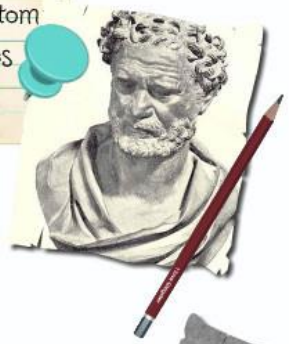
What is Atom?

Part 2

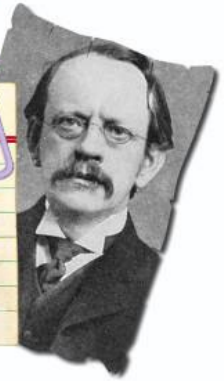
Democritus said that all atom are small, hard particles



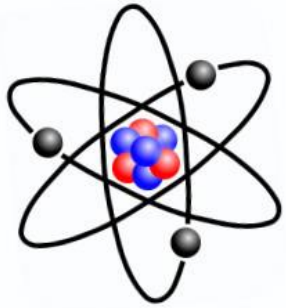
John Dalton developed his atomic theory from observations of many experiments

Glogster

J.J Thomson discovered that there are small particles inside the atom.



Schodinger and Heisenberg further explained the nature of electrons in the atom

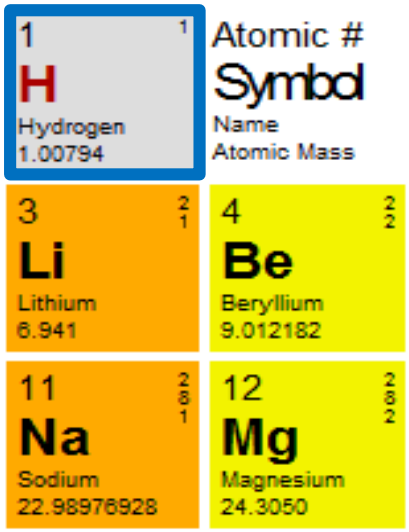


Rutherford decided to test Thomson's theory by an experiment to study the parts of an atom

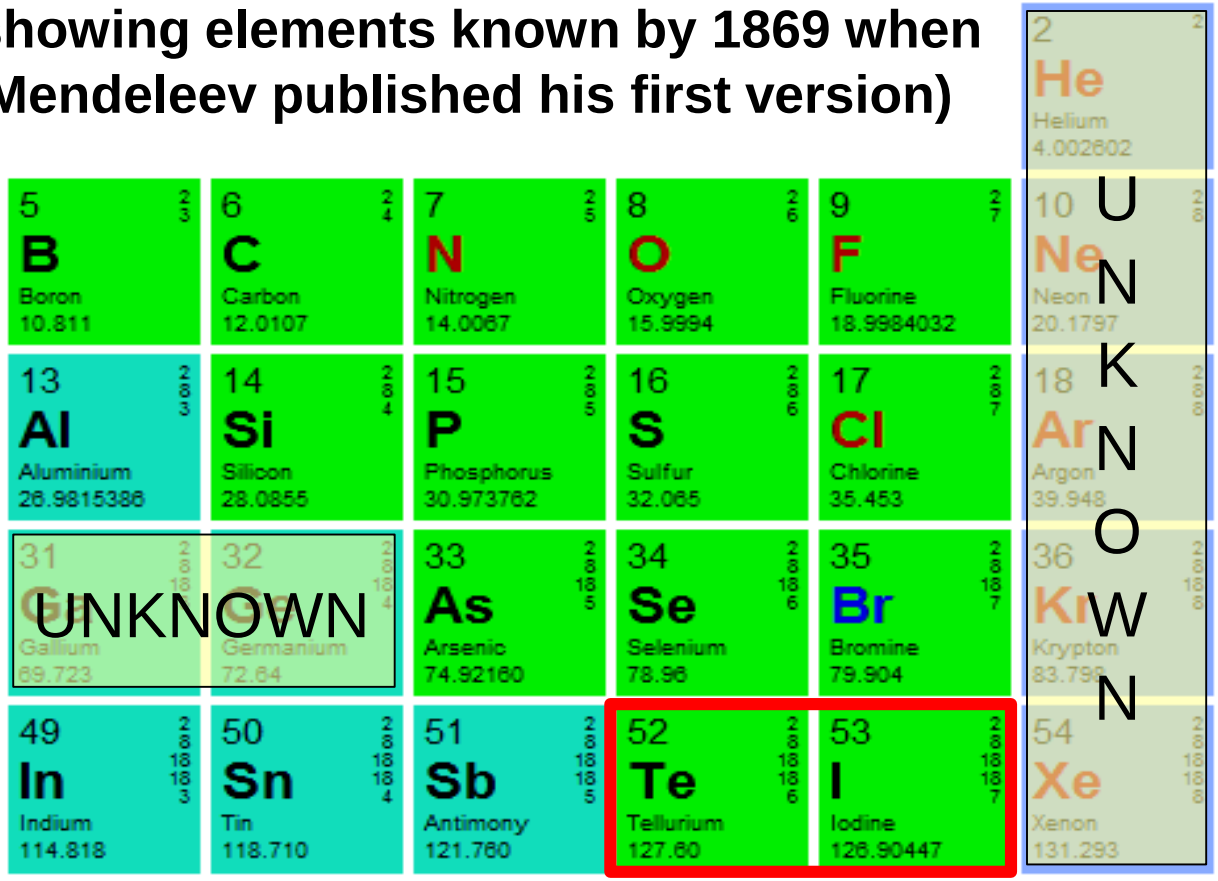
Bohr's results led him to propose that electorns move around nucleus in certain paths or energy levels.

