CHEMLAB 3

The Composition of Pennies

Background   U.S. pennies have been composed of copper and zinc since 1959, but the ratio of copper to zinc has changed over the years because of increases in the price of copper. Copper and zinc are both metallic elements and they share many physical properties, but they have different densities. Pure copper has a density of 9.0 g/mL, while pure zinc has a density of 7.1 g/mL. By measuring the density of pennies from different years, it's possible to track changes in the composition of the penny.

QUESTION

What are the approximate compositions of pennies having various mint dates?

OBJECTIVES

- **Measure** mass and volume and determine the density of pennies.
- **Interpret** class data to determine approximately when the composition of pennies changed.

MATERIALS

5 pennies of varying mint dates
balance sensitive to 0.01 g
50-mL graduated cylinder having 1-mL graduations

SAFETY PRECAUTIONS

PROCEDURE

1. Read and complete the lab safety form.
2. Record the mint date of each penny in the data table.
3. Determine the mass of each penny and record the mass to the nearest 0.01 g.
4. Half-fill the graduated cylinder with tap water. Read and record the volume to the nearest 0.1 mL.
5. Carefully add the five pennies to the cylinder so that no water splashes out. Jiggle the cylinder to dislodge any trapped air bubbles. Read and record the total volume of the water and the five pennies.

CHEMLAB (3)

DATA AND OBSERVATIONS

Data Table	
Volume of water (mL)	
Volume of water + 5 pennies (mL)	
Volume of 5 pennies (mL)	
Average volume of a penny (mL)	

Data Table		
Mint Date	Mass (g)	Density (g/mL)

ANALYZE AND CONCLUDE

1. **Calculate**   Substract the initial volume of water from the volume of the water plus pennies to calculate the volume of the five pennies. Divide the volume by 5 to calculate the average volume of a penny. Record this volume in the data table.

2. **Calculate** the density of each penny by dividing its mass by the average volume. Post your results so they are available to the other members of your class

3. **Observe and Infer**   Does your group data show any pattern that relates the densities of the pennies to the mint dates?

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2. **Classify** the pennies of each year that your group examined as mostly copper (8.96 g/mL) or mostly zinc (7.13 g/mL)

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5. **Graph** Design a graph to indicate the average density of the pennies for each year that your group examined.

6. **Infer** Look at all the data from your class. In what year do you think the composition of the penny changed? Use data to support your conclusion.

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APPLY AND ASSESS

1. **Explain** how you might determine the identity of an irregularly shaped solid that is soluble in water.

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2. **Research** In 1943, all pennies issued by the U.S. mint were struck from zinc-plated steel. Research to learn why steel pennies were struck in 1943. What was the purpose of the zinc coating?

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3. **Infer** Why would increases in the price of copper cause the mint to change the composition of pennies?

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INQUIRY EXTENSION

What factors do you think might lead to error in your density measurements? Which of these factors could not be corrected by improved technique?

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