a ball; one with one baffle or one with two baffles.

Help Received

The chemistry teacher and the physical science teacher helped me work out the problems I had making the mortars work. My mom helped me build the mortars, typed the application and gave me encouragement.

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)

Daniel R. Brownlee

Project Number

J0103

Project Title

Dihedral Angles and Their Effect on Flight

Abstract

Objectives/Goals

This experiment was designed to determine if the dihedral angle of a plane's wing affects a plane's length of flight. The dihedral angle is the angle of a plane's wing to a horizontal plane.

Methods/Materials

The test plane was created from a balsa wood kit, an arrow shaft and threaded rods. A hinge fitting was constructed by having a one inch dowel rod with a hole in it slid over a threaded rod on the fuselage. The hinge fitting was used to shift the dihedral angle of the wings. A launch system was created to insure each test was launched consistently. Fifty tests were completed for the following dihedral angels: 0o, 15o, 30o, -15o, and -30o. The data was recorded from where the nose hit each time. The tests were completed in an inside facility that was not affected by the outside elements.

Results

The -30o anhedral flew the farthest on average. The -15o flew the shortest on average. However, this angle flew with the most stability.

Conclusions/Discussion

The experimenter believes the -30o anhedral flew the furthest because a cushion of air formed under the plane which did not allow the normal vortexes to form and kept the plane aloft longer.

Summary Statement

This experiment was designed to determine if the dihedral angle of a plane's wing affects a plane's length of flight.

Help Received

Father helped launch and build airplane. Mother helped to type report. Used Gym at Mission Valley Church of the Nazerene.

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)

Stephanie L. Cagle

Project Number

J0104

Project Title

The Study of Varying a Parachute's Surface Area on a Rocket's Rate of Descent

Abstract

Objectives/Goals

My project was designed to determine how the surface area of a parachute affects a rocket's rate of descent.

Methods/Materials

One rocket was launched 30 times with three different parachutes (10 launches each parachute) of 100% surface area, 70% surface area (30% surface area was removed from apex), and 40% surface area (60% surface area was removed from apex). The rocket's descent was recorded from the apogee to the landing for each launch by two timers. The data was then analzyed and compared.

Results

The control parachute (100% surface area) descended at an averaged rate of 29.25 seconds. The parachute with 70% surface area descended at an average rate of 21.89 seconds, while the 40% surface area parachute descended at an average rate of 12.37 seconds. Compared to the control parachute, the 60% parachute descended 25% faster and compared to the control parachute, the 40% parachute 58% faster.

Conclusions/Discussion

The study showed that the rocket was able to descend at a faster rate with the altered parachutes. It also showed that even with the parachute's surface area reduced by 60%, the rocket landed in good condition. The results from the study could be used to further investigate the optimum surface area a parachute must have for a rocket's rapid descent and safe recovery. Even though the hypothesis was supported by the experiment, there is still much more research that can be conducted. Future experiments should include an altimeter to accurately measure the rocket's apogee, and parachutes with a surface area less than 40% should be tested. Also, the experiment could include measuring the distance from the launch pad to the landing site in relation to the parachute's surface area.

Summary Statement

The project was designed to determine how the surface area of a parachute affected a rocket's rate of descent.

Help Received

Andy Woerner, President of DART (Diego Area Rocket Team) aided in the construction and procedures for launching the rocket. His son, Alex, and my mother were timers. My mother also chauffeured me to and from the launch site over a period of three months.

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)

Bonnie Cao

Project Number

J0105

Project Title

Swim Faster! But How?

Abstract

Objectives/Goals

The purpose of this experiment was to find which hand angle in the stroke of freestyle produced the greatest amount of propulsion.

Methods/Materials

A propeller was built from chopsticks, spoons, and a NERF foam ball, with the spoons representing the "hands." The propeller was stuck to a chopstick axle which was firmly attached to the axle of a motor that was used more as a power generator. The propeller was placed under a steady stream of water, and every 15 seconds for one-minute and 45-seconds, the microvolts produced were recorded. A survey among competitive swimmers was also conducted.

Results

The 30-degree angle created noticeably the greatest amount of voltage. The 0-degree angle had a considerably lower amount of voltage than the other degrees. All results were constant, with each tests' results within 0.16 microvolts of each other. The survey showed that the majority of the swimmers used the 30-degree angle.

Conclusions/Discussion

This data suggests that the 30-degree angle is the most efficient angle for a swimmer's hand during the stroke of freestyle.

Summary Statement

My project is a study of the propulsive force of different hand angles in the swimming stroke of freestyle.

Help Received

Aunt lent Multimeter; Dad supervised use of glue-gun; Classmates held propeller during testing

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)

Michelle E. Danner; Joelle H. Jenkins

Project Number

J0106

Project Title

Spatter Spatter Everywhere

Abstract

Objectives/Goals

To see when we hit a small amount of blood with an object, if the amount of force will effect the pattern of the resulting bloodstains.

Methods/Materials

We mixed glycerin, milk, and red food dye together to make our fake blood. Next we placed the blood on the block of wood and dropped the hammer and the baseball bat at various hights. Then we took the 4 targets off the boards and put them on the garage to dry. Then we counted the dots and interpreted our data.

Results

The hammer's spatter pattern ended up with the majority of the dots on the front targets (B and C). The baseball bat's spatter pattern ended up with the majority of the dots on the side targets (A and D). We think that the shape of the object determined the pattern of the resulting bloodstains. With a greater amount of force used, we observed an increase in the number of blood dots. We also observed an increase in the number of blood dots with small diameters

Conclusions/Discussion

When we were comparing our data, we found that our hypothesis partly correct. The increase in force did result in an increase in the number of blood dots and blood dots with small diameters. It did not, however, change the pattern of the blood dots.

Summary Statement

This project is about the effect of force on blood spatter patterns.

Help Received

Bart Epstien, for giving us some very helpful books on bloodspatter patterns, ideas on how to improve our way of interpreting our data. Cordelia Willis, for talking to us about forensic science and for giving us the idea of using milk in our blood formula. Our moms, Lauren Jenkins and Karen Wcislo, for helping us

Name(s)

Christopher D. Edge

Project Number

J0107

Project Title

How Rocket Nozzles Affect Thrust

Abstract

Objectives/Goals

To determine if the angle of a rocket nozzle affects the amount of thrust.

Methods/Materials

* Rocket Nozzles
* Testing Apparatus
* A8 Estes Rocket Motors
* Potentiometer
* Digital Multimeter
* Estes Igniters

1. Construct the nozzles

2. Assemble the ballistic pendulum

3. Remove the nozzle from an Estes rocket motor

4. Place the nozzle in the pendulum

5. Get an at-rest reading from the multimeter

6. Ignite the motor and get a maximum reading from the multimeter

7. Repeat the steps 10 times for each rocket nozzle

8. Analyze the data

Results

The results showed that the 90 degree nozzle produced the most thrust. However, several problems were observed with the procedure that caused the results to vary considerably.

Conclusions/Discussion

The 90 degree nozzle produced the most thrust.

Summary Statement

This project measures the effect of the angle of a rocket nozzle on the amount of thrust produced.

Help Received

Andros Engineering provided the shop resources to machine the rocket nozzles. My mother provided encouragement and inspiration. My father helped me with building my apparatus and testing.

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)

Tommy Elliott; Peter Ferrari; John Walsh

Project Number

J0108

Project Title

Does Shape Matter?

Abstract

Objectives/Goals

Our objective is to see how the shape of a car can affect how fast it will go. Our hypothesis is that the shape of the cars will make a difference in how fast they go. This is because a car with a more aerodynamic shape should go faster. The more aerodynamic the shape, the less the car will stall from the air as it moves.

