



**CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY**

Name(s) Tithi Mandal	Project Number J0121
Project Title Airfoils and Winglets	
Abstract Objectives/Goals To find out if airfoils become more aerodynamic when a winglet is attached. I believe winglets will make a wing more aerodynamic. Methods/Materials For my experiment I made three airfoils with various camber styles and made three winglets, which can be attached at the tip of the airfoils to turn them into airfoils with winglets. I placed the each airfoil without attaching the winglet inside a wind tunnel one at a time and measured lift and drag force by two sensitive spring scales. Then I attached the winglets to the tip of the airfoils and again placed them inside the wind tunnel and took the same measurements. I kept the speed of the wind in wind tunnel and the angle of attack same. Results The wings did become more aerodynamic with winglets. For low camber and deep camber airfoils, the lift to drag ratio was 300% higher when the winglet was attached to them compared to the case when the winglet was not attached. For symmetric camber it was 200% higher! Also the lift force generated by airfoils with winglets was 200-300% higher! Planes need to fly at a safe altitude above all weather, so the lift force must be pretty high. To get a high lift force, the angle of attack has to be high, which again generates high drag as well. As the airfoil with winglet generates higher lift for a given angle of attack, a plane with winglet will need lower angle of attack hence less drag for the same lift compared to a plane without winglet. Conclusions/Discussion I concluded that wings with winglets are the most aerodynamic. All three types of wings have higher (200 - 300%) lift to drag ratio when a winglet is attached. This means that for the same lift the drag will be lower for a wing with winglet attached to it. For getting higher lift the angle of attack needs to be high, which generates higher drag. In case of a wing with winglet, a lower angle of attack will be needed to generate the same amount of lift as the wing without winglet. And due to lower angle of attack lower drag will be generated.	
Summary Statement To find out if airfoils become more aerodynamic and efficient when a winglet is attached.	
Help Received My parents helped me in making the airfoil and wind tunnel and preparing the board	