How are old and new pennies different?

Goal- Practice measurement techniques, reasoning skills

Safety- Pennies, balances, and rulers will be used in the lab. Normal lab expectations.

Everybody is familiar with the look of a penny. Besides minor changes in engraving, the portrait of President Lincoln is a classic look etched in copper. However, in 1983 the composition of the penny was altered. We are going to measure pennies to determine how much the pennies were changed.

You will need 5 pennies from 1980 or earlier, 5 pennies from 1990 or later, a balance, and rulers for measuring dimensions.

Measure the mass of each penny individually on the balance. Fill the data in below.

Old: _____ _____ _____ _____ _____

Total mass for Old: _____ Average Mass for Old:_____

New: _____ _____ _____ _____ _____

Total mass for New: _____ Average Mass for New:_____

Now put all five old pennies on the balance at once. Repeat for the new pennies. Is there a difference?

Old all 5 mass: _____

New all 5 mass: _____

Why do you think there is a difference between the added masses and the measured masses?

Compare the individual masses for the old and new pennies, as well as the totals. Which penny weighs more, old or new? Why?

As some of you may have known, penny composition changed to include more zinc in the 1980s. The composition switched from 95% copper and 5% zinc, to 95% zinc and 5% copper. You can even see this by scraping the copper off of the penny (more on that later this year).

The obvious answer would be that zinc weighs less than copper, but is this really the case? Let's look at the periodic table to help us compare. The mass of copper on the periodic table is approximately 63.55 g/mol while zinc is 65.38 g/mol. Zinc is actually more heavy than copper! Why is the copper based penny heavier than the zinc based penny?

To help us understand their difference we need another measurement. Now we need to estimate the volume of the pennies. Using a ruler the group should measure the height and diameter of the old and new pennies. Using those measurements we can calculate the volume.

Old Penny Height: _____ Old Penny Diameter: _____

New Penny Height: _____ New Penny Diameter: _____

Volume for a cylinder: $\pi r^2 * h$ (r = radius, h = height)

Old Penny Volume: _____ New Penny Volume: _____

Are these two volumes close?

Volume can also be measured by displacement. Find a graduated cylinder large enough to have a penny fit inside. Fill it with water about half way and record the initial volume. Add the penny and record the final volume. Subtract the two measurements to find the volume by displacement.

Old Penny:
Final Volume: _____

Initial Volume: _____

Volume of Penny: _____

New Penny:
Final Volume: _____

Initial Volume: _____

Volume of Penny: _____

Which method do you think is more accurate for measuring volume, calculating via measurements with a ruler or using displacement? Reflect on the tools used for each measurement type.

There is one more way we can compare the pennies. This time we will take a ratio of mass over volume, this is called the density. Here we should be able to make a complete comparison. Use average masses and the volumes determined by measuring with the ruler and calculating for each the old and new pennies.

Density = mass/volume

Old Penny Density: _____ New Penny Density: _____

Using your own words, how would you define density and use it to explain the difference in masses of the two pennies?