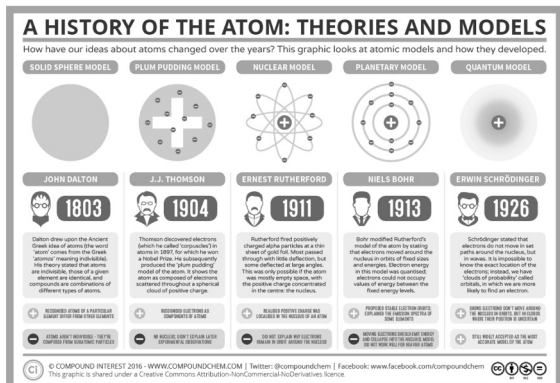


Studying Matter...

All materials on earth and the universe are made of matter. In this unit we will study the basic underpinning of matter...

The ATOM



From Matter to Atoms

Democritus Theory of Matter

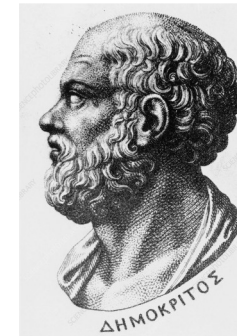
Democritus: Fifth Century BC (460 – 370BC)

If matter is divided into the smallest possible pieces you will eventually reach the smallest division of matter - "Atomos" – The atom



The Basic Elements

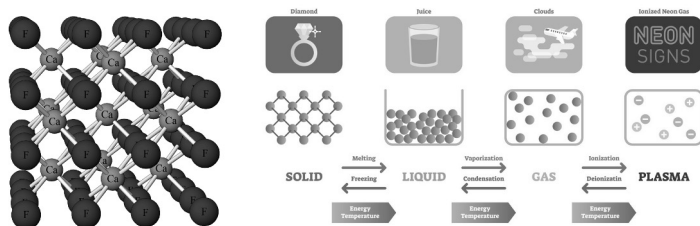
Prior to Democritus philosophers believed everything was made of Fire, Earth, Wind, Water, and Ether



From Matter to Atoms

Preliminary Atomic Theories

Democritus (400BC): The Atom Greeks (200BC): States of Matter



From Matter to Atoms

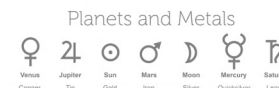
Alchemy and The Chemical Reaction

Alchemy (1500s)

Alchemists believed gold could be **transmuted** (changed) from more common elements using fundamental characteristics of atomic theory.

A **chemical reaction** is a process in which atoms are changed (**rearranged**) to make new combination of atoms (**compounds and molecules**)

Alchemical Symbols



Alchemy defined the first elements / atomic symbols

From Matter to Atoms

Preliminary Laws of Matter

Law of Conservation of Matter

Matter is neither created or destroyed just rearranged in new ways

Law of Conservation of Mass

The physical mass of matter is constant

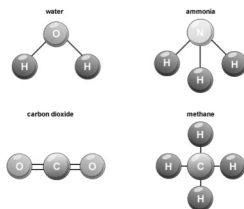
Law of Definite Composition (Proust's Law)

All combinations of atoms contain the same ratio (*by mass*) of all atoms that make up the matter

Compounds and Molecules

All combination of atoms are formed from existing atoms in definite proportions

Water is always 1 oxygen and 2 hydrogen [H_2O]



From Matter to Atoms

Dalton's Four Principles of the Atom

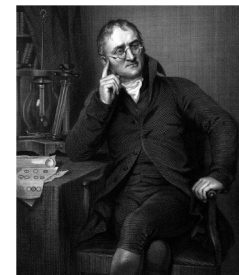
Matter and the atom is defined based on the basic principles of matter. His principles were:

First Principle of Atoms

All Matter is Made of Indivisible Atoms

Second Principle of Atoms

All Atoms of the same type have the same properties, including mass (*elements*)



John Dalton

English Chemist
1766 – 1844AD

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From Matter to Atoms

Dalton's Four Principles of the Atom

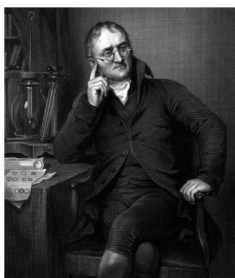
Dalton used the scientific method in this principles and was the first to write down the basic ideas in his principles of matter

Third Principle of Atoms

Compounds and Molecules are combinations of two or atoms combined together

Fourth Principle of Atoms

A Chemical Reaction occurs when atoms are rearranged forming new atom combinations



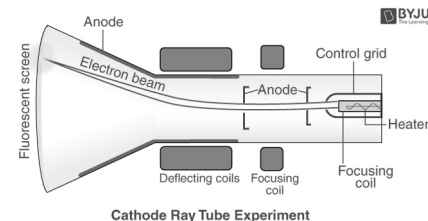
John Dalton

English Chemist
1766 – 1844AD

Subatomic Particles

Thomson's Cathode Ray Experiments

Thomson worked with Cathode "Canal" Rays in a vacuum to determine the energy and charge of e^-



