



**CALIFORNIA STATE SCIENCE FAIR  
2004 PROJECT SUMMARY**

<b>Name(s)</b> Megan S. Yoo	<b>Project Number</b> <b>S0822</b>
<b>Project Title</b> <b>Chlorination: Saving Lives Everyday, or Is It? A Study on the Formation of Trihalomethanes in Natural Water</b>	
<p style="text-align: center;"><b>Abstract</b></p> <p><b>Objectives/Goals</b> The objective of my experiment was to note the trend in the formation of trihalomethanes (THMs), based on water type, incubation time, and the amount of sodium hypochlorite (NaOCl) solution spiked into the water source.</p> <p><b>Methods/Materials</b> A calibration curve was created using different concentrations of the THM standard on the Varian GC/MS, for 2, 5, 20, 30, 50, and 100 ppb of THMs. For Experiment 1, water from various sources with different levels of organic content was spiked with varying levels of 6% NaOCl solution. DI water was used as a control. Experiment 2, after being slightly modified to test the hypothesis further, was conducted to validate the data found in Experiment 1. Two sets of each water sample were tested. The GC/MS was used to analyze the type and quantity of the THMs using 40 mL samples collected in amber vials for each water sample. The fluorobenzene internal standard#s ratios were checked to ensure that the results for the THM analysis were accurate. The amount of THMs in ppb formed in the water samples were recorded on the initial day of experimentation, and 1, 3, 5, and 7 days after the first day.</p> <p><b>Results</b> Water with a high content of organic substances, such as water from the Santa Ana River and Prado Wetlands, had a significantly higher number of total THMs (TTHMs) than relatively clearer water, such as OC reclaimed water and OC groundwater. The more the water has been filtered, whether naturally through the soil layer, or through purification filters, the lower the amount of THMs present in the water.</p> <p><b>Conclusions/Discussion</b> Trihalomethane formation is directly related to the organic content of water, the amount of chlorine spiked into the water, and the incubation period. The amount of TTHMs in water with large amounts of organic substances and a high concentration of NaOCl solution was drastically greater than water with few or no organic material and a low concentration of NaOCl solution. THMs, especially chloroform, are easily produced in many water sources after chlorination. THMs have been linked to bladder, colon, and rectal cancer, in addition to diseases in the kidney, liver, lung, and nervous system, and miscarriages. Known as toxins, significant amounts of THMs (over 60 ppb) can also cause large sores, in addition to the various diseases and illnesses. Both hard chlorine tablets and liquid forms of chlorine can cause THM formation in water.</p>	
<b>Summary Statement</b> I determined that trihalomethane formation has a positive association with the amount of organic substances in water, the level of chlorine present in the water, and the incubation period.	
<b>Help Received</b> I received prior training on running and interpreting the GC/MS, available at OCWD, from Supervising Chemist Lee J. Yoo during the past three years. Lab work for detection of trihalomethanes was done in the organic laboratory of OCWD under the supervision of Lee J. Yoo.	