Methods/Materials

We made three different car bodies (Car A, Car B, and Car C) with different shapes and tested them on a race track and in a wind tunnel. We alternated the car bodies with a standard car base in order to have a controlled experiment. We timed each car on the same track and with the same car base. We put each car body in the wind tunnel and sucked dry ice over the bodies with a shop-vac. We recorded and took pictures of the results. Some of the equipment we used was as follows: 1 track, 3 cars, 1 wind tunnel, dried ice, shop vac, and hot water.

Results

The results of the first test are as follows: Car A average time was 4.38 seconds (track was 12.19 meters long/5 races). Car B average time was 4.39 seconds (track was 12.9 meters /5 races), and Car C average time was 4.54 seconds (track was 12.19 meters long / 5 races). The results of test two are that we visually saw the wind going more smoothly over Car A than Car C and Car B was somewhere in between.

Conclusions/Discussion

Our conclusion proved that our hypothesis was correct. Car A was the fastest and most aerodynamic. Car C was the slowest and least aerodynamic. The shape of the cars is the determining factor on how fast they would go in a controlled experiment.

Summary Statement

Our project is about aerodynamics and how the shape of a car's body will affect it's speed.

Help Received

Mr. Walsh (John's dad) supervised the building, racing, and testing of the cars. Mrs. Tamasso (Science Teacher) reviewed and directed progress of project.

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)

Jarred Alan Goff

Project Number

J0109

Project Title

How Fast Will a Homemade Hovercraft Powered by Two Leaf Blowers Travel over Different Surfaces?

Abstract

Objectives/Goals

My objective was to learn what surface a homemade hovercraft would travel over fastest.

Methods/Materials

My project required wood, visquine, two 195mph leaf blowers, 12 volt jet-ski battery, screws, drill, jigsaw, 2 servos, 1 receiver, i transmitter, rubber handled plyers, adult superviser. After I got all of the materials, I built the hovercraft. Once I built my air distribution box that distributes the air to certain places, the design put itself together. By this I mean that after I put the box in place, I knew where all of the pipes and leaf blowers went.Then I did all of the electrical work, with the supervision of my father, Alan Dale Goff, Sr.

Results

The results of my experiment are that the hovercraft traveled fastest over the concrete, which was the hardest, smoothest, and most polished surface of the rest. The order from there on was following the same pattern of the hovercraft traveling fastest over the hardest, smoothest, and most polished surfaces. By doing this experiment I was planning to learn what surface my homemade hovercraft traveled over fastest, and I did.

Conclusions/Discussion

My hypothesis was that the homemade hovercraft would travel fastest over the concrete, and the hovercraft did. This also enabled me to attain my objective because I wanted to learn what surface the hovercraft traveled over fastest. The information from this project expands our knowledge of applied mechanics/ structures & mechanisms/ manufacturing by showing how electrical energy is converted to mechanical energy and mechanical energy is converted into an air source to lift and propell a homemade hovercraft.

Summary Statement

My project is about designing and building a hovercraft that is fully functional and able to be used as a basis for my hypothesis and to have fun with.

Help Received

Mother took pictures; Father supervised througout experiment.

Name(s)
Bethany A. Grove

Project Number
J0110

Project Title
The Answer Is Blowing in the Wind: How Shape Affects Drag

Abstract

Objectives/Goals
In this project, I wanted to see whether the shape of an object affected the amount of drag it had. My hypothesis was that a teardrop shape would have the least amount of drag.

Methods/Materials
To prove my hypothesis, I needed a wind tunnel, manila folders (to make models), 1/8 inch alder and a wind speed meter (to calibrate the wind tunnel).
For testing, I first mounted a model on a piece of alder and set it in the test rig before closing the test hatch and turning the wind tunnel to medium speed. By sliding a piece of splitshot along the ruler, I found how many millimeters (mm) it takes to balance the test rig.
After recording the number of millimeters and repeating this four times, I repeated the experiment with the other shapes. Finally I calculated the amount of force.

Results
The object with the least amount of drag was the teardrop (with the point facing into the wind). The rectangle side of the rectangular prism had the most drag. The teardrop had 0.0019 N/cm squared of drag. The circle had the most drag with 0.00741 N/cm squared. The average amount of drag was 0.0025 N/cm squared, with a median of 0.00237 N/cm squared and a mode of 0.00233 N/cm squared.

Conclusions/Discussion
After testing, results showed that my hypothesis was correct. However, I did not expect the teardrop with the point facing into the wind to have the least amount of drag; I expected the opposite. The teardrop model I used was more streamlined than the
otherother models, resulting in less drag. These results also prove my research was correct. As for errors, the most likely places would be in any inconsistencies in the airflow as well as mistakes in the math. All in all, this experiment proved both my hypothesis and research correct.

This data could best be applied in streamiling vehicles. Once a vehicle is streamlined, it performs much better,as well as getting better gas mileage. Therefore, a teardrop shaped car would have the least amount of drag. Planes would also benifit from streamlining, another place to use this data.

Summary Statement
In this experiment, I found how shape affects the amount of drag on an object.

Help Received
Father helped build wind tunnel

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)
Taylor Hattori; Joshua Kantor

Project Number
J0111

Project Title
How Does Angle of Attack Affect the Distance a Glider Can Fly?

Abstract

Objectives/Goals
OBJECTIVE: Our objective was to see if the angle of attack affects the distance a glider can fly. That was our question that we based our experiment on, throughout the science fair. Our hypothesis, says that the angle measured at +2 degrees would fly the farthest. A little bit of information about angle of attack. Angle of attack is the angle at which the wing is angled at on the fuselage. It is basically rotating the wing up and down.

Methods/Materials
MATERIALS & METHODS: To do the experiments, we used a foam glider (with a wingspan of 6ft). To make the experiment consistent, we designed and built a launch system that is basically the same as an aircraft carrier's but smaller. The launch system was made of a foldable table, a 2 x 4, a clamp and a bungee cord. We taped out and measured the All Saints Day School gym and launched it from one end to the other. The one that flew the farthest was the angle measured at 0˚.

Results
RESULTS:Our graph shows us that the angle measurement of -8 flew 2.9 m, +8° flew 3.7m, -5° flew 4.3°, +5° flew 6.3 m, -2° flew 6.3 m, +2°
flew 10.3 m, and 0° flew 14.6m.

Conclusions/Discussion
DISSCUSIONS:
From this collected data, we determined that -8° decreased the flight the most (2.9meters), and 0° allowed the glider to fly the farthest (14.6 meters). Our Hypothesis said that we thought that a +5° increase in the angle of attack would allow the glider
to fly the farthest. However, it appears that we were incorrect in our assumptions. 0°, which is the angle our glider came set at, allowed the glider to fly the farthest. So, it seems that too high an increase of degrees in the angle of attack causes the glider to stall and decreases the flight distance greatly, while too great a decrease of degrees in the angle of attack causes the glider to nosedive into the ground immediately after launch, also decreasing the flight distance greatly. Our increase of +5° was too much, and that is why it didn't fly far. Perhaps a more slight and subtle increase in degrees would increase the flight distance.

Summary Statement
We built a glider out of a kit, modified the angle of attack, and flew it to see which angle flew the best.

Help Received
Taylor's brother supplied us with a trigonometry formula to find the different angles.

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)

Travis J. Henderson

Project Number

J0112

Project Title

Lift Capabilities of Different Wing Designs

Abstract

Objectives/Goals

This project was designed to answer the question: "Which wing design creates the most lift?" Research of various planes and their wing designs led to the following hypothesis: I believe that of the three wing types being tested, the delta winged planes' lift will be least affected by an increase in cargo weight. I also think that of the delta winged designs, the 16.2cm by 10.2cm delta will be the least affected by the extra weight.

