# Naming and Writing Chemical Formulas

Prentice Hall – Physical Science Chapter 6 Sec 3

# Key Questions 

- **What information do the name and formula of an ionic compound provide?**
- **What information do the name and formula of a molecular compound provide?**

# Why name compounds?

- Remember DHMO?

- Two or more names for a compound can be confusing. Chemists use a single system for naming compounds.

# Binary Ionic Compounds

- Consists of two elements
- How to name: the name of the cation followed by the name of the anion with the suffix –ide.

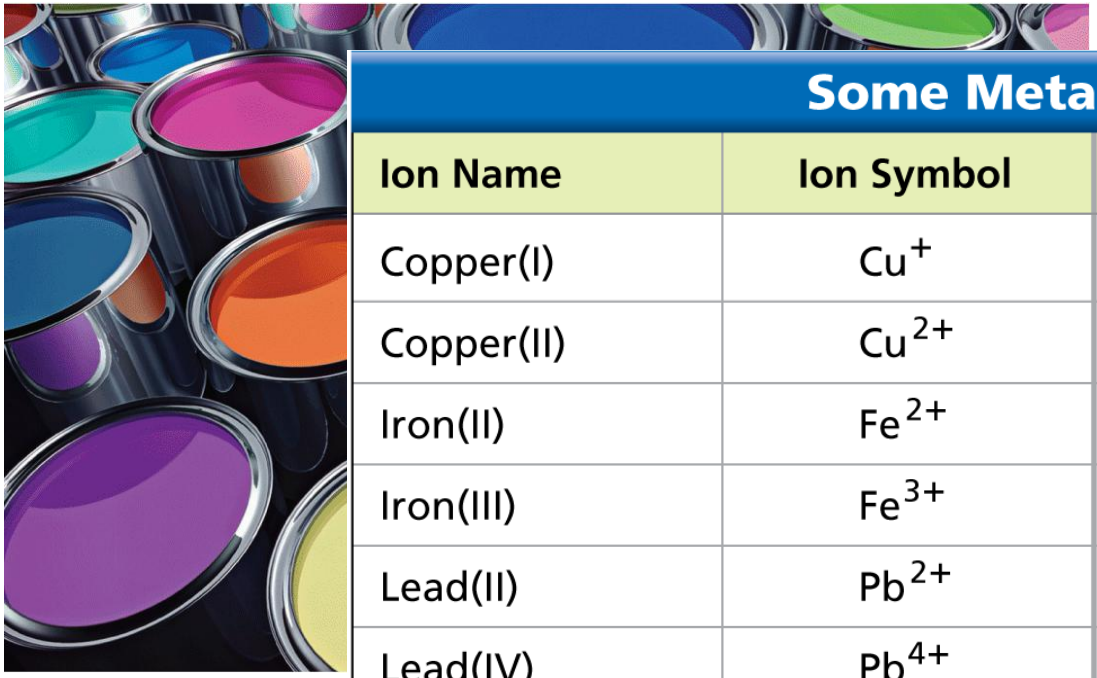
**Common Anions**

| Element Name | Ion Name | Ion Symbol | Ion Charge |
|---|---|---|---|
| Fluorine | Fluoride | $F^-$ | 1– |
| Chlorine | Chloride | $Cl^-$ | 1– |
| Bromine | Bromide | $Br^-$ | 1– |
| Iodine | Iodide | $I^-$ | 1– |
| Oxygen | Oxide | $O^{2-}$ | 2– |
| Sulfur | Sulfide | $S^{2-}$ | 2– |
| Nitrogen | Nitride | $N^{3-}$ | 3– |
| Phosphorus | Phosphide | $P^{3-}$ | 3– |

# Transition Metals

## Metals With Multiple Ions

Many transition metals form more than one type of ion.



| Some Metal Cations | | | |
|---|---|---|---|
| **Ion Name** | **Ion Symbol** | **Ion Name** | **Ion Symbol** |
| Copper(I) | $Cu^{+}$ | Chromium(II) | $Cr^{2+}$ |
| Copper(II) | $Cu^{2+}$ | Chromium(III) | $Cr^{3+}$ |
| Iron(II) | $Fe^{2+}$ | Titanium(II) | $Ti^{2+}$ |
| Iron(III) | $Fe^{3+}$ | Titanium(III) | $Ti^{3+}$ |
| Lead(II) | $Pb^{2+}$ | Titanium(IV) | $Ti^{4+}$ |
| Lead(IV) | $Pb^{4+}$ | Mercury(II) | $Hg^{2+}$ |

# Describing Ionic Compounds

The table shows a copper(I) ion with a 1+ charge and a copper(II) ion with a 2+ charge. These ion names can distinguish red copper(I) oxide from black copper(II) oxide.

- The formula for "copper one oxide" is $Cu_2O$ because it takes two $Cu^{1+}$ ions to balance the charge on an $O^{2-}$ ion.
- The formula for "copper two oxide" is CuO because it takes only one $Cu^{2+}$ ion to balance the charge on an $O^{2-}$ ion.