Scientific Mysteries of 1870s

LIGHTEST



Fragment of the Periodic Table (showing elements known by 1869 when Mendeleev published his first version)



Elements are grouped and *ordered* according to their atomic weight…

…but not always!

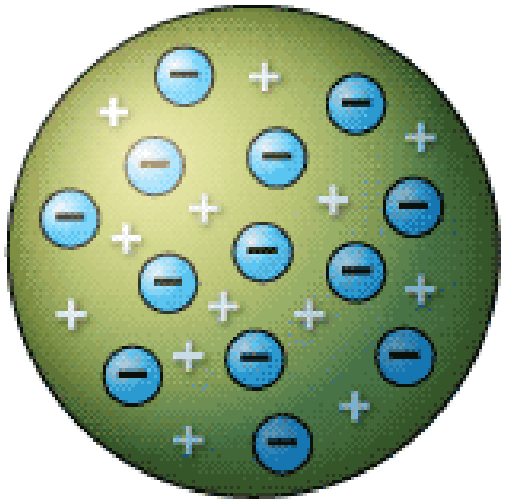
Another question: what carries electricity?

Discovery of Electron

Joseph John Thomson

1897: Thomson detected charged particles that were around 1800 times lighter than the lightest atom, hydrogen. Therefore they were not atoms, but a new particle, the first subatomic particle to be discovered. Originally it was called "corpuscle" but was later named *electron*.

- many elements were shown to emit electrons…
- …all atoms must contain electrons as universal building blocks
- atoms are neutral, so there must be balancing "cloud" of opposite charge



