



**CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY**

Name(s) Nathaniel L. Foote	Project Number S0805
Project Title Comparing CO Emissions between Hybrids and Gas-Powered Cars	
Abstract Objectives/Goals The objective is to compare the carbon monoxide emissions between gas-powered cars, both modern and pre-Clean Air Act(1988), to those of gas-electric hybrid cars. Methods/Materials Four different cars' CO emissions were compared: a 1998 Toyota Sienna minivan, a 1970 Mercedes-Benz 280 SEL, a 2003 Honda Civic Hybrid, and a 2004 Toyota Prius(hybrid). An air pump containing a carbon monoxide detector solution was placed ten inches from the exhaust pipe of each car and the exhaust was run through the solution at a rate of two liters per minute for twenty minutes. The solution changed to a shade of yellow based on its concentration of CO. That color was matched to one on a chart, which corresponded to a concentration in parts per million of CO. Based on my results and the 4:1 driving to idling ratio of the average city driver, I calculated a city-driving average of CO emissions. Results Both hybrids shut off the gasoline engine when idling, so there were no emissions for either at an idle. When revved up to 1700 RPM, the Civic had a 20-PPM concentration while the Prius' exhaust contained 23.5 PPM of CO, giving them a 16 and 18.8 PPM city-driving average, respectively. The Sienna registered at 62.5 PPM while idling and 48.5 PPM while revved, therefore yielding a city-driving average of 51.3 PPM. The Mercedes registered at an astounding 330 PPM at an idle and 320 PPM at rev and has a 322 PPM city-driving average. The city-driving average is the most important statistic, and the Sienna on average emits only 1/6 of what the Mercedes does, with the hybrids basically halving the emissions of the Sienna. Conclusions/Discussion It is clear how greatly the hybrids have improved upon the CO emissions of both modern gas-powered cars and those manufactured prior the Clean Air Act of 1988. All cars emit the most CO when idling, because that is when fuel is least efficiently combusted, so the fact that hybrids emit nothing when idling is a huge advantage and drives down their city-driving average. As hybrids gain popularity, our air quality will only improve and we can look forward to fewer air-pollution-related ailments such as asthma and lung cancer.	
Summary Statement My project shows how much better carbon monoxide emissions in hybrids are than in gas-powered cars.	
Help Received Used father's cars; Friend helped with finances	