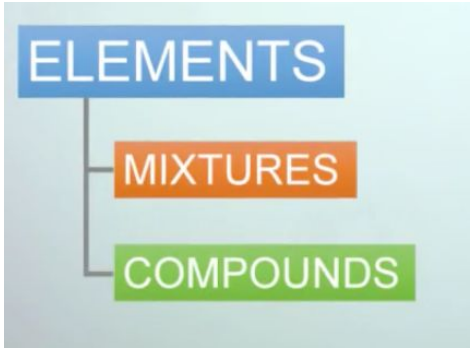
The Structure of Matter

(The technology of exploiting atomic structures in this way is called electronics.**)**

they thought, could be combined of different ways to come up with all sorts of wondrous mixtures and compounds



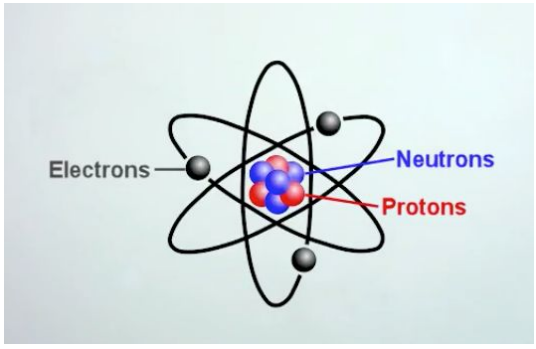
They gave the elements catchy names like hydrogen, nitrogen, oxygen, carbon ... and iron, copper,
First, they changed the design so that each element would be made up of tiny little particles arranged with a blob in the middle, and a cloud of other ones flying around and around it in space.
Next, they invented heat. Depending on how hot the things got, they could make the elements high energy,
or not, changing them from hard, to gooey, to runny, and even to invisible. Then, to keep things from flying apart, they invented charge,and a law that unlike charges would attract.

They then gave some of the particles in the middle of the blob a positive charge, and called them protons.

The particles flying around in orbit were given a negative charge to keep them attracted to the protons ...

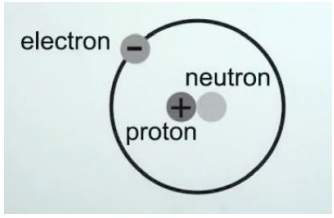
just enough to balance their kinetic energy, which kept them from flying off into space.

These were called 'negatrons' until 1891, when an Irishman named George Stoney talked everyone into calling them electrons. That was probably a good thing, since we'd otherwise have to call this a course in 'Basic Negatronics'.

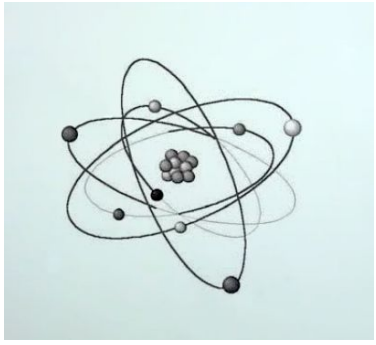


So we've learned that the smallest particle of an element is the atom, and that atoms are made up of several sorts of particles,the main three being **protons, neutrons, and electrons**. Structurally, the protons and neutrons form a nucleus at the center of the atom, with the electrons revolving around that in free space. The atoms of each element are distinctive, in that they differ in the number and distribution of these basic particles.

The hydrogen atom, for example, has only one of each: one proton and one neutron in its nucleus, with only a single orbital electron.