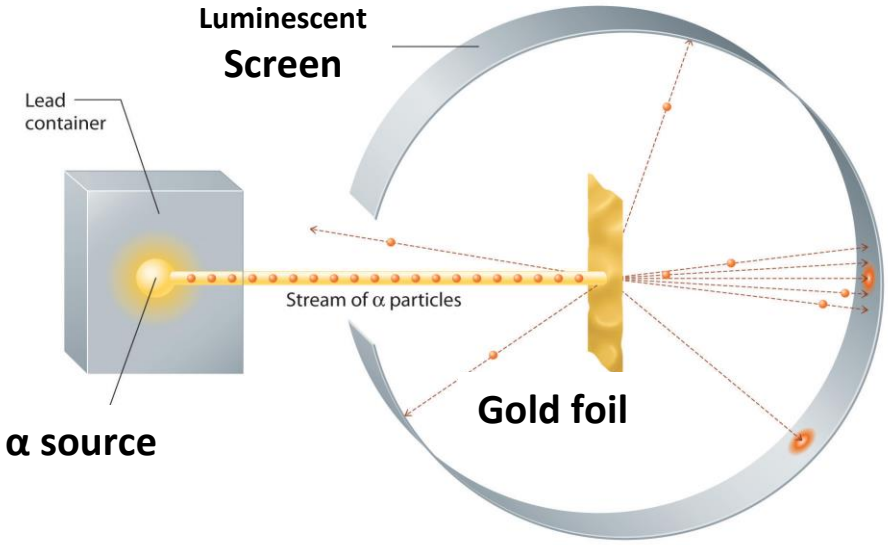
Plum Pudding Model, 1904

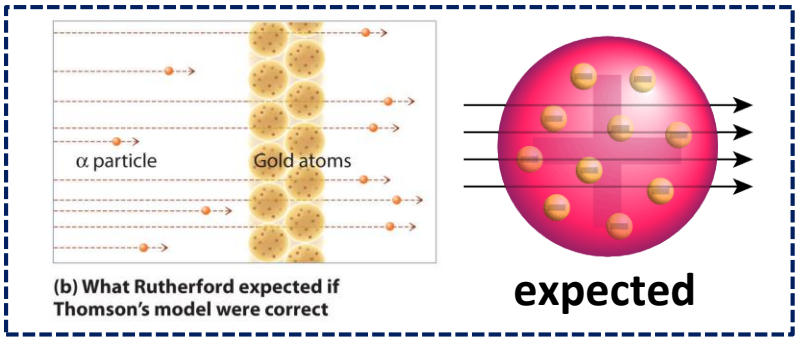
1906 Nobel prize in Physics

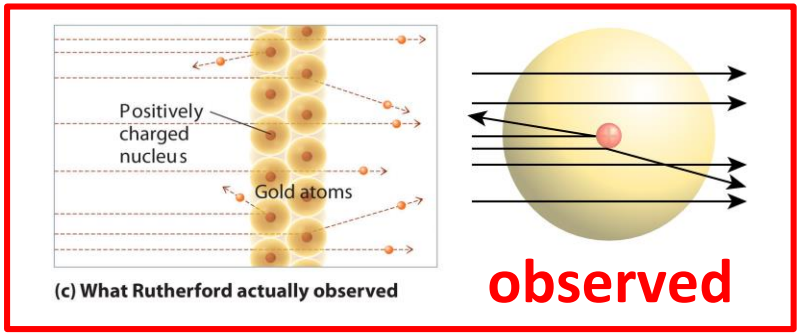
Discovery of the Nucleus

Rutherford (Geiger–Marsden), 1908-1913: Gold Foil Experiment

- **"Father of nuclear physics"**
- **Bombarded a thin metal foil with alpha particles. A majority of the particles passed through the sheet but a small percentage were deflected.**

