## Isotopes of Pennies

Name $\qquad$ Date $\qquad$ Period $\qquad$

## Pre-Lab Questions

You will do a lab that will deal with isotopes, mass number, and atomic mass. Before you begin your work in the lab, try to explain these terms in your own words. After you have finished the lab, you will have a chance to revise your explanations based on what you have learned in the activity.

## Terms:

Isotope:

Atomic Number:

Mass Number:

In 1982, the United States government changed the way it minted pennies. Before 1982, pennies were made of $95 \%$ copper and $5 \%$ tin. Now they are made of zinc coated with copper. Because they weigh different amounts (have different masses), we can call them isotopes of pennies.

1. What do the two kinds of pennies represent in this exercise?
2. How do the pennies differ? How do isotopes differ?
3. What do the pennies have in common? What do isotopes have in common?

## Part A

1. Obtain a sample of 14 pennies.
2. Weigh 5 pre-1982 (old) pennies and record their total mass. $\qquad$ g. Then, divide your total by 5 to determine an average mass. Record $\qquad$ g.
3. Weigh 5 post-1982 (new) pennies and record their average mass. $\qquad$ g. Then, divide your total by 5 to determine an average mass. Record $\qquad$
4. Calculate how much three old pennies plus seven new pennies should weigh. Record the predicted total mass $\qquad$ g
5. Divide your answer for number 4 by 10 to find the weighted average mass of the pennies in the sample containing three old plus seven new pennies. $\qquad$ g
6. Now, weigh your sample of three old and seven new pennies. Record the total mass of your sample $\qquad$ g
7. Divide your answer for number six by ten to find the average mass of a penny in your sample $\qquad$ g
() Compare your answer for number five to your answer for number seven. Is the weighted average mass closer to the mass of an old penny or a new penny? Why?
(:) How is this weighted average mass of the pennies related to atomic mass (of atoms)?

## Part B

1. Obtain a sample containing six old pennies and four new pennies.
2. Using the mass of an old penny and a new penny from part A above, calculate a weighted average mass for this sample of pennies. You need to find the mass of all ten pennies and divide by ten to find the weighted average mass
$\qquad$ g.
3. Now, weigh your sample of pennies. Record the total mass. $\qquad$
4. Divide the mass of your sample of ten pennies by ten to find the actual average mass of a penny in this sample. $\qquad$
() Compare your answer from number two to your answer for number four. Is the weighted average mass closer to the mass of an old penny or a new penny? Why?

## Part C: The Mystery Sample

1. Return your sample of ten pennies from part B to your teacher. Get a canister of pennies. Don't open it. Record its identifying number or letter $\qquad$ _.
2. Record the mass of the empty film canister, which is on the label of the canister $\qquad$ g.
3. Weigh the sealed film canister containing ten mixed pennies. Record the total mass of the canister and ten pennies $\qquad$ g.
4. Return the canister to your teacher.

## Calculations:

You now need to calculate the number of old and new pennies in your canister. Follow the steps to find out how many of each penny was in your canister.

1. Since the total number of pennies is ten, we can say that there are $\mathbf{X}$ old pennies plus ( $10-\mathbf{x}$ ) new pennies. The total mass of the pennies (canister with pennies minus the mass of the canister) is useful here. Record the total mass of the pennies $\qquad$ g.
2. $X$ times the average mass of an old penny, from part $A$, plus $(10-x)$ times the average mass of a new penny, from part $A$, equals the total mass of the pennies in the canister. Set up an equation and solve for $\mathbf{X}$. Then you will know how many old pennies are in your canister.
Show your math here:
3. Subtract that number from ten to find the number of new pennies that are in your canister.
Show your math here:
4. How many old pennies do you have? $\qquad$
5. How many new pennies do you have? $\qquad$
6. What percentage of old and new pennies do you have?

Smile! © You have completed the activity portion of this lab. Now, you need to complete the "Applying What You Have Learned" section on the last page.

## Applying What You Have Learned:

1. Calculate the average mass of potassium if the abundance and atomic masses making up its naturally occurring samples are:
Potassium-39 93.12\% 38.964
Potassium-41 6.88\% 40.962
2. Calculate the average mass of magnesium if the abundance and atomic masses making up its naturally occurring samples are:
Magnesium -24 78.70\% 23.985
Magnesium -25 10.13\% 24.968
Magnesium -26 11.17\% 25.983
3. Extra Credit The atomic mass of copper is 63.540 amu . It is composed of two isotopes, Cu-63 and Cu-65, with atomic masses of 62.930 and 64.928 respectively. What is the relative abundance (\%) of these isotopes in naturally occurring samples of copper?
4. Write a short summary explaining how this lab illustrates the concepts that you tried to explain at the beginning of the lab. Have your explanations changed? If so, explain how.
