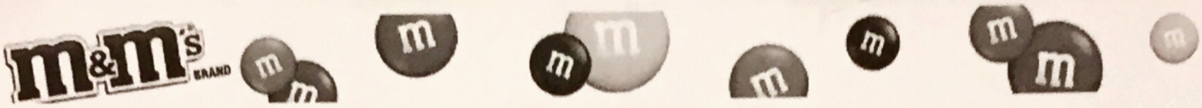
– M&M Isotope Lab



Introduction

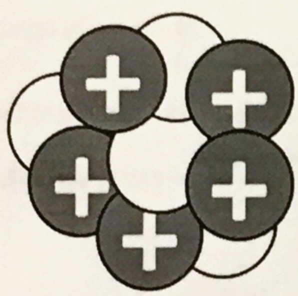
Isotopes are atoms of the same chemical element, each having a different mass number (different number of neutrons). Isotopes differ in mass number but never in atomic number (# of protons). Since we cannot see atoms, you will use M&M's to represent atoms. The purpose of this lab is to calculate the average atomic mass using M&M's, and to observe the difference between isotopes.

1. The **mass number** of the atom is the total number of ____________________ & ____________________

2. **Isotopes** are different types of atoms of the same element, but with a different number of ____________________

3. Carbon-13 is an isotope of Carbon with a mass number of 13. How many neutrons are in Carbon-13? ____________

Refer to this picture of an atom's nucleus to answer questions 4-9.



4. How many **protons**? ____________________

5. What is the **atomic #?** ____________________

6. What **element** is this? ____________________

7. How many **neutrons**? ____________________

8. What is the **mass #**? ____________________

9. What is the **isotope** name? ____________________

Procedure

1. Each group of 3 will get 1 small bag of plain M&M's and 1 small bag of peanut M&M's.

2. Count the number of Plain M&M's in your bag and record this number in the data table below. Repeat this step for the Peanut M&M's.

3. Using a piece of clean paper towel as a weighing boat, measure the total mass of your plain M&M's and record this number in the data table. Repeat this step for the Peanut M&M's. ****REMEMBER to ZERO out the paper towel!*

DATA TABLE:	Number of M&M's	Mass of M&M's
Isotope #1 - Plain M&M's		
Isotope #2 - Peanut M&M's		
Total Number of all your M&M's		

Calculate the average mass of each isotope using the formula to the right.

$$Average\ Mass = \frac{Total\ Mass}{\#\ of\ M\&M's}$$

Isotope #1 – Plain M&M	Isotope #2 – Peanut M&M
10. Average mass of Isotope #1 =	**11.** Average mass of Isotope #2 =

Calculate the percent abundance of each isotope. Of all the M&M's you have, what % of them are plain and what % are peanut?

$$\%\ abundance = \frac{\#\ of\ each\ type\ of\ M\&M}{TOTAL\ \#\ of all\ M\&M's}\ x\ 100$$

Isotope #1 – Plain M&M	Isotope #2 – Peanut M&M
12. % abundance of Isotope #1 =	**13.** % abundance of Isotope #2 =

14. Calculate the average "atomic mass" of your M&M's.

$$\boldsymbol{Average\ Atomic\ Mass} = \frac{\boldsymbol{(mass\ of\ isotope\ 1)(\%\ abundance) + (mass\ of\ isotope\ 2)(\%\ abundance)\ldots}}{\mathbf{100}}$$

Average Atomic Mass =

Conclusion Questions

15. Is your average "atomic mass" close to or the same as students in other groups?

16. Would using king size bags of M&M's make a difference to the average "atomic mass"? Why or why not?

17. How do Hydrogen-1, Hydrogen-2, and Hydrogen-3 differ from each other?

18. Sulfur has 4 isotopes: **sulfur-32 is 95.0%, sulfur-33 is 0.76%, sulfur-34 is 3.22%,** and **sulfur-36 is 0.89%** abundant. Calculate its average atomic mass.

Average Atomic Mass =

Isotopes Worksheet

All atoms of a particular element have the same number of protons (p) and electrons (e^-) (to maintain electrical neutrality), but may have differing numbers of neutrons (n).

These atoms are called **Isotopes** and have equal numbers of p and e^-, but not n.

Since isotopes have the same number of electrons, they have similar chemistry and can be very difficult to separate. Physical means must be used that separate them based on their mass differences (more neutrons, more mass).

Radioactive isotopes of certain elements are commonly used as tracers that can show where they are taken up in the human body, or in plants, or to follow the fate of species in the atmosphere or water systems.

There are two symbolic ways to represent isotopes:

The first method has the following format:

$$^{\mathbf{A}}_{\mathbf{Z}}\mathbf{X}$$

A = mass number = # nucleons = # p + #n

X = element symbol

Z = atomic number = # p

To calculate the number of neutrons in the nucleus, subtract the Atomic Number, Z, from the Mass Number, A.

 # neutrons = A – Z

ex:

$^{12}_{6}C$	$^{13}_{6}C$	$^{14}_{6}C$
6 protons 6 electrons 6 neutrons	6 protons 6 electrons 7 neutrons	6 protons 6 electrons 8 neutrons

The second, and more convenient, method doesn't show the Atomic Number, Z, since that can be readily determined from the Periodic Table, given the element symbol or name. It has the following format:

X – A

X = element symbol or name

A = Mass Number

For example:

Carbon – 14 (C – 14) has 6 protons, 6 electrons (from the Periodic Table) and 14 – 6 = 8 neutrons.

The **atomic mass** given on the Periodic Table is actually an average over all of the isotopes of that particular element, weighted based on the percentages of each isotope found in nature.

Problems:

Fill in the following table:

Element Name	Atomic Number, Z	Mass Number, A	# of protons	# of electrons	# of neutrons	X – A Notation	$^{A}_{Z}X$ Notation
Cobalt		60					
						I – 131	
			1		2		
	26	59					
							$^{99}_{42}Mo$
				11	24		
Strontium					52		
						U – 235	
		134	55				
		19		9			
	79				118		
Copper					36		
				56	81		
						K – 40	
		30	14				
Silver		108					
			8		9		
							$^{21}_{10}Ne$
	15	32					
						Xe –133	
				43	56		