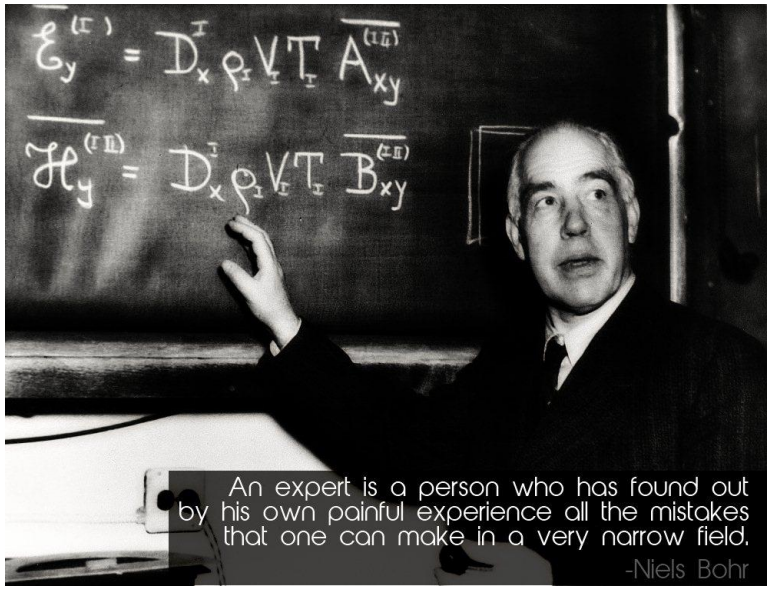






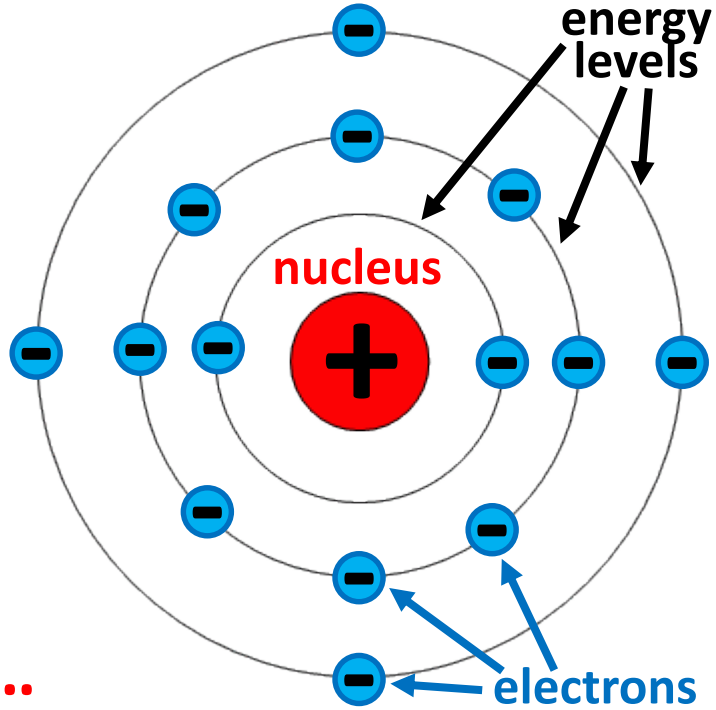
- **Rutherford's conclusion:** "the **greater part of the mass** of the atom was concentrated **in a minute nucleus**… carrying a charge".

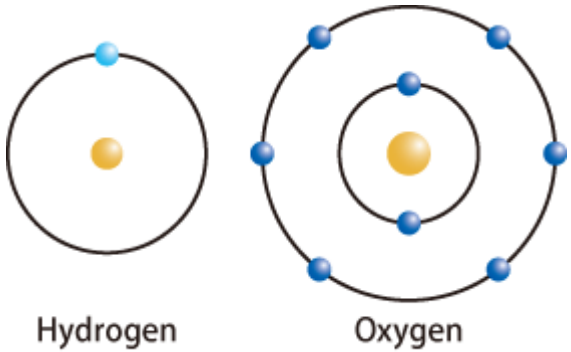
Planetary Model
Niels Bohr, 1913



Electrons move in definite orbits around the nucleus, much like planets circle the Sun.

- **These circular orbits, or energy levels, are located at certain distances from the nucleus.**
- **Electrons can jump between levels emitting (or absorbing) energy.**



