



**CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY**

Name(s) Melissa A. Merrill	Project Number J0524
Project Title Penny Corrosion: Gastric Acid Reactions with Copper vs. Zinc-Based Coins: A Serious New Health Hazard	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals The objective was to simulate gastric acid corrosion of different coins, and to assess the differences in chemical reactions and extent of corrosion (evaluated by weight loss) between copper versus zinc-based (minted since 1982) pennies.</p> <p>Methods/Materials 100 pre-1982 (solid brass, 95% copper) pennies, 100 post-1982 (copper plated, zinc core) pennies, and 100 lightly scratched zinc-based pennies were submerged in dilute hydrochloric acid baths simulating the gastric environment of pH 1-2. Solutions were changed twice daily and the pennies weighed daily for 7 days. Other coinage was submerged for 3 days for comparison only.</p> <p>Results All zinc-based pennies reacted immediately with the hydrochloric acid forming gas (H₂) bubbles and a black precipitate (ZnCl₂). Some coins were completely corroded within 2 days. The slightly scratched coins reacted faster, losing 32% of their weight by 7 days, about 50% greater than the unscratched pennies. Copper-based pennies initially lost no weight but after the second day started to develop a green solution, ultimately losing over 9% of their weight by day 7.</p> <p>Conclusions/Discussion Zinc-based pennies corroded about 3 times as fast as copper-based pennies, with slight surface scratches increasing the rate about 50% further. The zinc cores on all pennies immediately reacted with dilute HCl, even when no scratches were visible: no zinc-based penny could be considered "safe." In this experiment the availability of HCl seemed to be the limiting factor in corrosion rate. The reaction of copper-based pennies with HCl was unexpected and apparently more complex. Further analysis and research suggested that the copper reacted to form various compounds such as CuO, CuCO₃ and CuCl₂, only after repeated exposure to air, with the acid and CO₂ acting as catalysts. Therefore, copper pennies might not corrode at all in an airless stomach. However, this experiment demonstrated that the common scenario of a toddler swallowing a random penny can no longer be considered a harmless incident.</p>	
Summary Statement Corrosion of zinc vs.copper-based pennies in dilute HCl was analysed in order to simulate the effects of a coin ingestion.	
Help Received father provided initial article leading to idea for project; parents and advisor proofread and critiqued.	