Methods/Materials

Six wing designs of equal surface area were constructed. All wings were attached to plane bodies of like construction. To keep the thrust the same for all flights, a catapult launcher was used. All tests were conducted indoors to avoid problems with outside weather conditions. Each plane was first balanced and had its center of gravity marked, then flown five times without any added weight other than that needed for balance. This served as a control. To test lift, five conditions were created by evenly distributing weight around the center of gravity by adding one weight at a time to a maximum of five. Each design was flown five times under each condition. Distances of all flights were recorded for comparison.

Results

The results clearly showed that the 20.3cm by 7.6cm delta wing design was the best. To determine the best design, the difference of the control flight average distance and the maximum weight flight average distance was calculated and compared for each design. The 20.3cm by 7.6cm design had the smallest differance of 149.9cm. This was significantly less that the next closest design, the 16.2cm by 10.2cm delta wing which posted a differance of 179.3cm. The worst case was the straight tapered wing which had a difference of 410.5cm.

Conclusions/Discussion

My hypothesis was partially correct in that the delta wing designs, in general, had the best lift. However, the 20.3cm by 7.6cm winged plane was the least affected of all, not 16.2cm by 10.2cm as I thought. This must be because the 20.3cm by 7.6cm wing had more wing area near the center of gravity to minimize the effects of the added weight.

Summary Statement

This project was designed to determine the lift capabilities of different wing designs as payload weight increases.

Help Received

My dad took pictures while the project was conducted and gave me technical advise.

Name(s)

Jeremy R. Hurst

Project Number

J0113

Project Title

In Pursuit of the Perfect Propeller

Abstract

Objectives/Goals

This project is intended to find which propeller is most efficient for my 0.40 model airplane engine.

Methods/Materials

I took an O.S. engine max-.40 LA model airplane engine and mounted it to a board which was on linear ball bearings. The board was attached to springs to measure how much static thrust the entine and propeller generated.

Results

I tested each propeller three times, measuring the rotational speed of the propeller in RPM (rotations per minute), and the distance that the spring was stretched. The stretching of the spring gave me the static thrust.

Conclusions/Discussion

I found out that the bigger the propeller, the bigger bite it got out of the air, but that slowed down the engine, causing it to work harder and heat up making it less eficient. But the smaller the propeller the less bite out of the air and not making it work hard enough whitch was not verry efficient either. So I found out that the middle of the sizes of the diffrent proppellers was most efficient for the model air plane eingine. That was the 11x7 propeller.

Summary Statement

This project consists of testing different model air plane propellers on a model air plane eingine.

Help Received

My Dad helped me over all , my Grandad helped me test the propellers, and my Grandmother helped me with the board

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)
Dylan E. James

Project Number
J0114

Project Title
Rocket Nozzle Efficiency

Abstract

Objectives/Goals
To see how much useful thrust energy for powering model vehicles I could get out of a CO(2) cartridge by varying the size of the nozzle formed by puncturing with a needle.

Methods/Materials
17 CO(2) cartridges were punctured to form rocket nozzles and their total useful output was recorded. The cartridges were mounted on a counter balanced bicycle wheel and the time of each revolution was recorded using a video recording system and a computer stopwatch program. Excel spreadsheet was used to calculate the speed as a function of time and to plot the data.

Results
The hole (nozzle) diameter was not the factor determining how many revolutions the bicycle wheel made in a given run. However, hole size was found to determine time to top speed for the wheel.

Conclusions/Discussion
The efficiency of the nozzle was determined more by the hole shape than by the size. The literature says that the most efficient nozzle is an expansion nozzle and my nozzles had widely varying shapes due to an inability to control the shape when puncturing the foil on the CO(2) cylinder. When using needle-punctured CO(2) cartridges for power, use a large hole for short, high thrust bursts and a small hole for longer, lower thrust applications.

Summary Statement
My project is to study how the efficiency of a rocket formed from a CO(2) cartridge varies with the nozzle size.

Help Received
Father punctured holes in cartridges while I video-recorded the run, and father taught me how to use excel. Mother assisted with gluing the sheets on display.

Name(s)

Zachary N. Johnson

Project Number

J0115

Project Title

At What Angle of Attack Will a Plane Stall?

Abstract

Objectives/Goals

My objective was to find the exact degree of angle of attack that a plane would stall.

Methods/Materials

i built a wind tunnel that got 30 mph in the test section (where the plane is) using a 1/4 horsepower motor (1600 rpm). I also built two small wings and used a scale to test where the wing had stalled. I would change the degree and then test and see if the plane had stalled.

Results

My results showed that the average degree that a plane would stall was between 30 degrees and 40 degrees. My results agreed with my hypothesis.

Conclusions/Discussion

I concluded that the wing stalled in various areas because of a faulty scale. They were close but the degree was not exactly the same. If I were to redo this project, Iwould use another scale.

Summary Statement

My project was meant to find the angle of attack that a plane would stall.

Help Received

Uncle helped build wind tunnel

Name(s)

Lara R. Kenney

Project Number

J0116

Project Title

How Airfoil Design Affects Lift

Abstract

Objectives/Goals

To see how airfoil design affects lift.

Methods/Materials

To design a seires of 10 wings out of foam and test them in a home made wind tunnel to determine which wing went up the highest in centimeters when the fan in the wind tunel was turned on. each wing had the highest point of the wing one centimeter further back than it was on the wing before it, beginning with the highest point at the front of the wing, and ending with the highest poin at the back of the 10 centimeter wing. Each wing was two centimeters high at its highest point.

Results

The wings that had the highest point one centimeter back and two centimeters back both had an average lift distance of 8.5 centimeters.

Conclusions/Discussion

After doing three trials and calculating the average, I came to the conclusion that my hypothesis was wrong. I thought that wing number three would be the most effective because it looked like it would, but wings one and two tied for being the best out of them all. This is because the rest of the wings had either too abrupt of a slope on the front of the wing, or not enough. The front of wing zero was a total right angle, so it was obviously too abrupt to bend the air. On wings three, four, and five, the front of the wing was apparently too flat. On wings six thru ten, the slope was backwards, being the exact opposite of wings zero through four. This goes to show that it makes sense that wings one and two were the most effective over the others, because they are both a balance between having the slope too abrupt, and too smooth. It also makes sense, because if you look at wings one and two, they greatly resemble they shape of the wings on a commercial jet.

Summary Statement

My project was designed to determine if the shape of a wing affects lift.

Help Received

parents helped with wind tunnel, teacher helped with wings, mom helped with recoding data.

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)
Alexandra J. Kimball

Project Number
J0117

Project Title
Science Down the Drain

Abstract

Objectives/Goals
The objective of this experiment was to determine which variables affect how fast water flows through a pipe. I believe that many variables including the size of the pipe, the height and the pipe path will have an effect.

Methods/Materials
I built a 6-1/2 foot tall adjustable test stand using two copper pipes mounted vertically into a wooden base. Another piece of wood that could slide up and down on the pipes held one-liter bottles mounted upside down. Different sized vinyl pipes were hot-glued into holes made in the bottle caps. The pipes were squeezed closed with clamps so each bottle could be filled through a hole cut in its bottom.

The tests started when the clamp was removed. I used a stopwatch to time how long it took the water level to drop between two lines drawn on the side of the bottle. Each size pipe was tested at three different heights using straight pipes and at one height using angled and zigzagged pipes. Each test was run three times and the average time was used.

