

## Polishing Pennies 1 of 2

**P**ennies are made from bright, shiny copper, but they don't stay bright forever, because the copper reacts slowly with oxygen from the air to create a coating of copper oxides. The copper oxides are dull and dark. What is the best way to make pennies shine like new again?

### Materials

Masking tape

Pen

6 Small disposable plastic cups (3 oz.)

5 Old, dull pennies

Water

Dilute liquid dishwashing detergent

( $\frac{1}{4}$  teaspoon detergent in

1 cup of water)

Disposable plastic spoon

Lemon juice

Cola

Vinegar

Paper towels

Clock or timer

**SAFETY:** *Be sure to follow Milli's Safety Tips and do this activity with an adult! Do not drink any of the liquid samples in this activity. Eye protection must be worn by everyone performing this activity.*

### Procedure

1. Use the masking tape and pen to label the cups: "lemon juice", "cola", "detergent", "vinegar", and "water".

2. Place a penny in each of the cups, and describe each in the "What Did You Observe?" table.

3. Pour enough water, lemon juice, cola, vinegar, and detergent into the labeled cups so that each penny is completely covered.

4. Wait 3 to 5 minutes.

5. Use a plastic spoon to remove the penny from the "lemon juice" cup and observe how it looks. Write your observations in the "What Did You Observe?" table in the box under "lemon juice".

6. Polish the penny with a paper towel. Observe what happens and write your observation in the table. Look at the paper towel. What color is the material that you rubbed off?

7. Place the penny on the work surface in front of the cup from which it was removed.

8. Repeat steps 6–8 for each of the pennies in the other liquids, and record your observations in the table.

9. Wait about 5 minutes after all pennies are out of their solutions and observe them again. Write down your observations in the table.

10. Thoroughly clean the work area and wash your hands. Rinse the pennies with water, and dry them. Pour all liquids down the drain, and place the other materials in the trash.

### Try This..

Conduct your experiment again, using vinegar mixed with a few shakes of table salt. Also, try vinegar with a pinch of cream of tartar, a pinch of table salt, and a drop of dishwashing detergent. See if tomato ketchup or a water solution of baking soda is a good penny cleaner.

As you try these different cleaners, be certain that you continue to follow the safety guidelines, and that your adult partner approves.

## Polishing Pennies 2 of 2

### Where's the Chemistry?

Not all liquids are the same. In this case, the liquids that were acidic were better cleaners than the ones that were not. Lemon juice contains citric acid, cola contains phosphoric acid, and vinegar contains acetic acid. The detergent and the water are not acidic at all.

The acids in the lemon juice, the cola, and the vinegar react with the copper underneath the oxides on the outside of the penny to form new materials. These newly formed materials dissolve in the liquid and are washed away. So, what is left behind is a very thin coating of copper oxides that you can easily rub away. Did you notice whether any of the solutions changed colors?

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### What Did You Observe?

Penny	Lemon Juice	Cola	Detergent	Vinegar Water
Before putting into liquid				
When removed from liquid				
After rubbing on paper towel				
After 5 minutes				