# Candium Isotopes Formal Lab*; SC3d

Isotopes are different forms of the same element. Therefore, they have the same number of protons and electrons, but they each have a different number of neutrons. For example, think of the three isotopes of hydrogen: H-1 is "regular" hydrogen; H-2 is called deuterium and H-3 is known as tritium.  They are all types of hydrogen with only one proton in the nucleus and one electron in the electron cloud, but all three have different numbers of neutrons in their nuclei. In this lab, the "element" is called Candium.  The three types of candy you will use are M&Ms, Skittles, and Reese's Pieces. You will call the three forms (isotopes) of Candium "M&Mium," "Skittlium," and "Reesium." Each isotope of an element has a mass with a natural percent abundance.  The atomic mass of the element listed on the periodic table represents the masses of each isotope and their *percent abundances.* The relative abundance and mass of small atomic particles are measured in the laboratory by an instrument called a mass spectrometer.  The mass spectrometer separates particles by mass and measures the mass and relative abundance of each.  From these data a weighted average is calculated to determine the atomic mass of the element. For every element, each atom of a given isotope has the same mass; however, you know that each M&M does not have the same mass just like each skittle does not have the same mass.  Thus, in this lab you have to determine the average mass of one atom of each isotope of Candium. The purpose of this lab is to use the Candium model to explain the concept of atomic mass and to analyze the "isotopes of Candium" and calculate its average atomic mass.

**Safety Requirements:**  Do not eat the candies before, during or after the experiment. Contamination has occurred in this lab.  You must return the samples with the exact number of "atoms" that you received.

**Procedure:** 1). Obtain a sample of Candium. 2). Separate the three isotopes and count. Obtain the total mass for each group of isotopes 3). Complete the data table using the instructions found under the "Data Analysis Questions" section. The large X's in the table indicate cells that do not require data.

**Data:** (transcribe onto your paper)

| | Isotope: M&Mium | Isotope: Skittlium | Isotope: Reesesium | Total |
|---|---|---|---|---|
| **Total Mass of Atoms** (g) | | | | |
| **Total Number of Atoms** | | | | |
| **Average Mass** (g) | | | | |
| **Percent Abundance (%)** | | | | X |
| **Relative Abundance** | | | | X |
| **Relative Mass** | | | | |

Average Atomic
Mass of Candium

**Data Analysis Questions (show all work):**

1. Calculate the average mass for each isotope

   *Average Mass = total mass of atoms*
   *total number of atoms*

2. Calculate the percent abundance of each isotope

   *% Abundance = #of atoms for each isotope   x 100*
   *# of atoms for all isotopes*

3. Calculate the relative abundance of each isotope

   *Relative Abundance = Percent abundance   (basically the % expressed as a decimal)*
   *100*

4. Calculate the relative mass for each isotope.

   *Relative Mass = Relative Abundance x Average mass*

5. Finally, calculate the average atomic mass of this element, Candium (bold box in data table)

   *Average atomic mass of Candium = Sum of all relative masses*

**Post-Lab Questions:**

6. Compare and contrast the concepts of *average mass* and *relative mass*.  Which one is more *accurate*, and why?  Why is the one you did not choose *inaccurate*?

7.  If the isotopes of Candium were truly isotopes (not candy pieces), what characteristics would they have in common?  What would be different about each isotope?

8.  Get the average atomic mass of Candium from two other groups. What are **at least two** reasons why the average atomic mass of your Candium element that you calculated may not match the average atomic mass of any other lab group?

9. Is your calculated average atomic mass for Candium closest to the average mass of one of your "isotopes"?  Explain why this might occur.

10. A laboratory finds four isotopes of iron below, but does not know the exact mass of the last isotope. Using the known mass on the periodic table, what is the mass of the last isotope?

   Iron – 56 (91.75%)        Iron – 58 (0.28%)

   Iron – 57 (2.12%)         Iron - **???** (5.85%)

11.  The four isotopes of lead and its abundances are: Pb-204, 1.37%; Pb-206, 26.26%; Pb-207, 20.82%; and Pb-208, 51.55%. Calculate lead's approximate atomic mass.

**Conclusion:**

Use the ideas below to help you create an **RERUN outline** to draft your conclusion before you type it in paragraph format as part of this formal lab report.

**R**ecall what your group did during this lab (think about the procedures and calculations).

**E**xplain why you did this lab and what you were trying to find out (refer to the purpose).

**R**eflect on the lab's meaning and your results (what did you determine) and did it match your hypothesis or was your hypothesis wrong? Why?

**U**ncertainty (errors that were in the lab that you could not control or just any errors that you came across during this lab that you could fix for the next time you perform the lab). This should be very specific and related to the procedures. *For this lab, reflect on the answer for analysis question #1-5. Think about differences between group's data, included human error, among other reasons, that would cause our average atomic mass for Candium to be different.*

**N**ew questions or new discoveries (normally you put in at least two) generated from this lab.

**\*** This is you first "Formal Lab" in honors chemistry. We will complete numerous formal labs over the course of the year, which will help to prepare you for college. All formal labs must be typed using standard fonts and sizes (12 pt; Times New Roman, double spaced). In addition to a typed lab, this formal lab also includes a "conclusion" section that is written in paragraph format. RERUN is an acronym (see above) that will help guide you through the *minimum* requirements for the conclusion. It is customary in college-level courses to complete detailed formal lab reports that follow the same format utilized in the Honors Research Projects.