



**CALIFORNIA STATE SCIENCE FAIR  
2009 PROJECT SUMMARY**

<b>Name(s)</b> <b>Ethan D. Maahs</b>	<b>Project Number</b> <b>J0117</b>
<b>Project Title</b> <b>Spin It to the Limit</b>	
<b>Objectives/Goals</b> The objective is to determine if the rotation speed of a football affects drag on the football	
<b>Abstract</b>	
<b>Methods/Materials</b> Materials: Home-made wind tunnel - Football Suspension and rotation apparatus - Home-made anemometer - Force Gauge - Nike 1000 Spiral Tech Football - 18V DC Motor (2)-TORO Leaf blowers - 12 VDC Power Supply -Variable Autotransformer Methods: 1. Calibrate the wind tunnel at various wind speeds a. Place the anemometer in the center of the exit to the wind tunnel b. Turn one leaf blower to setting I c. Set the multi-meter to 200 mV. d. Record the output from the multi-meter. e. Set both leaf blowers to setting I and repeat steps c and d. f. Turn both leaf blowers to setting II and repeat steps c and d. g. Use the graph generated by using vehicle speeds and determine the wind speeds at the leaf blower settings. 2. Mount the rotation apparatus so the football is centered in the wind tunnel 3. Confirm the wire on top of the rotation apparatus contacts the force gauge 4. Zero the force gauge. 5. Turn one leaf blower to setting I. 6. Record the gram force. 7. Turn the DC motor on and set variable auto transformer to 10%(485 RPM). 8. Record the gram force. 9. Change the setting on the auto transformer to 15%(622 RPM). 10. Record the gram force. 11. Change the setting on the auto transformer to 20%(780 RPM). 12. Record the gram force. 13. Change the setting on the auto transformer to 25%(1020 RPM) 14. Record the gram force15. Turn the leaf blower and the auto transformer off16. Turn on both leaf blowers to setting I17. Repeat steps 6-15 with both leaf blowers on setting I18. Repeat steps 6-15 with both leaf blowers on setting II19. Repeat the procedure to collect 3 data sets at each wind speed. 20. Calculate the average gram force for each rotation and wind speed.	
<b>Results</b> The drag on the football reduced with increases in rotation speed for all wind speeds up to 780 RPM, but increases in rotation speed beyond this point increased drag.	
<b>Conclusions/Discussion</b> The drag force on a football seems to be inversely proportional, with the exception of the highest rotation speed where the drag on the football increases with increased rotation speed. Based on the test data the optimum rotation speed to minimize drag on the football is between 622 RPM and 780 RPM.	
<b>Summary Statement</b> My project was to study the affects of the rotation speed of a football on the drag of a football at various velocities.	
<b>Help Received</b> My father helped build the wind tunnel, suspension apparatus and suggested improvements that helped my experiment.; Mr. Hobbs for making sure I knew what I was doing before I started the experiment, checking my report and helping me practice my presentation .	