Results
The water drained quicker with the larger pipes. The height of the tubes made only a little difference in how fast the water flowed. When the pipe was higher, the water flowed faster. The speed difference was more noticeable with the smaller pipes. The water slowed down when the pipes were bent and slanted but I couldn't predict how much it would slow down. The water flows fastest when the pipe is vertical.

Conclusions/Discussion
The graph of my data shows that when you double the area of a pipe the water will drain twice as fast. My data also showed that water height has a small effect on water flow but bends in the pipe could have a larger effect. With the right data and more accurate tests, it might be possible to write an equation that could predict the exact drain times.

Summary Statement
This experiment tries to determine how fast water drains through pipes.

Help Received
My step dad helped build the test stand and print out the graphs.

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)

Anjaney P. Kottapalli

Project Number

J0118

Project Title

A Question of Propellers

Abstract

Objectives/Goals

My project was to determine whether an increase in propeller size of an indoor free flight rubber band powered aircraft will lengthen its flight duration. I believe that if you do increase the propeller size then the flight duration will increase.

Methods/Materials

Five different propellers of proportionally different sizes (long, short, wide, thin and, the original "control" propeller) and the same pitch were constructed out of a sheet of balsa wood using a self-made pitch form. One EZ Penny Plane (designed by George Xenakis) was used as the base test plane. Also used were five rubber bands each of the same cross section and length. All five propellers were tested on the EZ Penny Plane five different times for accuracy and repeatability (for a total of 25 test flights). After the test flights were completed my project advisor, Mr. Francis Lee, helped me analyze my data and put it into a presentable form.

Results

The long propeller had the longest flight duration with the short propeller coming in second followed by the thin propeller. The original propeller had the fourth longest flight duration with the wide propeller having the shortest flight duration.

Conclusions/Discussion

My hypothesis was partially true because the long propeller had the longest flight duration while the wide propeller had the shortest flight duration. When I began my project I thought that the only variable I had to think about was the propeller size. After analyzing my data I figured that there were some other variables to consider. For example, the drag created by the extra area on the propellers. In my analysis of variance I found that the original, short , and thin propellers had no significant difference between any one of them. The long propeller having the longest flight duration could be explained by the fact that it had so much more tip area that the extra area created more propeller lift or aircraft thrust but the extra area was not enough to create a lot of drag. For the wide propeller my explanation is that it had so much extra area that it created too much drag to be overcome and therefore had less aircraft lift, limiting its time in the air.

Using my project's results the aircraft manufacturers could design a fuel efficient propeller which provides more thrust for less fuel. This would increase the range of propeller aircraft.

Summary Statement

My project is about the effect of propeller size on the duration of flight.

Help Received

Built propellers and plane under supervision of Mr. Lou Young. Flew under supervision of Mr. Francis Lee. Father timed test flights.

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)

James E. Lawrence

Project Number

J0119

Project Title

Hull Texture vs. Performance

Abstract

Objectives/Goals

This experiment measured the resistance created by different surface textures on identical submarine hull specimens. The textures were GLOSSY, MATTE, GRIT, and GEL. It is expected that the hull with the smoothest texture would have the least resistance. Observing how water beads up on the hulls of the GLOSSY and GEL specimens, one would expect resistance would be lowest with these two specimens.

Methods/Materials

The identical submarines with different textures were submerged into a test tank filled with water. A controlled pump propelled the water past the submarines at a constant speed measured by a flow gauge. A torsion spring gauge attached to a linear slide measured the frictional resistance (drag) of each submarine. Frictional resistance becomes less important as speed increases so measurements were taken at four different speeds.

Results

As expected, the GRIT texture demonstrated the most resistance overall. The testing results showed at slow and medium flow rates, the GEL texture performed the best. At the fast flow rate, the GEL and MATTE textures performed best. At maximum speed, the GLOSSY texture had the least resistance. In the entire testing the MATTE texture demonstrated the least resistance over all.

Conclusions/Discussion

The testing results have shown that the MATTE finish performed best overall, with GEL, then GLOSSY, and then GRIT being the worst. Different finishes performed better at different flow rates. At the slow and medium flow rates, GEL performed the best, at fast flow rate GEL and MATTE performed the best, and at the flank flow rate GLOSSY performed the best.

Summary Statement

This experiment measured the resistance created by different surface textures on identical submarine hull specimens, submerged into a test tank filled with water.

Help Received

My father helped me build the test tank, and my neighbor, CMDR. Lagemann, advised me in the construction.

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)

Rebecca G. Lent

Project Number

J0120

Project Title

How a Solid's Temperature Affects Its Speed Falling through Liquids: Do Sizzling Spheres Sink Swiftly in a Syrupy Soup?

Abstract

Objectives/Goals

My objective was to determine how a solid's temperature affects its speed falling through a liquid. The viscosity of most liquids decreases as the liquid's temperature increases, and Stokes' Law predicts that a solid sphere will fall faster in a less viscous liquid. Therefore, a solid sphere should fall faster through hotter liquids. I hypothesized that if I were to heat the sphere instead of the liquid, the sphere would also fall faster, because it would tend to heat the liquid immediately surrounding it. Likewise, I predicted that colder spheres would fall more slowly. Applications and extensions of my idea and results could improve energy-efficiency of underwater travel, and possibly of air and space travel.

Methods/Materials

For each test, I dropped a sphere into a vertical, cylindrical, liquid-filled tube. After the sphere had fallen 10 cm, I timed the next 50 cm of its descent to find its average speed. Spheres were made of steel, glass, and acrylic and had diameters of 0.6 cm and 1.6 cm. The liquids were water, canola oil, and corn syrup, all at a temperature of 20°C. I heated or cooled the spheres to 0°C, 20°C (the control), 60°C, and 100°C. I compared average speed vs. sphere temperature.

Results

In almost all cases, over the 20° to 100°C range, as I predicted, hotter spheres fell faster! Behavior of cold (0°C) spheres was inconsistent--perhaps their density increased at the cold temperature, counteracting viscosity-related effects. Testing sub-0°C spheres could give a better picture of cold-sphere behavior.

Conclusions/Discussion

All except my 0°C results supported my hypothesis, showing that a sphere's behavior in a liquid is not only affected by the overall viscosity of the liquid, but that it can also be affected by other factors local to the sphere itself (in particular, by heat from the sphere). This idea might be extended to help understand the behavior of underwater vessels or projectiles, possibly improving the energy-efficiency of underwater transportation. Further experiments might even extend my idea to gases: Viscosity of a gas generally increases with temperature, so it may turn out that cold objects move faster than hot objects through gases, an idea that might be used to improve the energy-efficiency of air travel, as well as to understand better the behavior of objects from outer space that heat up on entering the Earth's atmosphere.

Summary Statement

My project demonstrates that the hotter a solid object is, the faster it falls through a liquid, which has possible applications to energy-efficient transportation.

Help Received

This project and hypothesis were my idea, based on my Internet research on viscosity and Stokes' Law. My father helped me design my experiment and find supplies. My tests required an assistant (my father) to time the spheres after I dropped them. My mother helped me paste up the poster.

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)

Curtis D. Lopez

Project Number

J0121

Project Title

Could Dry Ice Rockets Be Helpful in Finding a Clean Power Source for the Future?

Abstract

Objectives/Goals

The goals of this project is to see if the temperature of H2O (Water) combined with frozen CO2 (Dry Ice) will affect the launced distance of a Corning test tube at a 45 degree angle.

