**Chapter 2** (continued)

**Law of Multiple Proportions:**

Dalton's theory explained known facts and predicted new ones. He deduced the law of multiple proportions: If two elements A and B combine to form more than one compound, then the masses of B that can combine with a given mass of A are in the ratio of small whole numbers.

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**Atoms have Structure:**

Atoms are composed of subatomic particles, some of which are electrically charged either positive (protons), negative (electrons), or are neutral (neutrons)

J.J. Thomson (1897) Cathode ray tubes showed that the stream of particles (later to be known as electrons) were negatively charged.

He was able to calculate the charge of an electron/mass of the electron to be $1.76 \times 10^{8}$ coulombs/grams (C/g)

Robert Millikan's Oil drop experiment (~1909) measured the charge of an electron. Millikan calculated the mass of an electron.

Marie and Pierre Curie and Henri Becquerel (~1903) discovered high energy radiation (alpha, beta and gamma particles).

Ernest Rutherford (1907) and his undergraduate researcher Ernest Marsden used alpha particles in this Gold Foil Experiment to discover that the plum pudding model (Thomson's) wasn't correct. He developed the **Nuclear Model of the Atom.**

JJ Thomson's plum pudding model based on assumption that because electrons are the least massive subatomic particle, they would take up the least amount of space

Nucleus: dense region of positive charge. Most of the volume of the atom is nearly empty space of the electron orbitals.

Size scales: H atoms is 1.2 Angstroms (120 pm) in radius. The nucleus is about $10^{-4}$ Angstroms ($10^{-2}$ pm)

We made a blown up model of the H atom. If the electron orbital is 12 m, the nucleus is smaller than the tip of a nail (0.17 mm).

Atomic mass

Atomic mass is the isotope mass (protons+neutrons+the tiny mass contribution of the electrons) for individual isotopes.

1 g= 6.022 x $10^{23}$ atomic mass units (a.m.u.)

$^{12}C$ is defined as having a mass of 12 a.m.u.

Atomic weight of an element is an weighted average of the atomic masses of all of the naturally occurring isotopes of that element

Atomic Weight= f1 $Atomic\ Weight = f_1 \times m_1 + f_2 \times m_2 + f_3 \times m_3 + \ldots$

Keep in mind that the sum of all the fractional abundances, $f$ , add up to 1!