

## Early Chemistry

400 B.C.E.- Greeks- 4 elements / Demokritos- atomos

For the next 2000 years no major developments but, experimentation is done by alchemists.

The beginning of modern chemical experimentation comes in 1661 when Robert Boyle publishes "The Skeptical Chymist". Boyle studies primarily the behavior of gasses and introduces the concept of elements.

The first chemical laws were codified by Antoine Lavoisier in his "Treatise on Chemistry" published in 1789. Lavoisier's studies of combustion lead him to formulate the law of conservation of mass- in chemical reactions mass is neither created nor destroyed.

## Development of the Atomic Model

Law of definite proportion- a given compound always contains exactly the same proportion of elements by mass -Joseph Proust (1754-1826)

Law of multiple proportions- When two elements form a series of compounds, the ratios of the masses can always be reduced to whole numbers. -John Dalton (1766-1844) In 1808 Dalton publishes "A New System of Chemical Philosophy" the first modern atomic model

1- Each element is made up of tiny particles called atoms. 2- The atoms of a given element are identical; the atoms of different elements are different in a fundamental way.

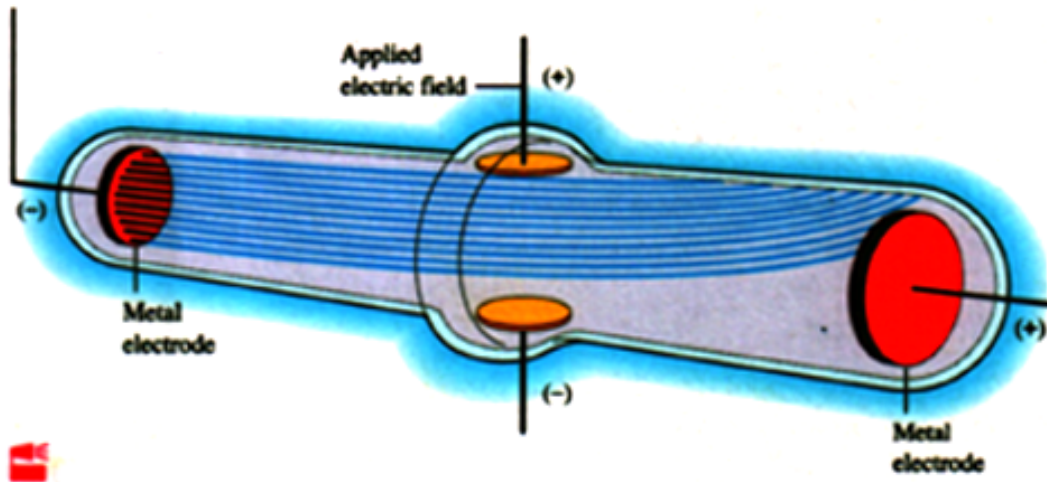
3- Chemical compounds are formed when elements combine. Compounds always have the same relative ratios

4- Chemical reactions involve reorganization of the atoms. The atoms themselves are not changed in a chemical reaction.

## Characterizing the Atom

With the development of the atom, the concept of atomic weights or masses are developed by Dalton and Joseph Gay-Lussac and in 1811 this leads Amadeo Avogadro to develop an important hypothesis that at the same temperature and pressure, equal volumes of different gases contain the same number of particles.

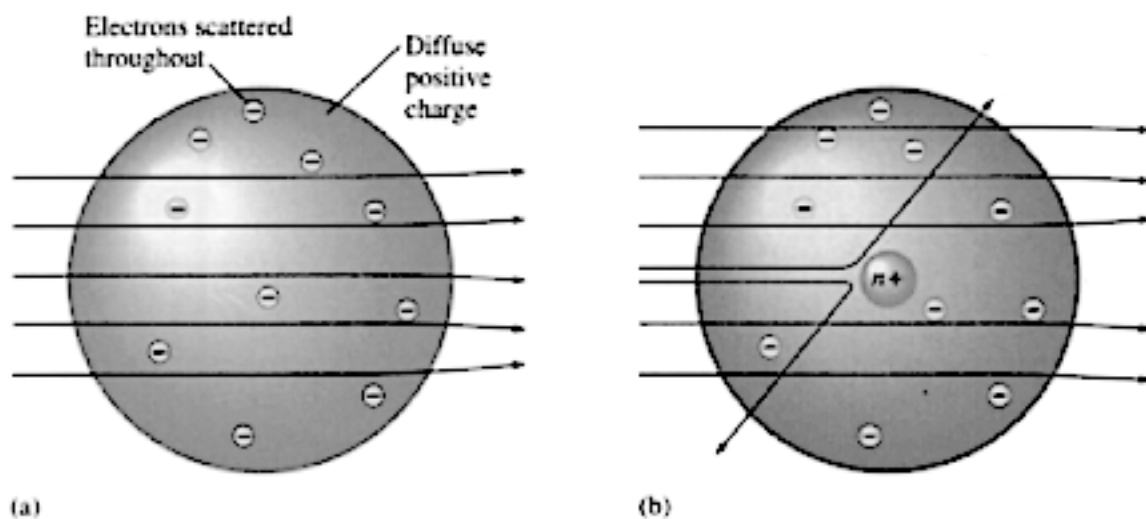
The first discovered sub-atomic particle was the electron. J.J. Thomson was studying cathode-ray tubes when he postulated the rays were actually particles with negative charge. Thomson postulated that the rest of the atom must be positively charged. He developed what was called the plum pudding model. Negatively charged electrons embedded in a positive surrounding.



### The Nucleus

With the discovery of radioactivity in 1896 the stage was set for the discover of the inner workings of the atom.

In 1911 Ernest Rutherford was conducting experiments to test Thomson's plum pudding model. By bombarding gold foil with alpha particles Rutherford discovers that the atom has a very dense, heavy, positively charged center, which he calls the Nucleus.

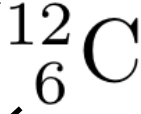


Rutherford theorizes that the electrons orbit around the nucleus as the planets orbit the sun.

## Modern Atomic Notation

Atomic Mass

$p^+ + n^0$

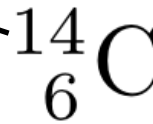


Atomic Number

$p^+$  or  $e^-$

Isotope- atoms with the same number of protons but different numbers of neutrons.

$6 p^+ + 8 n^0$



Ion- atom that has gained or lost electrons from it's neutral state.

Number of electrons gained or lost from neutral.



Ex: