Development of Modern Atomic Theory -- A Summary

J.J. Thomson

--discovered sub-atomic particles common to all elements in cathode ray tube experiments
--named negatively charged particles with very little mass **electrons**
--positively charged particles with much greater mass called **protons**

MODEL: "plum pudding" : positive charge of protons distributed throughout atom, electrons embedded like raisins or nuts in pudding

Ernest Rutherford et. al.

--designed alpha-particle scattering experiment using radioactive source and gold foil
--observed that most particles passed through foil undeflected, some slightly deflected and a very few *reflected*
--concluded that Thomson's model was incorrect

MODEL: "nuclear" atom : positive, very small center of atom is *nucleus* containing protons; electrons move around nucleus like planets around sun; atom is mostly empty space

Niels Bohr

--worked out mathematical model of hydrogen atom which explained emission line spectrum of only certain wavelengths using Planck's quantum concept, $E = h\nu$
--showed that calculations matched observed behavior of electrons as existing on only certain energy levels in the atom, "quantization"

MODEL: Bohr atom : similar to Rutherford in structure but electron energy levels fixed at certain amounts or distances from nucleus; electron transitions from higher to lower levels result in discrete wavelengths of emitted light

Erwin Schrödinger

--combined some particle behavior with wave behavior as suggested by deBroglie and formulated mathematical model for hydrogen atom
--derived equation which gives the *probability* of finding the electron at some point in a 3-dimensional space at any given instant; gives no information about the path the electron follows
--solutions from equation yield information about probability maps or shapes on different energy levels

MODEL: "wave/mechanical" : basic layout of atom similar to Bohr and Rutherford, but electrons do not follow simple orbits; their position can only be predicted in terms of <u>probability</u>