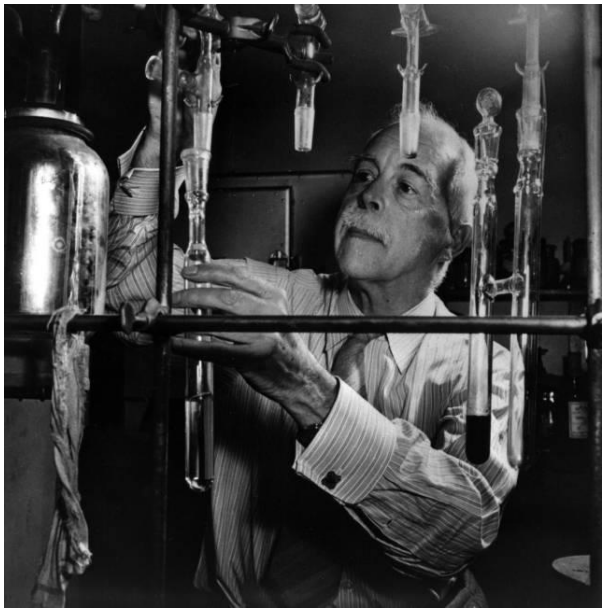


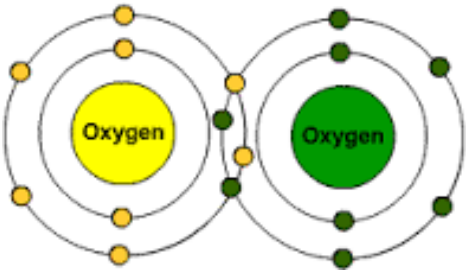
Here comes Quantum Theory…

Chemical Bond Explained

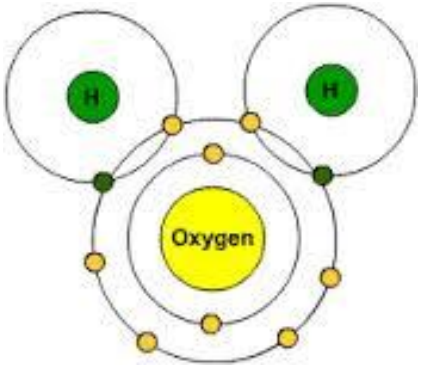
Gilbert Newton Lewis, 1916:

a covalent bond between two atoms is maintained by a pair of electrons shared between them.

