Chemical Foundations: **Elements, Atoms, and Ions**

Dalton's Atomic Theory and Writing Compounds

In the 18th century scientists observed:

Most natural materials are mixtures of pure substances. Pure substances are either elements or compounds. A given compound always contains the same proportions (by mass) of the elements.

- Water always contains 8 g of oxygen for every 1 g of hydrogen.
- Carbon dioxide always contains 2.7 g of oxygen for every 1 g of carbon.
- Law of constant <u>composition</u> → a given compound always contains elements in exactly the same proportion by mass.



Dalton's Atomic Theory

In the early 1800s, John Dalton explained the observations.

Dalton's Atomic Theory (model)

- 1. Elements are made of tiny particles called atoms.
 - Atom \rightarrow the fundamental unit of which elements are composed.
 - All atoms of one element are identical
- 2. The atoms different elements are different from each other
- 3. Atoms of one element can combine with atoms of other elements to form compounds.
- 4. A given compound always has the same relative numbers and types of atoms.
 - Atoms are indivisible in chemical processes.
- 5. Atoms are not created or destroyed in chemical reactions.
 - A chemical reaction simply changes the way the atoms are grouped together.

Dalton's Atomic Theory

Chemistry Explorers: John Dalton • 1766 - 1844

- From England.
- Best known for his atomic theory.
- Was colorblind to red and suffered from lead poisoning.



Dalton's Atomic Theory

- Not accepted immediately.
- Dalton also predicted that a given pair of elements might combine to form more than one compound.
 - Examples: NO, N₂O, and NO₂

 When the existence of these compounds was verified, Dalton's atomic theory became widely accepted.

 Compound → a substance made of two or more different elements joined together in a specific way.

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- Always contains exactly the same relative masses of those elements.
 - Contains the same relative numbers of atoms of each element.
 - Water always contains two hydrogen and one oxygen.
 - Which is water?

 Chemical formula → a representation of a molecule in which the symbols for the elements are used to indicate the types of atoms present and subscripts are used to show the relative numbers of atoms.

0

1

2

- Atoms indicated by element symbols.
- Number of each type of atom is indicated by a <u>subscript</u>.
- Subscript → a number that appears to the right of and below the symbol for the element.
 - (a subscript for 1 is not written)

Writing Formulas of Compounds

- Write the formula for each of the following compounds, listing the elements in the order given.
 - a. A molecule contains four phosphorus atoms and ten oxygen atoms.



Writing Formulas of Compounds

A molecule contains one uranium atom and six fluorine atoms.



Writing Formulas of Compounds

c.A compound contains one aluminum atom for every three chlorine atoms.



Formulas of Compounds Try finding the number of each element: 1. List the elements in the compound. 2. Determine how many of each element there are by looking at the subscripts. **2H** 10 H2U **1C** CO_2 20

1CI

1S

12 H

40

60

1H

2H

6C

- HCI

H₂SC

C₆H₁

For mulas of Compounds Try finding the number of each element: For compounds with parentheses, you must MULTIPLY the subscripts For example

Mn (OH)₂ 1Mn 20 2H

1 N 230x3

Fe

• The End!