Spring 2010

Experiment 2: Composition of Pennies

Skills/Concepts

- Qualitative Analysis of Physical Properties of Mixtures
- Inferring Percent Composition Based on Physical Properties

Relevant Reading

Hein & Arena 2.9; 4.1–4.4

Introduction, Part 1[a]

The U.S. penny has undergone a series of changes since its inception in 1793. For its first 44 years, the penny was made with pure copper. Since then, pennies have been made with a combination of metals commonly copper, zinc, and tin. In 1943, pennies composed of zinc-coated steel to conserve copper for the war efforts. Accordingly, for one year, the color of pennies resembled that of nickels and dimes. In 1962, the U.S. Mint stopped incorporating tin into pennies. They are now made with copper and zinc.

Introduction, Part 2

Many things, including coins and human bodies, are composed of multiple components. The composition of objects can be determined, in part, by comparing physical features of the object with that of its components. For example, consider the average densities of the human body, human bone, and of water listed below. The average density of the human body is much closer to the density of water than it is to the average density of human bone. One could thus infer that the human body contains more water than it does bone.

Average Density (g/cm^3)

Human Body	1.1[b]
Human Bone	1.85[c]
Water	1.00

In this lab, we will qualitatively observe differences in composition based on physical properties. In lab 9, we will return to the penny and investigate this topic quantitatively.

SAFETY 1: This lab requires working with 6 M hydrochloric acid. This is a strong acid that can burn you. Wear goggles and gloves.

- If you get acid on your skin, generously rinse the area with water.
- If you get acid on your gloves, remove your gloves, rinse your hands generously with water, dry your hands and then put on a new pair of gloves.
- If you spill some acid, sprinkle sodium bicarbonate on it until the spill no longer fizzes. Carefully wipe up the spill.

[a] www.usmint.gov

[b] Am J Clin Nutr. Dec 1989. 50(6): 1282-1289.

[c] Dentomaxillofac Radiol. Sep 2002. 31(5):313-6.

Name: _____

Pre-Lab

1. This lab requires working with 6 M hydrochloric acid, which can cause burns.
    a. What can you do to prevent spilling or getting in contact with the acid?

    b. What do you do if you spill the acid?

    c. What do you do if you get acid on your skin?

Procedure

Experiment #1: The mass of pennies as a function of year of manufacture

1) Mass 5 pennies and record their mass along with their year of manufacture.

Table 1: Mass and Year of Manufacture of Pennies in Grams

Year of Manufacture	Mass (g)

2) Record your measurements in the instructor's spreadsheet.
3) Observing the instructor's plot of the pennies mass as a function of manufacture year, compare the mass of pennies before and after 1982. Discuss the following with your lab partner(s) and answer the following questions. Your answers do not have to be correct, but they do have to be based on your experimental data.
    a. How are the masses from the two time periods different? Calculate the average mass of pennies from the two time periods.

    b. What could cause this change?

Procedure

Experiment #2: Exploring the composition of a penny via the physical properties of its components.

Complete the following tests on one pre-1982 penny and one post-1982 penny.

Volume

Fill a graduated cylinder part way with water. Record the volume of the water. Submerge the penny in the water and note the volume. Calculate the volume of the penny.
Note: 1 mL = 1 cm^3.

Table 2: Volume Measurements in cm^3

Grey areas denote calculated values

	Water	Water + Penny	Penny
Pre-1982			
Post-1982			

Density

Weigh each penny. Using the volume measurements from above, calculate the density of the pennies.

Table 3: Density Calculations

Grey areas denote calculated values

	Mass (g)	Volume (cm^3) Transfer from above	Density (g/cm^3)
Pre-1982			
Post-1982			

Acid Reactivity

Using a file, carve a small notch in the side of each penny. Observe the color of the interior of each coin. Gently place each penny into a beaker of 6M hydrochloric acid. Be careful not to splash. Observe the reactions and note similarities or differences between the reactions. When done, use tongs to remove the pennies. Rinse them off with excess water. Carefully dispose of the acid in the appropriate acid waste bin in the hood.

Table 4: Observations

	Color of Interior	Reaction Notes
Pre-1982		
Post-1982		

Name: _____ Lab Partner: _____

Post-Lab

Results:

Table 1: Mass and Year of Manufacture of Pennies in Grams

Year of Manufacture	Mass (g)

Table 2: Volume Measurements in cm^3

Grey areas denote calculated values

	Water	Water + Penny	Penny
Pre-1982			
Post-1982			

Table 3: Density Calculations

Grey areas denote calculated values

	Mass (g)	Volume (cm^3) Transfer from above	Density (g/cm^3)
Pre-1982			
Post-1982			

Table 4: Observations

	Color of Interior	Reaction Notes
Pre-1982		
Post-1982		

Discussion

1) The density of copper is 8.94 g/cm^3 and that of zinc is 7.14 g/cm^3. Look at your density data from experiment #2. Infer which metal is the predominant ingredient in pennies

   a. before 1982: _____

   b. after 1982: _____

2) Jean noticed that two pairs of her jeans have different levels of stretchiness. The first pair does not stretch well and the second pair is very stretchy. Jeans are commonly made with a blend of cotton and spandex. Which pair likely has a higher percentage of spandex?