Names and Symbols of Some of the More Familiar Elements

●	Aluminum	Al		Chlorine	Cl		Lithium	Li		Rubidium	Rb
	Antimony	Sb		Chromium	Cr	●	Magnesium	Mg		Selenium	Se
	Argon	Ar		Cobalt	Co	●	Manganese	Mn	●	Silicon	Si
	Barium	Ba	●	Copper	Cu	●	Mercury	Hg	●	Silver	Ag
	Beryllium	Be		Fluorine	F		Neon	Ne	●	Sodium	Na
	Bismuth	Bi	●	Gold	Au		Nickel	Ni		Strontium	Sr
●	Boron	B		Helium	He	●	Nitrogen	N		Sulfur	S
	Bromine	Br		Hydrogen	H	●	Oxygen	O	●	Tin	Sn
	Cadmium	Cd		Iodine	I		Phosphorus	P	●	Uranium	U
●	Calcium	Ca	●	Iron	Fe		Platinum	Pt		Xenon	Xe
●	Carbon	C		Krypton	Kr		Plutonium	Pu	●	Zinc	Zn
	Cesium	Cs	●	Lead	Pb	●	Potassium	K			

Names of Compounds

A compound can be identified either by its formula (e.g., NaCl) or its name (sodium chloride). In this section, you will learn the rules used to name ionic and simple molecular compounds. To start with, it will be helpful to show how individual ions within ionic compounds are named.

Ions

Monatomic cations take the name of the metal from which they are derived. Examples include

Na^+ sodium K^+ potassium

There is one complication: Certain metals, notably those in the transition series, form more than one type of cation. An example is iron, which forms both Fe^{2+} and Fe^{3+}. To distinguish between these cations, the charge must be indicated in the name. This is done by putting the charge as a Roman numeral in parentheses after the name of the metal:

Fe^{2+} iron(II) Fe^{3+} iron(III)

(An older system used the suffixes *-ic* for the ion of higher charge and *-ous* for the ion of lower charge. These were added to the stem of the Latin name of the metal, so that the Fe^{3+} ion was referred to as ferric and the Fe^{2+} ion as ferrous.)

Monatomic anions are named by adding the suffix *-ide* to the stem of the name of the nonmetal from which they are derived.

				H^-	hydride
N^{3-}	nitride	O^{2-}	oxide	F^-	fluoride
		S^{2-}	sulfide	Cl^-	chloride
		Se^{2-}	selenide	Br^-	bromide
		Te^{2-}	telluride	I^-	iodide

Polyatomic ions are given special names:

NH_4^+	ammonium				
OH^-	hydroxide				
NO_3^-	nitrate				
ClO_3^-	chlorate	ClO_4^-	perchlorate		
CN^-	cyanide				
CH_3COO^-	acetate				
MnO_4^-	permanganate				
CO_3^{2-}	carbonate	HCO_3^{2-}	hydrogen carbonate		
PO_4^{3-}	phosphate	HPO_4^{2-}	hydrogen phosphate	$H_2PO_4^-$	dihydrogen phosphate
SO_4^{2-}	sulfate				
CrO_4^{2-}	chromate	$Cr_2O_7^{2-}$	dichromate		

Certain nonmetals in Groups 15-17 of the periodic table form more than one polyatomic ion containing oxygen (oxoanions). The names of several such **oxoanions** are shown in below. From the entries in the table, you should be able to deduce the following rules.

1. When a nonmetal forms **two** oxoanions, the suffix *-ate* is used for the anion with the larger number of oxygen atoms. The suffix *-ite* is used for the anion containing fewer oxygen atoms.
2. When a nonmetal forms **more than two** oxoanions, the prefixes *per-* (largest number of oxygen atoms) and *hypo-* (fewest oxygen atoms) are used as well.