Methods/Materials

1) Experiments were done 20 times per test sample. There were a total of 5 various temperature ranges: 10, 15.55, 21.11, 26.66, 32.22 degree Celsius.
2) All Test Samples consisted of 15 grams of frozen CO2 and 12.5ml of H2O.
3) The one variable was the temperature of the H2O prior to combining it with the frozen CO2. I ran 2 experiments per each test sample per day (total of 100) over a 10 day period.
Material List: metal 45 degree angle launch pad; Corning 50ml plastic test tube; safety goggles; protective chemical rubber gloves; frozen CO2; H2O; metric thermometer; metric balance; metric tape measure; tongs; clear open area.

Results

My hypothesis was proven wrong with the farthest single flight being the H2O temperature of 15.55 degrees Celsius which went a distance of 46.421 meters. Then the furthest average flights overall went to 10 degrees Celsius with an overall average of 38.9934 meters.
Temperature/Single Flight/Average Flights: 10-C/44.132/38.9934;15.55-C/46.421/35.5973;21.11-C/40.5384/35.3303;26.66-C/40.447/35.1006;32.22-C/39.9593/30.8346

Conclusions/Discussion

I concluded that the reason the colder temperature went the furthest was due to the rate in which pressure builds up. The frozen CO2 does not sublimate as quickly in the colder temperature causing a slower pressure build up and thus allowing the test tube "rocket" to expand and hold more pressure before exploding. This extra pressure causes more power when the rocket launches out of the cylinder and in turn more distance. Whereas the hotter temperatures caused a fast rate of expansion and the plastic may not expand quick enough for the cap causing the cap to explode before the rocket reached a high pressure point and therefore providing less power to go as far.

While doing this years project I realized that I can take pressure caused by sublimation and use this to build a clean environmentally friendly alternative power source to steam or maybe even fuel. Although I only have a "working theory" at this stage of my project, I hope to build this clean power source in the next few years of my "continuing" project.

Summary Statement

My project is a series of experiments that will hopefully lead up to discovering a clean alternative power source using frozen CO2 and H2O.

Help Received

Steve Moses, Environmental, Health & Safety supervision; BioMedica Scientist help answer questions; Father built launch pad; Mother help type report and put together backboard.

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)

Krystle M. Maples

Project Number

J0122

Project Title

Parachutes

Abstract

Objectives/Goals

The objective is to determine if the shape of a parachute's canopy will effect the time it takes to fall to the ground.

Methods/Materials

Six canopies, with the same surface area, shaped like a square with each side being 25 centimeters, a rectangle with sides of 30 and 20.83 centimeters, a triangle with a height and base of 35.355339 centimeters, a circle with a radius of 14.108315 centimeters, a octagon with sides of 11.4 centimeters, and an octagon with sides of 15.7 centimeters were cut out of rayon like material. Eight strings were sewn on to all of the canopies and connected at the ends. Each parachute was dropped fifteen times, from the same height, for a total of ninty trials.

Results

The circle canopy increased the falling time the most with an average of 5.28 seconds. The square's average of 3.77 seconds was the lowest time of the six parachutes.

Conclusions/Discussion

My conclusion is that the circle shaped canopy increses the time it takes to fall to the ground the most, compared to the square, rectangle, triangle, hexagon, and octagon shaped canopies. Because of the circle's shape, it also proved to be one of the safest parachutes by not spinning out of control or turning over.

Summary Statement

How will the shape of a parachute's canopy effect the time it takes to fall to the ground?

Help Received

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)

Trevor M.T. Martin

Project Number

J0123

Project Title

FANtom of the Tunnel

Abstract

Objectives/Goals

My objective is to discover the difference of wing design and how it effects flight stability.

Methods/Materials

Build a wind tunnel. Suspend airplanes with various wing designs. Record stability.
materals,drum,fan,plaines,tools.

Results

I found that the wings in a v shape foward flew bes ti levels 1 and 2.

Conclusions/Discussion

I learned that different wings do different jobs. Ether fast slow or gliding.

Summary Statement

HOW Does The Shape of a Wing Affect It's Flight, using a wind tunnel.

Help Received

Mom and Sister helped edit typing, Dad helped cut steel.

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)

Melissa A. Medina

Project Number

J0124

Project Title

How Do Marble Mass, Water Density, and Temperature Affect Wave Speed?

Abstract

Objectives/Goals

The objective of my project is to determine how marble mass, water temperature and density affect the speed of a wave. In experiment one, i predict that as the marble's mass increases, the speed of the wave would also increase. Next, in experiment two, I predict that the temperature of the water would have no effect on the wave speed. Then in the third experiment, I predict that as the density increases, the wave speed would decrease.

Methods/Materials

During experiment one, three marbles with masses of 4.9 grams, 19.2 grams, and 51.2 grams were dropped one by one, 25 times from eighty centimeters above the water. The wave made by the marble's impact was measured in seconds, as it traveled eighty centimeters. In the second experiment, the only variable that changed was the temperature of the water, which was 28 deg. Celsius, 36.3 deg. Celsius, 38.7 deg. Celsius, and 43 deg. Celsius, and, only the marble with the mass of 19.2 grams was dropped 25 times. Then, in the third experiment, the densities of the water changed, 1.0 gm/mL, 1.12 gm/mL, 1.28 gm/mL, and 1.40 gm/mL, and the marble with the mass of 19.2 grams was used.

Results

In experiment one, when the mass of the marble increased, the average speed of the wave also increased. Then in experiment two, when the water temperature increased, the average wave speed increased too. In the third and final experiment, when the density increased, the average wave speed increased also.

Conclusions/Discussion

In conclusion, the results for experiment one supported my hypothesis because I correctly predicted that the bigger the mass, the faster the wave speed would be. Then for experiment two, the results refute my hypothesis because I incorrectly predicted that the temperature of the water would have no effect on the waves speed. The results fo the third experiment also disagreed with my hypothesis because of the incorrect prediction, that as density increased, the wave speed would decrease. Mass, temperature and density do affect wave speed. Their relationship is directly proportional. If one variable goes up, wave speed does too.

Summary Statement

This project investigates how marble mass, water temperature, and water density affect the speed of a wave.

Help Received

Teacher helped correct errors in the report.

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)

Arlee L. Mesler

Project Number

J0125

Project Title

Physics of Flying Fruits

Abstract

Objectives/Goals

Many plants disperse their fruits or seeds (diaspores) by wind; some of the best known are maples and conifers. I studied some of the variables that affect the rate of descent of a wind-dispersed diaspore (fruit or seed). I predicted that the time of descent of a diaspore would (a) increase as the wing surface area increases, (b) decrease as the weight of the seed increases, (c) stay the same across all of the sizes when the ratio of seed weight to wing area is the same, and (d) perform better if the seed weight is attached to the middle of the wing, rather than the bottom.

Methods/Materials

To test my hypotheses I built a series of artificial diaspores using stiff paper and parafilm and altered the size of the wing, weight of the seed and placement of the seed weight. I conducted four experiments where I changed those variables.

Results

As expected, diaspores with larger wing surfaces tended to take longer to fall to the ground than ones with smaller wings, diaspores with heavier seeds fell more rapidly than ones with lighter seeds, and diaspores with the seeds in the middle fell more slowly than the ones with seeds at the bottom. In contrast, the experiment that examined the effect of the ratio of surface are and weight did not turn out as expected. Diaspores of different sizes but the with same surface to weight did not fall at the same rate.

Conclusions/Discussion

The constant wing loading experiment's results may have turned out the way they did for many reasons. I think that the most likely is that having a larger wing gives a diaspore such an advantage that even if the ratio of weight to area was the same for a large and small wing the large wing would perform better. Over time, evoluton has resulted in many shapes, sizes, and weights of wind dispersed diaspores. This is how my project applies to the world.

