



**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	
<p style="text-align: center;">Abstract</p> <p>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.</p> <p>Methods Materials: tetrachloroauric acid (HAuCl₄), silver nitride (AgNO₃), 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).</p> <p>Method</p> <ol style="list-style-type: none">1. To prepare gold nanoparticles, I added 2.8 mL of 2.15 mM HAuCl₄ 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 AgNO₃ was used instead of HAuCl₄. 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. <p>Results</p> <ol style="list-style-type: none">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.	
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