



**CALIFORNIA STATE SCIENCE FAIR
2008 PROJECT SUMMARY**

Name(s) Griffin R. Lay	Project Number J1016
Project Title Making Acid Oceans: The Effects of Anthropogenic Atmospheric Carbon Dioxide Increase on the pH of Earth's Oceans	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals The goal of this project is to assess the potential effects of increasing amounts of atmospheric carbon dioxide resulting from anthropogenic activity on the pH of the oceans. Over the past 150 years oceanic pH has dropped, while atmospheric carbon dioxide has increased. Are these two phenomena causally related?</p> <p>Methods/Materials An enclosed aquarium was partially filled with distilled or ocean water of known initial pH, and the carbon dioxide level of the overlying air mass was increased by injection of known amounts of carbon dioxide. The water was gently circulated by a pump and the sealed system allowed to equilibrate, with the carbon dioxide content and pH measured after equilibrium. Changes in water pH were plotted as functions of atmospheric carbon dioxide concentration.</p> <p>Results The water pH decreased in proportion to the carbon dioxide contribution in the air up to a limiting value that appears to be a saturation level. The drop in pH was as large as -1.4 for very high levels of carbon dioxide, and -0.5 for factor of 10 increases in carbon dioxide which are in the range envisioned by unabated anthropogenic contributions over the next century. It is clearly established that atmospheric carbon dioxide level and ocean pH are causally related and past and future changes in ocean pH can be attributed to human induced increases in carbon dioxide emissions.</p> <p>Conclusions/Discussion As atmospheric carbon dioxide concentration increases in the future, oceanic pH will decrease from its current slightly basic level (pH ~8) to less basic or acidic levels. Global observations indicate that this has already occurred in the last 150 years: as the industrial revolution increased atmospheric carbon dioxide concentration, ocean pH dropped by about -0.1 in pH. This ocean/atmosphere coupling occurs irrespective of contentious global warming consequences from the role of carbon dioxide role as a greenhouse gas. With oceanic organisms having evolved within a narrow pH level, there should be concern that oceanic acidification may disrupt the metabolic processes of diatoms at the bottom of the food chain and essential for production of free oxygen. Unabated, this poses a global threat to the ecosystem.</p>	
Summary Statement A controlled experiment demonstrates that increase in carbon dioxide concentration in air overlying a water mass lowers the pH of the water, a fundamental cause of ocean acidification due to anthropogenic carbon dioxide emissions.	
Help Received Father obtained high resolution CO ₂ and pH meters, and helped type the report.	