Name: Maloney 2010-2011

A Matter of Laws & Theory

Review:
List 3 beliefs that philosophers and alchemists held regarding matter:

1.

2.

3.

Then in….

1661	Robert Boyle	Defined an element as…
1789	Antoine Lavoisier	Observed … ...and called it the "Law of Conservation of Matter"
1798	Joseph Proust	Observed… ... and called it the "Law of Constant Composition"
1803	John Dalton	Observed… ….and called it the "Law of Multiple Proportions"

The following activity is designed to help you understand these laws.

Two new elements have been discovered in the chemistry department of Hollis-Brookline High School. One has been named Rotellium and the other Saarium. Experiments with these two new elements show that they are very reactive and can form more than one compound with each other. This is very similar to carbon {C} and oxygen {O} which can form carbon monoxide {CO} and carbon dioxide {CO_2}. Samples of the newly discovered elements and their resulting compounds have been collected for you to study.

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Procedure:

1. Do not open the bottles. Carefully observe the labels on each bottle.
2. Using the balance at your station, record the mass of each substance in Table 1.
    - For this activity consider the mass of the container as part of the substance.
    - Be sure to record the mass of the bottle in the column and row that matches the label.
    - Remember that your measurement must reflect the precision of the instrument used.

Table 1. Raw Data

	Reactants		Product
Reaction #	Rotellium (g)	Saarium (g)	Compound (g)
1			
2			
3			
4			

Analysis:

1. Explain how the data in Table 1. supports the Law of Conservation of Matter.

2. Do you think reactions 1, 2, 3 and 4 created the same compound? Explain.

3.Often data needs to be "manipulated" (graphed, calculated, etc.) before patterns can be detected. Determine the percent composition by mass for each element using the following formula. Enter the data into Table 2.

$$\text{Element \%} = \frac{\text{Element (g)}}{\text{Compound (g)}} \times 100$$

Table 2. Manipulated Data

Reaction #	Rotellium (%)	Saarium (%)
1		
2		
3		
4		

4. Which two reactions probably produced the same compound? Support how you know this using the data in Table 2. Which law does this exemplify?

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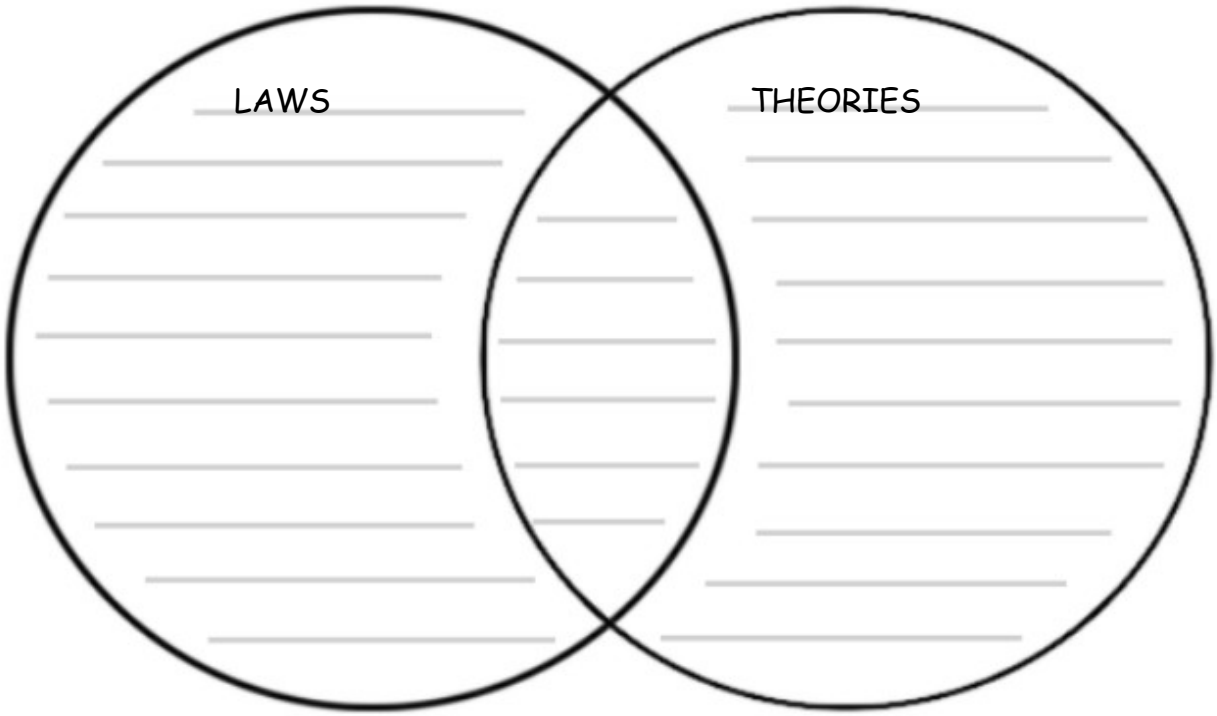
5. In order to understand the Law of Multiple Proportions we need to actually compare more than one ratio (thus we get "multiple proportions"). Round the masses recorded in Table 1 to whole numbers and fill in the boxes below.

