CALIFORNIA STATE SCIENCE FAIR
2015 PROJECT SUMMARY

Name(s)
Isaac John Anchanattu

Project Number
J0101

Project Title
Stabilizing Rubber Ball Octopus Projectile

Abstract

Objectives/Goals
Stabilize a rubber ball octopus projectile so that it gets attached to a white board surface as its target

Methods/Materials
white board
Needle and string
Graph papers
Party hat
Water bottle
Venire caliper
Rubber ball octopus

Results
From the tests conducted with a party hat 20 times, it is found that the octopus get attached to the target 19 times. The success rate was 95%.

Since the design had a flexible joint where party hat and rubber ball octopus connect, it helps to keep the projectile#s axis of symmetry and direction of flight aligned.

Conclusions/Discussion
In order to achieve a successful target attachment, the projectile with the rubber ball octopus has to be designed for stability. There are three major things to be considered in the design.

1) Proper placement of the Center of Gravity (CG) and Center of pressure (CP) so that the CG should be closer to the suction stem of the rubber ball octopus than the center of pressure.
2) There should be enough distance between CG and CP to provide stability.
3) The axis of symmetry and the direction of flight have to be aligned. To achieve this, the joinery between the attachment and the rubber ball octopus should be kept flexible.

Summary Statement
Stabilize a payload (rubber ball octopus), in a specific direction so that when it reaches the target object, it can get attached (using the suction) successfully.

Help Received
Photography and editing/formatting of word document from my mentor

CALIFORNIA STATE SCIENCE FAIR
2015 PROJECT SUMMARY

Name(s)

Michael L. Askins

Project Number

J0102

Project Title

Riding on Air: What Surface Does a Hovercraft Ride Over the Fastest?

Abstract

Objectives/Goals

The object of my project was to determine what surface a hovercraft would ride over the fastest. The surfaces chosen for the experiment were cement, grass, asphalt, rough dirt, and wet sand. The hypothesis of this experiment was that the cement would produce the fastest speed.

Methods/Materials

In order to conduct the testing, a hovercraft was built out of plywood and heavy plastic. A leaf blower was used as the engine for the hovercraft. A distance of 4.5 meters (fifteen feet) was measured over each of the five surfaces to measure feet per second and convert to miles per hour (mph). The hovercraft was ridden by an adult and a child over the five surfaces and timed. The tests were repeated by the same two people, five times over each surface, for a total of fifty trials.

Results

The hovercraft traveled at 1.02273 mph over the 4.5 meters, averaged between the adult and child's times. But riding over the wet sand, the hovercraft traveled 2.045 mph for 4.5 meters, the fastest time of the trials. Asphalt was the next fastest surface with a time of .681 mph over the same distance. In this experiment the hovercraft did not travel over the grass or the rough dirt at a measurable speed.

Conclusions/Discussion

The wet sand proved to be the fastest surface for the hovercraft to travel over. The smoother the surface the faster the hovercraft traveled. While the times for the adult were one to two seconds slower than the child's times, the speed results were the same. This experiment proved that the smoother the surface, the faster the speed of the hovercraft.

Summary Statement

My project was to determine what surface a homemade hovercraft would travel over the fastest.

Help Received

My father helped cut the plywood for the hovercraft.

CALIFORNIA STATE SCIENCE FAIR
2015 PROJECT SUMMARY

Name(s)

Phillip Chau

Project Number

J0103

Project Title

The Effect of Increasing the Chord Length of a Propeller on Its Efficiency

Abstract

Objectives/Goals

The purpose of my project was to observe the effect of increasing the chord length, or the width, of a propeller on its efficiency.
My hypothesis was that if the chord length of a propeller increases, then the efficiency of a propeller will increase as well.

Methods/Materials

First, a thrust meter was built in order to measure the thrust produced by each propeller at a given watt input. These two variables were used to find the propeller's efficiency. Then, 3 different propellers were trimmed to chord lengths of 24 mm, 21 mm, and 18 mm while keeping other parameters such as the pitch angle and diameter constant. A propeller with 27 mm chord length served as the control of the set. The propellers were then tested on the thrust meter with watt inputs of 10, 20, and 30 watts. A RPM meter was used to find the rotations per minute of each propeller. Finally, the efficiency of each propeller was found by multiplying the thrust, the pitch, and RPM of each propeller and dividing that by the watt input

Results

The results for the propellers tested at a 30 watt input were that the propeller with chord length of 18 mm had an average efficiency of 29%. The 21 mm chord length propeller had an average efficiency of 34%, while the 24 mm chord length propeller had an average efficiency of 36%. Finally, being the most efficient of the group, the 27 mm chord length propeller had an average efficiency of 38%. The same trend of greater efficiency with greater chord length was found when the propellers were tested at 10 and 20 watts as well.

Conclusions/Discussion

The data collected clearly proved my hypothesis that as the chord length of a propeller is increased, then the efficiency will increase as well. This is due to the fact that a propeller with a greater width would have more surface area. As a result, it could push back more air particles in a single revolution, and thus, cause a greater reaction force that'll push it forward according to Newton's 3rd Law of Motion.

Summary Statement

My project investigates the correlation between increasing the width of a propeller and its efficiency.

Help Received

My parents helped me get the materials necessary to conduct the experiment.

CALIFORNIA STATE SCIENCE FAIR
2015 PROJECT SUMMARY

Name(s)

Andrew C. Chiang

Project Number

J0104

Project Title

Wind Winds Windmills

Abstract

Objectives/Goals

This project investigated various blade configurations in order to optimize wind turbine efficiency.

Methods/Materials

* Build a wind tunnel; assemble the Kidwind Wind Experiment Kit with a base, a tower, a nacelle with gear set and generator, and a hub for mounting blades
* Modify gearbox for higher gear ratios; build rotor with twisted blades and stators with stationary blades
* Vary blade shape and dimensions, blade pitches, numbers of blades, gear ratios, and wind speeds.
* Record generated power on a load resistor.

