NOMENCLATURE SIMPLIFIED

The name of the compound always begins with the element that appears first in the chemical formula. However, we use different methods of naming compounds and ions depending on what they are. Ions and compounds are classified under one of the following.

Single Ions:
1) positive
2) single ions that exhibit more than one oxidation number (transition metals)
3) negative

Binary Compounds:
1) metal and nonmetal (salts)
2) Transition metal (that can exhibit more than one oxidation number) and a nonmetal
3) two nonmetals (covalent or molecular)

Compounds Containing Polyatomic Ions:
1) salts
2) acids
3) bases

Single Ions:

Positive ions are named with their name followed by the word ion.

H^+	Hydrogen ion	Al^{3+}	Aluminum ion
Mg^{2+}	Magnesium ion	Na^+	Sodium ion

Single ions that can have more than one oxidation number (see table #1) are named by the name of the atom, followed by the Roman numeral that represents the oxidation number followed by the word ion.

Cu^+	Copper (I) ion	Fe^{2+}	Iron (II) ion
Cu^{2+}	Copper (II) ion	Fe^{3+}	Iron (III) ion

Single negative ions are named by the stem of the name of the element (see table #2) followed by the suffix —ide.

F^-	Fluoride ion	N^{3-}	Nitride ion
O^{2-}	Oxide ion	S^{2-}	Sulfide ion

Binary Compounds:

Binary compounds are compounds that contain two different types of elements. The least electronegative atom is usually written first in the chemical formula. For binary compounds that contain a metal and a nonmetal, the metal is the least electronegative. These binary compounds are named with the name of the metal followed by the stem of the name of the nonmetal that is attached to the ending —ide.

KF	Potassium fluoride	$MgBr_2$	Magnesium bromide
NaCl	Sodium chloride	AlI_3	Aluminum iodide

Remember that the periodic table can tell you the charge on main group elements but does not for transition elements.

Binary compounds with transition metals are named as follows:

CuBr	Copper (I) bromide
$CuBr_2$	Copper (II) bromide
FeF_2	Iron (II) fluoride
FeF_3	Iron (III) fluoride
$FeSO_4$	Iron (II) Sulfate
$Fe_2(SO_4)_3$	Iron (III) Sulfate

The Roman numeral represents the oxidation number of the metal. This is known as the Stock number system. Another method for naming those metals that exhibit two possible oxidation numbers (see table #1) is to end the name of the metal with —ous or —ic instead of using Roman numerals. This is an outdated method that is seldom, if ever, used. However you will sometimes run into people who have learned and used this method for many years. The —ic ending is for the higher oxidation number and the —ous ending is for the lower oxidation number.

CuBr	Cuprous bromide
$CuBr_2$	Cupric bromide
FeF_2	Ferrous fluoride
FeF_3	Ferric fluoride

Mercury is a somewhat weird example. Mercury (I) ion is Hg_2^{2+} which is composed of two Mercury (I) ions each with a plus one charge bound together which ends up as a polyatomic ion with a two plus charge. It used to be called Mercurous ion. The Mercury (II) ion is Hg^{2+} which used to be called Mercuric ion. It is a single Mercury atom with a plus two charge.

Non—Metals

Two nonmetals are named the same as a metal—nonmetal except that prefixes are used before the names of both nonmetals (see table #3). Mono— is usually omitted for the first element in the formula.

CO	Carbon monoxide	SO_2	Sulfur dioxide	NO_2	Nitrogen dioxide
CO_2	Carbon dioxide	SO_3	Sulfur trioxide	N_2O_5	Dinitrogen pentoxide

Compounds Containing Polyatomic Ions:

Polyatomic ions have at least two different types of elements and are ionic in nature (see table #4). Negatively charged ions are called “anions” and positively charged ones are called "cations". Many polyatomic ions have special names that just have to be memorized. See table #4. Negative ions that have oxygen are called “oxyanions”. The names of these anions end in —ate or —ite. When the atom bonded to oxygen can have only one oxidation number the name ends in —ate. If the atom can only have two oxidation numbers the ending —ate is for the lower oxidation number and the ending —ite is for the higher oxidation number. You will only know these by memorization (see table #4) because what is an —ate and what is an —ite depends on the other atoms attached. If the atom can have more than two oxidation numbers the prefixes hypo— and per— are used. Hypo— is for the other element’s lowest possible oxidation state and per— is for the other element’s highest possible oxidation state.

NO_2^-	Nitrite	(one less oxygen than —ate)
NO_3^-	Nitrate	(most commonly found form)

Halogens are another very good example of how this can happen.

