Teaching Inorganic Nomenclature

A Systematic Approach

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Naming inorganic compounds seems to be unsystematic, unimportant, and subject to pure memorization. This impression is unavoidable when the leading textbooks for general chemistry in the United States are reviewed (1-12). From discussions with many colleagues, I also feel that many instructors who teach general chemistry do not know the subject of naming inorganic compounds well enough to teach it adequately and therefore either do a rather poor job or avoid the subject altogether.

Being able to name inorganic compounds is, in my opinion, something every student should master after completing one year of college-level general chemistry. Since I am not an advocate of memorization, I decided to present a semisystematic scheme that I have used successfully for the past four years in our entry-level (college freshmen) general chemistry course.

The scheme is divided into three parts: Cations, Anions, and Compounds (see Figs. 1-3). Cations are further subdivided into monatomic and polyatomic; anions, into monatomic, oxyanions, others and exceptions, and oxyanions containing hydrogen. Compounds are subdivided into ionic compounds, compounds containing hydrogen, and covalent compounds.

I am aware that dividing inorganic compounds into "ionic" and "covalent" compounds and then having a third category "compounds containing hydrogen" may be a little problematic and artificial, but for the purpose of naming compounds it is not, and the fine tuning can always be done in class when the subject is discussed. Students have generally reacted positively to the scheme, and the results as measured by the students' performance on the subject in examinations are encouraging.

Literature Cited


![Diagram of the naming cations scheme](image_url)

Figure 1. Scheme for naming cations.

- **Monatomic (Cations):**

  - **Rule:** Name of element + "ion."
  - **Examples:** Na⁺, sodium ion; Mg²⁺, magnesium ion; H⁺, hydrogen ion
  - **Comment:** The number of positive charges is not indicated in the name because it is not necessary

- **Polyatomic (Cations):**

  - **Rule:** (a) newer rule: positive charges indicated by a roman numeral
  - **Examples:** Fe³⁺, iron(III) ion; Cu²⁺, copper(II) ion
  - **Comment:** The older rule (but still used): Latin stem for the element + "ous" for the lesser charge and + "ic" for the greater charge.
  - **Examples:** Fe²⁺, ferrous ion; Cu¹⁺, cuprous ion; Sn²⁺, stannous ion

- **More Than One Possible Positive Ion Possible:**

  - **Examples:** NH₄⁺, ammonium ion; H₂O⁺, hydronium ion; Hg₂⁺, mercury(II) ion or mercuric ion

- **Only One Positive Ion Possible:**

  - **Examples:** H⁺, hydrogen ion; Hg⁺, mercury(I) ion, but (Hg⁺ is mercury(I) ion, but that is a monatomic ion.)
**Figure 2. Scheme for naming anions.**

**Rule:**
- Name of cation + name of anion (word 'ide' dropped)

**Examples:**
- NaCl: sodium chloride
- MgCl₂: magnesium chloride
- Fe₃O₄: iron(II) nitrate
- NH₄Cl: ammonium chloride
- NaH: sodium hydride
- Ca₃(PO₄)₂: calcium phosphate

**Comment:**
- The name does not indicate the numbers of cations and anions because there is only one possibility for the ions to combine to form a compound.

**Rule 1:**
- (without the presence of H₂O) hydrogen _ide

**Examples:**
- HCl: hydrogen chloride
- HF: hydrogen fluoride
- H₂S: hydrogen sulfide

**Rule 2:**
- (when dissolved in H₂O) hydro_ _ic acid

**Examples:**
- HCl(aq): hydrochloric acid
- HF(aq): hydrofluoric acid
- H₂S(aq): hydrosulfuric acid

**Comment:**
- a. These H-containing compounds are named as if they were ionic compounds.
- b. The (aq) in the formulas of the acids is often omitted when it is obvious from the context that they are acids.

**Figure 3. Scheme for naming compounds.**

**Rule:**
- a. Less electronegative element first (exceptions: when one of the elements is hydrogen).
- b. Number of atoms of each kind specified by Greek prefixes.
- c. Prefix (mono) at beginning is dropped

**Prefixes:**
- 1 = mono 6 = hexa
- 2 = di 7 = hepta
- 3 = tri 8 = octa
- 4 = tetra 9 = nona
- 5 = penta 10 = deca

**Examples:**
- HCl, ClH₂O₅: chloric acid
- H₂SO₄: sulfuric acid
- H₂PO₄: phosphoric acid

**Comment:**
- Tetravalent bromine becomes tetravalent bromine, and other acids, etc. so that the name sounds better.
- H-containing compounds do not follow a rule concerning the order in which the elements are written and should be memorized (H₂O, NH₃, etc.).