



BAG O' ISOTOPES

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Annotation

In this activity, students will calculate average atomic mass using the fictional element legumium.

Primary Learning Outcomes:

Students will be able to define the terms *isotope* and *average atomic mass*.

Students will be able to use correctly isotope notation to represent an isotope.

Students will be able to calculate the average atomic mass of an element given data from a representative sample of different isotopes and their atomic masses.

Georgia Performance Standards:

Characteristics of Science

SCSh4. Students will use tools and instruments for observing, measuring, and manipulating scientific equipment and materials.

SCSh5. Students will demonstrate the computation and estimation skills necessary for analyzing data and developing reasonable scientific explanations.

Physical Science Content

SPS1. Students will investigate our current understanding of the atom.

Chemistry Content

SC3. Students will use the modern atomic theory to explain the characteristics of atoms.

Duration:

Preparation: 60 minutes

Introduction: 10 minutes

Student Assignment: 30 minutes

Conclusion: 5 minutes

Total Class Time: 45 minutes

Materials and Equipment:

For Teacher Preparation:

1. 1-lb. Bag of large lima beans
2. 1-lb. Bag of baby lima beans
3. 1-lb. Bag of navy beans
4. Snack size plastic zipper bags (1 per group)

Per Group:

- 1 “Bag O’ Isotopes”

Safety:

There are no significant safety concerns associated with this activity.

Technology Connection:

Not applicable.

Procedures:

Teacher Preparation:

For each group, prepare a “Bag O’ Isotopes” containing 8 large lima beans, 11 baby lima beans, and 15 navy beans.

Introduction:

Isotopes are different versions of atoms having the same number of protons but different numbers of neutrons. These different versions vary in mass but are all atoms of the same element because they each have the same number of protons. Often one isotope of an element is more common than the others. Hydrogen provides an example for discussion of isotopes. The three isotopes of hydrogen (*i.e.* protium, deuterium, and tritium) all share similar chemical properties because each one is made of one proton and one electron. Protium, the most common isotope of hydrogen, contains only a proton in its nucleus. Deuterium, the second-most common isotope, contains one proton and one neutron in its nucleus. Tritium, an unstable and uncommon isotope, contains one proton and two neutrons in its nucleus.

Isotopes are represented by including the mass number and atomic number along with the chemical symbol for the element. For example, tritium would be represented as:



where 3 is the mass number and 1 is the atomic number. The number of neutrons can then be calculated by subtracting the atomic number (*i.e.* the number of protons in the atom) from the mass number (*i.e.* the combined number of protons and neutrons). In this example, $3 - 1 = 2$ neutrons.

The atomic mass listed for an element in the periodic table is an average atomic mass for all of the isotopes of the element as they are found in nature. The average atomic mass is a weighted average, so the more commonly found isotopes have a greater effect on the average than rare isotopes.

In this activity students will calculate the average atomic mass of the newly discovered element legumium (Lg). The three isotopes of legumium are represented by the three types of beans found in each Bag O’ Isotopes.

Student Assignment:



Students should follow directions outlined in the attached *Bag O' Isotopes* student handout.

Conclusion:

Collect *Bag O' Isotopes* student handouts and review sample calculation(s). Answer any questions.

Assessment:

Assessment should be based on completion of the *Bag O' Isotopes* student handout.



BAG O' ISOTOPES *Student Handout*

Introduction:

Scientists have recently discovered the element legumium (Lg). Your assignment is to calculate the average atomic mass of legumium based on the samples provided. The atomic number of legumium is 4. The smallest of the isotopes, Lg-4, has an atomic mass of 4 atomic mass units (amu). Lg-5, the intermediate isotope, has an atomic mass of 5 amu. The largest isotope, Lg-6, has an atomic mass of 6 amu.

Terms:

- _____ are different versions of atoms having the same number of _____ but different numbers of _____.
- The _____ is a weighted average of all of the isotopes of an element as they are found in nature.
- Isotope notation includes _____, _____, and _____.

Purpose:

To calculate the average atomic mass of the newly discovered element, legumium (Lg).

Materials:

Per Group or Individual:

1. 1 Bag O' Isotopes

Procedure:

1. Count and record in the data table the total number of isotopes in the sample.
2. Count and record in the data table the number of each legumium isotope.
3. Record the masses (provided in the introduction) of each legumium isotope in the data table.
4. Calculate the average atomic mass of legumium using the following equation.

$$\begin{array}{l} \text{Average} \\ \text{Atomic} \\ \text{Mass} \end{array} = \frac{(\# \text{ Isotope 1})(\text{Mass Isotope 1}) + (\# \text{ Isotope 2})(\text{Mass Isotope 2}) + (\# \text{ Isotope 3})(\text{Mass Isotope 3})}{\# \text{ Isotopes 1} + \# \text{ Isotopes 2} + \# \text{ Isotopes 3}}$$

Data and Calculations:

Data Table

Isotope	Quantity	Mass (amu)	Total Mass (amu)

Total Mass of Legumium Isotopes in Sample: _____

Total Number of Legumium Isotopes in Sample: _____

Average Atomic Mass of Legumium: _____

Discussion Questions:

1. For each legumium isotope, give the proper isotope notation.
2. Calculate the number of neutrons in each legumium isotope.
3. According to the sample, which legumium isotope is most abundant in nature?
4. If additional legumium-6 isotopes were added to the sample, how would the average atomic mass of legumium be affected?