Oxoanions of Nitrogen, Sulfur and Chlorine

Nitrogen		Sulfur		Chlorine	
				ClO_4^-	*per*chlorate
NO_3^-	nitrate	SO_4^{2-}	sulfate	ClO_3^-	chlorate
NO_2^-	nitrite	SO_3^{2-}	sulfite	ClO_2^-	chlorite
				ClO^-	*hypo*chlorite

Ionic Compounds

The name of an ionic compound consists of two words. The first word names the cation and the second names the anion. This is, of course, the same order in which the ions appear in the formula.

Example:	CaS	calcium sulfide
	$Al(NO_3)_3$	aluminum nitrate
	$FeCl_2$	iron(II) chloride

Binary Molecular Compounds

When a metal combines with a nonmetal, the product is ordinarily an ionic compound. As you have just seen, the formulas and names of these compounds can be deduced in a straightforward way. When two nonmetals combine with each other, the product is most often a binary molecular compound. There is no simple way to deduce the formulas of such compounds. There is, however, a systematic way of naming molecular compounds that differs considerably from that used with ionic compounds.

The systematic name of a binary molecular compound, which contains two different nonmetals, consists of two words.

1. **The first word** gives the name of the element that appears first in the formula; a Greek prefix (see below) is used to show the number of atoms of that element in the formula.
2. **The second word** consists of

- the appropriate Greek prefix designating the number of atoms of the second element
- the stem of the name of the second element
- the suffix *-ide*

To illustrate these rules, consider the names of the several oxides of nitrogen:

Example: N_2O_5 dinitrogen pentaoxide; N_2O_4 dinitrogen tetraoxide; NO_2 nitrogen dioxide; N_2O_3 dinitrogen trioxide; NO nitrogen oxide; N_2O dinitrogen oxide

Greek Prefixes Used in Nomenclature

Number	Prefix	Number	Prefix	Number	Prefix
2	di	5	penta	8	octo
3	tri	6	hexa	9	nona
4	tetra	7	hepta	10	deca

Example: SO_2 sulfur dioxide; PCl_3 phosphorus trichloride; SO_3 sulfur trioxide; Cl_2O_7 dichlorine heptaoxide

Many of the best-known binary compounds of the nonmetals have acquired common names. These are widely and, in some cases, exclusively used.

Example: H_2O water; PH_3 phosphine; H_2O_2 hydrogen peroxide; AsH_3 arsine; NH_3 ammonia; NO nitric oxide; N_2H_4 hydrazine; N_2O nitrous oxide; C_2H_2 acetylene; CH_4 methane

Acids

A few binary molecular compounds containing H atoms ionize in water to form H^+ ions. These are called **acids**. One such compound is hydrogen chloride, HCl; in water solution it exists as aqueous H^+ and Cl^- ions. The water solution of hydrogen chloride is given a special name; it is referred to as hydrochloric acid. A similar situation applies with HBr and HI:

Pure Substance	Water Solution	
HCl(g) hydrogen chloride	$H^+(aq)$, $Cl^-(aq)$	hydrochloric acid
HBr(g) hydrogen bromide	$H^+(aq)$, $Br^-(aq)$	hydrobromic acid
HI(g) hydrogen iodide	$H^+(aq)$, $I^-(aq)$	hydriodic acid

Most acids contain oxygen in addition to hydrogen atoms. Such species are referred to as **oxoacids**. Two oxoacids that you are likely to encounter in the general chemistry laboratory are:

HNO_3 nitric acid; H_2SO_4 sulfuric acid

The names of oxoacids are simply related to those of the corresponding oxoanions. The *-ate* suffix of the anion is replaced by *-ic* in the acid. Similarly, the suffix *-ite* is replaced by the suffix *-ous*. The prefixes *per-* and *hypo-* found in the name of the anion are retained in the name of the acid.

Example: ClO_4^- perchlorate ion; $HClO_4$ perchloric acid; ClO_3^- chlorate ion; $HClO_3$ chloric acid; ClO_2^- chlorite ion; $HClO_2$ chlorous acid; ClO^- hypochlorite ion; HClO hypochlorous acid