



**CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY**

Name(s) Seung Hye Choi	Project Number 34305
Project Title Electronic Tongue: Tastes of Toxic Metal Ions in Water	
Abstract Objectives/Goals The main objectives of my project are: (1) to develop a simple, cost-effective electrochemical sensor (electronic tongue) that can simultaneously detect Cd(II), Hg(II), Pb(II), and As(III), and (2) to seek its reusability. Methods/Materials Gold nanoparticles were synthesized, and their surfaces were functionalized with four different types of crown ethers that can selectively produce complexes with Cd(II), Hg(II), Pb(II), and As(III). These functionalized gold nanoparticles were individually drop-casted on four interdigitated array (IDA) electrodes, and these four IDA electrodes were integrated to construct an electronic tongue. The concentrations of toxic metal ions were quantitatively determined by measuring the conductance and junction potential of gold nanoparticle films. For the reusability test, my sensor was washed with a solution of 0.1 M ethylenediaminetetraacetic acid (EDTA). Results Each IDA electrode showed a linear response with a specific metal ion when it was measured with conductance and junction potential. The response from junction potential was more linear than that from conductance. However, measurements of As ³⁺ were not as accurate as the other three ions. Selectivity was quantitatively studied by determining selectivity coefficients with six interfering ions. The reusability test revealed that about 99% of metal ions trapped in the film were removed by EDTA for next use. Conclusions/Discussion My electronic tongue simultaneously responds all metal ions except for As(III) with high sensitivity and selectivity. The use of gold nanoparticles resulted in high sensitivity. Also, the different design of crown ethers drives high selectivity. The detection limits of Cd(II), Hg(II), and Pb(II) were better than those reported by other scientists. The reusability was accomplished by cleaning a used electronic tongue with EDTA.	
Summary Statement I have developed the reusable electrochemical sensor (electronic tongue) that can detect toxic metal ions (Cd(II), Hg(II), Pb(II), and As(III)) simultaneously.	
Help Received All experiments were conducted in the department of chemistry, California State University, Fresno, under the guidance of Drs. Attar and Choi.	