Early History
Fundamental Nature of Matter

Early History – Is matter continuous or discrete

- Empedocles: (air/earth/fire/water)
- Democritus: tiny indivisible particles called “atomos”
- Aristotle: Great philosopher, lousy chemist

The theory of Democritus and Leucippus held that everything is composed of "atoms", which are physically, but not geometrically, indivisible; that between atoms, there lies empty space; that atoms are indestructible; have always been, and always will be, in motion; that there are an infinite number of atoms, and kinds of atoms, which differ in shape, and size.

John Dalton – Atomic Theory

1. Elements are composed of minute, indivisible particles called atoms.
2. Atoms of the same element are alike in mass and size.
3. Atoms of different elements have different masses and sizes.
4. Chemical compounds are formed by the union of two or more atoms of different elements.
5. Atoms combine to form compounds in simple numerical ratios such as 1:1, 1:2, 2:3 etc.
6. Atoms of two elements may combine in different ratios to form more than one compound. (Law of Multiple Proportions)

- Law of Partial Pressures

Flaws in Daltons Model:

1. Atoms are chemically indivisible (but in nuclear reactions can be broken apart into protons, neutrons, electrons) (etc.)
2. Not all atoms of a specific element have the same mass (isotopes).

Rule of Greatest Simplicity

- When atoms combine in one ratio, it must be assumed to be binary
- Water = OH
- Ammonia = NH

Empedocles (490-430 BC)

Democritus (460-371 BC)

Aristotle (384-322 BC)

Robert Boyle (1627-1691)

Joseph Priestly (1733-1804)

Antoine Lavoisier (1743-1779)

Joseph Proust (1754-1826)

John Dalton(1766-1844)

Robert Boyle – Father of Chemistry

- Primarily studied gases (Ch. 12) → Boyles Law
- Atomic nature of matter (Elements)
- Compounds vs. Mixtures (Ch 3)

Joseph Priestly

- Discovered O_2 and (NO, HCl, NH_3, N_2O, CO, SO_2)
- Invented Soda Water
- Phlogiston Theory

Antoine Lavoisier

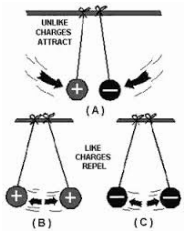
- O_2 required for combustion
- Qualitative → Quantitative
- Disproved Phlogiston theory
- Conservation of Mass: matter is neither created nor destroyed in a chemical reaction
- Water = compound ≠ Element

Joseph Proust

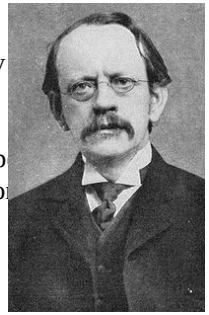
- Law of Definite Proportions: Substances always combine in constant and definite proportions
- Natural vs. Artificial $CuCO_3$

History (II)
Structure of the Atom

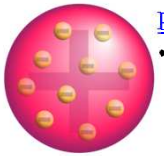
Study of Electricity and Magnetism
- Two types of charge (+/−)
- Opposites attract, Likes repel
- Charges may be transferred from object to object
- $F = \frac{kq_1q_2}{r^2}$



Joseph John (JJ) Thomson
- 1906 Nobel Prize – Discovery the Electron (Corpuscles)
- Plum-Pudding Model
- Mass Spectrometer and Isotop
- Gifted Teacher (7 students wo Nobel Prizes, and his son)

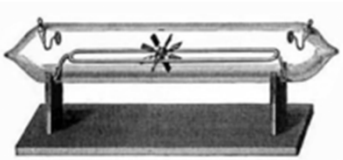


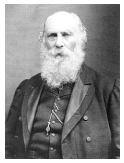
Properties of Electrons
- Travel in straight lines
- 1/1000th mass of H
- Same mass no matter source (all electrons are the same) "Universal"
- Deflected by magnetic fields (attracted to positive field therefore negatively charged)
- Produce Shadows
- Have mass (capable of turning a paddle wheel)



