Atomic Theory of Matter

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The Atomic Theory of Matter

Atom - the smallest particle of an element that retains the chemical identity of that element.

Dalton's Principles (1803)

Each element is composed of extremely small particles called atoms

All atoms of a given element are identical, but differ from every other element.

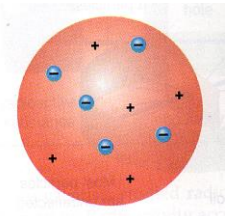
Atoms are neither created nor destroyed in a chemical reaction.

A given compound always has the same relative number and kinds of atoms.

Plum Pudding Model

In the later 1800's, Thomson discovered the electron, which needed to be incorporated into the model.

In the plum pudding model, an atom consisted of a sphere of positive charge, with electrons embedded in the positive charge.



Radioactivity

In the 1890's scientists began working with fluorescence, materials that turn black when hit by radiant EM energy, like x-rays and gamma rays.

1895 - Roentgen discovers X-rays, which react with fluorescence.

1896 - Becquerel discovers that some rocks can expose fluorescence

These two discoveries resulted in the development of the theory of radioactivity, that some materials can spontaneously emit radiation, which meant atoms could be made of something smaller.

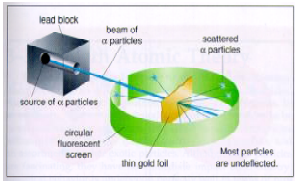
But where in the atom did the radiation come from?

Discovery of the Nucleus

In 1909, Rutherford performed his Gold-Foil Experiment:

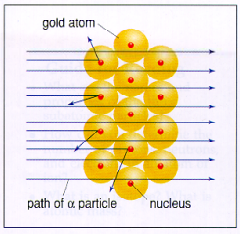
Alpha particles were fired at a thin layer of gold, with a fluorescent screen behind it.

The foil repelled some of the positive alpha particles, while the majority passed through the foil.

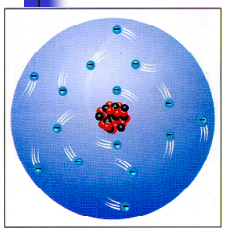


Discovery of the Nucleus

Since alpha particles are positive, there must have been a positive mass in the center of the atom that deflected the alpha particles.



Modern Atomic Theory



Atoms are composed of:

1) protons - positively charged particles located within the nucleus.
2) neutrons - uncharged particles located within the nucleus.
3) electrons - negatively charged particles which orbit the nucleus.

This positively charged center is called the nucleus

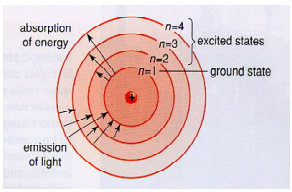
The Bohr Model of the Atom

Bohr developed Rutherford's solar system model of the atom to include energy levels (designated by a quantum number, n).

He stated that all electrons of the atom will fill the energy level orbital closest to the nucleus before moving to the next higher orbital. The ground state was the lowest energy level designated by n = 1.

The Bohr Model of the Atom

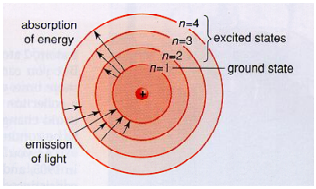
Bohr's theory also provided for a jumping of electrons to an excited state. When this happens, energy is absorbed by the atom, and the electron moves to a higher orbital.



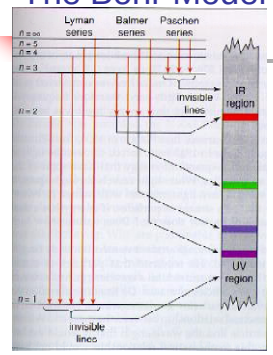
Bohr Model

When the electron falls back to its original energy level, it gives off quantized energy (E= hf), in the form of electromagnetic radiation.

Depending on the drop, the same atom can give off many different types & colors of light.



The Bohr Model of the Atom



This diagram explains the energy level changes for a hydrogen atom, and which transitions cause which type of light