



CALIFORNIA STATE SCIENCE FAIR 2006 PROJECT SUMMARY

Name(s) Laurel A. Kroo	Project Number J0199
Project Title A Fuel Cell Powered Underwater Glider for Marine Exploration	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals Underwater gliders are used for subsurface mapping, underwater scanning for the Navy, and other environmental purposes. Currently, these gliders are propelled by buoyancy engines that expand and compress air. The glider moves forward as it sinks and when the buoyancy is increased, it glides forward as it floats upward. The main problem with these gliders is that they have poor efficiency - about 12%. My goal is to radically improve the efficiency of underwater gliders by replacing the typical buoyancy engine with a reversible hydrogen and oxygen fuel cell, and changing the external design to minimize drag, and to accommodate this new engine. Other advantages of using a fuel cell are that it has no moving parts, and water for the fuel cell is always available.</p> <p>Methods/Materials The first step in the design of a new glider was to develop a new fuel cell buoyancy engine. I started with a fuel cell and modified it by capturing the gases using the electrolysis process. The fuel cell changes the water into oxygen and hydrogen gases (using energy from the batteries), making the craft more buoyant. Once the device reaches the surface, the fuel cell switches directions, combining the hydrogen and oxygen and making the craft sink. The process is repeated. I designed, built and tested several versions of this new buoyancy engine. The second step was designing an underwater glider. I designed a glider to work with my buoyancy engine, calculated the required buoyancy for the craft to go at different speeds, and compared the drag of this craft to three current gliders (Spray, Seaglider, and Slocum). In this process I learned many things about aerodynamics like drag area, skin friction coefficients, Reynolds numbers, and laminar versus turbulent flow.</p> <p>Results I calculated the efficiency of my new buoyancy engine, and the needed buoyancy for specific speeds of the craft. Current gliders are 12-15% efficient, where the fuel cell is about 75% efficient in electrolysis, and 51% efficient when producing water and electricity. Because of the new buoyancy engine, and of the new external design this glider could double or triple the time underwater gliders can stay at sea.</p> <p>Conclusions/Discussion Fuel cell powered underwater gliders could greatly contribute to ocean exploration and provide new research opportunities. My project could lead to a powerful tool to make advances into the ocean's vast unexplored depths.</p>	
Summary Statement In summary, I have built a fuel cell buoyancy engine, designed and analyzed an underwater glider, and demonstrated that fuel cells would greatly benefit these highly efficient aquatic vehicles.	
Help Received My mother helped me paste together my board. My father told me about underwater gliders, helped with the assembly of prototypes in situations with dangerous tools and/or substances, and talked with me about my design ideas.	