Plum Pudding Model
- Corpuscles (electrons) distributed in an even field of positive charge

Crookes Tube
- William Crookes (1832-1911)
- Used to "discovery" electrons and x-rays



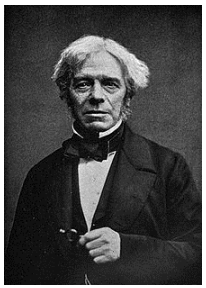


George Johnstone (GJ) Stoney
- Supporter of Metric System
- Theorized the fundamental unit of electricity "electron"

Eugen Goldstein: "Discovered Proton"
- Canel Rays/Protons – emitted opposite cathode rays
- Different for each element
- Properties measured by Thomson

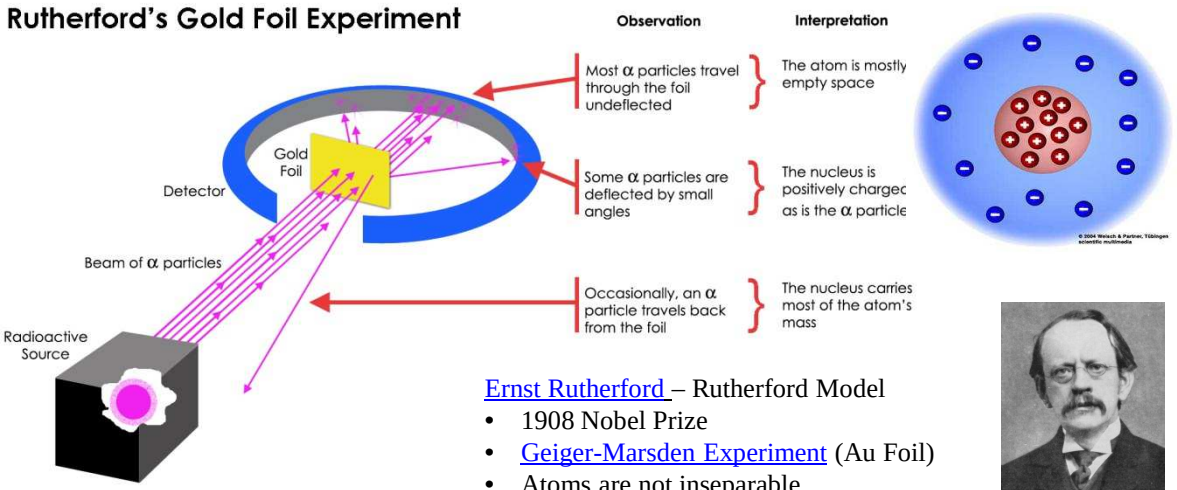
James Chadwick: Discovered Neutron
- 1935 Nobel Prize
- Student of Rutherford
- Manhattan Project

Michael Faraday (1791-1867) — G.J. Stoney (1826-1911) — Svante Arrhenius (1859-1927) — Eugen Goldstein (1850-1930) — J.J. Thomson (1856-1940) — Ernst Rutherford (1871-1937) — James Chadwick (1891-1974)



Michael Faraday
- Discovery of "ions" – certain substances when dissolved in water conduct electricity.
- Compounds decomposed electrically are attracted to different electrodes.
- Cathode (negative electrode)
- Anode (positive electrode)

Svante Arrhenius
- Don't need water
- $NaCl \rightarrow Na^+ + Cl^-$
- Cations (+)
- Anions (−)
- Acids/Bases (Ch 15)
- Arrhenius Equation
- Noble Prize Committee (1903 Nobel Prize)



Ernst Rutherford – Rutherford Model
- 1908 Nobel Prize
- Geiger-Marsden Experiment (Au Foil)
- Atoms are not inseparable
- α-particle, β-particle, γ-rays, ½ life,