Results

* (2.8 m/s wind/45° blade pitch/8:1 gear ratio) efficiency almost the same with 1, 2, 3, 6, and 12 blades
* (2.8 m/s wind/15° blade pitch/8:1 gear ratio) efficiency increased with 1, 2, 3, and up to 6 blades, but dropped at 12 blades
* (2.8 m/s wind/45° blade pitch/16:1 gear ratio) efficiency almost 3x of that of gear ratio of 8:1
* (1.2 m/s wind) Most of high gear ratio configurations did not work
* (1.2 m/s wind/30° blade pitch/12 blades) 16:1 gear ratio produced lower efficiency than 8:1 gear ratio
* With 15° pitch, inversed trapezoid blade with wider tip produced higher efficiency
* With 45° pitch, trapezoid blade with narrower tip produced higher efficiency
* (twisted blade/15° tip pitch/32:1 gear ratio) efficiency improved as the base pitch increased from 15° to 45°
* (twisted blade/15° tip pitch/16:1 gear ratio) efficiency plateaued at base pitch of 30° to 45°
* Highest efficiency of 12.3% reached with 32:1 gear ratio and base pitch of 45°
* Front stator caused drop in efficiency; rear stator caused even higher drop
* Front stator penalty much smaller in blow in configuration than that in blow out configuration; positive gain with 45° pitch

Conclusions/Discussion

* Drag should be minimized with lower blade pitch and torque should be maximized with higher blade pitch
* Optimized blade was twisted with high blade pitch at the base to increase torque and low blade pitch at the tip to reduce drag
* Stator can reduce drag by changing airflow direction, but also creates air blockage

Summary Statement

Drag should be minimized with lower blade pitch at the tip and torque should be maximized with higher blade pitch at the base in order to maximize windmill efficiency.

Help Received

Dad helped to purchase materials and build wind tunnel.

CALIFORNIA STATE SCIENCE FAIR
2015 PROJECT SUMMARY

Name(s)

Jack H. Donohoe

Project Number

J0105

Project Title

A Cheater's Curve: The Science behind the Spitball

Abstract

Objectives/Goals

The objective was to determine if a smooth baseball, or "spitball", will generate a smaller Magnus force and less lift in flight than a normal baseball, and therefore cross home plate at a lower height.

Methods/Materials

One or two strips of electrical tape were wrapped around a pitching machine dimpled baseball to replicate the spitball. Taped balls were alternately thrown with control balls, which had no tape, at ~60 mph by a Atec pitching machine at a target 18.3 m (60 ft.) away. Each pitch was videotaped, and the X and Y location of the ball as it hit the target was measured from still video frames.

Results

The tests showed that the "spitball" crossed home plate an average of 32 cm lower (ball A) and 52 cm lower (ball B) than the control ball. Balls with one or two strips of tape crossed home plate at similar heights (difference 4 cm).

Conclusions/Discussion

Baseball pitchers sometimes cheat and apply spit or foreign substances to the ball in an attempt to alter its trajectory. My tests show smoothing a ball with tape had a large effect on trajectory, but different amounts of tape did not. The effect of spit or Vaseline on the trajectory of a major league pitch will most likely be smaller, but even a small change can be enough to make the batter whiff completely. Sadly, cheating has great advantages.

Summary Statement

This project tests the effect of surface roughness on the trajectory of a rotating baseball.

Help Received

Father videotaped experiment.

Name(s)

Paolo GIovanardi; Krisna Sam

Project Number

J0106

Project Title

Bernoulli's Principle in Action

Abstract

Objectives/Goals

In our daily life, Bernoulli#s principle is being applied. We will understand how Bernoulli#s principle works and its importance in everyday life. This project will show us how Bernoulli#s principle applies in flight.

Methods/Materials

Bernoulli#s principle is displayed and put to the test in our homemade wind tunnel. We used foam to make wings and metal rods to support them in the wind tunnel. The scale is used to measure the force of lift in grams that the wing is creating. In our project, we made four different wing profiles. They are made to compare and contrast different models and see which has the greatest lift. To generate the wind, we used a brushless motor with an eleven inch propeller, in the twelve by twelve inch wind tunnel to generate the required wind speeds 4, 5 and 6 meters per second. We used cables to connect the motor to the electronic speed control and the power supply. We used an anemometer to measure the wind speed.

Results

We found out that airplanes are able to fly due to lift, weight, thrust and drag. Each of these counteracts each other. Drag counteracts thrust, and weight counteracts lift. This explains Bernoulli principle which states that as the velocity of a fluid increases, the pressure exerted by that fluid decreases. Since a wing has a larger distance on the top due to the curve, air has to travel faster therefore making the pressure decrease. The air will have to travel faster over the top of the wing leading to a loss in pressure. The difference in pressure is what creates the upward force called lift. These results are important in helping us understand the principles of flight and how Bernoulli#s principle plays a role in flight.

Conclusions/Discussion

Overall most of our wing profiles generated a fair amount of lift that could be used to actually fly a radio controlled aircraft or be scaled up with different materials to fly a full scale aircraft. We have learned how to make our own wing profiles out of just foam, glue, and a razor. We also learned to build our own wind tunnel that can operate smoothly and test our wing profiles. With our wind tunnel,we can test wings with different humidity and wind speeds or even different models. We can test racecars. The racecar wings are just like aircraft wings, but upside down. Our tests show the wing profiles generate lift. An upside down version of that on a sports car will keep it on the ground.