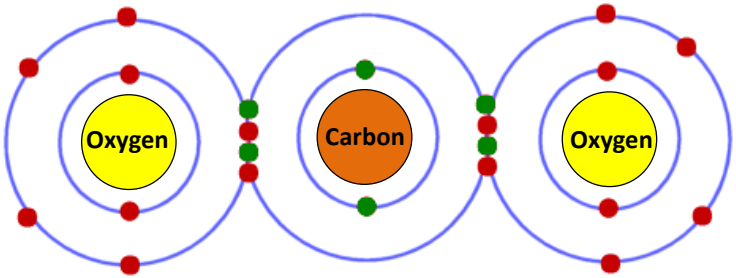




Oxygen molecule



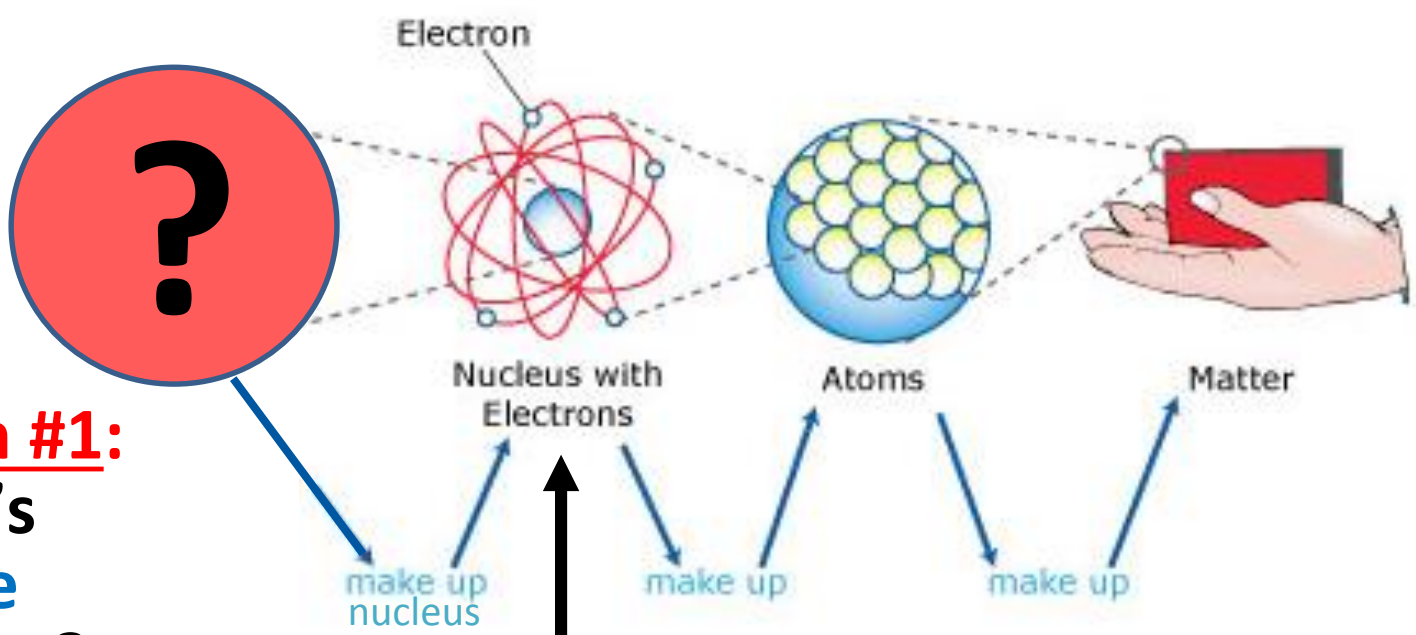
Water



Carbon dioxide

Although nominated 35 times (!), Lewis *never won* the Nobel Prize in Chemistry…

Structure of Matter

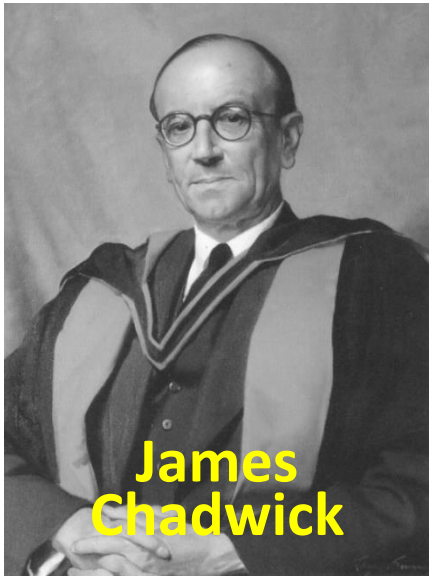


Question #1: What's inside a nucleus?

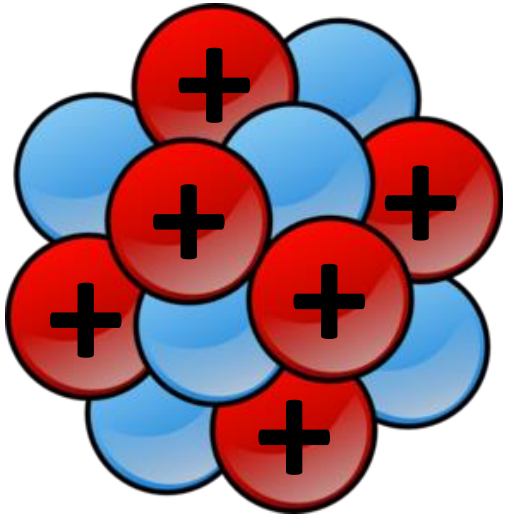
Question #2: Is planetary model of the atom *good enough* to explain all experimental observations?

Inside a Nucleus

- **Rutherford, 1920: discovery of a proton (Greek: "first"), a positively charged subatomic particle.**
- **1920-1932: search for a *neutral* particle.**
- **Chadwick, 1932: detected zero charged particles with about the same mass as the proton, eventually called neutron (1935 Nobel Prize in Physics).**



Atomic Nucleus Structure



Atom ~10^{-10}m

Nucleus ~10^{-14}m
Proton ~10^{-15}m
Neutron ~10^{-15}m