

Penny Density Lab

An Inquiry Lab

PURPOSE

- Students will use the density formula ($D = m/v$) to determine the density of different metals.
- Students will calculate the percent error for each of the different metals measured.
- Students will design and carry out a procedure to determine the density of pre-1982 and a post-1983 pennies and determine the materials that make up a penny.

BACKGROUND INFORMATION

Before 1982, pennies were made of a copper alloy that was mostly copper. Since then, they have been made with an outside coating of copper and a greater percentage of a different metal in the inner core. In this experiment, you will use a graph to determine the density of pre-1982 and post-1983 pennies. Then you will use the density values to identify the metal used in the core of these pennies.

MATERIALS

- Pre and post 1983 pennies (about 20 each)
- 100 mL graduated cylinder
- Aluminum metal
- Zinc metal
- Copper metal
- Lead metal
- 10 mL graduated cylinder
- Electronic balance

PROTOCOL

DAY 1:

1. Obtain each of the metal samples (aluminum, zinc, copper, and lead) and measure the mass and volume. Then calculate the density. Record it in the data table name, "Density of Metals"
2. Record the actual density of the metal samples and determine the percent error. *Record these calculations in the Data Processing section of your lab notebook.*
3. Design a procedure to determine the density of pre-1982 and post-1983 pennies using the graphing method. Devise and execute a data collection scheme as well as a graphical method of presenting your findings. Use as many pennies that you feel is necessary to come to a meaningful conclusion. (**THINK valid experiment!**) Get teacher approval before moving forward.

DAY 2:

1. Carry out the approved procedure to determine the density of the pennies.
2. Design a data table that will organize your data.
3. Plot the data for the pre-1982 and post-1983 pennies on a single graph and draw a best-fit line that goes through the point (0,0) for each set of data. Construct the graph of your results so that the slope of the line equals density.

DATA

Density of Metals

Metal	Mass (g)	Volume (cm ³)	Density (measured) (g/cm ³)	Density (actual) (g/cm ³)
Aluminum				
Zinc				
Copper				
Lead				

* You will design and include a second data table that has your penny data.

DATA PROCESSING

* For full credit, include the equation in words, a substitution, and a boxed answer with units

- Calculate the percent error for each of the known metals
- The accepted value for the density of the pre-1982 pennies is 8.8 g/cm^3 . Calculate the percent error for your pre-1982 pennies.
- The accepted value for the density of the post-1983 pennies is 7.2 g/cm^3 . Calculate the percent error for your post-1983 pennies.
- Calculate the slope of the best fit lines for pre-1982 and post-1983 pennies. Indicate which data points you used to calculate the slope for each.
- Include the graph of your pre-1982 and post-1983 penny volume vs. mass. Your graph will have two lines. Be sure to make your graph large and include a legend and an appropriate title, "The Effect of ____ on ____"

CONCLUSION/ANALYSIS:

*Paragraph 1:

- Topic sentence
- Based on your calculated density of the pennies and the density found for the metal samples, what metal do you think is used in the core of post-1983 pennies? Explain your choice.
- Discuss how the precision of your measurements is demonstrated by your graph.

*Paragraph 2:

- Discuss the percent error for each of the metal samples that were tested.
- Discuss your percent error for the calculated density of each type of penny
- Discuss your degree of accuracy
- How can your results be improved?