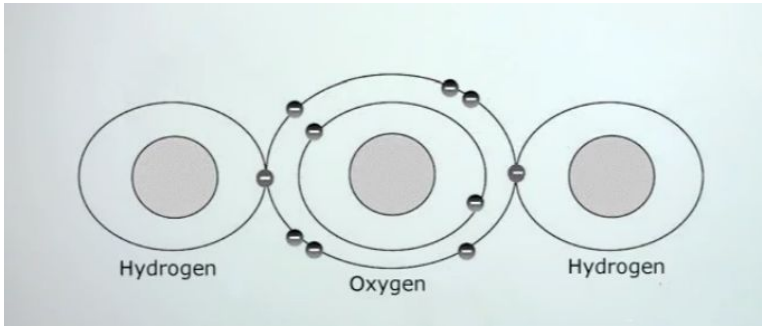


The oxygen atom

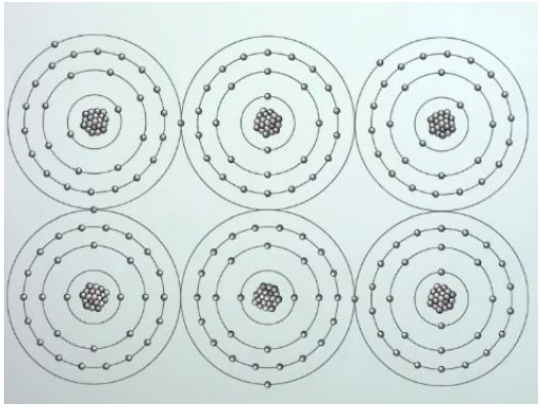


the higher energy level electrons are more loosely bound, and orbit at greater distances

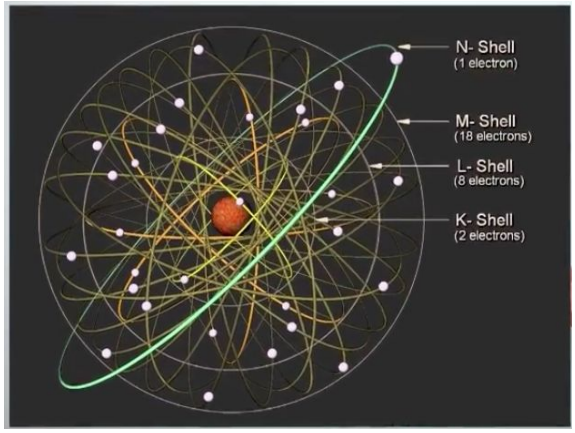
Compounds occur when different kinds of atoms are joined together by the sharing of these outer shell electrons.Water happens when two hydrogen atoms link up with a single oxygen atom; 'H2O' in other words.



Solid substances are formed when identical atoms arrange themselves in the same way,which results in a very organized three-dimensional sort of lattice structure.This is what the copper atom looks like in 3D, with twenty-nine orbital electrons arranged in four shells.

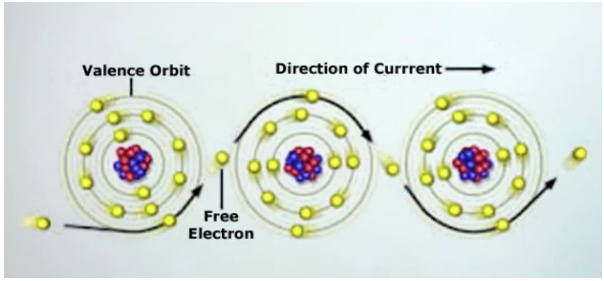


The outer shell electrons travel at the highest energy level of any others in the electron cloud.They are still subject to the forces of attraction imposed by the positive charges,but not as strongly as their inner-shell brothers and sisters.



This is why they're able to swap places with electrons in adjacent atoms, which, in combination with nature's penchant for balancing forces, results in the orderly lattice structure. But, what's more interesting, is that with a little bit of encouragement, it's possible to cause these outer shell electrons to flow through the material in a controlled way, as if they were actually free. That never happens of course, since nature abhors imbalances. With an electron flow from west to

east for example, an east-going electron from any particular atom will be replaced by one arriving from the west.



This flow of electrons is called electric current.

Its journey is always circular, beginning and ending at the same place, within what's called a circuit. The integrity of the conducting material is thereby maintained, even while we are able to use its free electrons to do useful things as an electric current. The technology of exploiting atomic structures in this way is called electronics.