



**CALIFORNIA STATE SCIENCE FAIR
2008 PROJECT SUMMARY**

Name(s) Bryce W. Cronkite-Ratcliff	Project Number S1606
Project Title The Intermolecular Structure of Water via XRS-based XANES	
Abstract Objectives/Goals Recent experiments have challenged the traditional tetrahedral bonding picture for bulk liquid water, suggesting instead an asymmetric bonding picture in which the majority of molecules have only two strong Hydrogen bonds. This project expands the body of experimental data on the intermolecular structure of bulk ambient liquid water using XRS-based XANES (see below). Additionally, the structure of water in confined geometries is examined, a topic of fundamental importance to industrial and biological applications. Methods/Materials XRS-based XANES, or X-ray Raman-based X-ray Absorption Near-Edge Spectroscopy, is an experimental X-ray technique that essentially allows for soft X-ray spectroscopy with hard X-rays. Experiments were performed at a synchrotron lightsource with incident energy ranges of ~6-7 KeV. Using a 14-crystal analyzer spectrometer, the very small energy losses (~500 eV) necessary to observe the oxygen K-edge were detectable with high energy resolution. Conclusions/Discussion Preliminary analysis has been performed at this point in the experiment, but, as detailed analysis and theoretical modeling has yet to be performed, experimental conclusions have not been drawn. Thus far, bulk water spectra seem in keeping with data that suggest the "asymmetric" bonding model. Confined water spectra, somewhat contrary to expectation, show no obvious deviation from bulk water spectra. More analysis and data is needed.	
Summary Statement My project uses novel X-ray techniques to contribute to the understanding of the intermolecular structure of water.	
Help Received I am a junior member of a four-person international research team studying water bonding at SSRL (Stanford Synchrotron Radiation Laboratory). My parents helped proofread the project board.	