

Hollow Penny

Kitchen Table Demonstration

The Rundown

Time: 5 minutes, plus time for penny to hollow (~2 hours), plus time for discussion

Content: metal properties, single displacement reactions, activity series

Safety Concerns: Hydrochloric acid (HCl (aq)) is corrosive and causes eye and skin burns.

Materials Availability: Hydrochloric acid is necessary for this demo. All other materials are common. If hydrochloric acid is not available, it can be replaced with “muriatic acid” which can be purchased from a hardware store.

Did you know that there is a significant difference between pennies that were made prior to 1982 and pennies that were made after 1982? The difference lies in



the composition of the penny. Prior to 1982 pennies were made of 95% copper and 5% zinc. After 1982, pennies were made of 97.6% zinc and 2.4% copper. So what can this composition of the penny tell us about the metals themselves?



Content Application

- Single Displacement Reactions
- Metal Properties
- Activity Series of Metals



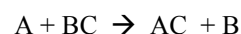
Enduring Understandings

- Single displacement reactions may or may not occur depending on the reactivity of the species involved.
- A more reactive metal will replace a less reactive metal in a single displacement reaction.



Chemistry

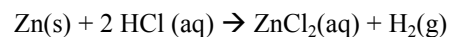
Single displacement reactions involve the reaction of an element with a compound to produce a new element and a new compound:



Single replacement reactions will not always occur. In a metal displacement, the metal that is being displaced must be less reactive than the metal that is doing the displacing. The same rules apply for nonmetal displacement.

An **activity series** can be used to predict whether or not a single displacement reaction will occur. The activity series of metals (or nonmetals) is a list of metals, typically arranged by decreasing relative reactivity. Metals of greater reactivity are arranged higher on the list than metals of lesser reactivity. If the metal that is doing the displacing is located higher on the activity series than the metal that is being displaced, then the reaction will occur. If not, then no reaction will take place.

In this demonstration, a hollow penny is produced after the reaction of hydrochloric acid with the zinc core of the penny. The single displacement reaction is as follows:



Although hydrogen is not a metal, one can predict the relative reactivities of zinc and copper by comparing how they behave in the hydrochloric acid. Because the reaction successfully took place with the zinc, but not with the copper, one can predict that zinc is a more reactive metal than copper. Therefore, one can also predict that zinc would be arranged higher on an activity series than copper.



Materials

- Post-1982 penny
- 6M Hydrochloric acid (HCl(aq))
- 250 mL beaker
- metal file
- tongs



Safety

- Goggles – In case of exposure hydrochloric acid.
- Hydrochloric acid (HCl) is very corrosive. It is a skin and eye irritant. Do not come into direct contact with this chemical.



Procedure

1. Using a metal file, etch into the penny along its edge in four different places until you see the silver colored zinc.
2. Place about 25 mL of 6M HCl into a 250 mL beaker. Place the etched penny into the acid. Allow the reaction to take place until all zinc has reacted (the production of bubbles of hydrogen gas will stop when the reaction is complete).
3. Remove what is left of the penny from the acid using tongs. Rinse the hollow remains with water and allow it to dry.



Disposal

- The excess hydrochloric acid solution can be discarded down the drain once diluted.



Student Participation and Follow-Up

Suggestions:

1. While the demonstration is taking place, have the students write down observations about what happens during each part.
2. Based on student observations, have the students write a balanced chemical equation for the reaction that took place.
3. Based on student observations, have the students predict the relative location of copper and zinc in the activity series of metal.

Try the following follow-up activities:

1. Perform the same exact experiment with a pre-1982 penny (which is made of only 5% zinc). In this case, the penny will not become completely hollow. This simply shows the difference in composition between pre-1982 and post-1982 pennies.
2. Have the students work in pairs in lab to perform the same experiment. The purpose of this experiment would be to determine the percent copper and percent zinc in a penny.