Summary Statement

What is Bernoulli#s Principle, how it applies to our lives and how we can test the principle to prove to ourselves that it works

Help Received

Parents help with photo taking;Parents helping with handling power tools; Science teacher guidance, Electronics recommendation from hobby shop at Aero Micro

CALIFORNIA STATE SCIENCE FAIR
2015 PROJECT SUMMARY

Name(s)

Clarence Harmon, IV

Project Number

J0107

Project Title

Perfect Propeller Performance

Abstract

Objectives/Goals

The objective of this project is to determine how the pitch, length, and number of blades affect propeller efficiency.

Methods/Materials

The following materials were used to construct two test stands (shoebox and wooden) to determine propeller efficiency.
1. (8) Propeller Blades: (1) 3-Bladed Propeller (30 x 15 cm), (1) 3-Bladed; Propeller (28 x 15 cm), (1) 2-Bladed Propeller (30 x 15 cm), (1) 2-Bladed; Propeller (25 x 20 cm), (1) 2-Bladed Propeller (28 x 15 cm), (1) 2-Bladed; Propeller, (1) 2-Bladed Propeller (25 x 15 cm), and (1) 2-Bladed. 2. (15) Marbles (Mass). 3. (6) Rubber Bands (11 x ⅕ cm). 4. (1) Fan (41 x 40 cm). 5. (1) Shoebox: Bottom (29 x 6 x 18 cm), Lid (30 x 3 ½ x 19 cm). 6. (2) Paper Towel Roll: 27 ½ x 3 cm, 27 x 3 ½ cm. 7. (5) Paper Cups: 88 mL each. 8. (1) Piece(s) of String: 45 cm. 9. (1) Pen. 10. (2) Ruler(s). 11. (1) Stopwatch.

The testing stands were assembled and propeller were placed onto the front of the shaft and secured. To minimize variability, the fan distance and speed were constant during all tests.

Results

The results obtained from the shoebox test stand revealed that the 3 blade-28 x 15 cm propeller lifted the ballast in the least amount of time. However, it was observed that the results were influenced by friction between the wooden dowel and the paper towel rolls. Therefore, a wooden test stand was built to mitigate the effects of friction. The wooden stand results found that the 3 blade-28 x 15 cm propeller lifted the ballast in less time than the shoebox stand.

Conclusions/Discussion

My conclusion is that individually pitch, length, and number of blades affect propeller performance. The greater the propeller pitch and number of propeller blades does impact efficiency. However, the efficiency of the blade length is determined by weight.

Summary Statement

My project is to find the propeller that performs work in the most efficient manner.

Help Received

My father oversaw my use of power tools during the construction of the wooden test stand.

CALIFORNIA STATE SCIENCE FAIR
2015 PROJECT SUMMARY

Name(s)

Pranav Kantamaneni

Project Number

J0108

Project Title

Hovercrafts

Abstract

Objectives/Goals

The overall purpose of this investigation was to understand how hovercrafts operate on different surfaces, and how aerodynamics and friction affect their flight.

Methods/Materials

To begin, I created the hovercraft, which consisted mainly of a DVD, balloon, and a pop-top lid from a plastic drinking bottle. I tested the hovercraft on cement, carpet, glass, table, and water. I tested the hovercraft three times on each surface and recorded the duration of flight in my lab notebook.

Results

The balloon hovercraft hovered the longest on table, while it hovered the shortest on water. For all the trials on carpet, the hovercraft had no leverage. While testing the balloon hovercraft on water, I observed that the hovercraft was weighed down on one side by the balloon. As a result, the hovercraft was thrashing around in the water.

Conclusions/Discussion

My hypothesis was that the hovercraft would hover longest on the smoothest surfaces and not as well on the rough surfaces. The results for all three trials remained consistent on all surfaces except for glass. This probably happened because the stopwatch was timed inaccurately. My hypothesis was supported in my experiment because the duration of flight on smooth surfaces surpassed that of the rougher surfaces. The cause of these results is due to the way friction affects flight. It was harder for the hovercraft to gain lift on rough surfaces with more friction because the friction hampered the hovercraft's ability to accelerate off the ground. One possible source of error in my procedure was that I may have ended the timer on the stopwatch slightly early or late. If I were going to continue this research, I would like to investigate how well a real, controllable hovercraft would maneuver on different surfaces. I would also like to observe the changes that would take place if I created the base of the hovercraft with a different material, other than a DVD.

Summary Statement

I performed this experiment to understand how aerodynamics and friction affect maneuverability in hovercrafts.

Help Received

I would like to acknowledge my parents for helping me execute this experiment by timing the hovercraft with a stopwatch.

CALIFORNIA STATE SCIENCE FAIR
2015 PROJECT SUMMARY

Name(s)
Collen M. Kennedy

Project Number
J0109

Project Title
What Is the Best Aerodynamic Design for a UAV Wing?

Abstract

Objectives/Goals
My science project was to identify the best aerodynamic design for a Unmanned Aerial Vehicle wing. I understand why different UAVs had such a larger difference in the shapes and sizes of their wings.

Methods/Materials
I built 8 different shapes that could be tested within the wind tunnel. 5 of the shapes were non-flying shapes but were used to demonstrate smoke patterns off of different surfaces. 3 of the shapes were traditional wing shapes of varying aspect ratios. I placed each shape into the wind tunnel and used video to record the test events. Each shape was moved through a series of directions. The point of turbulence noted on each shape was identified. Using a contrasting grid pattern I was able to utilize a ratio to compare each shape as to its aerodynamic attributes.

Results
The smaller wing shape had the least noted turbulence.

Conclusions/Discussion
My conclusion is that a traditional wing shape is preferred shape but the most important characteristic for the long loiter time requirement of a UAV is aspect ratio. The higher the aspect ratio, the better the lift characteristics.

Summary Statement
My science project was to determine what is the effect of changing the shape of a wing and how that affects its flight characteristics.

Help Received
My entire project was built in my garage. I used household items that could be repurposed for this project. My father helped with the cutting of the cardboard while building the wind tunnel and provided a second set of hands for the larger items.

