



**CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY**

Name(s) Sarah E. Whipple	Project Number J0124
Project Title Magnus Force on Spinning Spheres	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals The objective of my project was to explain how well the Kutta-Joukowski Lift Theorem explains Magnus Force on spinning spheres by comparing theoretical lift to measured lift for various spin frequencies, wind velocities, and diameters.</p> <p>Methods/Materials I built my wind tunnel using various materials, including wood pieces for the frame, electronic components for the motor control switchbox, a tachometer kit for measuring spin frequency, a homemade anemometer for measuring wind velocity, an electric leaf blower for the wind source, and a dietetic scale for measuring lift.</p> <p>Results I demonstrated that the Kutta-Joukowski Lift Theorem does, in fact, explain the linear relationships between lift and spin frequency, as well as lift and wind velocity. This theorem also explains the cubic relationship between lift and sphere diameter.</p> <p>Conclusions/Discussion My project taught me many math and science skills. I first learned about the origins of Magnus Force and the Kutta-Joukowski Lift Theorem. I learned some basic fluid dynamics, including Bernoulli's Principle, viscosity, laminar air flow, and turbulent air flow. I also learned about various linear and cubic mathematical relationships. I learned about Ohm's Law and how motor speed changes with current. Lastly, I learned soldering and other construction skills.</p>	
Summary Statement I designed and constructed a wind tunnel to measure transverse forces on spinning spheres, and compared those forces to the predictions of the Kutta-Joukowski Lift Theorem.	
Help Received My parents supported, guided, and encouraged me when working on my science project. My father helped me in the construction of my wind tunnel, and my mother helped me in the design of my board.	