Summary Statement

I studied some of the variables that affect the rate of descent of a wind dispersed diaspore.

Help Received

Mother and father helped coduct experiments by doing things such as timing and recording.

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)

David J. Michon

Project Number

J0126

Project Title

Turbines and Tunnels: Spacing Turbines in Wind Farms

Abstract

Objectives/Goals

To investigate how the spacing between two inline wind turbines affects their performance by modeling them as two propellers in a wind tunnel and varying the spacing between them.

Methods/Materials

A wind tunnel consisting of diffuser, accelerator, test chamber, decelerator, and drive sections was constructed from melamine coated hardboard glued and taped together, plastic egg-crate light panels, and a 20 inch electric fan. The removable test chamber held two propellers with a position indexing system built from LEGO. A infrared emitted/detector pair in the path of each propeller passed through a SPDT selector switch to a digital frequency meter.

The following measurement procedure was used:

1. Set fan speed to high, turn on power supply, frequency meter, and fan.
2. Set rear prop to position 0 (79.6 mm from front turbine).
3. Record speed of back prop (in Hz).
4. Press the SPDT switch and record speed of the front turbine.
5. Move rear prop to next position (16 mm farther away)
6. Go to step 3 and repeat until index position 14 (303.6 mm)
7. Repeat steps 2 through 6 for a total of five trials.
8. Increase load on front prop (add friction) and repeat steps 2 through 7

Results

To reduce the impact of time varying influences on measurements, the ratio of the front to back turbine frequency was computed and then averaged across all five trials. The average ratio ranged from 1.053 at the first (closest) position to 1.037 at the last (farthest) position on the first test set and from 0.940 to 0.885 at on the second set.

Conclusions/Discussion

Per expectation, the ratio of the front prop speed to back prop speed decreased steadily with distance. On the no load test, the ratio stayed above 1.00 while on the loaded test the ratio stayed below 1.00. Upon further investigation, I learned that the limitations of my test setup make an imperfect model of real world wind farm turbines largely because my propellers were very near the diameter of the wind tunnel, making my system a ducted fan whose behavior is different from a propeller in free air.

Summary Statement

This project models the effect of spacing between two inline wind turbines by measuring the speed of two inline propellers in a wind tunnel while varying the distance between them.

Help Received

Father helped design and build wind tunnel and explain the electronics; mother helped create backboard and record data; brother helped take photos, assemble wind tunnel, and record data.

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)

Roxanna E. Moradi

Project Number

J0127

Project Title

Winging It

Abstract

Objectives/Goals

My project was to find out what type of airplane wing has the least amount of drag. I believe that the great sweepback wing will have the least amount of drag.

Methods/Materials

I built a wind tunnel, and drew an x and y axis on it and a 25° line that crosses the (0,0) point. The whole wing lined up with this. I then started testing the wings: complex delta wing, simple delta wing, slight sweepback wing, moderate sweepback wing, great sweepback wing, straight wing, straight-rounded wing, straight-tapered wing. All wings were made out of particle board.

Next, I took 3 rubber band pieces and taped them to the nose and sides of the wing. Then I placed the wing in wind tunnel and taped the ends to the outside surface. I placed a fan on the right opening. I placed a brick with a ramp inside to increase airflow, and then put fan adaptor and plastic sheet over fan. I turned the fan on HIGH. I marked the point where the wing moved back the most and measured the distance (displacement) between the mark and the (0,0) point. This measurement is the amount of drag. I took three measurements for each wing. The average of the three measurements was my ultimate result for that wing. I did the same steps for all of the other wings.

Results

The simple delta wing had the least amount of drag. It's displacement was 0.354 inches. My hypothesis was incorrect- its displacement was 0.625 inches. Results for the other wings: Complex Delta- 0.729in.; Slight Sweepback- 0.771in.; Moderate Sweepback- 0.604in.; Straight- 1.042in.; Straight/rounded- 0.896in.; and Straight/tapered- 0.854in.

Conclusions/Discussion

Besides learning the answer to my question, I learned that wings that are long and have a narrow width have hardly any drag, while wings that are short and wide have more drag. This can also explain why rockets hardly have wings-they just have fins because more surface area means more drag. This information is quite valuable because it identifies how air travel can be more efficient. Furthermore, it can probably be useful for engineers when building future airplane models.

Summary Statement

My project basically tested different wing types to see how much drag they have.

Help Received

Father helped me build the wind tunnel and cut out wings with a power tool.

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)
Aiyana K. Mourtos

Project Number
J0128

Project Title
Designed to Fly

Abstract

Objectives/Goals
To compare the design and performance of birds and airplanes.

Methods/Materials
I searched several books and websites, and selected 25 birds and 25 airplanes. For each bird and airplane, I recorded the weight (W), the wing area (S), and the flight speed (V). From the first two parameters I calculated the wing loading (W/S). I looked for trends in the relationship between W and W/S and in the relationship between V and W/S.

Results
Birds and airplanes are very similar in their design. There are two main differences between birds and airplanes: (1) Birds flap their wings; airplanes do not. (2) Birds use their wings to produce lift and thrust; airplanes use their wings to produce lift only and have engines or combinations of engines/propellers to produce thrust. My data analysis pointed out two similar trends in the two groups; (1) Heavier birds & airplanes have higher W/S. (2) Faster birds & airplanes have higher W/S.

Conclusions/Discussion
Birds and airplanes follow the same flight principles. Both push air down to produce lift and push air back to produce thrust. Birds have small, flexible wings and can flap them. Airplanes have big, heavy wings, which are impossible to flap. Airplanes glide just like birds but cannot flap their wings like birds. W/S tells us how much lift a wing generates per unit area. A higher W/S means the wing is more efficient in generating lift. The graphs show that as W increases, so does W/S because as birds and airplanes get heavier, their wings have to be more efficient in producing lift, otherwise they would be huge. A huge wing gives you more lift but it also gives you more drag and weight. This makes flight more difficult because higher drag requires more thrust. The graphs also show that faster birds and airplanes have higher W/S. A high W/S means a smaller wing for a given weight. This makes sense because when a bird or airplane flies fast, it generates most of its lift from speed (Bernoulli effect), so it does not need a large wing area. Moreover, a smaller wing makes long flights at high speeds more efficient because it generates less drag.

Summary Statement
This project compares the design and performance of birds and airplanes.

Help Received
Father pointed out some of the references I used.

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)

Anthony J. Neuberger

Project Number

J0129

Project Title

Development and Utilization of a Model to Predict Rocket Velocity, Acceleration, Altitude, and Distance

Abstract

Objectives/Goals

The objective of my project was to design and build a functional rocket engine test apparatus to collect engine thrust data from rocket engines subjected to different masses.

Methods/Materials

I designed and built a chart recorder to collect data from the rocket engine test device that I designed and built. As the burning engine displaced a wood doweling, a permanent trace was recorded on graph paper attached to the turning drum unit. I tested two different types of engines, slow burning engines and fast burning engines. Each type of rocket engine was test fired against 3 different total masses: 65 grams, 145 and 198 grams.

Results

Data collected from this series of tests demonstrated that Estes rocket engines have 2 distinct phases. The first burn phase is a brief, high thrust generation period. The burn period for B4-4 engines lasted approximately 0.26 seconds while the initial burn period for B6-2 rocket engines was 0.24 seconds. The second burn phase is a low thrust generation period. The length of this phase was 0.83 seconds for slow burning engines and 0.53 seconds for fast burning engines. The maximum and total thrust generated during the initial burn phase of both types of rockets was approximately. The second burn phase for slow burning engines generated less thrust but for a longer period of time compared to the fast burning engines which generated more thrust but for less time. Finally, fast burning engines were able to displace each mass more than slow burning engines.