CALIFORNIA STATE SCIENCE FAIR
2015 PROJECT SUMMARY

Name(s)

Ava M. Killoran

Project Number

J0110

Project Title

New Wind Turbine Blade Design Improves Turbine Output Compared to Standard Airfoil Models

Abstract

Objectives/Goals

The objective of my project was to create a new design of wind turbine blade and test its efficiency at varying wind speeds against two previously designed blades, the standard airfoil and a design similar to the fin of a humpback whale (Whale Power Inc.).

Methods/Materials

My blade design, the Spoonfoil, is modeled after the standard airfoil but with an additional concave section engineered to capture more wind energy. The three dimensional blade designs were shaped from styrofoam blocks. Each set of three blades were attached to the rotor of a model wind turbine and tested ten times at three different wind speeds. Turbine output voltage was measured using a digital multimeter.

Results

For all blade designs, the voltage output increased significantly as the wind speed got higher. The Spoonfoil blade had the highest output at all wind speeds tested. At high wind speed the Spoonfoil blade had an 85% higher output than the standard airfoil, and a 54% higher output than the Whale Power blade.

Conclusions/Discussion

Overall the Spoonfoil blade was more efficient than the Whale Power and airfoil blades. The increase in the voltage output of the turbine at high fan speed was more pronounced in the Spoonfoil blade than in the other blade designs. The standard airfoil produced the lowest output of the three blade designs. Wind energy is the cleanest source of energy because it does not emit any kind of gas or use fossil fuels. As the planet is experiencing global warming, largely because of greenhouse gases, scientists are constantly looking for a way to enhance the clean sources of energy because one day we might be reliant on them. While doing my project I created a model for a new type of blade that generated a higher wind turbine output than the standard airfoil blade, the design that most wind turbines are using today.

Summary Statement

I designed and built a model wind turbine blade that increased wind turbine output by 85%, when tested against a standard airfoil design model.

Help Received

Mother helped edit/proof read

Name(s)
Alex Kirley

Project Number
J0111

Project Title
3...2...1... Blast Off! An Experiment in Building and Testing Rocket Cars to Achieve High Speeds

Abstract

Objectives/Goals
The purpose of the project was to build three rocket cars and test their aerodynamic attributes to determine which design was the fastest.

Methods/Materials
Three rocket cars were constructed for testing. Each rocket car constructed had different configurations of stabilizers, wings, tube diameters, nosecone shapes, and chassis lengths. Their designs were each based around a different influence ranging from Formula 1 cars, to missiles and rockets. The F1 had many wings and stabilizers to create large amounts of both downforce and stability. The Missile had a combination of stability and aerodynamic efficiency with a small top mounted wing and stabilizers both in front and back. The Rocket was the most minimal design with only three tail mounted stabilizers. The rocket cars were propelled by C-6-5 Estes rocket engines and shared identical wheels, tires, and chassis to insure consistency in my testing. For additional safety and preventing catastrophic crashes, a guide tube was placed on the bottom of each rocket car. The guide tube would loosely direct each car on a 15 pound fishing line the length of the 150# course. Only minimal tension was necessary to achieve consistent results and a safe test environment.

Results
In my experiment, the car that had the best balance of stability and aerodynamic efficiency was the fastest. The F1 influenced car created the most downforce helping with stability, but also creating drag. The F1 only achieved an average top speed of 48.33 mph and an average time of 4.7 seconds on the 150 foot course. The second fastest, The Rocket, was unstable and wasn't able to stay on the ground at launch. The Rocket had an average top speed of 49.33 mph and an average time of 4.44 seconds. The Missile car concept was the fastest and most balanced design achieving an average top speed of 53.33 mph and an average time of 3.33 seconds.

Conclusions/Discussion
My experiment proved a balance of stability and aerodynamic efficiency will consistently allow a rocket car to achieve the highest speeds.

Summary Statement
The purpose of the project was to build three rocket cars and test their aerodynamic attributes to determine which design was the fastest.

Help Received
My dad showed me how to use the tools needed to construct my rocket cars and the display board. He also was my assistant during testing. My mom helped me edit my final report.

CALIFORNIA STATE SCIENCE FAIR
2015 PROJECT SUMMARY

Name(s)

Dylan J. Lee

Project Number

J0112

Project Title

What Is the Most Efficient Angle of Attack of an Airplane's Wing?

Abstract

Objectives/Goals

The objective of this science project was to determine the critical angle of attack, or most efficient angle of attack, of an airplane's wing. The hypothesis stated that the efficiency of the airfoil would continue to increase until the force of drag was too great compared to the force of lift for the airfoil to be efficient.

Methods/Materials

The materials used for this project were wood for the wind tunnel, an attic fan to go inside the wind tunnel, two Vernier force sensors, a Vernier LabQuest Mini, and foam for the airfoil. The wind tunnel consisted of a contraction cone, a test section, a diffuser, and an attic fan. The contraction cone at the front increases air speed and pressure. The test section in the middle is the area where the object is tested. The diffuser at the end decreases air speed and pressure. The attic fan is installed at the end of the diffuser. The airfoil was tested inside the wind tunnel at five-degree increments from zero to sixty degrees. Each sensor measured a different force: lift and drag. The amount of both forces at each increment were recorded, graphed, and charted for analysis. The experiment was repeated three times.

Results

The results recorded from all three trials indicated that the critical angle of attack was at five degrees. This pertained to the objective of this experiment because the critical angle of attack of the foam airfoil tested was obtained.

Conclusions/Discussion

The hypothesis was proven correct, as the force of drag continued to increase, and eventually the force of lift began to decrease toward zero. However, research indicated that the critical angle of attack should be about fifteen degrees. Thus, it can be concluded that the critical angle of attack of an airfoil varies based on shape, surface area, speed, and the density of the air around the airfoil.

