Activity: Beanium Isotopes

For the Teacher

Submitted by:
Layne Maki
Marion High School in
Marion, Indiana

Thanks to:
Flinn Scientific

Summary
In this activity, students will determine the average atomic mass of a sample of an imaginary element called Beanium.

Grade Level
High School

NGSS Alignment
This activity will help prepare your students to meet the following scientific and engineering practices:
- Using Mathematics and Computational Thinking
- Developing and Using Models

Objectives
By the end of this lesson, students should be able to:
- Determine the atomic mass from a mixture of isotopes.

Chemistry Topics
This lesson supports students' understanding of:
- Isotopes
- Atomic mass

Time
Teacher Preparation: 10 minutes
Lesson: 30-40 minutes

Materials
For each group:
- 3 different types of beans for "Beanium" (suggested: kidney beans, pinto beans, black beans)
- 100-mL beaker or plastic cup (for holding beans)
- Balance
- Student activity sheet (per student or per group)

Safety
No special safety considerations are required for this activity.

Teacher Notes
- It may be helpful to work through a sample atomic mass problem before having the students complete the activity. The Isotopes & Atomic Mass Simulation could be used before this activity to introduce atomic mass calculations or after to provide additional practice.
- Before the activity, mix together three different types of bean in a large bowl. Include large amounts of three types of beans. If you want, you can include very small amounts of additional types of beans to present the idea of "impurities" in the sample. Students will grab a "scoop" of beans in their 100-mL beaker or plastic cupfor their sample of Beanium.
- Ideally, at least one of the types of beans should be substantially different in size from the other types so students have a visual cue that not all beans (isotopes) will have the same mass. Black beans are much smaller than the other suggested beans, for example.
- Students are told how to calculate the average mass and the % abundance of each type of bean in the calculations table provided. For an additional challenge, you can remove those instructions.

- Another way of increasing the difficulty level is to add more types of beans to the mixture.
- After the activity, you could discuss analysis question #4 so students realize that each group's calculated atomic mass should be similar, even if their sample sizes were slightly different. (The larger the sample sizes and the better mixed the beans, the closer the results should be.)

FOR THE STUDENT

Lesson

Beanium Isotopes

Background

The only research chemist at Anywhere High School has discovered a new element! This element was discovered in the mixture that makes up the baked beans in the cafeteria. The researchers have named this element Beanium. No tests have been done on this element because the researchers could not determine the atomic mass of this new ground breaking element.

There is a large sample of this new element in the lab at the research facility at the high school. A reporter has learned that this top secret facility is funded from the same people that fund AREA 51. As you may know, this secret funding comes from the international alien cover-up conspiracy started in Roswell, New Mexico in 1947.

This lowly research chemist has brought this new element to your classroom so that the lab technicians can determine the atomic mass of Beanium.

Materials

- 100-mL beaker or plastic cup
- Sample of Beanium
- Balance

Procedure

The different isotopes of Beanium are shaped like different types of beans.

1. Obtain a sample of Beanium from your teacher in your beaker. Sort the Beanium sample into the different isotopes. Find the mass of each isotope. This is not the mass of one atom, it is the mass of all the atoms of that particular isotope. Record these masses in the data table.

2. Record the number of each isotope in the data table.

3. Follow the directions in the data table, and use your vast knowledge of average atomic masses to find the atomic mass of Beanium.

Data

	Isotope #1	**Isotope #2**	**Isotope #3**	**Total**
Mass of Sample				
# of atoms				

Calculations

Show work for calculations in the boxes provided	**Isotope #1**	**Isotope #2**	**Isotope #3**
Mass of one atom (mass of sample / # of atoms) (rounded to nearest .01)			
Percent Abundance (# atoms / total atoms x 100) (rounded to nearest .01)			

To find the atomic mass of Beanium, use the mass of one atom of each isotope as the mass number and the percent of each isotope.

Show your work below:

The atomic mass of Beanium is __________________ g.

Analysis

1. What is an isotope? What do isotopes of a particular element have in common, and what makes them different from each other? (Think about subatomic particles.)

2. You calculated the mass of your Beanium sample using the mass of one atom and the percent abundance of each isotope. You could also calculate the average mass of the sample just using the total mass and the total number of atoms (beans). Show the work for this calculation below. How does your answer compare to your earlier calculation? Does it make sense? Why or why not?

3. Would the method you used in #2 work with real atoms? Why or why not?

4. How close was your calculated atomic mass of Beanium to another lab group's calculations? Does this make sense? Why or why not?

5. Why were you asked to determine the mass of one atom by dividing the mass of the entire isotope sample by the number of atoms in the sample, rather than just taking the mass of one individual atom?

6. How are the different types of beans in this lab similar to isotopes? How are they different?

7. The *mass number* of a specific atom cannot be found on the periodic table because the periodic table lists the *atomic mass* of each element. Justify this statement by explaining the difference between mass number and atomic mass.

8. Calculate the atomic mass of Thallium (Tl), showing all work in the space below. Its isotopes are Tl-203 with an abundance of 29.5%, and Tl-205 with an abundance of 70.5%.