ClO^-	Hypochlorite	(one less oxygen than —ite)
ClO_2^-	Chlorite	(one less oxygen than —ate)
ClO_3^-	Chlorate	(most commonly found form)
ClO_4^-	Perchlorate	(one more oxygen than —ate)

Other prefixes sometimes used are Di— and Bi—. Di— indicates there are two atoms of the element attached to the oxygen(s) and Bi— indicates the presence of hydrogen in the polyatomic ion. We have recently stopped using bi— as a prefix and now just say hydrogen.

CrO_4^{2-}	Chromate
$Cr_2O_7^{2-}$	Dichromate
$N_2O_4^{2-}$	Dinitrite
SO_4^{2-}	Sulfate
HSO_4^-	Hydrogen sulfate or bisulfate
HCO_3^-	Hydrogen carbonate or bicarbonate
HPO_4^{2-}	Hydrogen phosphate or biphosphate
$H_2PO_4^-$	Dihydrogen phosphate

Salts

The polyatomic salt has a metal bonded to a polyatomic ion. The metal is named first followed by the name of the polyatomic ion.

$Ca(NO_3)_2$	Calcium nitrate
$CuSO_4$	Copper (II) sulfate
KNO_3	Potassium nitrate

Acids

Acids are most often written with hydrogen first in the chemical formula. The names of acids that have anions whose names end with —ide have the prefix "hydro—" followed by the root of the name of the anion followed by the ending —ic, followed by the word "acid".

HF	Hydrofluoric acid
HBr	Hydrobromic acid

Notice that these anions are from our single ion classification. There are also oxyacids that contain polyatomic ions that have oxygen in them already. The prefix "hydro—" is omitted from these and the ending of the name is changed to —ous from the —ite ending or the —ate ending which is changed to —ic.

H_2SO_3	Sulfurous acid	comes from sulfite ion
H_2SO_4	Sulfuric acid	comes from sulfate ion
$HClO_2$	Chlorous acid	comes from chlorite ion
$HClO_4$	Perchloric acid	comes from perchlorate ion

Bases

Most bases contain the hydroxide ion (OH^-) along with a metal cation. Bases are named by naming the metal followed by the word "hydroxide".

NaOH	Sodium hydroxide
$Ni(OH)_2$	Nickel (II) hydroxide

TABLE #1
Some transition metals that exhibit more than one oxidation number

Sc	1+,2+,3+
Ti	2+,3+,4+
V	2+,5+
Cr	2+,3+,6+
Mn	2+,4+,7+
Fe	2+,3+
Co	2+,3+
Ni	2+,3+
Cu	1+,2+
Ag	1+,2+
Au	1+,2+,3+
Hg	1+,2+

TABLE #2
Stems of common nonmetals

Fluorine	Fluor—
Chlorine	Chlor—
Bromine	Brom—
Iodine	Iod—
Oxygen	Ox—
Sulfur	Sulf—
Nitrogen	Nitr—
Phoshorus	Phosph—
Carbon	Carb—
Hydrogen	Hydr—

TABLE #3
Prefixes

1—Mono—
2—Di—
3—Tri—
4—Tetra—
5—Penta—
6—Hexa—
7—Hepta—
8—Octa—
9—Nano—
10—Deca—

TABLE #4
Common Polyatomic ions
(memorize these but there are others also)

NH_4^+	Ammonium
H_3O^+	Hydronium
CN^-	Cyanide
BH_4^-	Borohydride
OH^-	Hydroxide
NO_2^-	Nitrite
NO_3^-	Nitrate
SO_4^{2-}	Sulfate
HSO_4^-	Hydrogen sulfate
SO_3^{2-}	Sulfite
HSO_3^-	Hydrogen sulfite
CO_3^{2-}	Carbonate
HCO_3^-	Hydrogen carbonate
CrO_4^{2-}	Chromate
$Cr_2O_7^{2-}$	Dichromate
SCN^-	Thiocyanate
PO_3^{3-}	Phosphite
PO_4^{3-}	Phosphate
HPO_4^{2-}	Hydrogen phosphate
$H_2PO_4^-$	Dihydrogen phosphate
MnO_4^-	Permanganate
$C_2O_4^{2-}$	Oxalate
ClO^-	Hypochlorite
ClO_2^-	Chlorite
ClO_3^-	Chlorate
ClO_4^-	Perchlorate
$C_2H_3O_2^-$	Acetate
H^-	Hydride
Hg^{2+}	Mercury (II)
Hg_2^{2+}	Mercury (I)