Summary Statement

The central focus of this project was to determine the critical angle of attack of an airplane's wing.

Help Received

Father helped cut plywood down to size.

CALIFORNIA STATE SCIENCE FAIR
2015 PROJECT SUMMARY

Name(s)
Mackenzie Lee

Project Number
J0113

Project Title
The Effect of Vane Tilt Angles on the Speed of a Revolving Lantern

Abstract

Objectives/Goals
This project is to study how the vane tilt angles of a revolving lantern affect its rotational speeds through experimental study, data analysis, and modeling.

Methods/Materials
Data generation in this project is by direct measurement of rotation period at various vane tilt angles from 15-degree to 120-degree, a stop watch is used to measure the rotation periods. The end point is the rotational speeds, which are converted from rotation periods. Additional experimental groups include different numbers of vane blades, different percentages of top surface opening, different wattages of light bulbs, and different distances between the light bulb and the lantern top. The materials used in this project include paper, wires, light bulbs, snap buttons, stop watch, thermal image camera, and convective flow simulator.

Results
Thermal images show that the light bulb heats up the surrounding air and the warm air exits through the top openings. Convective flow simulation shows the exiting warm air approaches the blades and then deflects away, out of the openings at the top of lantern. The control experiment shows the rotational speed decreases from 30-degree to 90-degree, while no motion is observed for 120-degree. Slight increase in rotational speeds is observed from 15-degree to 30-degree. Similar trends are also observed in various experimental groups. The effective force for rotation correlates to the blade angles in several aspects: the normal force exerted on the blade, its horizontal component for rotation, and the effective blade area for the oncoming air current. This leads to a relation which shows that the effective force for rotation is proportional to sin(tilt angle) x [cos(tilt angle)]^2, and the rotational speed decreases accordingly at large tilt angles.

Conclusions/Discussion
The experimental results support my hypothesis that the rotational speed decreases at large tilt angles. The relation of sin(tilt angle) x [cos(tilt angle)]^2 gives a good approximation to the trend of decreasing rotational speeds at large tilt angles. It is interesting to see the lantern rotates even at 90-degree when cos(90-degree) equals to zero. Therefore additional factors may be involved, and further studies at higher tilt angles will elucidate these factors and provide closer theoretical approximation to experimental results.

Summary Statement
The experimental results show that the rotational speed of the lantern decreases from 30 to 90 degrees tilt angles, further data analysis shows the effective force for rotation is proportional to sin(tilt angle) x [cos(tilt angle)]^2.

Help Received
None.

CALIFORNIA STATE SCIENCE FAIR
2015 PROJECT SUMMARY

Name(s)
Sergio Lopez

Project Number
J0114

Project Title
Wind Velocity

Abstract

Objectives/Goals
My objective is to demonstrate that at certain level of a propeller angle and at certain level of RPM's can generate more propulsion by the wind generated by an airplane.

Methods/Materials
1. Speedometer.
2. Pilot.
3. Propeller airplane.
4. Airplane gasoline.
5. Paper and pen to record the answers.

Results
Yes, it does affect the airflow while having more propeller angle and maintaining the same RPM. Every other angle that was not the flat one had more propulsion with the same RPM. So, when you have more angle and more RPM makes an airplane go faster. I tested angles 15, 20 and 25, and resulted that at 25 came out to be the one with the highest propulsion (68 mph with 1700 RPM).

Conclusions/Discussion
Did my conclusion support my hypothesis? Yes, based on my research on the airplane propeller angle, yes it does affect its speed while maintain the same RPM and I predict that angle 25 is the best one when it comes to speed because it has more angle which makes it go faster than the others. It goes at 68 mph when it has the angle 25 and at 1700 RPM.

Summary Statement
This project is about learning how a propeller angle in an airplane affects the propulsion made by the wind generated at certan level of RPM's

Help Received
My grandfather helped me teaching basics of airplane function since he is a Pilot, using real airplane at Mexicali Valley supporting me by experimenting different levels of propeller angles.

CALIFORNIA STATE SCIENCE FAIR
2015 PROJECT SUMMARY

Name(s)

Jared A. Lyon

Project Number

J0115

Project Title

The Effect of Parachute Canopy Shape and Apex Venting on Parachute Performance

Abstract

Objectives/Goals

The objective of my experiment is to determine which parachute canopy shape (Triangular, Square, Star, or Circular) will perform best, and whether adding an apex vent to the canopy will improve parachute performance regardless of the canopy shape.

Methods/Materials

Eight parachutes of identical total canopy surface area and weight were constructed (1 of each shape with and without apex vents). I used direct measurement of expired time from parachute release to payload landing to compare parachute performance utilizing a stopwatch. Poor parachute deployments due to partial opening, wind, or excessive oscillation were noted and the best eight of twelve drops for each design were averaged to compare performance. Longer flight times were equated to better performance, and shorter flight times were equated to lower performance, due to the goal of landing at the lowest speed being preferable.

Results

My results indicate that the non-vented parachutes finished in order from longest to shortest flight time as follows: Circle, square, triangle, and star. The best performing (circular) parachute performed approximately 30% better than the worst performing (star-shaped) parachute. When I added canopy apex vents, the vented parachutes finished in the identical order as the non-vented versions, but each vented shapes# flight time increased approximately 6% over the non-vented version. This clearly demonstrated that venting did improve parachute performance regardless of canopy shape.

Conclusions/Discussion

My hypothesis was proven correct; the vented circular parachute performed the best by having the greatest flight time, demonstrating that it generated the most aerodynamic drag and best stability during flight. My experiment results matched well with my background research information. Specifically, that parachute shape is a key factor because it defines how efficiently a parachute will generate aerodynamic drag. This is due to the canopy shape determining the effective area exposed to airflow, and that area being directly proportional to the amount of drag. Also, my experiment demonstrated that venting is an effective way to increase drag. An apex vent is a hole in the canopy that allows turbulent trapped air escape from its center, which improves airflow by decreasing turbulence and improving parachute stability. This improved stability also increases the parachute aerodynamic drag force.

