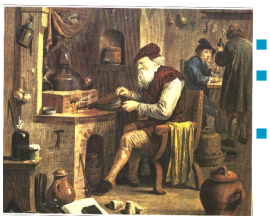
History of Chemistry

The Greeks

- 4 elements:
  - Fire: Hot & Dry
  - Earth: Dry & Cold
  - Water: Cold & Wet
  - Air: Wet & Hot

The Alchemists



- "Fake Scientists"
- Tried to turn cheap metals into gold
- Discovered elements such as mercury and sulfur

"The First Chemist"
Robert Boyle (1627-1691)

- **Science should be firmly grounded in experiments.**
- **An element is something that cannot be broken down into simpler substances.**
- **There are probably many elements.**

II. Elements

A. Abundant Pure Elements in the Atmosphere

- Nitrogen
- Oxygen
- Argon

B. Abundant Elements (By Mass)

Human Body	Earth's Atmosphere	Earth's Oceans	Earth's Crust
O (65) C (18) H (10) N (3) Ca (1.5) P (1.2) Others	N (78.1) O (20.9) Ar (0.96) C H Others	O (85.8) H (10.8) Cl (1.9) Na (1.1) Others (0.4) Sorry, oil. Lots and lots of oil.	O (46.6) Si (27.7) Al (8.1) Fe (5) Ca (3.6) Na (2.8) Others

C. Trace Elements

- Elements that your body needs, but only in small amounts.
- Examples:
  - Copper - production of red blood cells
  - Iodine - functioning of thyroid gland
  - Chromium - metabolism of sugars

III. Laws of Matter

A. Law of Conservation of Mass

- Mass can neither be created nor destroyed

B. Law of Definite Proportion (constant composition)

- A given compound always contains exactly the same proportion of elements by mass
- NaCl: 39.3% Na; 60.7% Cl
- H_2O: 11.1% H; 88.9% O

C. Law of Multiple Proportions

- When 2 elements form a series of compounds, the ratios of the masses of the second element that combine with 1 gram of the first element can always be reduced to whole numbers.
- Example:
  - H_2O
    1 gram H, 8 grams O
  - * H_2O_2
    1 gram H, 16 grams O

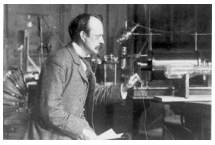
The Atom
John Dalton (1766-1844)

- **Dalton's Atomic Theory**
  1. Elements are made of tiny particles called atoms.
  2. All atoms of a given element are identical.
  3. The atoms of a given element are different from those of any other element.
  4. Atoms of one element can combine with atoms of other elements to form compounds. A given compound always has the same relative numbers and types of atoms.

The Atom
John Dalton (1766-1844)

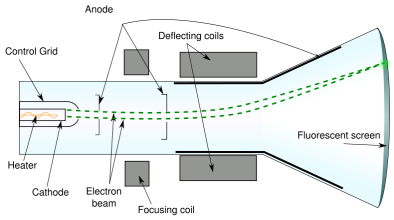
- **Dalton's Atomic Theory**
  5. Atoms are indivisible in chemical processes. That is, atoms are not created or destroyed in chemical reactions. A chemical reaction simply changes the way atoms are grouped together.

The Atom
J.J. Thomson (1856-1940)



- Discovered electrons using the cathode ray tube experiment
- With Lord Kelvin, he believed that the negative electrons were stuck in a positive sphere (Plum pudding model)

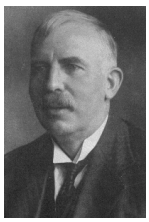
Cathode Ray Tube



The Atom
Robert Millikan (1909)

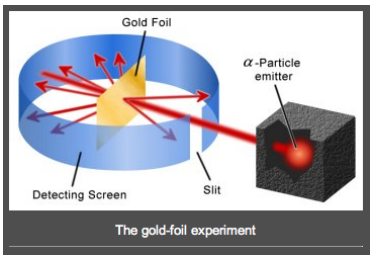
- **Calculated the charge (-1.6 x 10^{-19} Coulombs) and mass of an electron using the oil drop experiment**

The Atom
Ernest Rutherford (1871-1937)



•Discovered the positively charged nucleus using the gold foil experiment.
(The atom was mostly empty space, with a dense, positive center.)

The Atom
Gold Foil Experiment



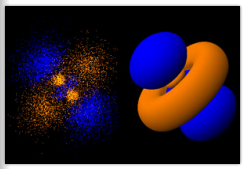
The Atom
Niels Bohr (1913)

- **Believed that electrons moved around the nucleus in rings or shells like planets around the sun**
  (Solar System Model)

The Atom
James Chadwick (1932)

- **Discovered the neutron**

The Atom
Quantum Mechanical Model



Electrons exist in orbitals around the nucleus.

Sources

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