Atomic Theory Timeline

Democritus – 450 B.C.

- Democritus was a Greek philosopher who came to the conclusion that everything was made up of tiny particles.
- He used the term “atomos”.
- Unfortunately, since Democritus was just a philosopher, he had no scientific evidence, and so the masses would not believe something that their visual observations could not explain.
- Democritus’ ideas were ignored for over 2000 years.

Aristotle – 350 B.C.

- Proposed that all matter was made of four elements.
- Earth, Air, Fire, and Water.
- These were all things people could see, and could explain results of many observations.
- Was the believed and followed theory for centuries.

Ben Franklin - 1750

- Proposed and performed many experiments related to electricity.
- Proposed the famous kite and key experiment.
- Main important point for our discussions is that he named the charges that particles might have positive or negative.
- Also stated that like charges repel and opposite charges attract.

Lavoisier - 1789

- In the 1600's, science and experimentation were taking hold in physics, and by the late 1700's the scientific method was being used to explain many chemistry concepts.
- Lavoisier studied gases and determined that the mass of gases before and after a reaction were the same.
- He is responsible for the Law of Conservation of Matter stating that matter cannot be created or destroyed in a chemical reaction.

Proust - 1799

- Proust stated that a compound like water will always have the same ratio of one element to another.
- This was known as the Law of Constant Composition. (Law of Definite Proportions)
- Blame him for Stoiciometry!

Dalton - 1803

- Dalton created the first atomic theory that had a foundation in experiments.
- Dalton was also well read and learned of many ideas and experiments of other scientists.
- Needed an explanation for what made up matter.
- Enabled him and all scientists after to propose many new experiments and make predictions.

Dalton's Theory

- The Theory:
  - All matter is made up of atoms
  - Atoms of the same element are the same while atoms of different elements are different.
  - Atoms are indestructible.
  - Atoms join in whole number ratios to make compounds.
- Dalton pictured the atom like a solid sphere or marble.
- This picture endured for almost another 100 years.

Faraday - 1839

- Faraday did a series of experiments to determine fundamental laws of electricity.
- Significance - Part of his conclusions was that matter is somehow composed of charged particles.

Maxwell - 1873

- Maxwell did lots of experiments and proposed many theories about electromagnetism.
- This explained the properties of electromagnetic radiation.
- Significance – electricity and magnetism are related, and gave insight into the properties of light.

Crookes - 1879

- Used a cathode ray tube (CRT) design first created by Plucker in 1859.
- Determined that these rays have a negative charge because they make objects they hit charged negative, and could be deflected by negative electrical or magnetic fields.
- Also determined that the rays has mass since it could cause pinwheels to spin.
- Later the particles were named electrons by Stoney in 1894.
- Significance – electricity is made up of moving particles.

Roentgen - 1895

- Using a CRT, discovered that there were invisible, massless, and chargeless rays.
- Named the rays “X-ray” for lack of a better name.
- Determined that these rays could pass through objects.
- Significance – new kind of unexplained energy.

Becquerel - 1896

- While doing experiments with a phosphorescent material (absorbs energy from the sun and releases it back later) determined that the sun was not necessary for the material to release energy.
- Discovered nuclear radiation.
- Material was a Uranium ore (rock containing a uranium compound).
- Significance – determined that there are other unexplained phenomena related to the atom.

Thomson - 1897

- Using a CRT, determined the charge to mass ratio of an electron.
- Determined electrons actually come from atoms.
- Using a canal ray which created a beam of oppositely charge particles than the CRT, determined them to be hydrogen ions.
- Created plum-pudding model where there was a positively charged region that the negatively charged electrons were stuck in.

Rutherford - 1898

- Studied the radiation emited from Uranium and Thorium.
- Noticed that they would be deflected by an electric field.
- Named the particles deflected toward the negative plate alpha particles.
- Particles defected toward the positive plate beta.
- Radiation not deflected was called gamma.
- Also noticed that alpha particles deflected twice as much. (double charge)

Curie - 1898

- Marie and her husband did further research on Becquerel's discovery (they were his lab assistants.)
- Determined that they were decaying and called it radioactivity.
- Also discovered two other radioactive elements, Polonium and Radium.
- Significance – radioactivity is common and cannot be ignored, an explanation must be discovered.

Plank - 1900

- Studied black-body radiation (energy given off by hot objects).
- Determined that it could only be explained if there were only specific amounts of energy that could be released.
- Called these specific amounts “quanta”

Einstein - 1905

- Proposed $E=mc^2$ which explained the matter – energy equivalence (matter is just made up of large amounts of energy)
- Also determined that light contains specific amounts of energy determined by its wavelength and frequency.
- Significance – light has properties like a wave like what Maxwell said, but also has properties like a particle following Plank's idea.

Millikan - 1909

- Conducted the oil-drop experiment that used electric fields of known amounts to move oil droplets.
- Significance – determined the charge and the mass of the electron using Thomson's ratio.

Rutherford - 1911

- Created an experiment run by Hans Geiger that shot alpha particles at a thin piece of gold foil.
- Alpha particles are massive and positively charged, so it was expected that they would go right through Thomson's atom.
- Most went through, but some 1 in 6000 bounced back or changed direction.
- Discovered the small, dense, positively charged nucleus. (Protons)
- Created the solar system model, but classical physics said this model was wrong!

Moseley - 1914

- Determined the charges of nuclei of different atoms and rearranged the periodic table by atomic number.

Bohr - 1922

- Came up with an experimental explanation of the pattern of the periodic table.
- Electrons orbited in rings that had quantized energies.
- Electrons could only move between rings if they gained or lost the exact amount of energy needed to get to the next quantized energy.
- Significance – was experimentally proven and made Rutherford's solar system model acceptable again.

DeBroglie - 1923

- Using Einstein's idea of the dual nature of light and matter energy equivalence, determined that electrons (and all other particles) have wave-like properties.
- Significance – explained that Plank's quantization could explain why electrons can only have certain energies since only certain wavelengths are possible.

Heisenberg - 1927

- Created the uncertainty principle which states you cannot know the exact position and momentum of a particle at the same time.
- The more you know one, the less you know the other.
- Significance - Meant that the position of the electron in an atom at any time is based on probabilities.

Schrodinger - 1930

- Created wave functions – mathematical representations of the probability distribution of electrons.
- Meaning an equation that tells us where each electron is most likely to be found.
- Gave us the quantum model of the atom where you have electrons found in orbitals or regions of space (shapes) where each electron is likely to be.

Chadwick - 1932

- Discovered neutron