Name: _____

Candy Isotopes & Atomic Mass

Background

- *Isotopes* are atoms of the same element with different numbers of neutrons. The number of neutrons will affect the mass of the atom.
- Elements can have a variety of isotopes, and a sample of an element will contain a mixture of those isotopes. Since each isotope has a different weight, it becomes useful to look at the average weight of an atom; this is called *average atomic mass*. It is a weighted average and usually contains several decimal places. An individual atom won't have a mass equal to the average atomic mass, but individual atoms are rarely dealt with.
- The actual number of protons and neutrons in an individual atom is called a *mass number.*

Pre-lab Questions

1. What is an isotope?

2. What is the mass number of an element?

3. What is the average atomic mass of an element?

Problem

How do isotopes affect the average atomic mass of an element?

Materials

- **4** red pretzel M&M's and **1** red chocolate M&M (representing Boron)
- **1** green pretzel M&M and **3** green chocolate M&M's (representing Chlorine)

Safety

- Lab tables should be washed before and after activity.
- Students should wash hands before and after activity.
- Do not consume lab materials, even if they're otherwise edible products.
- Food in the lab should be considered a chemical not for consumption.

Procedure

1. Make a pile of 4 red pretzel M&M's and 1 red chocolate M&M. **The different sized candies represent different isotopes of the same element (same color candy).
2. Boron has two isotopes, represented by the red M&M's. Boron-11 has 6 neutrons and Boron-10 has 5 neutrons. Boron-11 is the red pretzel M&M because Boron-11 is heavier than Boron-10, and the pretzel M&M is bigger.
3. Assume that each red pretzel M&M has a mass of **11 units** (5 protons and 6 neutrons) and the red chocolate M&M has a mass of **10 units** (5 protons and 5 neutrons).

4. The average atomic mass (sometimes called atomic weight) is a weighted average. This means it takes into account how many of each isotope exists in nature. For Boron, 4 out of 5 atoms of Boron are Boron-11, and 1 out of 5 atoms is Boron-10.
5. To calculate the average atomic mass of Boron, multiply the number of red pretzel M&M's (4) by its mass (11) and number of red chocolate M&M's (1) by its mass (10). This calculation should be recorded in the data table.
6. Divide the total mass of all the M&M's of a certain color by the total number of M&M's in that sample.
7. Repeat this process with the green M&M's representing the two isotopes of Chlorine. Assume that the green pretzel M&M has a mass of **37 units** (17 protons and 20 neutrons) and each green chocolate M&M has a mass of **35 units** (17 protons and 18 neutrons). Make note that the number of pretzel and chocolate M&M's are different in this sample than the previous one.
8. To calculate the average atomic mass of Chlorine, perform the same type of calculation as described in steps 5 & 6 but with the data from the green M&M's.

Data & Calculations

	Pretzel	**Chocolate**	**Average**
	# of M&M's × mass	#of M&M's × mass	$\frac{\text{Total mass}}{\text{Total M\&M's}}$
RED (Boron)			
GREEN (Chlorine)			

Analysis

1. Compare your calculations of average atomic mass (atomic weight) to the values for Boron and Chlorine on a periodic table. Were they similar? Explain why or why not.

2. If you round off the average atomic mass of Boron to the nearest whole number, does it give you the mass number of the most common isotope? How about for Chlorine? Explain why or why not.

3. Most average atomic masses are NOT whole numbers. Why do you think this is so?

4. An element needed in your diet is Magnesium. The three most common isotopes of Mg have a mass of 24, 25, and 26. Using your periodic table, predict which of these is the most common isotope, and explain your choice.

5. What is the difference between *mass number* and *average atomic mass*?

6. If a sample of the element Chemistrium (Ch) contain 100 atoms of Ch-12 and ten atoms of Ch-13 (for a total of 110 atoms in the sample), what is the average mass of Chemistrium? Calculate here:

Extension
Research the practical application of any 2 isotopes and report on them below. Include the mass number, how the isotope is used, and what is special about that particular isotope.