Summary Statement

My experiment is to determine which parachute canopy shape will perform best, and whether adding an apex vent to the canopy will improve parachute performance regardless of its shape.

Help Received

My Father dropped the parachutes from 5 meters off the ground (from our roof) while I timed the drops. He also helped proofread my display board.

CALIFORNIA STATE SCIENCE FAIR
2015 PROJECT SUMMARY

Name(s)

Callie M. McCaffery

Project Number

J0116

Project Title

Capturing Wind Energy

Abstract

Objectives/Goals

Objective: To understand how to build the most efficient windmill.

The focus will be to change the windmill blade angles and measure the change in the number of rotations per minute without changing other variables, such as wind speed.

Methods/Materials

Materials:
- Home made windmill. Started with a tinker toy prototype and modified it to build a test windmill (tinker toy hub, bass wood blades, clamp supports, and rotation counter)
- Wind tunnel (box fan and foam board tunnel)

Method:
The blade angle was adjusted to 5 different settings (0, 30, 45, 60, and 90 degrees) on the test windmill. At each blade angle setting, the windmill was tested in the wind tunnel for a minute. The number of rotations was recorded for each setting. Five data sets were collected for each blade angle. The tests were run at two wind speeds. The data was recorded and reviewed.

Results

Testing showed that the most efficient blade angle was at 30 degrees. At 45 and 60 degrees the windmill worked, but not as well.

At 0 and 90 degrees, the windmill did not work.

Conclusions/Discussion

I learned that there is an optimum blade angle for windmill operation, and my optimum blade angle was 30 degrees. Although this is the best angle for my windmill, further testing may show that the best setting is a little less or more than 30 degrees (I could not precisely test these angles with my windmill.)

I also learned that changing wind speeds did not change the best angle. From this it is seen that the correct blade angle at low wind speed can perform better than a less efficient blade angle at high wind speeds.

Summary Statement

My project is to determine how windmill blade angles affect the windmill's performance by changing blade angles and measuring results in a wind tunnel.

Help Received

My Dad helped build the test windmill after I built the prototype. My Mom helped during the test and with lessons on the computer.

CALIFORNIA STATE SCIENCE FAIR
2015 PROJECT SUMMARY

Name(s)

Anamaria Mejia; Juan Samanamud; Lalita Thavisay

Project Number

J0117

Project Title

The Intensity of Wind

Abstract

Objectives/Goals

Our question is: What blade shape is most aerodynamic, with the least drag, to make a wind energy rotor spin faster, causing more electricity to be generated?

We hypothesized that blades similar to the shape of a leaf or bird wing would be the most aerodynamic, generating maximum electricity. Our goal was to create a blade based on aerodynamic shapes, such as the wing of a bird where the shape of the blade is 3-D, the tip of the blade is narrow, and where the bottom of the blade would be twisted to give the blades more torque and generate lift. We are trying to design a blade that could harness the power of the wind.

Methods/Materials

We used PVC pipes to make our stand for the wind energy device. A DC motor is connected to a hub for the blades. This is the rotor.

We then glued the wooden spokes to the material we used for our blades: coroplast, manila folder, and poster paper, creating 7 different blade shapes. The blades were connected to the plastic hub that was connected to the motor. Our wind source is a twenty inch fan. We tested the blades at different pitches using a protractor to measure the degrees. We tested for volts on a multimeter. We used what we learned to keep testing and refining our blade design. The addition of a gear box with gears at a ratio of 7 to 1 increased the velocity of the rotor.

Results

After preliminary wind testing, Blade 2, a flat leaf shape design, measured one volt on a multimeter. The increased length and 3-D twisted shape of the phoenix airfoil blade resulted in an increase of 5 volts, at maximum of 6.29 V. Voltage measured ranged from 0.4 V, blade three arrow shape, to 6.29 V, blade six, the phoenix blade. Further increasing the pitch beyond 10 degrees at the wrist of the blade did not increase the voltage.

Conclusions/Discussion

The hypothesis was proven correct. The bird wing airfoil blade shape captured the most wind speed just like a falcon wing. The difference between the flat blades, 1-5, and the 3-D airfoil blades was dramatic, a difference of 5 volts. The 3-D bird airfoil phoenix blade gave the best performance.

Finding blade shape designs that will capture the maximum wind energy to generate clean electrical energy is crucial. Our project is part of the science and engineering study of aerodynamic shapes such as the falcon wing and humpback whale fin. This will guide us in designing a more efficient blade and capturing the energy of the wind.

Summary Statement

How do bird wing shaped blades affect maximum wind power?

Help Received

Teachers, Ms. Ward, guidance and materials, Mr. Donovan, constructing a gear box, MLMS STEM Lab for testing our device

CALIFORNIA STATE SCIENCE FAIR
2015 PROJECT SUMMARY

Name(s)

Nathan G. Mermilliod

Project Number

J0118

Project Title

The Speed of Salty Swimmers: The Effects of Salt Water vs. Chlorine Water in Competitive Swimming

Abstract

Objectives/Goals

The objective of this experiment is to test what kind of swimming pool is best for competitive swimmers.

Methods/Materials

A fan was placed on one side of a box, which was filled with chlorine water. A tennis ball was set in the box on the same side as the fan. The fan was turned on and the time the tennis ball took to go from one end to the other was recorded. These steps were repeated to record times for salt water. Twenty trials were recorded for each type of water. The buoyancy of the tennis ball in each type of water was also recorded by measuring how deep the ball sat in the water. The temperature of the water was also noted. Afterwards, a data study of recorded event times from the 2014 swim season was conducted to compare the times of human subjects on a local competitive swim team in salt water and chlorine water pools.

