Name: **Period:**   **Seat#:**

Pre-Activity Questions:

1) Read the background information provided below. Which pennies have more copper? Which have less copper?

2) What is an isotope?

3) Why are the masses on the periodic table not whole numbers, why aren't the masses just protons+neutrons?

4) What is the general equation used to calculate the Average Atomic Weight of a set of isotopes?

5) Rubidium has two common isotopes, 85Rb and 87Rb. If the abundance of 85Rb is 72.2% and the abundance of 87Rb is 27.8%, what is the average atomic mass of rubidium? Show your work.

6) Read the Instructions and Procedure section of this handout. Make sure you understand what you will be doing in class so you don't waste time!

Background: In 1982, the composition of a penny was altered to contain 20% less mass by substituting the less dense element zinc (Zn), in place of some of the copper in order to save money. According to the U.S. Mint,

Pennies dated 1962-1982:   Pennies dated 1982-present:
Composition: 95% copper, 5% zinc   Composition: 97.5% zinc, 2.5% copper

In this activity, a mixture of pre- and post- 1982 pennies will represent the naturally occurring mixture of two isotopes of the imaginary element "Coinium." The pennies will allow you to learn one way that scientists can determine the relative amounts of different isotopes present in a sample of an element.

Instructions:

1) You will be given a sealed container, which holds a mixture of ten pre-1982 and post-1982 pennies. You container might hold any particular combination of the two "isotopes." Your task is to determine the isotopic composition of the element "Coinium" **_without_** opening the container. In other words, what % of the sample is pre-1982 pennies and what % of the sample is post-1982 pennies?

2) An obvious, but important, notion is that the mass of the entire mixture equals the sum of the masses of all the pre-1982 and post-1982 pennies. The idea can be expressed mathematically as follows:

   Total mass of pennies =   (Number of pre-1982 pennies) * (Mass of one pre-1982 penny)
                   + (Number of post-1982 pennies) * (Mass of one post-1982 penny)

   The problem is that we don't know how many of each type of penny we have! That is what you are solving for. We know that we are using ten pennies total so:
         Your goal is to find the value of:
               x = the number of pre-1982 pennies
               (10-x) = the number of post-1982 pennies

3) Using the information above we can substitute in "x" and "10-x" to make a useful equation for us to use.
   Total mass of pennies = (x * mass of pre-1982 penny) + ((10-x) * mass of post-1982 penny)

Procedure:

1) Obtain a pre- and post-1982 penny and record their masses. Obtain and record the code number of a sealed container containing a total of 10 pennies. Weigh it and get the mass of an empty container from Mrs. Farmer.

2) Calculate the values of the number of pre-1982 pennies (x), and the number of post-1982 pennies (10-x)

Unknown Sample # _____

Mass of Empty Container		**Mass of Post-1982 Penny**	
Mass of Container + Pennies		**Mass of Pre-1982 Penny**	
Total Mass of just Pennies *Show work*			
How many pre-1982 pennies are in your sample? *Show work*			
How many post-1982 pennies are in your sample? *Show work*			

Conclusion Questions Set

1) In what ways is the penny mixture a good analogy or model for actual element isotopes? Explain.

2) In what ways is the analogy misleading or incorrect? Explain.

3) Name at least one other familiar item that could serve as a model for isotopes. Support.

4) Using the following information, calculate the AVERAGE molar mass of naturally occurring copper. Naturally occurring copper consists of 69.1% copper-63 and 30.9% copper-65. The molar masses of the pure isotopes are:

$$\text{copper-63} \quad = \quad 62.93 \text{ g/mol}$$
$$\text{copper-65} \quad = \quad 64.93 \text{ g/mol}$$