Major classes of compounds

- Acids
  - Have one or more H^+ ion
  - Ex: HCl HNO_3 H_2SO_4
- Bases
  - Have one or more OH^- ion
  - Ex: NaOH $Ca(OH)_2$ NH_4OH
- Oxides
  - Contain one or more O^{2-} ion
  - Ex: CaO Na_2O $(NH_4)_2O$
- Salts
  - Composed of positive and negative ions ***other than*** H^+, OH^-, or O^{2-}
  - Ex: NaCl NH_4NO_3 $Ca(C_2H_3O_2)_2$

Binary compounds

- Contain two (2) elements
  - Use *–ide* ending for negative ions
  - Ex: NaF – sodium fluoride Ag_3N – silver nitride
- Some elements have more than one oxidation number
  - Copper, iron, and tin
    - Cu may be Cu^{1+} or Cu^{2+}
      - Use copper (I) for Cu^{1+}, and copper (II) for Cu^{2+}
      - Ex: CuCl = copper (I) chloride; $CuCl_2$ =copper (II) chloride
    - Fe may be Fe^{2+} or Fe^{3+}
      - Use iron (II) for Fe^{2+}, and iron (III) for Fe^{3+}
      - Ex: $FeCl_2$ = iron (II) chloride; $FeCl_3$ = iron (III) chloride
    - Sn may be Sn^{2+} or Sn^{4+}
      - Use tin (II) for Sn^{2+}, and tin (IV) for Sn^{4+}
      - Ex: $SnCl_2$ = tin (II) chloride; $SnCl_4$ = tin (IV) chloride
    - Sometimes the oxidation number (charge) is not obvious
      - Look at the negative ion
        - O, S, SO_4, and CO_3 are all 2-
        - N, P, and PO_4 are all 3-

- Determine the oxidation number for the positive ion *from the negative ion*
    - Examples:
        - $CuO \rightarrow Cu^{2+}O^{2-}$ → copper (II) oxide
        - $FeN \rightarrow Fe^{3+}N^{3-}$ → iron (III) nitride
        - $SnS \rightarrow Sn^{2+}S^{2-}$ → tin (II) sulfide
- Binary acids
    - Hydro + stem + ic & acid
        - Ex: HCl = hydro+chlor+ic acid → hydrochloric acid

          HBr = hydro+brom+ic acid → hydrobromic acid

- Some elements can have both negative & positive oxidation numbers
    - Ex: $NO \rightarrow N^{2+}O^{2-}$ → nitrogen oxide
    - Common elements of this type (+/-): C, N, P, and S
    - Prefixes: 2 – di 3 – tri 4 – tetra 5 – penta 6 – hexa
        - Examples:
            - N_2O → dinitrogen oxide
            - N_2O_3 → dinitrogen trioxide
            - S_2Cl_2 → disulfur dichloride
            - P_2O_5 → diphosphorous pentoxide
- Special names:
    - H_2O → water
    - NH_3 → ammonia
- Ternary compounds
    - Contain three (3) different elements only

- Can be monatomic **+** polyatomic ions, *or* polyatomic **+** monatomic ions
- Examples:
  - $CaSO_4$ → $Ca^{2+}SO_4^{2-}$ → calcium ion + sulfate ion → calcium sulfate
  - NH_4Cl → $NH_4^{1+}Cl^{1-}$ → ammonium ion + chloride ion → ammonium chloride
  - Na_2CO_3 → $2Na^{1+}CO_3^{2-}$ → sodium ions (2) + carbonate ion → sodium carbonate
- Ternary acids:
  - H_2SO_4 = sulfuric acid
  - HNO_3 = nitric acid
  - $HC_2H_3O_2$ = acetic acid
  - H_3PO_4 = phosphoric acid

- Compounds of two polyatomic ions
  - Name of positive ion + name of negative ion
    - Examples:
      - $(NH_4)_2CO_3$ = ammonium carbonate
      - NH_4NO_3 = ammonium nitrate

- Ternary oxy-acids in a series
  - Ternary oxy-acids = Hydrogen + oxygen + one other element
    - Examples: $\mathbf{H}_2\mathrm{S}\mathbf{O}_4$ $\mathbf{H}\mathrm{Cl}\mathbf{O}_3$
    - Name is derived by knowing the oxidation number of the middle element
      - Rule 1: The oxidation number of *each* **H** is **1+**
      - Rule 2: The oxidation number of *each* **O** is **2-**
      - Rule 3: The oxidation number of the middle element is calculated by the ***number of positives and negatives***, and what is needed to make them ***balance out to 0***.

- Examples:
  - $HClO_2$
    - **H = 1+**
    - **O = 2 X 2- = 4-**
    - **1+ & 4- = 3-**
    - So, **Cl must be 3+ to balance the 3**-

- When there are only two oxy-acids in a series, the lower oxidation number for the middle element results in *–ous* being added to the acid's root name. The higher oxidation number results in adding *–ic*.
  - Example: H_2SO_3 & H_2SO_4
    - The S in H_2SO_3 is 4+, so it is named sulfur*ous* acid
      - H: 2 X 1+ = 2+ O: 3 X 2- = 6-
      - 2+ & 6- = 4-, so S must be 4+ to balance charges
    - The S in H_2SO_4 is 6+, so it is named sulfur*ic* acid
      - H: 2 X 1+ = 2+ O: 4 X 2- = 8-
      - 2+ & 8- = 6-, so S must be 6+ to balance charges

- When there are four oxy-acids in a series
  - The lowest oxidation number for the middle element gets the prefix *hypo*- and the suffix *–ous*
  - The next lowest gets just the suffix *–ous*
  - The next higher gets just the suffix *–ic*
  - The highest get the prefix *per*- and the suffix *–ic*
  - Example:
    - $HBrO \rightarrow H^{1+}Br^{?}O^{2-} \rightarrow H^{1+}Br^{1+}O^{2-}$
      - Name= hypobromous acid

- $HBrO_2 \rightarrow H^{1+}Br^{?}O_2^{2-} \rightarrow H^{1+}Br^{3+}O_2^{2-}$
    - Name= bromous acid
- $HBrO_3 \rightarrow H^{1+}Br^{?}O_3^{2-} \rightarrow H^{1+}Br^{5+}O_3^{2-}$
    - Name= bromic acid
- $HBrO_4 \rightarrow H^{1+}Br^{?}O_4^{2-} \rightarrow H^{1+}Br^{7+}O_4^{2-}$
    - Name= perbromic acid

- Salts of these ternary oxy-acids
    - When a metal replaces the hydrogen in a oxy-acid, a salt is formed, and the ending of the acid part of the name changes
        - -ous → -ite
        - -ic →-ate
        - hypo- and per- are kept when present in the acid's name
        - Examples:
            - NaBrO → sodium hypobromite
            - $NaBrO_3$ → sodium bromate
            - $NaBrO_2$ → sodium bromite
            - $NaBrO_4$ → sodium perbromate

- Salts with more than one positive ion
    - Name each positive ion in order, then name the negative ion
        - Examples:
            - $NaHSO_4$ = sodium hydrogen sulfate
            - $KHCO_3$ = potassium hydrogen carbonate
            - NH_4CaPO_4 = ammonium calcium phosphate
            - NH_4HS = ammonium hydrogen sulfide