CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY

Name(s)

Arthur Kumalo Alm

Project Number

J0101

Project Title

Bicycle Wheel Wind Turbines

Abstract

Objectives/Goals

The idea of this test is to find out what the most efficient way is to wrap duct tape around bicycle wheel spokes to turn them into wind turbines. I will test two blade designs, blade design a having nine solid blades and blade design b having eight split blades.

My question is what blade design, a or b will generate more electricity?
My hypothesis is that it will design a will have a larger power output.

Methods/Materials

My original plan was to put both wheel designs, (at separate times) next to a fan. The wheel would turn a generator, and the voltage drop across a resistor would be measured. I'm going to try 1 ohm, 10 ohm, and 100 ohm resistors. Using Ohm's law, i=v/r, I can find the current. Then I can multiply the current by the voltage to get the power. However, the generator we had would not be spun by the wind with either blade design, even when the wheel was moving at about 240 rpm.
I did have a wheel with a generator built into the hub, which I was able to get spinning in the wind with design b at around a Beaufort wind scale of four. I then modified my plan to
1.Test for the better blade design just as in my original plan, but without the generator,
2.Put whichever design turned out to be better on the wheel with the hub generator, and
3.Do more tests with the new wheel.

Results

Design A on average reached 97 rpm, but that included an outlier test that got up to 110 rpm. When I deleted the outlier test, the average came out to 86 rpm. Design B on average reached 97 rpm. The torque on design a was .0465 Newton metres (Nm), as compared to .057 Nm on design b.

Conclusions/Discussion

I found that design b is a more efficient wheel design, and I will continue to do real world tests with design b.

The fact that the generator wouldn't turn when the wheel was going 240 rpm was surprising to me given the rough calculation that
A biker at a moderate speed would be going at about 10 mph,
27 inch diameter of the wheel would make about 90 inch circumference, or 7.5 feet,
5280/7.5 is aprox.700, making 700 rotations in a mile,

Summary Statement

I made two different designs of bicycle wheel wind turbines, and tested them with a fan and in various outdoor wind conditions for rpm, voltage generated, and torque.

Help Received

Art Alm, for helping me design and test my experiment, and Patty Freedman, my mentor.

Name(s)
Jonah Z. Bard

Project Number
J0102

Project Title
Wind Turbine Layout Optimization for Energy Efficiency

Abstract

Objectives/Goals
The objective of this experiment is to ascertain the energy generation differences between varied placements of wind turbines.

Methods/Materials
A 6ft x 12 ft x 4ft wind tunnel was constructed from a metal frame and large tarpaulin to maintain airflow, coming from six box fans. Six small-scale wind turbines were placed in different configurations, including a staggered group (based on migrating bird formations) and a stacked group (turbines places one in front of the other), in addition to varying spacing between rows within each group. Voltage was measured and recorded six times for each arrangement, with a system of switching the turbines around, so each turbine could be placed in every possible position.

Results
The results showed that one-in-front-of-the-other (stacked) configurations will generate more energy than staggered configurations. Overall averages comparing the groups showed that the stacked group produced .9V, 20 percent more than the staggered group, at .75V. The results additionally showed that with the increase in spacing of turbines, energy decreased, at an average of .0475V for every 4 inches.

Conclusions/Discussion
Contrary to the hypothesis, closer, stacked spacing of wind turbines maximized energy production. The experiment presented rough but constant averages which can be helpful as supporting data for additional experimentation. If confirmed by additional tests, the information could lead to greater efficiency in wind turbines, advancing the field of renewable energy.

Summary Statement
I determined the most energy-efficient relative placement configurations of wind turbines.

Help Received
Science teacher provided input for design of experiment and feedback for parts of report, math teacher gave input on wind tunnel design, family helped build wind tunnel

Name(s)
Zachary S. Barnes

Project Number
J0103

Project Title
A Hole in One for Aviation

Abstract

Objectives/Goals
The objective was to find if dimples on the top of an airfoil would allow it to generate more lift and less drag than a conventional airplane wing.

Methods/Materials
9-inch long airfoil, wind tunnel, computer with LoggerLite Pro. Tested 6 times, 3 for lift and 3 for drag, then added 10 dimples evenly spread across top, until reached 50 dimples.

Results
I found that dimples on an airfoil do decrease drag and increase lift, but they create extra turbulence, which makes for a bouncier wing.

Conclusions/Discussion
I tested to see if dimples could be something that would improve efficiency on an airplane wing and found that they do help decrease drag and increase lift, but they create extra turbulence.

Summary Statement
I tested to see if dimples could be something that would improve efficiency on an airplane wing and found that they do help decrease drag and increase lift, but they create extra turbulence.

Help Received
Scott Barnes (Dad) helped me construct my airfoil and test it in the wind tunnel. Jennifer Barnes (Mom) helped me layout my board, and Elizabeth Conrad (Science Teacher) allowed me to borrow her wind tunnel and helped me through the registration process for the Orange County Science Fair.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY

Name(s)

Ayaan S. Bhatkar

Project Number

J0104

Project Title

Improving Wind Turbine Efficiency

Abstract

Objectives/Goals

The purpose of this experiment is to determine which variable (the number of blades, length, or pitch of blades) has the greatest impact on wind turbines' electricity generation

Methods/Materials

3 wind speed window fan, Voltmeter, DC motor, wooden strips, 5 inch 4 blade, 3 blade and 2 blade propellers. 7 inch 4 degree and 6 degree pitch angle 2 blade propeller

I took 10 voltage readings for each blade at each wind speed, tabulated it, averaged readings for each blade at each wind speed and compared the results

Results

1) Number of Blades: The 4 blade 5 inch turbine was the most efficient across all wind speeds with an average of 0.22 V across all wind speeds and the 2 blade 5 inch turbine was the least efficient with a 0.16 V average. However, the 2 blade turbine was the most efficient at the highest wind speed with 0.27 V generated.
2) Length of blades: The 7 inch blade turbine was the most efficient across all wind speeds. However, the 5 inch blade turbine was the most efficient at the highest wind speed
3) Pitch Angle: The 4 degree pitch angle blade turbine was the most efficient across all wind speeds compared to the 6 degree pitch angle blade turbine

Conclusions/Discussion

Different blades may be required to get peak efficiencies from a wind turbine in different wind conditions. A 4 blade or longer blade turbine may be the most efficient where the wind speed varies a lot. However, in an area where the winds are consistently high, a 2 blade turbine or smaller blade turbine may be more efficient.