Results

The data showed that there was a small, but measurable, difference between the speed the tennis ball traveled in salt water and in chlorine water. The tennis ball traveled faster in the salt water. The examination of data from human subjects also showed that competitive swimmers swim faster in salt water versus chlorine water.

Conclusions/Discussion

The data supports the original hypothesis in that the tennis ball traveled faster in the salt water, which is denser than chlorine water. As predicted, increased density was linked with increased buoyancy in the salt water. In addition, the 2014 swim season data examined from a local competitive swim team supports the original hypothesis and the results of the tennis ball experiment.

Summary Statement

My project tested the speed of movement through water in two water treatments (salt and chlorine).

Help Received

Dr. Laosheng Wu, UCR Professor and CE Specialist, assisted as a project mentor for regional science fair

Name(s)
Ethan A. Muzzio

Project Number
J0119

Project Title
Testing Aerodynamics in a Wind Tunnel

Abstract

Objectives/Goals
The objective is to construct a small scale wind tunnel to observe the aerodynamics of various car designs.

Methods/Materials
A small scale wind tunnel was constructed from Styrofoam insulation board using duct tape, Plexiglas, and a household box fan. Three scale model toy cars were selected as test subjects. Dry ice was used as a visual aid to observe the aerodynamics/drag of three common car designs: sports car, muscle car and pickup truck.

Results
The low profile and sleek design of the Lamborghini Aventador sports car produced the least amount of drag. The Ford Mustang GT muscle car with rear spoiler produced less drag than the Ford F150 pickup truck, but more than the sports car. Lowering the tailgate of the pickup truck appeared to reduce the amount of drag and improve the truck's aerodynamics.

Conclusions/Discussion
It is possible to construct a small scale wind tunnel from common household items and materials found at a local hardware store. The aerodynamics of various car designs can be observed inside the wind tunnel with the aid of dry ice to visualize the drag produced by the surface curvature of the car.

Summary Statement
A small scale wind tunnel was constructed to observe the aerodynamics of various car designs.

Help Received
Father asisted with cutting of large sheets of Styrofoam insulation board and PVC pipe sections for flow straightener.

CALIFORNIA STATE SCIENCE FAIR
2015 PROJECT SUMMARY

Name(s)

Amanda Nguyen; Victoria Truong

Project Number

J0120

Project Title

Riding on Air

Abstract

Objectives/Goals

Our purpose of making the project was to make a hovercraft and test different weights on different surfaces. We wanted to know how to build a hovercraft and how they work. We also wanted to learn more about how weights and surfaces like rough or smooth and how they affect the hovercraft.

Methods/Materials

To make the hovercraft, we took a wooden disk and cut a hole in the wood with the leaf blower. Next, we placed a plastic skirt on the bottom of the wood disk. Then we flipped the wood disk over so the skirt faces up. Afterward, we attached a plastic disk to the plastic skirt in the center. We then made six vent holes, to let out air. Next, we turned it over to the wood side, placed the leaf blower in the hole. We tested the hovercraft first mark a 10-12 foot mark between the launch and Distance X. Afterward, we launched the hovercraft with Weight one and Surface A with Force F, started to time the hovercraft once it passed Distance X. We repeated three times for Weight 1, Surface A, Weight 2, Surface A, Weight 3, Surface A, Weight 1, Surface B, Weight 2, Surface B and Weight 3, Surface B.

Results

We recorded our data differently because of the different weights and surfaces, concrete and asphalt. The concrete worked better than the asphalt because of the friction of the weight and the surface. The result answered both our questions. The weights did affect the results.

Conclusions/Discussion

Our project wasn't successful because our second hypothesis wasn't correct. Overall, we learned more about friction on the weights traveling on different surfaces.

Summary Statement

The project showed how weights and surfaces affect how the hovercraft moves.

Help Received

Parents helped on building the hovercraft.

CALIFORNIA STATE SCIENCE FAIR
2015 PROJECT SUMMARY

Name(s)

Austin L. Parlett

Project Number

J0121

Project Title

Pinwheel Sensitivity

Abstract

Objectives/Goals

My objective for this project was to determine if changing the amount of blades on a wind turbine, or in this case a pinwheel, would affect how sensitive it was to wind.

Methods/Materials

To begin, I bought six pinwheels from our local toy store. The first step was to attach a hairdryer to a stool and one of the pinwheels to another stool. To measure the distance between the pinwheel and the hair dryer, I measured 9 feet on the ground. I then turned on the hairdryer and slowly moved away from the pinwheel. I kept moving the hairdryer back until the pinwheel stopped moving. I kept repeating this process and removed one blade each time. After I was in the middle of my experiment I realized I couldn't actually see where the air was hitting the blades. To solve this, I attached a laser pointer to the hair dryer and started the whole thing over to make sure I had accurate results.

Results

My data shows that three blades effectively capture the most wind. An example of this is when there were only four blades, the blades only spun for 58.6 inches and when there were three blades, it spun for 57.6 inches.

Conclusions/Discussion

After changing the distance and shape of a pinwheel, the sensitivity of the pinwheel changed. My hypothesis was that "If I change the distance and shape of the pinwheel, then the farther it gets from the hair dryer the slower the pinwheel will move." My hypothesis was correct because as I got farther away from the pinwheel, the slower it spun. This shows that when a pinwheel is symmetrical it will spin for a longer distance. Also as I took away blades from the pinwheels, the harder it was for the pinwheel to spin. During the experiment the problems that I encountered were minimal. One problem was that I wasn't sure where the air was hitting the pinwheel. As a solution, I added a laser to the hair dryer so I could aim and see exactly where the air was hitting the pinwheel. As I was looking at my graphs and data, I realized that when I removed blades, the pinwheels would change the distance at which they would spin. If I were to look more into this experiment in the future, I would like to learn more about who invented wind turbines and learn more about the history of them. Overall I felt this experiment was very successful, fun to organize and would recommend it for other people to try.

