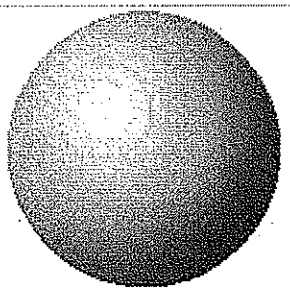
History of Atomic Theory

Democritus (500 BCE)

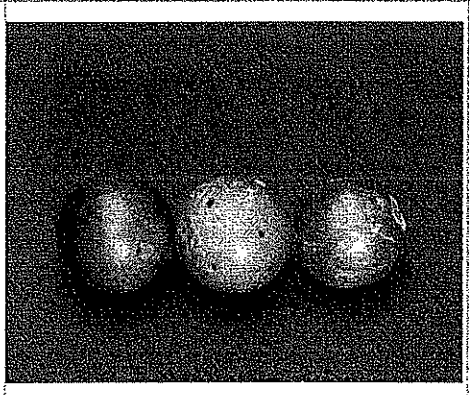
Many people in his day thought Democritus was crazy because he believed that there was a limit to how many times something could be cut into pieces. In other words, he thought that you would eventually get a piece so small and hard that it could not be cut anymore. He named those tiny particles "Atoms" and claimed they were indivisible, which means they cannot be divided. Democritus believed that atoms came in many different sizes and shapes, but that they were all made of the exact same stuff. He often used small round stones to illustrate his idea, so we can imagine his model of the atom to be like a tiny solid stone.



Democritus (400 B.C.)

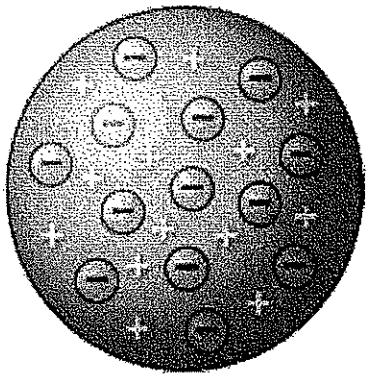
John Dalton (1803)

Like Democritus, Dalton believed that atoms exist and that they are indivisible, but he didn't think that all atoms were made of the same stuff. Instead, he found that there is a different atom for each element. He often used different sized wooden balls like the one to the right to illustrate his model of the atom. In addition, Dalton also discovered that different atoms could combine to form other things called compounds. Unlike Democritus who was a philosopher, Dalton used science experiments to make his discovery.



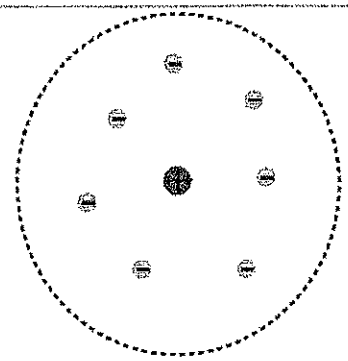
JJ Thomson (1897)

Thomson was a scientist who noticed that some gasses become negative when electricity is passed through them. From this observation he learned that there must be some kind of particle with a negative charge. He named this negative particle an "electron". In Thomson's model, he describes the atom as being filled with a positively charged material in which the electrons are scattered. He called this the "Plum Pudding" model because he imagined it would look like a bowl of pudding (the positive material) with raisins (the electrons) in it.



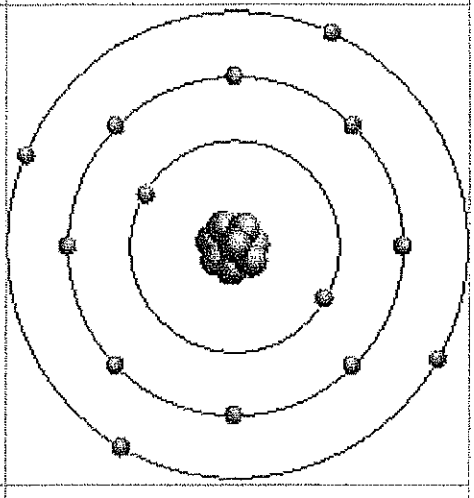
Ernest Rutherford (1910)

Rutherford blasted a thin piece of gold foil with particles. When he did, he noticed that most if the particles passed right through but a few would bounce back. From his observation he was able to infer that atoms are NOT solid blobs of goo like Dalton's model suggests. Instead, they are mostly empty space! In his model, Rutherford describes atoms as having a tiny, dense nucleus around which all the atom's electrons orbit in random pathways.