Reaction 1		Reaction 2		Reaction 3
Rotellium (g)	:	Rotellium (g)	:	Rotellium (g)
Saarium (g)		Saarium (g)		Saarium (g)

6. When the amount of one element is held constant (doesn't change) we should be able to see a ratio among the second element that can be reduced down to small whole numbers. The amount of Rotellium has been held constant in each reaction above. What is the ratio ***between the amounts of Saarium*** from each reaction. Be sure to reduce the numbers.

_____ :	_____ :	_____
Reaction 1	Reaction 2	Reaction 3

7. The laws described in this activity were crucial in the development of atomic theory. Use the Venn diagram to explore the differences and similarities between natural laws and scientific theories.



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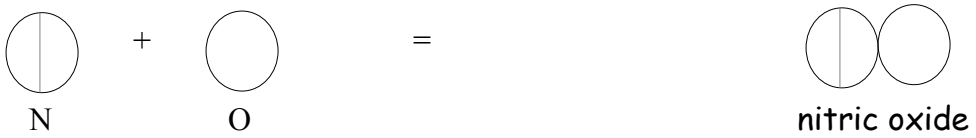
1808	John Dalton	Infers the existence of atoms and is credited with the first modern atomic theory.

8. Match the following postulates of Dalton's atomic theory :

1. Elements are considered pure because _____
2. Elements differ from each other because _____
3. Unlike mixtures, compounds are pure substances because _____
4. Compounds have constant composition because _____
5. Compounds and elements are the outcomes of chemical changes because _____

A. atoms of different elements are "hooked" (bonded) and can only be chemically unhooked.
B. chemical reactions involve the rearrangement of combinations of atoms.
C. all atoms of an element are identical in mass and other chemical and physical properties.
D. they contain fixed ratios of atoms and each atom's mass is fixed so the compounds mass is fixed.
E. atoms of each element are different from each other.

9. In 1808 Dalton presented a model of his theory in the form of a chart of symbols and formulas for elements and several compounds. For example he symbolized the elements nitrogen, oxygen and two of their compounds as follows:



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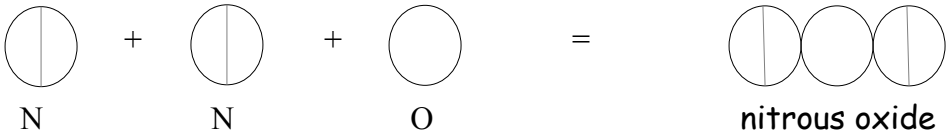
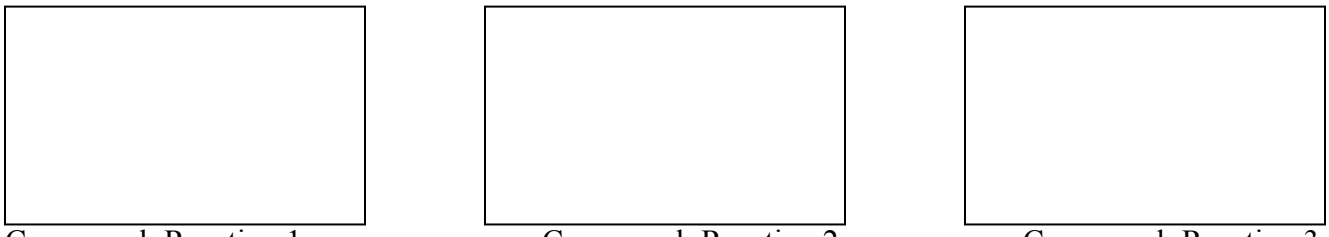


Infer as to the chemical formulas for the three compounds that form between Rotellium and Saarium. In the circles below create a symbol for Rotellium and Saarium. In the boxes use your symbols to depict the compounds that formed.



Compound: Reaction 1 Compound: Reaction 2 Compound: Reaction 3

Homework: Assume the role of John Dalton and <u>using your own words</u> prepare a speech to present to the scientific community of 1808 that will convince them of the existence of atoms.

I John Dalton know that atoms exist because...