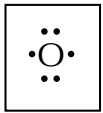
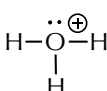
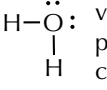


916 APPENDIX 1 Useful Expectations from General Chemistry

Figure AP0106

Valence and bonding in the main group elements (rows 1 and 2).

	H•							He:
	Li • (Li ⁰)	Be: (Be ⁰)	•B•	•C•	•N•	•O•	•F•	•Ne•
closed shell & positively charged	Li ⁺	Be ²⁺			$\begin{array}{c} \text{H} \\ \\ \text{H}-\text{N}^+-\text{H} \\ \\ \text{H} \end{array}$	$\begin{array}{c} \text{H} \\ \\ \text{H}-\text{O}^+-\text{H} \\ \\ \text{H} \end{array}$	$\begin{array}{c} \text{H} \\ \\ \text{H}-\text{F}^+-\text{H} \\ \\ \text{H} \end{array}$	
closed shell & uncharged	H—H			$\begin{array}{c} \text{H} \\ \\ \text{H}-\text{C}-\text{H} \\ \\ \text{H} \end{array}$	$\begin{array}{c} \text{H} \\ \\ \text{H}-\text{N}-\text{H} \\ \\ \text{H} \end{array}$	$\begin{array}{c} \text{H} \\ \\ \text{H}-\text{O}-\text{H} \\ \\ \text{H} \end{array}$	$\begin{array}{c} \text{H} \\ \\ \text{H}-\text{F}-\text{H} \\ \\ \text{H} \end{array}$	He, Ne
closed shell & negatively charged	H: [−]		$\begin{array}{c} \text{H} \\ \\ \text{H}-\text{B}^--\text{H} \\ \\ \text{H} \end{array}$	$\begin{array}{c} \text{H} \\ \\ \text{H}-\text{C}^--\text{H} \\ \\ \text{H} \end{array}$	$\begin{array}{c} \text{H} \\ \\ \text{H}-\text{N}^--\text{H} \\ \\ \text{H} \end{array}$	$\begin{array}{c} \text{H} \\ \\ \text{H}-\text{O}^--\text{H} \\ \\ \text{H} \end{array}$	$\begin{array}{c} \text{H} \\ \\ \text{H}-\text{F}^--\text{H} \\ \\ \text{H} \end{array}$	
Assigning formal charge: gain or loss of possessed electrons relative to normal valence, where the charge is 0. Possessed electrons = nonbonding pairs plus half of bonding								
 uncharged atom	Oxygen: O atomic # 8 = 8 protons 8 electrons: 1s²2s²2p⁴ 6 valence electrons (2s²2p⁴)		valence e = 6 (gives charge = 0) possessed e = 2 + 1/2 of 6 = 5 e 1 electron (-) less than valence, gives formal charge = +1		valence = 6 possessed = 7 charge = -1			

In the first row (H, He), the nearest closed shell electron configuration is that of helium (2 electrons in the "1s" level), also called the duet rule, typically achieved by H taking on 1 more electron through sharing or gaining.

In the second row (Li, Be, B, C, N, O, F, Ne), the nearest closed shell configuration is either that of helium (2 electrons, typically achieved by Li and **Be** losing 1 or 2 electrons, respectively, giving the lithium cation, Li⁺, or beryllium dication, Be²⁺) or that of neon, called the octet rule, typically achieved by the remaining atoms taking on the required number of electrons through sharing or gaining to get a total of 8 electrons: 2 from the 2s sublevel plus 6 electrons from the 2p sublevel.

With atoms following a single rule (achieving a closed shell configuration), some broad generalizations about bonding result.

Compounds that include Group 1 and 2 metals are assumed to involve metal ions and to be ionic. Covalent compounds with uncharged, closed shell atoms have consistent and predictable bonding behavior: Hydrogen atoms have 1 shared electron bond; carbon atoms have 4; nitrogen atoms have 3 bonds, with 1 nonbonding electron pair (nbe); oxygen atoms have 2 bonds, with 2 nbe; and chlorine has 1 bond with 3 nbe. Any other situation for these atoms means, by definition, that the atom is open shell, or charged, or both. Although exceptions exist, atoms on the right-hand portion of the second row (B, C, N, O, F) rarely have formal charges other than -1, 0, or +1.