

## Counting by Weight

**Purpose:** To practice methods and calculations for counting by weight.

**Procedure:**

1. Obtain a sample of pennies from your instructor.
2. Weigh ten of the pennies and record their total mass to three decimals.
3. Weigh a new ten-penny sample, recording its total mass to three decimals.
4. One more time, weigh a ten-penny sample, recording its mass to three decimals.
5. Write the three totals on the board. We will use these to calculate a class average.

**Observations and Data:**

Sample#1 28.2 grams for ten pennies

Sample#2 26.4 grams for ten pennies

Sample#3 26.3 grams for ten pennies

	Group1	Group2	Group3	Group4	Group5
Sample#1	26.6	25.9	28.2	26.0	25.5
Sample#2	25.7	24.7	26.4	26.5	25.3
Sample#3	26.2	25.2	26.3	26.4	26.0

**Calculations:**

1. Calculate an average mass of One penny based on the results you obtained in your lab group. (Total mass of 30 pennies/30)

**Answer:** We add all our amounts and divide by 30 and you get 2.697grams.

2. Calculate an average mass of One penny based on the results of all lab groups as recorded on the board. (Total mass 150 pennies/150)

**Answer:** Add all the lab groups' amounts and then divide by 150 and you get 2.626 grams.

3. Using the results from Calculations#1, what would be the mass in **kilograms** of exactly one million pennies?

**Answer:** Multiply 2.697 by one million and divide by 1000 and you get the answer 2,697 kilograms.

4. Using the results from Calculation#2, what would be the mass in **kilograms** of exactly one million pennies?

**Answer:** Multiply 2.626 by one million and divide by 1000 and you get the answer 2,626 kilograms.

**Questions for Discussion:**

1. Pennies made through 1981 are pure copper. In 1982, the U.S Government began to make pennies with a zinc core and copper on the outside. How does this fact help explain the differences in the masses obtained by the groups in class?

**Answer:** If we used some pennies that were made before 1982, they will be heavier because of their higher density than the new pennies made after 1982. Picking the pennies at random made the possibility of getting pennies made before 1982 really high. Thus, depending on how many pennies that were weighed that were made before 1982 will increase the entire average mass of the pennies when we weighed them.

2. Which average is more reliable- the one you obtained by your lab group for your coins alone, or the one based upon the results from the entire class? Explain!

**Answer:** The entire class results, because they all include different averages that contain different amounts of pennies that were made before 1982. The entire class results are more reliable because it has a wider range of answers and it is better to have different answers and to get an average from that would make the answer more reliable.

3. Pennies all have the same value, but apparently they don't have identical mass. Atoms of the same element all have the same properties but they don't have identical masses either. What accounts for the variations in masses of atoms of the same element?

**Answer:** They have different structures and shapes. Each atom is created differently thus have different masses.