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| **Best Way to Remove Tarnish From a Penny** |
| INT1 Task 3 |
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**Observation:** A penny becomes gritty and faded and gets a build up on its’ surface after some time. The pennies look like this because they are covered in copper oxide, which is a combination of oxygen atoms mixing with the copper atoms of the penny.

**Hypothesis:** There must be a household solution (agent) that could remove this buildup. I theorize that it would be a liquid with acidic content that would “eat away” the grime on the penny. After finding the right agent the pennies can be easily restored to a shiny finish.

**Experiment:** I will use five different agents to test my theory: water, lemon juice, lime juice, vinegar alone, and a vinegar and salt mixture. Each solution will have tarnished pennies soak in them for five minutes. After five minutes in the solution, the pennies will be removed, wiped down with a paper towel and observed. Each penny will have a before solution picture and an after in order to see the difference.

**Solution 1, Water:**

Results of Solution 1: After soaking for five minutes in a pure water solution, the tarnished penny appears no different than before.

**Solution 2, lemon juice:**

**Results of Solution 2:** After soaking in the lemon juice solution for five minutes, the pennies were all slightly cleaner than before.

**Solution 3, lime juice:**

**Results of Solution 3:** After soaking in the lime juice solution for five minutes, the pennies were all slightly cleaner than before. Not as clean as the lemon juice but much cleaner than the water solution.

**Solution 4, Vinegar:**

**Results of Solution 4:** After soaking in the lime juice solution for five minutes, the pennies were all slightly cleaner than before.

**Solution 5, Vinegar & Salt:**

**Results of Solution 5:** After soaking in the vinegar and salt solution for five minutes, the pennies were completely clean.

**Conclusion:** The experiment was successful because I was able to identify a solution that could be made at home to clean the pennies. The Vinegar and salt solution proved to be the best agent to get the job done. Why? The copper oxide dissolves in a mixture of weak acid (the vinegar) and table salt.

**Secondary experiment:** After determining that the vinegar and salt mixture was the best solution, a secondary experiment was conducted to see how long it would take this solution to restore to pennies as close to their original shine as possible.

Five new pennies were acquired from the bank for comparison. Ten “tarnished” pennies were chosen based on the appearance of having 10% shine remaining. All ten pennies were put into the vinegar & salt solution at the exact same time.

* 2 minutes elapsed: One penny was removed and determined to be at 20% shine.
* 4 minutes elapsed: One penny was removed and determined to be at 30% shine.
* 6 minutes elapsed: One penny was removed and determined to be at 50% shine.
* 8 minutes elapsed: One penny was removed and determined to be at 70% shine.
* 10 minutes elapsed: one penny was removed and determined to be at 90% shine.
* 12, 14, 16, 18 & 20 minutes elapsed and a penny was removed at each mark. The pennies did not appear to achieve additional shine after the 10 minute point. All pennies retrieved after 10 minutes were rated at 90% shine.

**Conclusion of experiment 2:**  It appears that the amount of time necessary to restore an old “tarnished” penny is 10 minutes in a solution of vinegar and salt.