CALIFORNIA STATE SCIENCE FAIR
2008 PROJECT SUMMARY

Name(s)
Michael Chu; Steven Davies; Trent Lawler

Project Number
S0205

Project Title
The Wing Structure Effect on Lift vs. Drag Ratio

Abstract

Objectives/Goals
There are many different types of designs of wings that can be created. However, some of these designs are more desirable then others due to the change in lift and drag of the wing. An increased lift and a decreased drag on a wing can impact the fuel efficiency of the wing. We have chosen to experiment with wing designs and hopefully find a design that will increase the fuel efficiency of a plane.

Methods/Materials
We first created 1 control wing and 5 different test wings with design tweaks. We then measured the lift of each wing by hanging the wings from springs and observing the change in distance between the original and the final length of the spring. To measure the drag we attached a spring to the wing in a horizontal direction and measured the change in distance. Then we compared this to the control wing to find out the difference in force exerted on the wing, giving us the relative drag. We kept the angle of attack constant.

Results
First, the control had a lift force of .075 N. The wing we created with bumps on the top had only a 0.0042 N increase in lift; however the wing had .061 N more drag then the control. The wing with grooves on top produced a lift of .0894 N and the wing with grooves on bottom produced a lift of .0972 N. But the drag, presumably form drag, increased slightly: in the first wing's case .0069 N and in the second wing's case, .0087 N. Furthermore we created wings with indentations on the sides of the wing, which had a lift of .0474 N and an additional drag of .006 N.

Conclusions/Discussion
Side indentations lowered lift force, possibly due to disruption of airflow because of the increase in shearing forces on the air. The drag is not very bad, but it is clearly worse, so nothing is gained. The rough, bumpy textures applied to the wings only provided beneficial forces in the case of the rough top trial. This was such a small margin that it was probably an error. As for the grooves, they increase lift dramatically, while not increasing drag significantly. Unfortunately we cannot know the actual drag, simply the relative drag, so the lift to drag ratio cannot be calculated. We believe the added lift to be due to surface area that the wind must travel through on top, increasing velocity, and the bottom grooves must add to the angle of attack on the wing. Angle of attack will usually increase drag more than additional induced and form drag, so this fits with the data.

Summary Statement
In our experiment we tested wings with different designs to determine which wings had the most lift and drag in order to find a design that will increase the fuel efficiency of a plane.

Help Received
Our mentor Mr. Burns explained a couple tough aerodynamics concepts for us.