Lower pitch angles improve the efficiency of the turbine

Summary Statement

One type of blade may not be optimal for wind turbines under all wind conditions; the number and size of blades for a turbine should depend on the wind conditions where it will be installed

Help Received

I designed the project myself. However my dad bought all the materials needed and my advisor, Ms. Najwan, ensured that I stayed on task and completed my project on time

CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY

Name(s)

Lalitha S. Dhyaram

Project Number

J0105

Project Title

Which Is the Optimum Model Rocket Fin Shape to Reach the Highest Altitude?

Abstract

Objectives/Goals

The objective of this project is to determine which fin shape will allow a model rocket to reach the highest altitude.

Methods/Materials

Estes Alpha III model rockets, poster board and balsa wood sheet. Make new fin mounts by cutting different fin shapes out of balsa wood and making new fin mount tubes with poster board; replace Estes plastic fin mounts. Rockets are assembled with new and varying fin mounts. Launch each model rocket 3 times, recording both the inclinometer and altimeter results for each flight.

Results

Assembled rockets had the following fin shapes; (trapezoid, rectangle, square, triangle, clipped delta, asymmetrical parallelogram, elliptical, pointed ark, & original Estes model). Averages by test number to the nearest centimeter bring these overall results - 40.29 m, 36.08 m, 41.26 m, 45.28 m, 45.02 m, 54.61 m, 40.82 m, 40.66 m, and 39.43 m respectively to the fin shape order given. These results suggest that the asymmetrical parallelogram fin shape on a model rocket is the best in reaching the highest altitude.

Conclusions/Discussion

Repeated launch trials of 9 model rockets with different fin shapes showed that the asymmetrical parallelogram fin shape performed better than the other fin shapes. This means that having a fin mount with asymmetrical parallelogram shaped fins made from balsa wood on a model rocket provides a significant increase to the altitude reached by the model rocket.

Summary Statement

I measured the altitude that each model rocket reached and found that the asymmetrical parallelogram fin shape is the best fin shape on a model rocket to reach the highest altitude.

Help Received

I designed the fin shapes and assembled the rockets myself. I got help from my Science teacher in reviewing my project reports. I got help from my mom in cutting out the fin shapes from the balsa wood. I got assistance from my parents for transportation to the launch site.

Name(s)
Eric R. Dubois

Project Number
J0106

Project Title
The Best Seawall to Save Our Highways

Abstract

Objectives/Goals
I wanted to learn which type of seawall is the most efficient to prevent coastal erosion.

Methods/Materials
The idea for this project was to find the most efficient seawall to use to protect the highway and bluffs. I built a homemade wave tank out of wood and plexiglass and tested the following seawalls: The rock wall, which we already have. The standard wall, which is the most common. The rock wall submerged, which is experimental and hasn't been used before. And finally, the recurve wall, which was predict to be the most effective. For each wall, there were ten trials. In each trial, six consistent waves were created and sent towards the wall that was in place, and the water that flowed over the top of the wall was collected and recorded in a reservoir in the back of the tank.

Results
I predicted that the recurve wall would have the least amount of overflow because the water would go up the wall like a skateboard on a halfpipe, then fall over itself. I predicted that almost no water would go over the wall. My hypothesis was correct. This wall worked very well, with almost no overflow, as I predicted. The average overflow on the recurve wall was 11 ML of water, the 2nd best wall was the rock wall, with an average overflow of 39.5 ML of water. The average overflow for the standard wall was 360 ML, whereas the average overflow for the rock wall submerged was 158.9 ML.

Conclusions/Discussion
Based on the results, if you want to reduce erosion in your area, and if you had the money, you should go for the recurve wall, because it is the most efficient, and almost no water went over the top of the wall. But, if you don't have the money, you should go for the rock wall because it works almost as well as the recurve wall, and is a lot cheaper.

Summary Statement
I tested different types of seawalls in order to prevent coastal erosion. I found that the most efficient seawall was the recurve wall.

Help Received
Both of my parents helped me in this project. My dad helped me build the wave tank and my mom helped me edit my writing.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY

Name(s)

James D. Fagan

Project Number

J0107

Project Title

Design of a Low Density Subsonic Wind Tunnel for Martian Research

Abstract

Objectives/Goals

My objective was to build a wind tunnel that could simulate the low density environment of Mars.

Methods/Materials

I constructed a closed circuit, double return wind tunnel using schedule 80 PVC pipe, which has a vacuum capacity of 30 Hg. I used an electric model airplane fan for my tunnel wind source. This was powered by a 12 volt power supply. A thrust tester was used to control the fan RPM. Air velocity was measured by a anemometer that I modified to work inside the enclosed tunnel. I built my tunnel's settling chamber using 3 flanges, which allowed me to remove or exchange various screen mesh assemblies. A removable honeycomb section was built, also using flanges to install it into the settling chamber. String probes were built into the tunnel viewing ports for flow visualization. 12 airfoils were built with magnets attached for attaching to the viewing ports. A strain gauge was built into my test section for measuring drag and thrust forces. Several different tunnel configurations were tested before final assembly: single return, double return, single nacelle, dual nacelle, 90 degree corners, 2x 45 degree corners. Each was also tested with and w/o turning vanes. Each configuration was evaluated for flow quality and air speed.