Conclusions/Discussion

The first burn phase identified is short in duration, but high in thrust generation. This high thrust generation is critical for accelerating the rocket from the resting state. During the second phase slow burning engines produce less thrust but for a longer period of time while fast burning engines produce more thrust but for a shorter period of time. Therefore, I predict that the fast burning engine should be able to launch rockets of greater total mass more efficiently than slow burning engines. In contrast, the slower burning engine should be more efficient at propelling rockets of lower total mass over greater distances because they produce thrust for a longer period of time. My data suggests that the optimal rocket flight parameters such as velocity, altitude and total distance traveled can only be achieved by optimizing the total mass of the rocket to the thrust generated per time period.

Summary Statement

I designed and built a rocket engine test device that I used to collect the data needed to develop a model to predict optimal rocket designs.

Help Received

Dr. Tim Neuberger, Dr. Mike Otto

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)

Emily A. Ogawa

Project Number

J0130

Project Title

Do Particulates or Liquid Contaminants Affect Oil Viscosity When Heated?

Abstract

Objectives/Goals

The goal of my project was to discover if there was a substance that could be added to oil to enhance the viscosity, and what affects the contaminants had on the oil.

Methods/Materials

To determine this I performed two experiments. The first experiment I performed using a viscometer cup. I poured 60 milliliters of oil that was heated to 212ºF into this cup that has a small hole on the bottom and timed how long it took for the oil's flow to stop. This was done a total of 40 times with 6 different contaminants for each test, and also a controlled test. My second experiment consisted of meter tubing and a ball bearing. I used 7 separate lengths of meter tubing. I pushed a ball bearing into one end of the tubing. I used a turkey baster to squirt 70 milliliters of 212ºF contaminated oil into the meter tubing. Then I dropped a small ball bearing in the tubing and put a cork into it making sure no air was trapped. I flipped the tubing that was attached to a meter stick 180º and timed how long it took for the ball bearing to fall to the other end. I also conducted this experiment 40 times with the same 6 different contaminants as the first experiment and one control test.

Results

I hypothesized that the liquid contaminants would affect the oil's viscosity the most but this proved to be incorrect. I found that the granular substances changed the viscosity the most. The sand affected the oil the most. Following the sand was the oil and sugar. Then came the control test. Following that was the first liquid contaminant, water. After the water was the salt, the last of the granular contaminants. Second to the last was the oil and brake fluid mixture. The contaminant to have the least time was the oil and antifreeze mixture.

The results concluding my second experiment were that the salt had the greatest affect on the oil. The oil and sand mixture was the contaminant to have the second highest time. Third was the control test. Preceding the control test was the oil and sugar. The brake fluid was the first of the liquids to have the highest time. Followed by the antifreeze. Lastly was the water contaminated oil having the least time.

Conclusions/Discussion

To conclude this experiment I found that there is no "safe" contaminant to mix with oil. As shown in my experimentation none had the same consistency as the 30 wt. Oil.

Summary Statement

Determining whether liquids vs. granular substances when contaminating oil have any affect on oil's viscosity when heated.

Help Received

Mother helped edit papers.

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)

Zachary E. Ogden

Project Number

J0131

Project Title

Model Rocketry: The Correlation between Increased Weight and Decreased Altitude

Abstract

Objectives/Goals

The goal of my experiment was to determine if there is a correlation between increased rocket weight and decreased rocket altitude. I think that after my experiment I will be able to predict how high the rocket will go if I put on a certain amount of weight. I predict that there will be a linear correlation between increased rocket weight and decreased rocket altitude.

Methods/Materials

I launched a 16" long, 1" diameter, 1.6-ounce Estes model rocket seven times at a 90 degree angle; weighted with lead shot in the nose cone at 20-gram intervals, starting at zero and going up to 140 grams using an Estes B6-4 engine. Prior to launch, I set up a 200-meter baseline with a standard tape measure for altitude calculation. I used an Apogee Altitude Tracker and Apogee Altitude Calculator to determine the altitude of each launch. Each launch was completed using the same launch procedures and on the same day with the same temperature and wind conditions.

Results

The initial test showed a height of 180 meters. Each altitude after that was reduced in correlation to the added weight by approximately 40 meters per launch, until flight 4 when it was thereafter reduced by 23 meters per launch. The rocket was damaged on the seventh launch due to the weight did not give the parachute enough time to release.

Conclusions/Discussion

I conclude that there is a nearly linear correlation between increased rocket weight and decreased rocket altitude. The data were not able to conclude the correlation was as linear as I predicted due to possible human error in measuring the angle of flight and limited number of data points. I planned to verify the results using the same rocket and different engines; however, that was not possible due to the damage the rocket received on the launch with 120 grams added. These data suggest that using this correlation I can apply it to any rocket engine, given the zero-weight altitude.

The linear correlation can be related to real-world applications by applying how weight would affect rockets (manned and unmanned) and satellites. The correlation could ensure that too much weight was not added.

Summary Statement

My project was designed to determine if there was or was not a linear correlation between increased model weight and decreased model rocket altitude.

Help Received

Mom helped purchase materials, friend Ryan took photos, Dad surpervised launches and reviewed my data.

Name(s)

Zachary D. Olsen, Jr.

Project Number

J0132

Project Title

How Does the Fin Size Affect the Trajectory of a Projectile?

Abstract

Objectives/Goals

The objective of this project was to determine what fin size will make my rocket go the top velocity, and top height that it will go.

Methods/Materials

Six different sized fins with the same shape were put on the same rocket, flown three times each and recorded. Every rocket that was flown was propelled by the same amount of thrust with a B4-4 engine. The project shows that I recorded height, velocity, and distance from the launch pad; all the equations that I used were basic common knowledge equations.

Results

The rocket with the second to the smallest fin went the highest, the smallest fin went the lowest, and the biggest fin went second to the lowest.

Conclusions/Discussion

My conclusion for this project is that fin size has an important role in stability. The more stability on the rocket more friction. The more friction that the rocket has the total height.

Summary Statement

To find a perfect fin size according to the manufactures fin shape.

Help Received

Mr. Hodges, who mentored me and inspired to put more effort into my board. Crag Baker, who gave me helpful advice, in the field of aerodynamics. Mom for giving me support though out the project.

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)

Patrick J.G. Saris

Project Number

J0133

Project Title

Positive Effects of Turbulence on Wind Turbines

Abstract

Objectives/Goals

The objective is to determine how the surface texture and shape of turbulators affect turbine rotor performance. I hypothesize that turbulators with a textured surface or a zigzag shape will result in greater performance than turbulators with a smooth surface or rectangular shape.

Methods/Materials

A wind tunnel and rotor were built. The rotor was made with two left wings of an airplane with zero angle of attack. Six turbulators of equal surface area were made with different texture/shape combinations: fine sand paper/zigzag, coarse sand paper/zigzag, ribblets/zigzag, smooth/zigzag, ribblet/rectangle, smooth/rectangle. Each was tested on the rotating rotor three times for three minutes each. Voltage generated was recorded with a Vernier probe.

Results

The turbulator made with the ribblet/zigzag combination consistently improved rotor performance the most. The smooth/rectangular turbulator actually decreased rotor performance.

Conclusions/Discussion

Turbulators are known to prevent laminar flow separation by generating microturbulence, increasing lift and decreasing drag.

My conclusion is that both surface texture and shape of the turbulators affect rotor performance and that turbulators with ribblets in a zigzag shape will significantly improve the performance of wind turbines.

