IUPAC

• The International Union of Pure and Applied Chemistry, IUPAC, has set rules for naming compounds.

• IUPAC set the rules for the naming and classification of inorganic compounds in 1940.

• These rules are still in use today.
Metals That Form Multiple Ions

• If a metal can form more than one cation (usually the Transition Metals), it is named for the parent, followed by the charge in Roman numerals in parentheses followed by the word “ion”.

  Fe\(^{2+}\) is the iron(II) ion
  Fe\(^{3+}\) is the iron(III) ion

• This is called the Stock system of naming cations.
Cation Charges

- Shown are some metals on the periodic table and their common charges.

Remember: 5 Exceptions!!!
More Polyatomic Anions

• The formula for the chlorate ion is ClO$_3^-$.
  What is the formula for the chlorite ion?
  – The suffix has changed from -ate to -ite.
  Chlorite must have one less oxygen than chlorate,
  so its formula is ClO$_2^-$.

• Notice that the charge does not change as the number of oxygen atoms changes.

• There are three polyatomic ions that end in -ide:
  – hydroxide, OH$^-$, cyanide, CN$^-$, and peroxide, O$_2$^{2-}.

Memorize these 3 exceptions.
Limitation of the Crossover Rule

• The crossover rule will not always work if we forget to reduce the ratio of cations to anions when possible:

  Ex) Cu$^{2+}$ and O$^{2-}$

  Crossover rule gives Cu$_2$O$_2$ (wrong!)
  We must reduce the ratio to CuO (correct!)

  Ex) Sn$^{4+}$ and O$^{2-}$

  Crossover rule gives Sn$_2$O$_4$ (wrong!)
  We must reduce the ratio to SnO$_2$ (correct!)
Writing Formulas of Binary Ionic Compounds

Write the formula of the following binary ionic compounds given their constituent ions:

1. Li$^+$ and Cl$^-$

2. Sn$^{4+}$ and I$^-$
Determining Ionic Charge

- If an ionic compound contains a metal which can have more than one ionic charge, we must determine the charge on the ion. The sum total charge of an ionic compound must equal zero.

- What is the charge on the iron ion in Fe$_2$O$_3$?
Classification of Compounds

INORGANIC COMPOUNDS and ACIDS

- Ionic
  - Binary ionic compound
  - Ternary ionic compound

- Molecular
  - Binary molecular compound

- Aqueous acid
  - Binary acid
  - Ternary oxyacid
Naming Binary Molecular Compounds

• The first element in the compound is named first and the second element has the suffix -ide.

• The number of atoms of each element must be indicated by Greek prefixes.

Table 7.4  Greek Prefixes for Binary Molecular Compounds

<table>
<thead>
<tr>
<th>Atoms</th>
<th>Prefix</th>
<th>Atoms</th>
<th>Prefix</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>mono-</td>
<td>6</td>
<td>hexa-</td>
</tr>
<tr>
<td>2</td>
<td>di-</td>
<td>7</td>
<td>hepta-</td>
</tr>
<tr>
<td>3</td>
<td>tri-</td>
<td>8</td>
<td>octa-</td>
</tr>
<tr>
<td>4</td>
<td>tetra-</td>
<td>9</td>
<td>nona-</td>
</tr>
<tr>
<td>5</td>
<td>penta-</td>
<td>10</td>
<td>deca-</td>
</tr>
</tbody>
</table>

*Although the Latin prefix nona- is commonly used, IUPAC prefers the Greek prefix ennea-.*
An Exception

• There is one exception to the use of the Greek prefixes when naming binary molecular compounds.

• If there is only one atom of the first element, the \textit{mono}- is never used:
  
  – IF$_6$ is iodine hexafluoride (not \textit{mono}iodine hexafluoride)
Naming Ionic Compounds - Latin

For **metals** where two charges are possible there are two ways to name them:

1) Roman Numeral:
   - We add a roman numeral in brackets to indicate the charge of the metal. (Already covered this way)

2) Latin System:
   - We add the following endings to their old (Latin) root names:
     - “ous” ending for ion with the **LOWER** charge
     - “ic” ending for ion with the **HIGHER** charge
Name the following compounds using the Latin naming system:

1. FeCl$_3$ = ferric chloride/iron 3 chloride

2. PbO = plumbous oxide/lead 2 oxide

3. Cu$_2$SO$_3$ = cuprous sulfite/copper sulfite

4. Sn(CO$_3$)$_2$ = stannic carbonate/tin 2 carbonate