1.4 The General Chemistry of the Organic Main Group Elements

A. Closed Shell Valence Bond Molecular Structure and Properties

Closed Shell Electron Configuration. Much of the behavior of atoms, both in bonding and in reactivity, and particularly for the organic main group elements, is dictated by the attainment of closed shell electron configurations. In the first row (H, He) this means having 2 valence shell electrons (the duet rule). In the second row, for the s-block (**Li**, Be), this means losing electrons to get the helium configuration, and for the p-block (B, C, N, O, F, Ne), this means having 8 valence shell electrons (the octet rule). Elements in the third row mimic the properties of those in the second row, but the octet of electrons can be exceeded in hypervalent bonding, where participation with the d-level can begin to take place. In later studies of chemistry, you may encounter the 18-electron rule that governs basic bonding properties in the fourth, fifth, and sixth rows.

Electronegativity. Negatively charged electrons are attracted to the positively charged nucleus by an electrostatic force. An electron will be attracted to a more positive charge over a less positive charge, and it will be more attracted when it is closer to the positive charge than farther away from it. The electronegativity of an element is a measure of how relatively attracted a given electron is to its nucleus. In a row of the periodic table, the relative placement of electrons is about the same distance from the nucleus, so as you move from left to right, and the positive charge in the nucleus is increasing by +1 with each element, the attraction for the electron goes up and (a) the electronegativity of atoms therefore increases as you move from left to right in a row, and (b) the size of atoms decreases slightly as you move from left to right because the electrons are held a little more tightly. As you move down a column on the periodic table, there is a conflict in criteria. The nucleus is significantly more positive, but (a) some of the positive charge is diminished by the intervening electrons, and (b) the lower you move in a column, the significantly farther away from the nucleus the electrons are sitting. As a result, the interaction between the electrons and the nuclei of larger atoms is poorer than for the smaller ones above it on the periodic table, and so the electronegativity decreases as you move down a column. Fluorine, then, has the highest electronegativity because it has the greatest positive charge that a new electron can feel (Figure 0137).

Figure 0137

Electronegativity values (Pauling scale).

B 2.04	H 2.20	C 2.55	N 3.04	O 3.46	F 3.99
		Si 1.90	P 2.19	S 2.58	Cl 3.16
				Se 2.55	Br 2.96
					I 2.66