Results

After conducting over 220 tests, I have determined that a double return tunnel is more efficient than a single return tunnel, given equal return passage diameters, that wind tunnel corners comprised of 8 x 45 degrees are more efficient than corners comprised of 4 x 90 degrees. The less abrupt 45 degree corners decreasing energy loss by 7.2% on average, 10.19% in my final chosen double return design. I tested individual settling chamber screens as well as combinations for best tunnel flow quality, and also determined screen losses to be cumulative. I found turning vanes not only improved flow quality as I had expected, but surprisingly they actually increased air speed as opposed to no turning vanes by approx. 5%.

Conclusions/Discussion

My low density tunnel will allow testing of aerodynamic forces to see if they occur in the same proportion as expected, or if entrainment or Coanda effect were greater or lesser due to increased molecular spacing of the Martian atmosphere, ultimately affecting lift generation associated with Bernoulli's principle. This is vital to know for the proper design of an efficient Mars aircraft.

Summary Statement

I have designed and constructed a wind tunnel to simulate the Martian atmosphere to test aerodynamic forces in its lower density environment.

Help Received

I designed and built the tunnel on my own. Mrs Duncan, my woodshop teacher allowed me access to the shop after school to build my tunnel components. Ms Mcallister, my science teacher was always helpful in suggesting where to get supplies, websites helpful in graph production, and critiquing my raw data.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY

Name(s)

Brady C. Fendt

Project Number

J0108

Project Title

Soaring High with Rockets: How Fin Length Affects a Rocket's Maximum Altitude

Abstract

Objectives/Goals

My objective for this project is to determine how a rocket's fin length affects its altitude.

Methods/Materials

Balsa wood, model rocket kit, c6-5 motors, epoxy resin, altimeter, launch pad. Launched rocket 3 times for each fin configuration and recorded the altitude reached.

Results

The shortest fin configuration yielded the highest mean altitude, but only by one foot over the medium fin configuration. the medium fin configuration yielded the two highest flights of the experiment, but one low outlier brought down the average.

Conclusions/Discussion

In conclusion, the shortest fin configuration yielded the highest average flight, but only by 1 foot over the middle fin configuration. The middle wingspan may have been the best had the 1st launch not curved at ignition (lost a fin) causing an outlier in data. The longest fin configuration was clearly the worst performer, averaging roughly 70ft lower than the short fin configuration.

Summary Statement

Through the process of launching the rocket, I determined that fin length definitely affects flight; shorter fins equals higher altitude reached.

Help Received

I received help while building, launching, and fixing the rocket, building my project board, and help from my science teacher on any questions I needed answered.

Name(s)
Grace F.S. Hanson

Project Number
J0109

Project Title
Testing Building Designs with a Wind Tunnel

Abstract

Objectives/Goals
I wondered if you could reduce the damage caused by high winds by using different building designs. This inspired my question, "Which building designs are better for areas that experience high wind phenomena?" I evaluated three sets of variables: shapes, surface treatments, and the use of wind barriers. My hypothesis was that a hemisphere shape with a dimpled surface with a tall wall would be impacted the least by wind.

Methods/Materials
A wind tunnel with Vernier force sensors was built and tested. Next, test objects were created with volume as the common factor for comparison. Initially, I used clay over forms to create objects. Because these cracked, I could not repeat the tests. I used molds and Fix-It-All to create a second set of shapes. A test protocol was created to establish the validity of the data. Each object was then placed on the platform in the wind tunnel. Smooth surfaced objects were used for the comparison of shapes. Smooth, rough and dimpled surfaces were used for each shape in the comparison of surface treatments. Finally, each shape with each surface feature was tested using no wall, a short wall and a tall wall.

Results
For the shape study, I compared a cube on its side and its edge, a cylinder, a pyramid on its side and its edge, a cone, and a hemisphere. The pyramid edge, cone, and hemisphere experienced drag that was closer to zero than the cube side, cube edge, cylinder, and pyramid side. In the surface study, the rough surface provided the most improvement for the cube side, the cube edge, the pyramid side, and the cone. For the hemisphere and the cylinder, the different surfaces did not substantially affect the drag on the object. In the barrier study, the short wall reduced drag for every test object. The tall wall appeared to create strong eddy currents. Often, these eddy currents produced wind forces greater than or equal to the force of the wind without a wall but in the opposite direction.

Conclusions/Discussion
The least wind-impacted shapes were the pyramid edge, cone, and hemisphere. The rough surface provided the best improvement for the cube side, cube edge, pyramid side, and cone. For the hemisphere and the cylinder, no surface feature was more favorable. The short wall produced the best wind barrier results. These data proved my hypothesis to be incorrect. This data can be used to help design buildings to lessen the impact of high wind.

Summary Statement
My project was to determine which building shape and building surface experienced the least amount of drag as well as the impact of barriers on the drag.

Help Received
My Dad helped me build the wind tunnel. My mom helped me with editing my report. I would like to thank my teacher, Mr. Blum, for encouraging me.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY

Name(s)

Nolan Hanson; Max Poveda; Robert Ramirez

Project Number

J0110

Project Title

How Does Rocket Design Affect the Distance of Flight of an Air Pressure Rocket?

Abstract

Objectives/Goals

The objective of this study is to determine the distance of flight, using air propulsion and different designs of rockets.

Methods/Materials

Bike pump, rocket launcher, various lengths of string, tape measure, PVC pipe, foam, styrofoam, cardboard, paper, wax leaves, cardstock.

