

### 3.8: The Brief Periodic Table is Complete

With element number 20, all of the elements required for the abbreviated periodic table have been described. As noted above, the placement of electrons in elements with atomic number 21 and higher is a little too complicated to explain here. However, these elements are important and they are all shown in the complete periodic table at the end of this chapter. Among the heavier elements in the complete periodic table are the transition metals, including the important metals chromium, manganese, iron, cobalt, nickel, and copper. Also included are the lanthanides and the actinides. Among these elements are thorium, uranium, and plutonium, which are important in nuclear energy and nuclear weaponry.

The abbreviated periodic table with the first 20 elements is illustrated in Figure 3.9. In addition to atomic number and atomic mass, this table shows the Lewis symbol of each element. It is seen that the symbols of the elements in the same vertical columns have the same number of dots showing identical configurations for their outer-shell electrons. This very simple, brief table contains much useful information, and it is recommended that the reader become familiar with it and be able to reproduce the Lewis symbols for each of the 20 elements. As will be seen in later chapters, the chemistry of the first 20 elements tends to be straightforward and easily related to the atomic structures of these elements.

		First period					
		1					2
		H ·					He ·
		1.0					4.0
Lewis symbols of elements below		X ·	X :	X :	X :	X :	X :
Second period	3	4	5	6	7	8	9
	Li	Be	B	C	N	O	F
Third period	11	12	13	14	15	16	17
	Na	Mg	Al	Si	P	S	Cl
Fourth period	19	20					
	K	Ca					
		39.1	40.1				

Figure 3.9. Abbreviated 20-element version of the periodic table showing Lewis symbols of the elements.

In examining the periodic table, hydrogen should be regarded as having unique properties and not belonging to a specific group. Otherwise, the elements in vertical columns belong to *groups* with similar chemical properties. Excluding hydrogen, the elements in the first group on the left of the table — lithium, sodium, and potassium — are *alkali metals*. In the elemental state alkali metals have a very low density and are so soft that they can be cut with a knife. Freshly cut, an alkali metal surface has a silvery-white color which almost instantaneously turns to a coating of gray metal oxide with exposure to air. The alkali metals (represented by M, below) react violently with water,



to produce the metal hydroxides, strongly basic substances that can be very destructive to flesh that they contact. The alkali metals react with elemental chlorine to produce the ionic chloride salts including, in addition to NaCl shown in Figure 3.8, LiCl and KCl. The second group of the abbreviated periodic table contains beryllium, magnesium, and calcium, all known as *alkaline earth metals*. Freshly exposed surfaces of these metals have a grayish-white luster. These metals are highly reactive to form doubly charged cations ( $Be^{2+}$ ,  $Mg^{2+}$ ,  $Ca^{2+}$ ) by the loss of 2 electrons per atom. The second group from the right, which in the abbreviated periodic table consists of fluorine and chlorine, is known as the **halogens**. These elemental halogens are diatomic gases in which the two atoms of  $F_2$  or  $Cl_2$  are held together by a single covalent bond consisting of two shared electrons. These elements are the most nonmetallic of the elements. Rather than losing electrons to produce positively charged cations, as is common with metals, the halogens readily gain electrons to complete their outer shell electron octets, producing  $F^-$  and  $Cl^-$  anions. The far right group of the abbreviated periodic table is composed of the *noble gases*, helium, neon, and argon. These elements have complete outer shells, exhibit no tendency to enter into chemical bonds, and consist of individual gas-phase atoms.

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