Summary Statement

This project is about determining if the amount of blades on a wind turbine affects how sensitive it is to wind.

Help Received

My mom drove me to the store to purchase the pinwheels and my teacher supported me throughout the experimental process.

CALIFORNIA STATE SCIENCE FAIR
2015 PROJECT SUMMARY

Name(s)

Nicholas W. Tan

Project Number

J0122

Project Title

Planes, Birds, and "V" Shapes

Abstract

Objectives/Goals

The objective is to determine if planes will save fuel when flying in a "V" shape formation. My hypothesis is "If planes fly in a "V" shape like birds, then they will save fuel."

Methods/Materials

A wind tunnel was created from a cardboard box, air conditioner filter and electric box fan. Each model plane was placed on a digital scale in the wind tunnel at a measured distance from the filter. The weight of each plan was recorded with the fan turned off and on. The three planes were then arranged in a "V" shape and the weight of each was recorded with the fan turned off and on. I compared the weight of each plane by itself and when it was in the "V" shape.

Results

When tested by itself, each individual plane decreased in weight no matter the distance from the fan or the fan speed. While in the "V" shape, I observed the weight of the lead plane did not change. However, the side planes in the "V" shape weighed slightly less (up to half a gram) than while they were flying by themselves.

Conclusions/Discussion

In my experiment, it appears that a plane flying in the "V" formation weighs less than when it is flying by itself (up to half a gram). A lighter plane does not need to provide as much lift and thrust--the factors that oppose weight during flight. Since thrust is created with fuel and the plane does not need as much thrust when flying in the "V" shape, the plane will consume less fuel. This experiment can provide us with a concept of how planes can save fuel.

Summary Statement

Use a wind tunnel to determine if planes flying in a "V" shape formation will consume less fuel.

Help Received

Borrowed digital scale(s) from my science teacher; Mom purchased model planes, procured cardboard box, and helped assemble display board

CALIFORNIA STATE SCIENCE FAIR
2015 PROJECT SUMMARY

Name(s)
Jason X. Tuermer-Lee

Project Number
J0123

Project Title
Investigating the Effects of Camber on Airfoil Lift

Abstract

Objectives/Goals
The purpose of this project was to determine the effects of camber on airfoil lift. The upper surface of a cambered airfoil is longer than the lower surface. As air moves over a cambered airfoil, a difference in air pressure and velocity arises, which, by Bernoulli's principle, creates lift.

Methods/Materials
The five airfoils tested in my experiment had cambers of 0%, 2%, 4%, 6%, and 8%. These were the NACA 0015, 2415, 4415, 6415, and 8415 airfoils, respectively. A hot wire foam cutter was used to cut out the Styrofoam airfoils. The body of the wind tunnel was constructed out of wood and foam board. The fan was made from a quadcopter motor and blade. A servo tester and speed control were used to adjust the speed of the fan. The fan was adjusted to the lowest possible speed needed for the airfoils to create 20 centimeters of lift. At this time, the pulse-width of the fan was recorded. Twenty trials were run.

Results
The NACA 0015 airfoil created 20 centimeters of lift at an average pulse-width of the fan of 1.37 ms, the NACA 2415 airfoil at 1.32 ms, the NACA 4415 airfoil at 1.3025 ms, and the NACA 6415 airfoil at 1.2825 ms. The airfoil with the most camber, the NACA 8415 airfoil, created 20 centimeters of lift when the fan was running at an average pulse-width of 1.2675 ms. This was a 7.48% decrease of average pulse-width compared to the NACA 0015 airfoil with no camber.

Conclusions/Discussion
The airfoil with the most camber created the most lift, supporting my hypothesis. The real-world applications of this project include airplanes that use less fuel by using wings that create more lift. This would not only be good for the earth, but also lower ticket prices on commercial airlines. Wings that create more lift will also require shorter takeoffs. This project could be improved by building a new stand to fly the airfoils on with less friction, adding an air filter to reduce turbulence in the wind tunnel, and installing an anemometer and tachometer (which would allow different representations of the data). Further research could include testing more accurate airfoils cut by machine and testing airfoils with different thicknesses and cambers at different angles of attack.

Summary Statement
The purpose of this project was to investigate the effects of camber on airfoil lift.

Help Received
Mother helped gather materials, assemble backboard, and supervised construction of wind tunnel.

CALIFORNIA STATE SCIENCE FAIR
2015 PROJECT SUMMARY

Name(s)

Julia V. Vaughan

Project Number

J0124

Project Title

Does Elevation Affect Distance?

Abstract

Objectives/Goals

The purpose of this experiment was to see how different elevations will affect the distance of a thrown ball.

Methods/Materials

I went to three different elevations. I set up a pitching machine and launched three trials of five balls, making a total of fifteen balls thrown. I put place markers where the balls landed and recorded the distance. I made sure that at each location the pitching machine was set up exactly the same to make sure the machine pitched the balls at the same angle and the same speed. I used a radar gun to verify that the balls were thrown at the same speed.

Results

The balls thrown at the higher elevations consistently went the farthest, and at the lowest elevation the ball went the shortest distance.

Conclusions/Discussion

My conclusion is that higher elevations do make balls travel farther distances. This is because higher elevations have less air pressure, and thinner air helps make a ball travel farther. At lower elevations the air is thicker, and this thicker air actually works against the ball and pushes on it making the ball go slower.

Summary Statement

This project was conducted to determine if a ball thrown at different elevations will affect the distance it travels.

Help Received

My father drove to the different elevations and helped set up the pitching machine.