Results

Three rockets were created with different materials and design, then launched using air propulsion, and the distance of each flight was recorded. Repeated trials were run to determine which rocket design flew the farthest consistently. This difference clearly showed how the material and design affected the distance of flight.

Conclusions/Discussion

Repeated trials with various rocket designs launched revealed clear differences in their aerodynamics. It is concluded that the design and the materials used to create rockets has a direct impact on the distance of flight.

Summary Statement

We showed that a rocket's design has significant impact on it's aerodynamic capabilities.

Help Received

None. We designed, built, and performed the experiments ourselves.

Name(s)

Braedyn D. Hutchison

Project Number

J0111

Project Title

The "Sweetest" Rocket Candy: Evaluating Sucrose, Glucose, and Fructose as Fuels for Sugar-Based Solid Rocket Motors

Abstract

Objectives/Goals

Determine which sugar among Sucrose, Glucose, and Fructose makes the best choice of sugar fuel for sugar-based solid propellant motors. Gain experience with materials, equipment, methods, and safety precautions necessary for continuing research with higher-energy composite and electric solid propellants that are relevant for modern launch, orbital, and space operations.

Methods/Materials

Solid propellant motors were prepared using a Potassium Nitrate (KNO_3) oxidizer with Sucrose ($C_{12}H_{22}O_{11}$), Glucose ($C_6H_{12}O_6$), and Fructose ($C_6H_{12}O_6$) sugar fuels. Observations regarding ease of preparation were recorded. A reusable test motor harness and test firing safety cage were constructed of durable materials to ensure safe and consistent test conditions. Thrust measurement equipment was constructed using a strain-gauge-based single-point load cell, a voltage-regulated instrumentation amplifier circuit, an analog-to-digital data acquisition device, and a laptop computer. High-sample-rate thrust data were recorded during test firings of motors prepared with each sugar fuel. Data were analyzed in terms of performance metrics and statistical significance/validity.

Results

Qualitative observations regarding ease of solid propellant motor preparation as the average ordinal ranking among six factors were: Sucrose = 1.67, Fructose = 2.00, and Glucose = 2.33. Quantitative measurements (and ordinal ranking) of the average specific impulse produced by solid propellant motors were: Sucrose = 129.41s (1), Glucose = 126.17s (2), and Fructose = 124.20s (3). Total scores (qualitative average rank + quantitative rank) were: Sucrose = 2.67, Glucose = 4.33, and Fructose = 5.00.

Conclusions/Discussion

The experimental results of this project provide a clear answer to the research question: Among Sucrose, Glucose, and Fructose, Sucrose (score = 2.67) makes the best choice of sugar fuel for sugar-based solid propellant motors; Glucose (score = 4.33) makes the second best choice of sugar fuel; and Fructose (score = 5.00) makes the third best choice of sugar fuel. These results help inform the amateur rocketry community regarding the preparation and use of sugar-based solid propellant motors for small-scale rocketry. Further, knowledge and experience gained via this project enable continuing research into preparation and use of composite and electric solid propellants which are extremely relevant in current rocketry operations.

Summary Statement

This project determined which of Sucrose, Glucose, and Fructose makes the best choice of sugar fuel for sugar-based solid rocket motors when evaluated in terms of both quantitative thrust performance and qualitative ease of preparation.

Help Received

Adult supervision and assistance by Tre Hutchison for procedures involving potential safety concerns, including: operating power tools on exceptionally durable materials, transferring molten propellants to molds, and designing safety equipment.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY

Name(s)

Mohammed Khan

Project Number

J0112

Project Title

Miracle of Flight: Design of Split Scimitar and Blended Winglets Using Computational Flow Dynamics

Abstract

Objectives/Goals

In my project, I designed the split scimitar winglet, blended winglet, and the wing with no winglet using Autodesk Inventor, AutoCAD software, at different cant angles of directly proportional to various angles of attack. Using the measurements from AutoCAD, I performed computational flow dynamics (CFD) with Auto Foam software to calculate the Lift Coefficient, Drag Coefficient, and the Lift-to-Drag ratio. The purpose was to determine which design can increase in better fuel efficiency and better aircraft performance.

Methods/Materials

My designs were made using an Autodesk AutoCAD software program using my measurements and dimensions. The measurements of these designs were fed into autofoam CFD Software using the Navier Stokes equations to calculate pressure, momentum, Drag coefficient, Lift coefficient, and lift-to-drag ratio.

Results

The thirty degree blended winglet has the most Lift and Drag at various angles of attack. But if you put into a lift to drag ratio, the split scimitar winglet has the most lift to drag ratio. The split scimitar winglet is the most fuel efficient at 4-degree angle of attack

Conclusions/Discussion

Finally, I concluded that the split scimitar winglet which is the 90-degree winglet is the most fuel efficient. This means that this design can reduce the most wingtip vortices and drag. I also concluded that the wingtip vortices increase with an increase of an angle of attack. The split scimitar winglet increased by 2% lift than the blended winglet. This means that it can save 5 million gallons of fuel within its design.

Summary Statement

My project is a experimental design of split scimitar and blended winglets at different cant angles using computational flow dynamics.

Help Received

I designed autocad design and computational flow dynamics myself. I was trained on autodesk and computational flow dynamics by my teacher Mr. Charles Pascal

CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY

Name(s)

Owen W. L'Heureux

Project Number

J0113

Project Title

The Effect of Wing Configuration on Pressure

Abstract

Objectives/Goals

This project was an investigation of how different wing configurations affect the pressure measured on aircraft.