# Polyatomic ions

- A covalently bonded group of atoms that has a positive or negative charge and acts as a unit
- Most are anions.

| Some Polyatomic Ions | | | |
|---|---|---|---|
| **Name** | **Formula** | **Name** | **Formula** |
| Ammonium | $NH_4^+$ | Acetate | $C_2H_3O_2^-$ |
| Hydroxide | $OH^-$ | Peroxide | $O_2^{2-}$ |
| Nitrate | $NO_3^-$ | Permanganate | $MnO_4^-$ |
| Sulfate | $SO_4^{2-}$ | Hydrogen sulfate | $HSO_4^-$ |
| Carbonate | $CO_3^{2-}$ | Hydrogen carbonate | $HCO_3^-$ |
| Phosphate | $PO_4^{3-}$ | Hydrogen phosphate | $HPO_4^{2-}$ |
| Chromate | $CrO_4^{2-}$ | Dichromate | $Cr_2O_7^{2-}$ |
| Silicate | $SiO_3^{2-}$ | Hypochlorite | $OCl^-$ |

# Writing formulas

- Use the name of an ionic compound to write its formula. The symbol of the cation is first, followed by the symbol of the anion.
- Use subscripts to show the ratio of the ions in the compound.
- Parentheses are used with the subscript for polyatomic ions. The formula for iron(III) hydroxide is $Fe(OH)_3$.

# Writing Formulas

Let's try Na and S

Because all compounds are neutral, the total charges on the cations and anions must add up to zero. Suppose an atom that gains two electrons, such as sulfur, reacts with an atom that loses one electron, such as sodium.

- There must be two sodium ions ($Na^+$) for each sulfide ion ($S^{2-}$).
- The formula for sodium sulfide is $Na_2S$. The 2– charge on one sulfide ion is balanced by the 1+ charges on two sodium ions.

# Describing Molecular Compounds

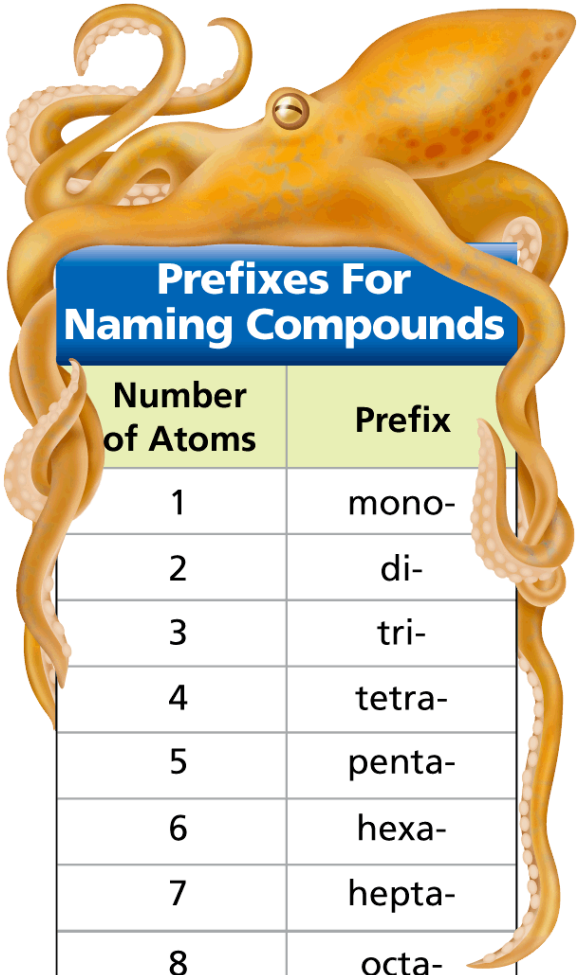
## Naming Molecular Compounds

- The general rule is that the most metallic element appears first in the name. These elements are farther to the left in the periodic table.
- If both elements are in the same group, the more metallic element is closer to the bottom of the group.
- The name of the second element is changed to end in the suffix *-ide,* as in carbon dioxide.

# Describing Molecular Compounds

There may be more than one molecular compound that can exist with the same two elements.

The Greek prefixes in the table are used to name molecular compounds. The prefix *octa*-means "eight," as in the eight tentacles of an octopus.



**Prefixes For Naming Compounds**

| Number of Atoms | Prefix |
|---|---|
| 1 | mono- |
| 2 | di- |
| 3 | tri- |
| 4 | tetra- |
| 5 | penta- |
| 6 | hexa- |
| 7 | hepta- |
| 8 | octa- |
| 9 | nona- |
| 10 | deca- |

# Describing Molecular Compounds

Two compounds that contain nitrogen and oxygen have the formulas $N_2O_4$ and $NO_2$.

- The name of the compound with the formula $N_2O_4$ is dinitrogen tetraoxide.
- The name for the compound with the formula $NO_2$ is mononitrogen dioxide. The prefix *mono-* often is not used for the first element in the name, so a more common name is nitrogen dioxide.

# Describing Molecular Compounds

## Writing Molecular Formulas

To write the formula for a molecular compound, write the symbols for the elements in the order the elements appear in the name.

- The prefixes indicate the number of atoms of each element in the molecule.
- The prefixes appear as subscripts in the formulas.
- If there is no prefix for an element in the name, there is only one atom of that element in the molecule.

## Assessment Questions

1. Which of these formulas describes a binary ionic compound?
   a. $O_2$
   b. $MgCl_2$
   c. $NO_2$
   d. $Fe(OH)_3$

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   ANS: B

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2. What is the correct name for $CCl_4$?
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   b. carbon tetrachlorine
   c. carbon tetrachloride
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