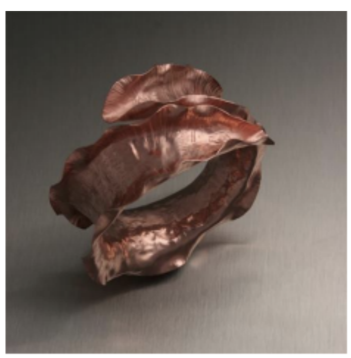
Build an Atom Webquest

Objectives:
Students will be able to:

- Construct a model of an atom.
- Determine the charge of an atom or ion.
- Explain how to determine the numbers and types of subatomic particles in an atom.

Background Information:

Elements are the purest form of matter and cannot be separated into any other substance. There are 118 different types of elements known, and everything in the universe is made up of these elements. The smallest amount of an element is a single particle called an **atom**. Atoms are particles that cannot be broken down into smaller parts and still have the same properties as the element. If an atom is broken down into the pieces that make it up, those pieces look and behave very differently from an element.



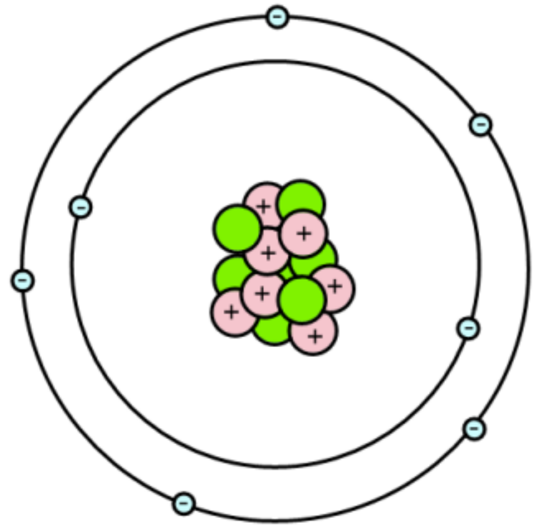
Elements from Left to Right: Sodium, Copper and Neon

There have been a number of different models of the atom over the years to help us understand and explain how an atom is put together and how the parts of an atom relate to one another. The most commonly used model is called the Bohr model of the atom. In the Bohr model, an atom is made up of smaller pieces that are arranged similarly to a solar system. In a solar system, the large sun is in the middle, and the smaller planets go around the sun in circular orbits. In an atom, the large **nucleus** is in the middle, and the tiny **electrons** whiz around it in spherical orbits called **energy levels**. A solar system has only one planet per orbit, but in an atom there can be multiple electrons in one energy level.

The nucleus in the center of the atom is made up of two different kinds of particles: **protons** and **neutrons**. Protons and neutrons have about equal masses, but protons have a +1 charge and neutrons have zero charge. The electrons orbiting the nucleus have a -1 charge, and have much less mass than a proton or neutron. If a proton weighed the same as a car, an electron would weigh as much as a can of beans. When the numbers of protons and electrons are equal, the atom has no overall charge. If the atom gains electrons, it will have more negative electrons than positive protons, and will be negatively charged. If the atom loses electrons, it will have more protons than electrons and will be positively charged. An atom whose protons and electrons are out of balance like this is called an **ion**.

All of the elements are organized into a chart called the **periodic table**. The way the elements in the periodic table are arranged, you can tell different things about each element just by where it is in the table, so you don't have to memorize a lot of information. Each element is given a symbol that represents its name, and is assigned a number called the **atomic number**. The atomic number tells you how many protons are in the nucleus of atoms of that element. Since the atomic number of carbon is 6, that means all carbon atoms have six protons in their nucleus, and any atom that has six protons is a carbon atom. Neutral atoms have the same number of electrons as they do protons, so carbon's atomic number of 6 also tells you that a neutral carbon atom has six electrons. The unusual shape of the periodic table is because the row and column assigned to each element is based on the position of the electrons in that element's atoms. The Build an Atom simulation doesn't go into detail on the arrangement of electrons, so we won't go into detail here. The simulation simply shows the first two energy levels, which correspond to the first two rows of the periodic table.

When textbooks show a picture of a solar system, the sizes and distances of the



Bohr Model of Nitrogen

planets are never to scale, because if they were the smaller planets would just be dots. Pictures of atoms are also never shown to scale because the distance between the nucleus and the electrons is far greater than the size of the nucleus itself. To understand the proportions of the size of the nucleus to the size of the overall atom, imagine a housefly sitting on the 50-yard line of a football field. If that housefly was an atomic nucleus, the electrons would be as far away as the end zone. If you shrink that model down small enough to fit into a textbook, the nucleus would be too small to see. The pictures you see in a textbook or online show the nucleus and the electrons much bigger and much closer together than they really are.