Methods/Materials

Using an engineering application called SimScale that performs computational fluid dynamics (CFD), I set up wind tunnel simulations for three wing configurations; straight, swept, and forward swept. I kept the same fuselage with the different wings attached. Each configuration was subjected to 80 m/s winds.

Results

The swept wing, as predicted, did have the least pressure, but unexpectedly the forward swept wing had the most. The average pressures on the combined wing and fuselage were: 134 psi for the straight wing, -69 psi for the swept wing, and 494 psi for the forward swept wing.

Conclusions/Discussion

This investigation contributes to science it because provides measurements of different wing configurations. Knowing exactly how much a wing changes flight characteristics can be important for aerospace engineering and maximizing the efficiency of an aircraft, and my project makes contributions towards this.

Summary Statement

I found that forward swept wings experience the most pressure and swept wings experience the least.

Help Received

The model and simulation were designed without external help and Dr. Warrick of the USGS assisted me in extracting the data.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY

Name(s)

Amelie G. Leviant

Project Number

J0114

Project Title

Polyvinyl Alcohol Slimes: Measuring How pH Correlates to Viscosity in a Non-Newtonian Fluid

Abstract

Objectives/Goals

The objective of this project is to explore how the viscosity of slime (a non-Newtonian Fluid that happens to be fun) changes as the pH of the cross-linking solution (sodium tetraborate) increases, with the ultimate goal of determining the pH level at which the maximum degree of viscosity is obtained for any fixed volume of cross-linking solution.

Methods/Materials

Used weight measured quantities of sodium tetraborate mixed into distilled water to create solutions of sodium tetraborate ranging from 1 to 7 percent. In multiple trials for each solution strength, the pH of the sodium tetraborate solution was measured, and then 10ml of sodium tetraborate solution was mixed into 100ml of 4 percent polyvinyl alcohol (PVA) solution. After a cross-linked polymer was formed, the viscosity was measured in multiple trials by timing the descent of a metal bearing through the PVA slime to the bottom of a cylindrical container.

Results

For a ration of 10ml of sodium tetraborate solution to 100ml of 4 percent polyvinyl alcohol (PVA) solution, viscosity measurements plateaued at the 4 percent sodium tetraborate solution concentration and pH were observed to plateau just above that concentration, at the 5 percent sodium tetraborate solution concentration.

Conclusions/Discussion

For purposes of identifying polyvinyl alcohol (PVA) slime with optimal characteristics, understanding how different parameters impact viscosity permits the formulation of a recipe that is best suited to the application. For example, PVA-type slimes used for industrial clean-up purposes may have narrow ranges for operating viscosity because the slime must be piped over substantial distances. For commercial or recreational purposes, a child using slime as a toy would likely prefer an intermediate viscosity product that is highly elastic but still cohesive (cohesion also likely important to a parent, as the ability to clean up slime would depend upon its viscosity).

Summary Statement

I showed that the viscosity of polyvinyl alcohol slime increases and then plateaus as the concentration of sodium tetraborate in a cross-linking solution is increased to locate an optimal viscosity point for a fixed mixture ratio.

Help Received

My science teacher, Mrs. Cathy Grimes, discussed experimental approaches with me, but I developed the idea of measuring viscosity myself after reading about the chemistry involved in creating non-Newtonian polymer slimes.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY

Name(s)
Graham M. Luckin

Project Number
J0115

Project Title
The Effect of Different Golf Ball Dimple Patterns on Travel Time in a Fluid

Abstract

Objectives/Goals
I am determining which golf ball dimple pattern travels the fastest through a fluid.

Methods/Materials
I took 5 different patterned golf balls and dropped them in a 1.8 meter long tube filled with water. I dropped each golf ball into the tube 15 times and timed how long it took to go from the start line to the end line.

Results
The different golf ball dimple patterns did effect the travel time through a fluid. The golf ball with 4 large circles and one small circle traveled the fastest while the golf ball with no specific pattern and a variety of dimple sizes traveled the slowest.

Conclusions/Discussion
Having circle shaped dimples with little gaps between the dimples allows for better fluid flow around golf ball. The ball that traveled the slowest had larger gaps between the dimples which slowed down the golf ball as it traveled through the fluid.

Summary Statement
I found that different dimple patterns do effect the time it takes for a golf ball to travel through a fluid.

Help Received
None. I designed and tested by myself.

Name(s)

Charlotte B. MacAvoy

Project Number

J0116

Project Title

Exploring an Ancient Wonder: Understanding the Difference in Height, Viscosity and Tube Diameter Has on a Siphon

Abstract

Objectives/Goals

The goal of my project was to find how the difference of height, tube diameter, and viscosity has affects flow rate of a siphon. I hypothesized that thinner tubes and higher viscosity would have slower flow rates and that rung height would not change the flow rate. I used my new understanding of a siphon to prototype a perpetual siphon sink.

Methods/Materials

My project explores the effect that tube diameter and viscosity of a liquid have on a siphon at different heights. Viscosity variables were water, acetone, and canola oil. 5 different tube diameters (0.4cm, 0.6cm, 0.8cm, 1.2cm, 2.5cm) and 3 different rung heights (87cm, 116cm, 145cm) using a ladder were tested. Tube length and temperature were constant. Testing sequence was as follows: 1. fill the tube with the liquid, 2. manually seal both ends of the tube, 3. rest tube over rung, 4. simultaneously release seals while starting the timer, 5. stop timer when bubbles first enter tube and record time. Flow rate was calculated as volume per time (mL/sec) and graphing performed in Google Sheets.

Results

90 trials were performed by 45 different combinations of variables. Flow rate increased exponentially with increase in diameter, in some trials approximating radius4. All of the canola oil trials proved to be the slowest flow rate of all the viscosities when compared to water and acetone. Rung heights variable effect on flow rate for all three liquids and tube diameters. There was no distinct relationship with flow rate and rung height.

