

## PENNIES IN YOUR POCKET

Do you have a piggy bank? If not, maybe someone in your family has some pennies in their wallet or purse. Ask if you can have a few of those pennies, then we'll see what we can discover about them.

Look closely at your pennies. You will probably find that some are a shiny, bright, copper color while others are a dull brown or even greenish brown. Notice the dates on your pennies. What do you observe? Are the older or newer pennies brighter? Why are some pennies bright and others dull? If they were just dirty you could wash them with soap and water, but it is easy to see that this doesn't help. Is there a way to make the dull pennies bright and shiny again?

Let's try the following **chemistry** activity with our pennies. Chemistry is the branch of science that studies substances, what they are made of, and how they interact. Chemistry will help us understand what happens to the pennies during the activity.



You will need the following items:

- 1 shiny penny and 4 dull brown pennies.
- $\frac{1}{4}$  teaspoon salt
- $\frac{1}{4}$  cup vinegar
- $\frac{1}{4}$  cup water
- $\frac{1}{4}$  cup lemon juice
- $\frac{1}{4}$  cup ketchup
- Paper towel
- 4 glass or plastic cups or bowls
- Spoon
- Timer
- Note: you can use less than  $\frac{1}{4}$  cup of the liquids. You need just enough to cover the pennies.

Label your cups or bowls: "vinegar", "water", "ketchup", "lemon juice". If you don't have all of these ingredients, you can do this activity with water plus one other liquid, preferably vinegar. You can also substitute orange juice for the lemon juice.

Add  $\frac{1}{4}$  teaspoon of salt to the vinegar and stir until dissolved.

Place a dull penny in each of the liquids, making sure that it is covered by the liquid. The shiny penny is just for comparison. You will not need to do anything with it. Just put it aside for now.

Set a timer for 15 minutes. After the timer goes off, remove the pennies from their respective liquids. Rinse them and dry all except the one that was in the vinegar and salt solution.

#### SOME OBSERVATIONS:

***How do the pennies soaked in liquids look compared to the shiny penny that didn't soak in liquid?***

***Which liquid worked best?***

***What happened to the penny soaked in vinegar and salt that was not rinsed?***

Over time a newer, shiny, copper-plated penny turns a dull brown color because of a **chemical reaction** called **oxidation**. Chemical reactions happen when one or more chemicals are changed into one or more other chemicals.

You may already know that **atoms** are the basic building blocks for all the matter in the universe. They are extremely small. Any time two atoms join together, they form a **molecule**. The copper atoms in the penny bind with oxygen atoms in the air through the process of oxidation to form a molecule called **copper oxide**. The pennies look brown because they are coated with copper oxide, which is reddish in color.

Acidic liquids like vinegar, lemon juice, and ketchup, especially when mixed with salt, help break up the copper oxide on the pennies.

After pennies are cleaned with vinegar and salt, it's easier for the copper atoms to join with the oxygen atoms from the air and chlorine atoms from the salt to create a blue-green **compound** (a chemical that is formed by combining two or more elements) called **malachite**. Malachite also forms a beautiful mineral that's bright green with bands of lighter green inside. That is why the unrinsed penny, which was soaked in vinegar and salt, turns blue-green.



Unpolished malachite



Polished malachite

That penny you set aside and didn't soak was the **control** for our activity. A control is something that you expose to "normal" conditions by not making any changes to it. We used our control penny to compare with the pennies soaked in the different liquids and to see what changes occurred.

Now you have a few shiny pennies to put in your (or someone else's) pocket, and you've learned a bit of chemistry in the process!

### **ADDITIONAL RESOURCES**

<https://www.livescience.com/32401-whats-a-penny-made-of.html>

<https://www.usmint.gov/learn/educators/lesson-spotlight/make-a-penny-float>

These videos are from the series *How Kids become Scientists*:

[https://www.youtube.com/watch?v=AFUmN\\_aHCE&list=PLECF229625A9D0B6D&index=2](https://www.youtube.com/watch?v=AFUmN_aHCE&list=PLECF229625A9D0B6D&index=2)

<https://www.youtube.com/watch?v=FF4D3iKFfs&list=PLECF229625A9D0B6D&index=3>

<https://www.youtube.com/watch?v=29SqYIAjqFo&list=PLECF229625A9D0B6D>

Books available from the Washoe County Library System:

*Chemistry: The Story of Atoms and Elements* by Gore, Bryson

*Chemistry: Getting a Big Reaction* by Green, Dan; Basher, Simon.

*Crackling Chemistry* by Parker, Steve

*Acids and Bases* by Oxlade, Chris