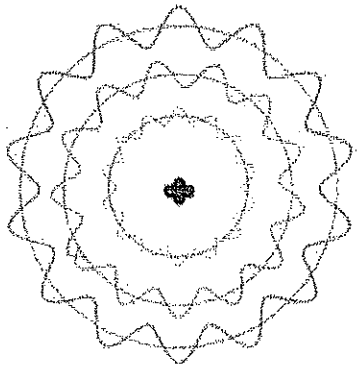
Niels Bohr (1913)

Niels Bohr noticed a problem with Rutherford's model. He showed that an atom would be unstable if all the electrons orbited in random paths because they would end up colliding with one another causing the atom to collapse. Instead, he proposed a model in which the electrons all orbit in different pathways (or shells) based on the amount of energy they have. He explained that low energy electrons orbit closer to the nucleus, while electrons with higher energy orbit farther away. In this way Bohr was able to modify Rutherford's model to explain how atoms can hold enough electrons to balance the positively charged nucleus without collapsing.



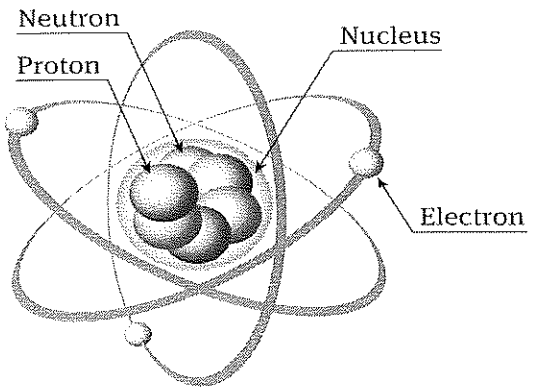
Electron Cloud/Wave Model of the Atom (1924)

Unfortunately, the Bohr model still failed to explain some of the strange things that electrons do. This is why Louis de Brogile modified the theory so that the electrons do NOT just spin around the nucleus like planets around a sun. Instead, Brogile claimed that electrons act like both a particle and a wave. He also said that, because electrons are so fast, it is impossible to know exactly where they are at any given time. You can, however, know where it *might* be based on its energy level. As in the Bohr Model, electrons with higher energy will be found farther from the nucleus than those with less energy.



Atomic Structure

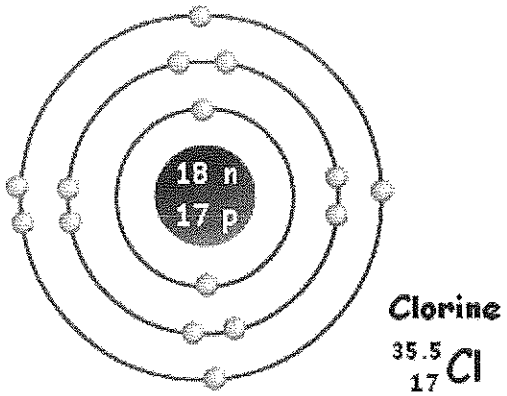
- Atoms have a nucleus that contains **Protons and Neutrons**
- Electrons are contained in **shells** that surround the nucleus
- An atom is made of mostly **empty space**
- Protons have a **positive (+)** charge
- Electrons have a **negative (-)** charge
- Neutrons are **Neutral**



Valence Electrons

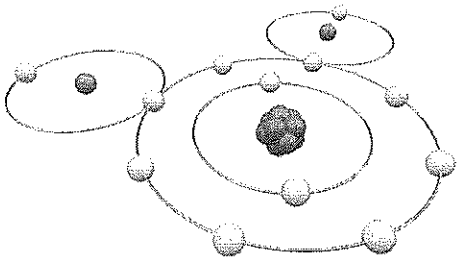
- Each electron shell can hold a certain number of electrons
- Electron shells are filled from the **inside** out
- Noble Gases have **full** outer electron shells
- All other elements have **partially filled** outer electron shells

Electron Shell	Number of Electrons
1	2
2	8
3	8
4	18
5	18
6	32
7	32



Valence Electrons

- The electrons in the outer most electron shell are called **valence** electrons
- The shell containing electrons that is **furthest** from the nucleus is called the valence shell
- The **number of electron shells** with electrons is the **same as (=)** the **period** number
- Atoms will try to gain or lose electrons to have a **full** valence shell



Modern Understanding of Atomic Structure

Electron Cloud - energy levels are not circles, but are probabilities – Probability (% chance) of finding an electron in any particular location at any particular time