Conclusions/Discussion

As predicted, liquids with higher viscosities had lower flow rates. Fluids with higher viscosities have more internal friction and more resistance to flow. Also, as Poiseuille's law predicts, tubes with larger diameters had an exponentially higher flow rate. With bigger tube diameters, there is more space in between the walls of the tube and this reduces friction and encourages laminar flow within the tube. Increasing rung height had an unpredictable effect on the siphon flow rate. I predicted that the flow rate would be the same with increasing heights because the more uphill the tube has the more downhill it will have to balance the forces out and the more potential energy at the top of the siphon. I used this understanding of flow characteristics to design a perpetual siphon sink.

Summary Statement

Tube diameter and liquid viscosity predict flow rate through a siphon with greater accuracy than maximum height

Help Received

In order to start the large diameter siphons, I needed an assistant to seal the opposite end of the tube with their hand.

Name(s)

Alec N. Mnatzakanian

Project Number

J0117

Project Title

An Uplifting Discovery: What Is the Optimal Angle of Attack for Maximum Lift?

Abstract

Objectives/Goals

The purpose of this experiment is to prove that if the angle of the wing relative to the ground is increased over a certain range, then the lift will increase proportionally, because CL(coefficient of lift) is directly proportional to the angle of the wing.

Methods/Materials

Assemble and build the airtight wind tunnel, with a fan in the front and an exit vent in the back. Use duct tape to seal inner edges of tunnel. Confirm airtight seal by testing for leaks around the wind tunnel. Correct if necessary. Build an airfoil shape (NACA 2411) out of a block of lightweight foam. Support the wing on beams connected to a scale, which will be used to measure lift. Place the wing at 0 degrees (parallel to ground) facing incoming air inside wind tunnel. The wind should flow parallel to the bottom of the wing. Keep fan speed constant during testing. Begin first control test by starting fan and measuring weight delta generated by wing at 0 degrees. Adjust the wing by one degree and measure lift force. Repeat until 22 degrees. This will be a full set of tests, beginning at 0 degrees and ending at 22 degrees. Repeat each set of tests 6 times. Because the unit measured is force, we must divide each result by 100, then multiply by 9.8 (the gravitational constant) to get lift force, so use the equation F=9.8W to convert, then log the results and graph force vs angle of attack. Average for each degree and find greatest lift force.

Results

It was found that as the wing's angle of attack grew, the climb in lift force also grew. It was also found that the critical angle of attack for maximum lift force is around 18-20 degrees, after which the numbers began to plateau then drop.

Conclusions/Discussion

when the angle of attack is increased over a certain range, then the lift will increase proportionally, because CL is directly proportional to the angle of attack, and there has to be an optimal angle of attack because CL cannot increase indefinitely with the angle of attack.

Summary Statement

The purpose of this experiment is to prove that if the angle of attack is increased over a certain range, then the lift will increase proportionally.

Help Received

CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY

Name(s)
Gianna Pauline D. Nicomedes

Project Number
J0118

Project Title
Rocket Science: What Fin and Fin Placement Is Optimal for a Rocket's Altitude?

Abstract

Objectives/Goals
The objective of this experiment is to determine which fin and fin placement combination is most optimal for a rocket's altitude.

Methods/Materials
Inclinometers, air pressure launcher, two rocket body tubes and cones, various fin shapes, varying placements were used. Rockets were launched with different fins and fin placements and the altitude was measured with the use of inclinometers.

Results
The average altitudes were compared with each varying fins and placements. The rectangular four-finned, parallelogram four-finned, and elliptical three-finned appeared to be the most optimal for altitude.

Conclusions/Discussion
Most of the four-finned rockets performed more superior compared to the three-finned rockets. With the swept shape of the parallelogram, this fin type executed a higher altitude when collated with the outcomes. Combined together, the parallelogram four-finned rocket's stability with greater amount of fins and its lower drag with the shape appear to be the most aerodynamic fin and placement for altitude.

Summary Statement
After launching, I found that the rectangular three-finned, parallelogram four-finned, and elliptical three-finned appear to be the most optimal for a rocket's altitude.

Help Received
I was assisted with the creation of the launcher with the help of a mechanical engineer associated with GE Healthcare. I performed the experiments and the making of rockets myself.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY

Name(s)

Yomal D. Perera

Project Number

J0119

Project Title

A Sticky Situation

Abstract

Objectives/Goals

The objective of this experiment is to find out which type of liquid is the most resistant/viscous when using a marble as a frame of reference? (I used a mathematical equation to calculate.)

Methods/Materials

Used graduated cylinder to fill up the liquid and then mark 5 cm below the starting of the liquid and 5 cm above the boundary as friction can change results. Also used various liquids, and one marble to get the hang time of the liquids.

Results

From all of the liquids, my hypothesis was accepted as ketchup had the highest calculated viscosity. By only looking at the hang times, however, I thought my hypothesis was denied because honey had a larger hang time.

Conclusions/Discussion

I can deduce from the experiment that not only did ketchup had the highest viscosity, but the certain implications for the subject of viscosity. One of the major ones are the density of the liquid, temperature (which was one of my controlled variables), and in this case, the marble's factors. Using this type of technique, viscosity calculation can help in situations such as medicine, pipe efficiency, and even volcano eruption timing.

Summary Statement

In this project, I showed the different variables to viscosity, and how to calculate it using many liquids and determining them by using a marble for the hang time.

Help Received

None, I thought of, built, and conducted the full experiment myself.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY

Name(s)

Trisha D. Prajapati

Project Number

J0120

Project Title

That's Cool! Which Fan Blade Characteristics Affect Airflow?

Abstract

Objectives/Goals

The objective of my experiment was to determine what fan blade characteristics affect the amount of airflow.

