

# Atomic Mass of Beanium Lab

based on a concept by Kathleen Davies

## PROBLEM

How is the average mass of isotopes determined?

## INTRODUCTION

Imagine a new element has been discovered, and has been given the name "beanium". Students at local high schools have been given the job of determining the number of isotopes of this new element, the mass of each isotope, the abundance of each isotope and the "atomic weight" of the new element. Fortunately, beanium atoms are very large, so you will be able to sort and weigh them easily. In this laboratory investigation, you will determine the abundance of each "isotope" of beanium, and determine the average mass (atomic weight) of the element in much the same way the average mass of other elements is determined. Then you will compare your result to a standard measurement of average mass.

## MATERIALS (per group)

a bag of atoms of the new element, a weigh boat, balance

## PROCEDURE

1. Determine the number of isotopes of beanium based upon the appearance (size, color, etc.).
2. Sort the beanium atoms into groups based on appearance. Each group represents a different isotope. Count the total number of atoms of each isotope and record the result in column (a) of the data table, *Method 1*, on the next page. Add those numbers to get the total number of atoms in your sample. Record the total in the data table.
3. Determine the abundance of each isotope using the formula below:

$$\text{Abundance} = \frac{\text{number of atoms of each isotope}}{\text{total number of atoms}}$$

Record the results in column (b) of the data table, *Method 1*, on the next page.

4. Using a balance, measure the total mass of **all** the atoms of each isotope individually. Record the total mass in column (c) of the data table.
5. Find the typical mass of ONE atom of each isotope by *dividing the total mass by the number of atoms* ((c) ÷ (a)). Record the result in column (d) of the data table, *Method 1*, on the next page.
6. Multiply the abundance of each isotope by its mass to find the product ((b) × (d)), and record the result in the last column of the data table.
7. Add the products in the last column to find the "atomic mass" of the element beanium. Record the result in the data table, *Method 1*, on the next page.

## OBSERVATIONS

Beanium Isotope	(a) Number of atoms (beans)	(b) Abundance	(c) Total mass (grams)	(d) Mass of Isotope (grams)	(e) Product of mass x abundance
1					
2					
3					
<i>total</i>				Atomic Mass of "Beanium"	

## CONCLUSIONS

1. What do the three kinds of beans represent in this exercise?
2. Why isn't the atomic mass of most of the elements on the *Periodic Table* an integer (why do they contain decimals)?
3. What do isotopes have in common? How do isotopes differ?
4. What is the difference between mass number and atomic number?

5. Copper (atomic mass 63.5 amu) has two known isotopes, copper-63 and copper-65. Explain why the atomic mass of copper is not exactly 64. (In other words, why isn't it midway between the mass numbers for the two isotopes?)

6. Calculate the atomic mass of the element described below (both atoms of the same element). Then use the periodic table to identify the element.

Isotope	Mass (amu)	Percent Abundance (%)
Element-35	35	75.8
Element-37	37	24.2

7. (extra credit) Because isotopes have identical chemical properties, radioactive isotopes can be used for medical use. Based on where the following elements are likely found in the body, match each radioisotope with its medical use.

\_\_\_\_\_ Sodium-24

a. study of bone formation

\_\_\_\_\_ Calcium-47

b. red blood cell studies

\_\_\_\_\_ Iodine-131

c. diagnose thyroid disorders

\_\_\_\_\_ Iron-55

d. measure extracellular fluid

\_\_\_\_\_ Phosphorus- 32

e. genetic (DNA) research