



**CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY**

Name(s) Alan Chen	Project Number S0606
Project Title Colorimetric Detection of Toxic Heavy Metal Ions by Metal Nanoparticles	
Abstract Objectives Gold and silver nanoparticles exhibit intense colors, because of surface plasmon resonance. In this project, I demonstrate that this unique property can be exploited for the colorimetric detection of toxic heavy metal ions because of their chemical reactivity with the nanoparticle surface. Methods Materials: tetrachloroauric acid (HAuCl ₄), silver nitride (AgNO ₃), sodium citrate, mercuric(II) acetate (Hg(OAc) ₂), lead(II) acetate (Pb(OAc) ₂), barium acetate (Ba(OAc) ₂), cobalt(II) acetate (Co(OAc) ₂), chromium (II) acetate (Cr(OAc) ₂), copper(II) acetate (Cu(OAc) ₂), zinc acetate (Zn(OAc) ₂). Method 1. To prepare gold nanoparticles, I added 2.8 mL of 2.15 mM HAuCl ₄ into 20 mL of water. The solution was then heated to boiling on a hotplate. I then added 0.6 mL of sodium citrate (10 mg/mL) into the solution, and continued the boiling for 30 minutes. I found that the solution color changed from yellow to wine red. 2. Silver nanoparticles were prepared by using the same procedure except that AgNO ₃ was used instead of HAuCl ₄ . The eventual solution color was yellow. 3. The obtained nanoparticle solutions were diluted with distilled water such that the maximum optical absorbance was about 1 (by using a ultraviolet-visible absorption spectrometer). 4. The optical spectra were collected with the addition of a different amount of salt solutions. Results 1. I measured the size of the gold and silver nanoparticles by using transmission electron microscopy, which were 10 and 20 nm in diameter, respectively. 2. I tested the optical absorption of gold and silver nanoparticles. Gold nanoparticles showed a strong absorption at about 520 nm, and silver nanoparticles at 400 nm. These are due to their unique surface plasmon resonance. 3. I then tested the optical response of the nanoparticles when metal ions were added into the solution. I saw no color change of the gold nanoparticle solution even with the addition of 20 micromolar metal ions. This means that the gold nanoparticles were not a good choice for colorimetric detection of heavy metal ions,	
Summary Statement Metal nanoparticles can be used for the selective colorimetric detection of toxic heavy metal ions.	
Help Received Dr. Bingzhang Lu, University of California Santa Cruz	