The Graphical Language of Molecular Structure

How is it that a chemist can instinctively draw a complex molecule? The reason is that the electronic structure of atoms leads to predictable patterns of chemical bonding. These patterns can be broken down to the level of the individual atom, according to atom type (e.g., C, H, N, O, F), formal charge (-1, 0, +1) and connectedness. At the level of the individual atom, patterns of chemical bonding can be described as the distribution of electron pairs within domains, or regions of space about the atom. **Electron pair domains**, or EPDs, provide a convenient scheme around which the patterns of bonding can be organized. **Practice and experience solidifies these patterns in the chemist's mind.** Bonding patterns, in turn, lead to the notion of a **functional group**, a recurring set of atoms with a specific structure that instills certain reactivity. Familiarity with the EPD model is what gives the chemist a seemingly effortless ability to construct complex molecular drawings, even for structures that they have never before encountered – it's a powerful graphical language that opens the way through the "monstrous and boundless thicket" of organic chemistry.

Table of Octet Configurations

Let's be systematic. Write out the various combinations of nonbonding pairs, single bonds, double bonds, and triple bonds that sum to eight electrons about atom "A". These are all the ways an atom can have an octet of electrons!

number nonbonding electron pairs	number of electron-pair domains			
	four	three	two	
0	A	A	A	A
1	A	A	A	
2	A	A		
3	A			
4	A			

There are just 11 ways to produce an octet of electrons about an atom.