



**CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY**

Name(s) Magnus B. Herrlin	Project Number J0112
Project Title The Magnus Effect in Action: The Impact of Surface Roughness	
Abstract Objectives/Goals The objective of my project was to determine if the speed of a rotor ship as propelled by the Magnus Effect is affected by the surface roughness of the rotor when exposed to the same cross-wind. My hypothesis was that a rough rotor would make the boat go faster. Methods/Materials I built a model rotor ship with two exchangeable rotors with two different surface roughness by using materials such as coarse sandpaper, a LEGO Technic motor, a 9V battery, and a boat hull. The two rotors had identical dimensions and weight. Some other items I used were a table fan, a timer, and a plastic flower box to act as a tub. I placed the boat on the water in the tub, started the rotor, and turned on the table fan (cross-wind). I timed the boat travelling from one end of the tub to the other and then changed rotors and repeated the process. Results In my winning project to the Regional Science Fair, I identified a couple of less than ideal test conditions (mainly interference by room surfaces). So, I repeated the measurements for the CA State Science Fair in a more controlled environment, and I increased the sample size. I performed 40 trials in two series: 20 with the rough rotor, 20 with the smooth rotor. The boat with the rough rotor surface went consistently faster by an average of 22%. The mean speed for each of the two series are three standard deviations apart. These findings support my hypothesis. Conclusions/Discussion In aerodynamics, there are two main forces on a body: lift and drag. Golf balls have dimples because they create more lift and less drag when the spinning ball travels through the air. If golf balls were to have a smooth surface, they would go a shorter distance. The same effect could be seen with my spinning rotors, which helped me understand why the boat with the rough rotor went faster. In my case, the "lift" caused by the Magnus Effect propelled the boat forward. An optimization of the surface roughness may increase the speed of the boat beyond my results.	
Summary Statement My project is about finding out whether the speed of a model rotor ship (propelled by the Magnus Effect) depends on the surface roughness of the rotor.	
Help Received None. I designed, built, and performed the experiments myself.	