



**CALIFORNIA STATE SCIENCE FAIR
2005 PROJECT SUMMARY**

Name(s) Vasco H. Morais	Project Number S0712
Project Title The Effect of Temperature on PEM Hydrogen Fuel Cell Efficiency	
Abstract Objectives/Goals My hypothesis was: If the temperature of a proton exchange membrane (PEM) hydrogen fuel cell were increased in the range of 9°C to 40°C, then electrical output in voltage (as a measure of efficiency) would increase as well (a direct relationship). Methods/Materials A PEM separates the protons and electrons in hydrogen atoms, freeing the electrons to travel via a circuit generating electricity for electromagnetic applications, emitting no waste or by-products other than heat and water vapor. For the experiment, the fuel cell was stored in the freezer until its temperature dropped to 9°C. A hydrogen tank was attached to the fuel cell and a multimeter was attached to the electrodes on the fuel cell, displaying the voltage. I recorded the voltage for each degree as the temperature rose from 9°C to room temperature (23°C). I then used a blow dryer to increase the temperature to 40°C and recorded the voltage for each degree as the temperature decreased from 40°C to room temperature (23°C). Results My hypothesis was refuted. My results displayed an indirect linear relationship. Conclusions/Discussion I found the 9°C to be the optimum temperature for maximum efficiency. Electrical applications using fuel cells would not be running at optimal efficiency at room temperature.	
Summary Statement The experiment tested the effect of temperature on voltage output of a PEM (Proton-Exchange Membrane) hydrogen fuel cell.	
Help Received I was assisted by my father in obtaining the materials, my science teacher helped develop the experimental procedures, and my parents helped edit my report. It took two people to run the experiment, so while my dad read the data values aloud, I recorded the data.	