Introduction

Chemistry is a subject about matter, its properties, and how it is transformed during a chemical change (such as when eggs, flour, oil and salt are mixed together and cooked to form a pancake or when an iron nail rusts). When a chemical change occurs, the atoms of one or more substances are rearranged to form new substances (pancakes are no longer eggs). The transformation occurs when the bonds that hold the atoms together in the substances break. Then what happens is new bonds are formed as the new substance or *product* is created. The **bonds**, which are the forces that are holding a substance together, are made by negatively charged electrons that are attracted to positively charged protons in the nuclei of atoms. When one bond is broken and a new bond is formed, the electrons which exist in one kind of **orbital** (a particular location in an atom) is moved to a different orbital, or a new location, perhaps in a different atom.

We are studying **atomic orbitals** and **electron configurations** because both of these topics describe the locations of electrons in atoms. If we understand the basic structure of where electrons are in atoms, we can better understand what happens when a chemical transformation occurs.

Orbitals are volumes of space in which an electron is most likely to be found. We say "most likely" because it is not currently possible to tell *exactly* where an electron is, and so we talk instead about the *probability* of where an electron is in an atom. This is similar to not being able to say *exactly* where a wave is at the beach. It is kind of spread out all along the coast so you cannot point to just one spot and say that all of the wave is there. We don't have to worry about this probability; the main thing is that when we discuss orbitals, they are similar to the coastline area, the wave is there, but it keeps moving and it occupies lots of locations at once so we cannot say exactly where the wave is. Similarly, because electrons are extremely small and move extremely fast, it is not possible to say *exactly* where the electron is.

Subshells are a way of grouping similar orbitals. **Subshells** are a group of orbitals that have similar shapes. All orbitals in a subshell have similar *features* in their shapes, even if the shapes themselves are not identical. There are four types of subshells and they are labeled s, p, d and f. The "s" type of orbital is spherical in shape. The "p" type of orbital looks like an 8. You should remember these two shapes. The d and f orbitals have more complex shapes and you do not have to remember what they are.

There is only one orbital in the s subshell.
There are three orbitals in the p subshell.
There are five orbitals in the d subshell, and
There are seven orbitals in the f subshell.

Shells are another way of grouping orbitals. This is a broader category than subshells so shells contain one or more subshells. These groups of orbitals have similar energy. The shells are labeled 1, 2, 3, 4, 5, etc... The lowest energy orbital is in Shell 1. The orbitals in shell 2 are higher in energy than those in shell 1, but lower in energy than those in shell 3. So as the shell number gets higher, the electrons in the orbitals, have more energy.