

## COUNTING BY WEIGHING

Goggles need not be worn during this activity – no chemicals will be used.

### PRE-LAB DISCUSSION:

This lab will introduce the concept of counting by weighing. It may seem to be a waste of time to count by weighing when dealing with small numbers of units, and you would be correct. Counting by weighing is used in business and in chemistry when dealing with very large numbers of units -- often many orders of magnitude above anything you would consider counting by hand. In chemistry, we count atoms and molecules by weighing, since the minute size and immense numbers make counting by hand impossible. The United States Mint counts money by weighing, using well established averages to quickly "count by weight" millions of coins more accurately than any human or coin counting machine.

### PURPOSE:

To practice methods and calculations for counting by weighing.

### PROCEDURE:

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

### OBSERVATIONS AND DATA

Sample #1 \_\_\_\_\_ grams for ten pennies  
Sample #1 \_\_\_\_\_ grams for ten pennies  
Sample #3 \_\_\_\_\_ grams for ten pennies

	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	Group 7
Sample 1							
Sample 2							
Sample 3							

### CALCULATIONS:

1. Calculate an average mass of ONE penny based on the results you obtained in your lab group. (Total mass of 30 pennies  $\div$  30)
2. Calculate an average mass of ONE penny based on the results of all lab groups as recorded on the board. (Total mass of 210 pennies  $\div$  210)
3. Using the results from Calculation #1, what would be the mass in **kilograms** of exactly one million pennies?
4. Using the results from Calculation #2, what would be the mass in **kilograms** of exactly one million pennies?

### QUESTIONS FOR DISCUSSION:

1. Pennies made through 1981 are pure copper. In 1982, the US Government began to make pennies with a zinc core and copper on the outside. How does this fact help to explain the differences in the masses obtained by the groups in class?
2. Which average is more reliable – the one obtained by your group for your coins alone, or the one based upon the results from the entire class? Explain!
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 all have identical masses either. What accounts for the variation in mass of atoms of the same element?