# AVERAGE ATOMIC MASS LAB
"BEANIUM"

All elements on the Periodic Table exist in at least two isotopic forms. **_Isotopes_** are atoms with the **_same atomic number_** but with **_different mass numbers_** due to varying numbers of neutrons. The atomic mass shown on the Periodic Table for each element, is actually an **_average_** of all the isotopes of that element, weighted by the percentage of the abundance in which they occur.

PURPOSE:
1. Identify the number of Beanium isotopes
2. Determine the mass of each isotope
3. Find the percent abundance of each isotope
4. Calculate the average atomic mass of Beanium

NEWS FLASH!!! A NEW ELEMENT HAS BEEN DISCOVERED.

Springfield USA—Nuclear Chemists, performing basic research on food products at Springfield Power Plant, have discovered what is believed to be a new element. Mr. Burns, the plant's owner, says, "We have tentatively named this element Beanium." Mr. Smithers, assistant to Mr. Burns adds, "We derived this element from the protein nodules we put into our chili."
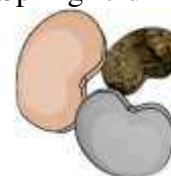
"Beanium atoms" look strangely like bean seeds

Further research of the new element will be conducted in more suitable surroundings, namely laboratories in a nearby school. Because Springfield apparently only has an elementary school, research work has been contracted to neighboring Flowing Wells High School. "Student excitement regarding this discovery is running at a fever pitch!" says Lisa Simpson, student. Many chemistry students have generously volunteered their time and expertise to help with the follow-up experiments involving the new element.

Dr. Julius Hibbert says the first follow-up experiments conducted at Flowing Wells High School will determine how many isotopes of this element exist. The second experiment will determine the mass of each isotope. The third experiment will determine the percent abundance of each isotope. The final calculations will discover the average atomic mass of the new element.

"One unique property of Beanium should make these experiments particularly easy—unlike normal atoms, Beanium atoms are very large." says Mr. Smithers. "They can be easily seen, and different isotopes can be sorted by hand."

Scientists are expecting a complete, comprehensive summary of this new element within two days, including diagrams and collected data tables.

"This is the most exciting Chemistry discovery this century!" exclaimed Mr. Burns.

PROCEDURE:
1. Sort the Beanium sample into the different Isotopes (by color.) Diagram each isotope.

Isotope #1	Isotope #2	Isotope #3

2. Pick one of the isotopes to be #1. Record the **MASS of all isotopes #1.**

3. Count the number of atoms of isotope #1 and record in the data table. Verify this number by having your lab partner count again. If you do not agree on the number, count them again together.

4. Calculate the **average mass of one isotope**#1 using the following formula and record:

$$\frac{\textbf{\textit{Total mass of all}\ \#1}}{\textbf{\#\ \textit{atoms isotope}\#1}}$$

THIS IS THE MASS OF ONE ATOM OF ISOTOPE #1. When you are through with isotope#1, put it back into the zip-lock baggie. Be careful not to spill any atoms on the floor!

5. Repeat the same procedures for isotopes #2, and #3. Be sure to record the mass of each isotope and the exact number of each isotope. Record the average mass of each isotope. Be sure to return all isotopes to the zip-lock baggie.

6. Now you will calculate the **percentage abundance** of each of the isotopes. Find the total number of atoms present (all kinds of isotopes together) by adding the total number of isotope together.

7. Calculate the **average atomic mass** of Beanium to be placed on the Periodic Table

Data: (Total Mass /# Atoms)

Total Mass isotope #1:	# isotope #1:	Avg Mass #1:
Total Mass isotope #2:	# isotope #2:	avg mass #2:
Total Mass isotope #3:	# isotope #3:	avg mass #3:
	TOTAL # ALL ATOMS:	

a) Percent Abundance of Isotope #1: _____

$$\% \text{ isotope } \#1 \ = \frac{\text{count of \#1 isotope}}{\text{count of ALL atoms}} \times 100$$

b) Percent Abundance of Isotope #2: _____

$$\% \text{ isotope } \#2 \ = \frac{\text{count of \#2 isotope}}{\text{count of ALL atoms}} \times 100$$

c) Percent Abundance of Isotope #3: _____

$$\% \text{ isotope } \#3 \;=\; \frac{\text{count of } \#3 \text{ isotope}}{\text{count of ALL atoms}} \times 100$$

d) AVERAGE ATOMIC MASS OF BEANIUM: _____

Average atomic mass = Σ(mass of isotope × relative abundance)

Σ = "sum of"

(% of avg Mass #1) + (% of avg mass #2) + (% of avg mass #3)

(%isotope #1) x avg Mass #1 + (% isotope #2) x avg Mass #2 + (% isotope #3 x avg Mass #3

Conclusion Questions :

1. In the lab what represented the different isotopes of the element Beanium that would be like the isotopes of a real element? Explain how they represented isotopes.

2.   What was different about each "isotope" of Beanium besides color? What was the same?

3. Explain why there might be differences between the atomic mass of your Beanium sample and that of a different lab group. Explain why the difference would be smaller if larger samples were used for each group.

4. From the procedure you have data for   1) mass of one tan bean that is on the large side; 2) the mass of one tan bean that is on the small side; 3) the mass of one average size tan bean; and 4) the average mass of all the tan beans in your sample. Fill in the values below and answer the questions. Which do you think is the most accurate the average looking bean or the average of all tan beans? Why? Which is the least accurate? Why? Explain each answer!!

Mass of small tan bean =

Mass of average tan bean =

Mass of large tan bean =

Average mass of all tan beans =

5. Why isn't the atomic mass of most of the elements on the Periodic Table an integer (not a decimal)?

6. The element Chlorine has two isotopes. Cl atomic mass 35 Percent Abundance = 76%; and Cl atomic mass 37, Percent Abundance 24%. What is the weighted average atomic mass of the element Chlorine?   Compare your answer to the reported atomic mass for chlorine on your periodic table. SHOW CALCULATIONS!! (See page 102-103 in text book)

7.   An imaginary element (Atomic weight 93.7140) has three naturally-occurring isotopes with isotopic weights of 92.9469, 93.2923 and 94.9030. The abundance of the lightest isotope is 42.38 %. What is the percentage abundance of the heaviest isotope? Hint the three abundances must add up to 100 percent, so if you know one of them, use algebra to find the others. SHOW CALCULATIONS!!