Joseph John Thomson

English Chemist
1856 - 1940AD

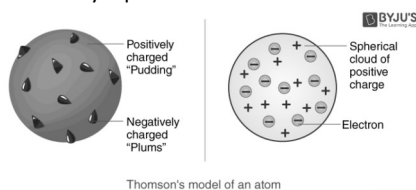
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Subatomic Particles

Thomson's Plum Pudding Model

Thomson's discovery of the electron (e^-) led to the *plum pudding model*, e^- in an atom surrounded by a positive *matrix*



Thomson's model of an atom

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Joseph John Thomson
English Chemist
1856 - 1940AD

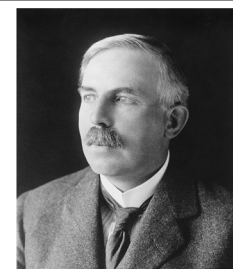
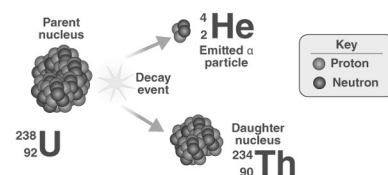
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Subatomic Particles

Radiation and Alpha Particles

Rutherford separated nuclear radiation into three types of radiation. Alpha Decay (α), the weakest had 2 positive and 2 neutral particles

ALPHA DECAY OF URANIUM 238



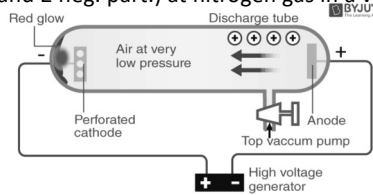
Ernest Rutherford
English Chemist
1871 - 1931AD

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Subatomic Particles

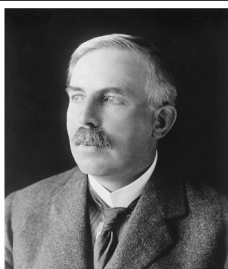
Rutherford's Nitrogen Experiment

Rutherford accelerated *shot* alpha particles (2 pos. and 2 neg. part.) at nitrogen gas in a vacuum.



Discovery of proton

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Ernest Rutherford
New Zealand Chemist
1871 - 1931AD

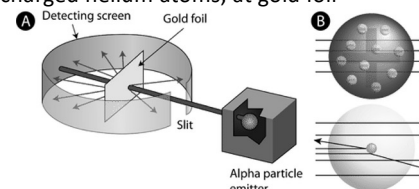
The resulting particles were positive protons (p^+)

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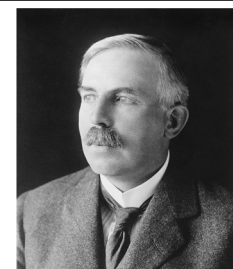
Subatomic Particles

Rutherford's Gold Foil Experiment

Rutherford accelerated *shot* alpha particles, charged helium atoms, at gold foil



The alpha particles showed the atom to be basically empty except for a nucleus in the center



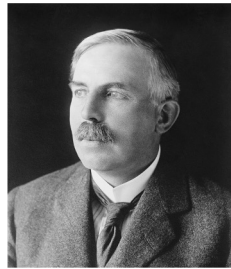
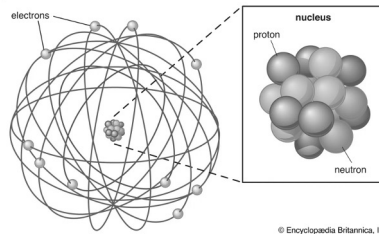
Ernest Rutherford
New Zealand Chemist
1871 - 1931AD

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Subatomic Particles

Rutherford's Atomic Model

Strong positive center to the atom (*nucleus*) surrounded by negatively charged electrons (e^-)



Ernest Rutherford

New Zealand Chemist
1871 - 1931AD

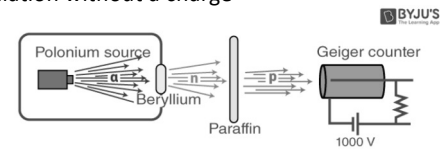
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Subatomic Particles

Chadwick Alpha Particle Experiments

Chadwick observed a heavy byproduct of nuclear radiation without a charge



Discovery of neutron

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The Learning App

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James Chadwick

English Chemist
1891 - 1974AD

The neutron (n^0) is a neutral charged particle balancing the protons (p^+) in the nucleus

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Role of Subatomic Particles

The modern atomic model contains protons, electrons, and neutrons (*+, -, and neutral*)

Protons

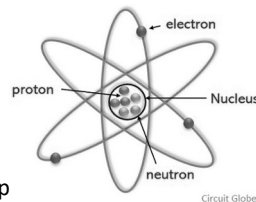
In nucleus (*center of atom*), identifies atom, keep electrons within the outer portion of the atom

Electrons

Atomic communication, connection to other atoms, balancing protons in the atom

Neutrons

Barrier between protons/electrons, shielding



Circuit Globe

Basic Structure of the Atom

Includes electrons (e^-), protons (p^+), and neutrons (n^0)

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