Methods/Materials

Using homemade items, I made a fan and an anemometer. I made the fan using a DC motor, an electric circuit with a switch, and a 9V battery. I made different kinds of fan blades. First, I made fan blades using a plastic water bottle. I made fans with 2 blades, 3 blades, and 4 blades. Then, I made fans using PVC window blind panels which I cut into the same size and shape as the plastic bottle blades. Using the PVC blades, I made different fans with pitches of 0 (perpendicular to axis of rotation), 45, and 90 (parallel to axis of rotation) degrees. Lastly, I made fan blades half the width of the previous PVC blades (3 cm v. 6 cm). Next, I made an anemometer using 3-ounce paper cups and straws. The anemometer had a diameter of 21 cm. I attached the fan blade to the fan motor and placed the anemometer 18 cm from the fan. I ran the fan for one minute and counted the number of revolutions of the anemometer. I did 10 trials for each type of fan blade. I calculated the air velocity of each type of fan blade. I used air velocity as a surrogate for air flow.

Results

The 3 blade fan had the most air velocity at 0.694 m/s. The 2 blade fan had the least at 0.432 m/s. The fan blade with a pitch of 45 degrees produced the most airflow with a speed of 0.618 m/s. The wider fan blade produced more air velocity compared to the narrow fan blade (6 cm v. 3 cm). The wider width produced an airspeed of 0.692 m/s compared to the narrow width with a speed of 0.490 m/s. The material of the fan blades did not have a significant effect in my experiment.

Conclusions/Discussion

Based on my experiment, 3 blade fans produced more airflow than 2 and 4 blade fans. Fan blades with a pitch of 45 degrees produced more airflow than fan blades with 0 or 90 degrees. Lastly, the wider the fan blade, the more airflow was produced in my experiment. I can conclude that a fan with 3 blades at a pitch of 45 degrees and wide fan blade width produced the most airflow in my experiment. In the future, I hope to continue my project using different types of fan materials and more scientifically accurate equipment to help determine the ideal fan blade design.

Summary Statement

The goal of my project was to determine what fan blade characteristics affect the amount of airflow produced.

Help Received

My father helped building the fan, and my mother helped with my poster.

Name(s)
Blake T. Scurry

Project Number
J0121

Project Title
A Unique Spin on Aerodynamics: Airfoil Augmented with Semi-Auto Rotating Leading Edge Cylinder

Abstract

Objectives/Goals
Determine if an airfoil with a semi-auto rotating leading edge can efficiently increase lift by 25%.

Methods/Materials
A low speed wind tunnel built of cardboard, wood, Plexiglas, and portable fan for wind generation. An apparatus was created to hold a rotating cylinder and airfoil suspended on a scale. The cylinders and airfoils are made from 3D printing. The data was collected utilizing weight, RPM, and wind speed measurements. Dry ice was used for flow visualization.

Results
The data from multiple test runs of both a stand-alone cylinder and an airfoil augmented with a leading-edge rotating cylinder resulted in a 7% increase in lift.

Conclusions/Discussion
The test results of 7% increase in lift varied from the predicted 25% increase in lift by approximately 70%. This discrepancy is primarily related to the inability to meet target RPM speeds due to instability.

Summary Statement
The addition of a semi auto-rotating leading-edge cylinder to an airfoil does increase lift.

Help Received
Help was received from a neighbor who is an aerospace engineer as well as from my father in correcting my airfoil assembly when excess vibration occurred.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY

Name(s)
Liliana Torres

Project Number
J0122

Project Title
Does the Type of Wind Turbine Affect Energy Produced?

Abstract

Objectives/Goals
My experiment is addressing the following question: Does the Type of Wind Turbine Affect Energy Produced?

Methods/Materials
Construct the four turbines (Savonius VAWT, Giromill VAWT, Modern HAWT, and Pinwheel HAWT). Set Up: Place the D.C. motor over the small hole on the long platform, with the shaft pointing down. Tape the D.C. motor to the platform. Connect the wires of the multimeter to the D.C. motor. Place the platform with the hole hanging over the edge of an elevated platform. The hole must be about 7 in. away from the edge. Tape the platform to the elevated platform. Procedure for testing the Wind Turbines. Connect the pen refill that is on a turbine to the D.C. motor shaft. Place the fan 1 foot away from the turbine and turn it on. For the HAWTs place the fan lying down on the floor still a foot away from the turbines using a shoe box if needed. Check the multimeter every 30 seconds and record the amount of energy being produced.

Results
The result of my investigation on which type of pinwheel design will produce the most energy showed that the pinwheel with four blades (square shape) was the best, using both the homemade model and the ev3 LEGO Mindstorm machine.Four Blade Pinwheel (square)
Homemade model results: Quickest time = 6.6 Slowest time = 7.76 Ev3 LEGO Mindstorm machine results: Most energy produced = 2.6v Least energy produced = 2.1v
Discussion: This pinwheel produced the most energy using both machines.

Conclusions/Discussion
After completing my investigation on different pinwheel designs and how much energy they would produce, I found that my hypothesis for the pinwheels was not supported. My hypothesis stated that the pinwheel with five blades would produce the most energy. However, the pinwheel with four blades produced the most energy. I learned that the pinwheel with four blades produces more energy than any of the other pinwheels I have tested. It is possible that the four blade pinwheel is the best at producing energy, because its blades have the biggest surface area. Since this number of blades on pinwheels produces the most energy, they may be a very efficient way to make energy using wind turbines. This is similar to how scientists test wind turbines in real life. They build prototypes of a wind turbines and see which ones can produce the most energy just as I have done.

Summary Statement
My investigation showed that the pinwheel with four blades produces more energy than any of the other pinwheels I have tested.

