The Parts of an Atom

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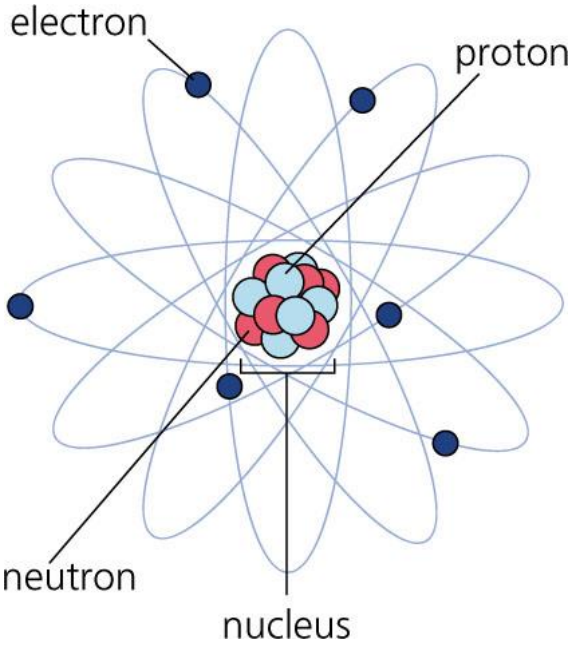
Everything is made of atoms. And all atoms are made up of three parts: protons, neutrons, and electrons. Protons and neutrons are both found in the nucleus of the atom and are about the same size. Electrons are about 2000 times smaller than protons and neutrons and are found shooting around the atom outside of the nucleus at about the speed of light (that's really fast – in fact it's the fastest speed we know). Now you may have been taught at some point that the electrons orbit the nucleus like planets orbit the sun. Even though we often draw it this way because it's simple, it is not how the electrons actually move. The electrons are shooting around within a certain shaped area around the nucleus called the orbital. But the electron can be anywhere within the orbital and heading in any direction, it's not just a simple circular path like an orbit. In fact, the electron can actually go flying out of the orbital for brief amounts of time. It does this about 10% of the time. Therefore, an orbital is defined as the area in which the electron is found 90% of the time.



Now, here's the amazing part. An atom is 99.99% empty space. That means nada, nothing, a vacuum. Think about that. Everything is made up of atoms and atoms are 99.99% nothing. Everything you look at and touch is 99.99% empty space. Put your hand on the table. Both your hand and the table are mostly empty space. How is that possible? How do they both feel so solid?

Here's how it works. Pretend that an atom is the size of the superdome – all the way out to the nosebleed seats. If an atom were that size, then the nucleus of the atom would only be the size of a marble on the 50 yard line. Not only is that all the bigger the nucleus is, but remember that all of the protons and neutrons are in that little bitty nucleus and they contain almost the entire mass of the atom. The electrons take up all of the rest of the space in the entire superdome. But each electron is 2000 times smaller than a proton. In other words, in our superdome analogy, they are about the size of a small grain of sand. Depending on which element the atom is, it may have anywhere from 1 to about 100 electrons taking up all that space. All of the rest of the superdome is empty space – there is absolutely nothing there. So how on earth do things look and feel solid? It has to do with the speed at which the electrons are moving. Remember that the electrons are moving basically at the speed of light. This gives the atom the appearance to us of being solid. Think about it this way. Picture a fan that is turned off. The circle that appears when the fan is turned on only has blades taking up about 1/3 of the space of that circle when the fan is off. You can easily stick a finger through this space when the fan is

off. However, things change when the fan blades are moving. Even though 2/3 of the space of that circle are technically still empty, now you cannot stick your finger through the circle. It has the appearance and characteristics of being at least somewhat solid. Those fan blades are moving nowhere near the speed of light. The electrons in an atom are. So if we stopped all the motion in an atom, it would be almost entirely nothing. But the electrons are moving so fast that the atom has the properties of being a solid. So, you can't put your hand through the table even though both are 99.99% nothing.