Summary Statement

This project investigates how the shape and texture of turbulators affect the performance of wind turbines..

Help Received

Probe ware and revising draft of the paper; Science teacher Mr. Garcia. Help with statistical analysis; Math teacher Mrs. Argano-Rush. Mentor aerodynamics; Dr. Nando Timmer, Section Wind Energy, Delft University of Technology, The Netherlands. Engineering mentors; Mark Kramer, Pat Masse. Parents

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)

Zachary R. Schmidt

Project Number

J0134

Project Title

Pitch Control: An Analysis of Pitch

Abstract

Objectives/Goals

In this project I will attempt to find the right combination of variables to generate electrical power at low wind speeds without having too much force exerted on the wind turbine at high wind speeds.

Methods/Materials

I used 14 inch model airplane propellers for the wind turbine blades and a small, 3 VDC hobby motor as the generator. I also soldered a network of 5 electrical switches and 5 ohm resistors so that as more resistors were switched on, the resistance decreased, which put more load on the generator. A gear box was also added to increase the speed of the generator, since it was designed to spin at 11,000 RPM. To measure the force, I mounted the turbine on a stand in the wind tunnel that pivoted away from the wind as more force was applied. When the stand moved due to the force, I measured it with a yardstick and recorded it in my notebook.

Results

The 16:1 gear ratio produced the most power with the 4-blade design. The 4-blade design produced 3X more power than the 25:1 at all 3 wind speeds. The 2-blade design produced 4X more at the highest wind speed and 1.5X more at the lowest wind speed.

Conclusions/Discussion

According to my results, I conclude that as the pitch angle increased, the force increased. This is because the blades become more efficient at extracting power from the wind from a higher TSR. Wind turbine blades take power from the wind by slowing it down. This is done by applying a force to the wind and the wind applies that same force to the blades.

My data also shows that as the force increased, the electrical power increased. Force can be defined as mechanical power, therefore, as the mechanical power from the wind increases, the electrical power increases.

The key to a good wind turbine design is one that will generate the most amount of electrical power with the least amount of force. The best combination of blades, gear ratio and pitch angle is 4 blades, 16:1 gear ratio and 60 degree pitch angle. This is because the 4 blade can generate enough torque to prevent stall conditions, and at 16:1 gear ratio, the 4 blade produced the most electricity. Also, at 60 degree pitch angle, the 4 blade produced a lot of electricity with a medium amount of force.

Summary Statement

My project is about finding the right combination of variables to generate the most power with the least amount of force on the wind turbine.

Help Received

Dad financed this project and helped me build the wind tunnel. Mom corrected the grammer in the report. Nicholas donated piece needed for the experiment.

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)

David P. Shelton

Project Number

J0135

Project Title

Invention and Trial of an Air-Propelled Car

Abstract

Objectives/Goals

My project was to determine whether my air-propelled car would have the highest velocity and acceleration using a 4 inch 3 bladed propeller, a 6-inch 2 bladed propeller, or a 4-inch 2 bladed propeller. I think the three bladed propeller will have the highest velocity and acceleration, the 6-inch 2-blade propeller will be next, and the 4-inch 2-blade propeller will have the least velocity and acceleration.

Methods/Materials

I constructed a car that was propelled by a model airplane propeller that was run by an electric motor. I then ran the car on a straight 26 foot course, starting from a standstill, and measured the time it took it to get to the various points using different propellers. I ran the different propellers over the course 5 times, sometimes more if there was a "no time" on one of the trials, and used the average times to calculate the velocity and acceleration at each point.

Results

The 3-blade propeller was the fastest and had the most acceleration, the 4-inch 2 bladed propeller was slowest and had the least acceleration, and the 6-inch 2 bladed propeller was in the middle. There was very little difference between the 3-blade and the long 2-blade propellers, but there was a lot of difference between those two and the short 2-blade.

Conclusions/Discussion

My conclusion is that the three bladed propeller and the long two bladed propeller performed the best and were very close in speed and acceleration and the short two bladed propeller was far behind.

Summary Statement

I compared velocity and acceleration of my air car using different propllers.

Help Received

Mother typed most of the report from my dictation, helped with the layout, and helped with the stopwatch timing. Dad did the work that required power tools.

Name(s)
Ashley E. Sulzen

Project Number
J0136

Project Title
What Is the Most Productive Pitch for an Electric Generating Prop at Various Wind Speeds?

Abstract

Objectives/Goals
My objective was to find the most productive pitch for an electric generating prop, or windmill, at various wind speeds. I wanted to know which pitch, at which wind speed, would produce the greatest energy output. I thought that at the highest wind speed a higher degree of pitch would be more efficient, while at lower wind speed a lower degree of pitch would be more efficient.

Methods/Materials
To do this experiment I set up my windmill after constructing it, as well as a cardboard box, which served as a wind tunnel and stopped any other factors from affecting my results. Then I connected a voltmeter to the windmill to display the data. I tested each degree of pitch from 5-15 at high, medium, and low wind speeds. While the blades of the windmill turned I recorded the highest and lowest readings in millivolts. I then averaged the two to get my results.

Results
I found that at the lowest wind speed setting the most efficient pitch was 10 degrees, at medium wind speed, 9 degrees, and 8 degrees at high wind speed. Therefore, I found out which pitch was the most productive for each different wind speed.

Conclusions/Discussion
My results did not support my hypothesis but proved it incorrect. The information I have learned is important because wind is a source of energy that will not run out. It will always be available. If we adjust the pitch to the most productive degree according to the wind speed we can make windmills more efficient and they may become a strong source of energy.

Summary Statement
I wanted to find out what was the most productive prop pitch at three different wind speeds.

Help Received
Mr. Joe Krainock, my teacher, gave me my backboard and lots of instruction and examples on how to do a science fair project. Mark Sulzen, my Dad, halped me build my windmill hub and create charts. At my school, Olive Pierce Middle School, I was able to do research. Linda Sulzen, my Mom, helped me make

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)

Sarah E. Whipple

Project Number

J0137

Project Title

Explaining Lift and Drag Using Newton's Laws

Abstract

Objectives/Goals

The objective was to explain what causes lift and drag on an airplane wing. I have designed and built a low speed wind tunnel to show that a simple mathematical model based on Newton's 2nd and 3rd Laws of Motion gives reasonable predictions of lift and drag forces for small angles of attack and wind speeds.

Methods/Materials

I built my wind tunnel in our garage using materials found around the house, plus a few inexpensive items purchased from the hardware store. I measured the angle of attack using a plastic protractor. The measurements of the lift forces were made with a common kitchen scale. Wind velocity was measured with a homemade anemometer.

Results

I demonstrated that lift and drag on an airplane wing do, in fact, follow Newton's Laws for small angles of attack. I showed that lift increases as the sine of the angle between the wind direction and the wing cord, and that drag increased as one minus the cosine. I also showed that both lift and drag increase as the velocity of the wind squared.

Conclusions/Discussion

My project taught me many math and science basics. First, I learned how to calculate the mass of a certain volume of air. I learned that air moves smoothly over the wing contour for small angles of attack. I learned that force, velocity, and acceleration are vector quantities, i.e., they have both magnitude and direction. I learned how to calculate the horizontal and vertical components of these vectors with simple trigonometry. Lastly, I learned how to apply Newton's Laws to these components.

Summary Statement

My project uses a wind tunnel that I designed and constructed to show how Newton's 2nd and 3rd laws of motion explain the forces of lift and drag on an airplane wing.

Help Received

Father introduced me to Newton's Laws of Motion, and helped to cut materials for wind tunnel.