Help Received

CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY

Name(s)

Gursimar Virk

Project Number

J0123

Project Title

Watt's the Deal with Waterwheels?

Abstract

Objectives/Goals

Question to be addressed: Does the paddle angle and separation change how much power an Overshot waterwheel could make?

Methods/Materials

I first built a waterwheel according to design instructions I found online. Testing waterwheel:
Place waterwheel in a pan. Place a pan around 42 cm above the waterwheel and 2cm away.
Fill pan with a liter of water. Place wave maker in the pan. Connect multimeter to DC motor
Turn on multimeter. Set multimeter to 200 milliVolts. Turn on wavemaker. Set waver maker to W3. Check multimeter results . Record results. Repeat until all results for the current category is listed. Turn off wavemaker. Refill the correct amount of water. Change paddle placement. Repeat steps 6 - 13 until all categories are tested

Results

The outcome of my testing on the amount of paddles a waterwheel should have and the angle at which the paddles should be at, lead to showing 16 paddles on a waterwheel are the optimum choice, instead of 8 paddles. As well the 60° paddle angle would being the best result for the angles of a waterwheels paddles, rather than 180° paddle and 90° paddle.

Conclusions/Discussion

Once I concluded my test on the separation and angle difference on waterwheels. I found my hypothesis for the separation of paddles was supported. A part of my original hypothesis stated the 16 paddle separation will probably produce more energy than 8 paddle separation. Which corresponds with the results of more paddles equaling to more energy and less paddles not being as effective, showing 16 paddles are superior to 8 paddles. Furthermore my hypothesis for the angle measurements wasn't supported. The hypothesis had claimed the 90° paddle angle will probably produce the most energy and the 60° paddle angle would probably be at the mid point of energy production while 180°paddle angle will produce the least amount of energy. Showing that my hypothesis was unsupported because the results show 60° was better at creating energy compared to 90° or 180°.

Summary Statement

Paddle angle and separation does change how much power an Overshot waterwheel could make.

Help Received

CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY

Name(s)
Brianna H. Vu

Project Number
J0124

Project Title
Turbines: A Wind Wind Solution

Abstract

Objectives/Goals
In our daily life, electricity is the most common usage in our entire world. With wind energy, life is a lot cleaner, faster, healthier, and more efficient than any other energy producer. This project focuses on how electricity could be produced without harming our environment using a free energy source, wind. With testing which blade will generate the most electricity, it will improve our society by being able to generate more electricity in more time. This is the problem, our society uses so much electricity that we sometimes even have to pay more money, but with this project being done, we will be able to produce more electricity in faster time.

Methods/Materials
This experiment requires, a motor/generator, 2 Blades, 3 Blades, 4 blades, 5 blades, 6 Blades, a fan, multi-meter, data charts, collet, wood, wires, light bulb, and a "L" bracket.

Results
At the speed level of 9.1 miles per hour, the average amount of voltage for 2 blades is 1.71 volts;3 blades is 1.70 volts;4 blades is 1.68 volts;5 blades is 1.68 volts;6 blades is 1.68 volts. At the speed level 8.5 miles per hour, the average amount of voltage of 2 blades is 1.67 volts;3 blades is 1.65 volts;4 blades is 1.63 volts;5 blades is 1.62 volts;6 blades is 1.62 volts. At the speed level of 8.0 miles per hour, the average amount of voltage of 2 blades is 1.63 volts;3 blades is 1.59 volts;4 blades is 1.55 volts;5 blades is 1.51 volts; 6 blades is 1.52 volts. This experiment shows that, as matter as a fact, 2 blades generates the most electricity because of how easily the fan pushes the blades from one to the other.

Conclusions/Discussion
In conclusion, my hypothesis was incorrect. My hypothesis was: If different numbers of blades are tested on a wind turbine, then 3 blades will produce the most electricity. I was very surprised to see that 2 blades have actually created the most electricity. Around many parts of the world, I have noticed some 2 bladed wind turbines, but wind turbines with 3 blades seemed to be more common, thus, I thought that 3 blades will produce the most. With 3 blades, there would be more balance to rotate faster, but I was wrong. My data results have shown that 2 blades generated the most electricity, then 3 blades, after that, 4 blades, next, 6 blades, and lastly 5 blades. The number of blades that produced the most electricity is 2 blades. Two blades generate enough momentum to spin faster than any other blade.

Summary Statement
Testing the amount of blades on a wind turbine and how it would affect the voltage, wind energy benefits our society in an eco-friendly and safe process.

Help Received
With the supervision and wisdom of my science teacher and father, I have done this whole project individually.

Name(s)
Madeleine E. Yee

Project Number
J0125

Project Title
Computational Comparison of Laminar and Turbulent Flow Erosion

Abstract

Objectives/Goals
The purpose of this project is to numerically determine the difference between laminar (smooth) flow and turbulent (chaotic) flow erosion.

Methods/Materials
This research consists of two parts, a numerical simulation using ANSYS Fluent Student Edition and an experiment to collect data to validate the simulation results. The experimental approach was comprised of laminar and turbulent water flow in a straight pipe washing away a chocolate coating. For the numerical simulations, a model was representative of the experimental apparatus and flow conditions was created and exercised.

Results
From the simulations, the wall shear calculations were compared to the erosion rates observed experimentally. Based upon the simulation results, the shear from turbulent flow was significantly higher than that for laminar flow indicating higher erosion.

Conclusions/Discussion
The results were consistent with the experimental results and showed a computation comparison is valid and can be applied to more complicated flows.

Summary Statement
The project consisted of a comparison between laminar and tuebulent flow erosion.

Help Received
My father helped me build the experimental appratus and explained the equations used in the numerical simulations.