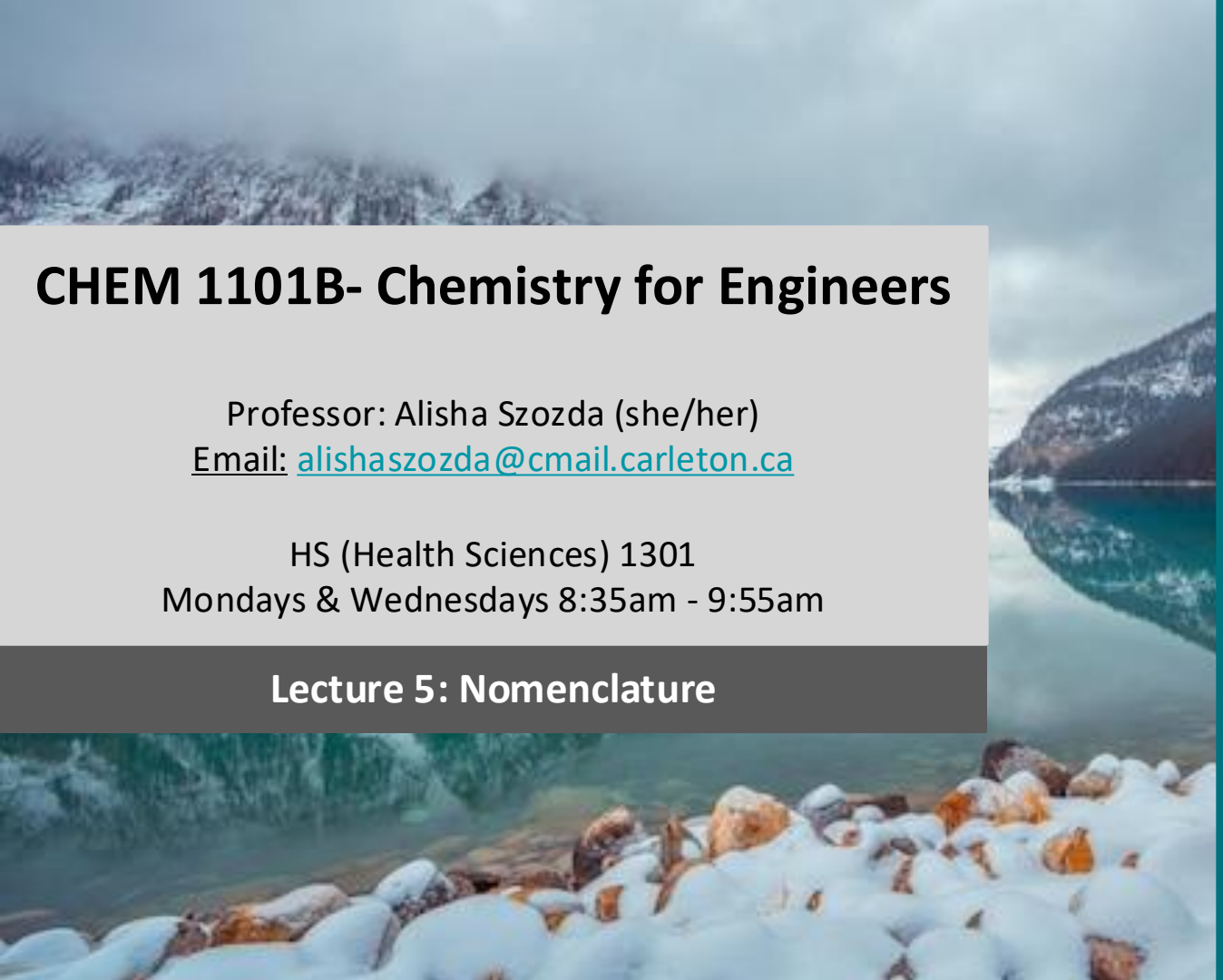

CHEM 1101B- Chemistry for Engineers

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HS (Health Sciences) 1301
Mondays & Wednesdays 8:35am - 9:55am

Lecture 5: Nomenclature

Please feel free to introduce yourself to your neighbors– name, pronouns, a hobby, etc.

and/or

Answer the first question on Wooclap!

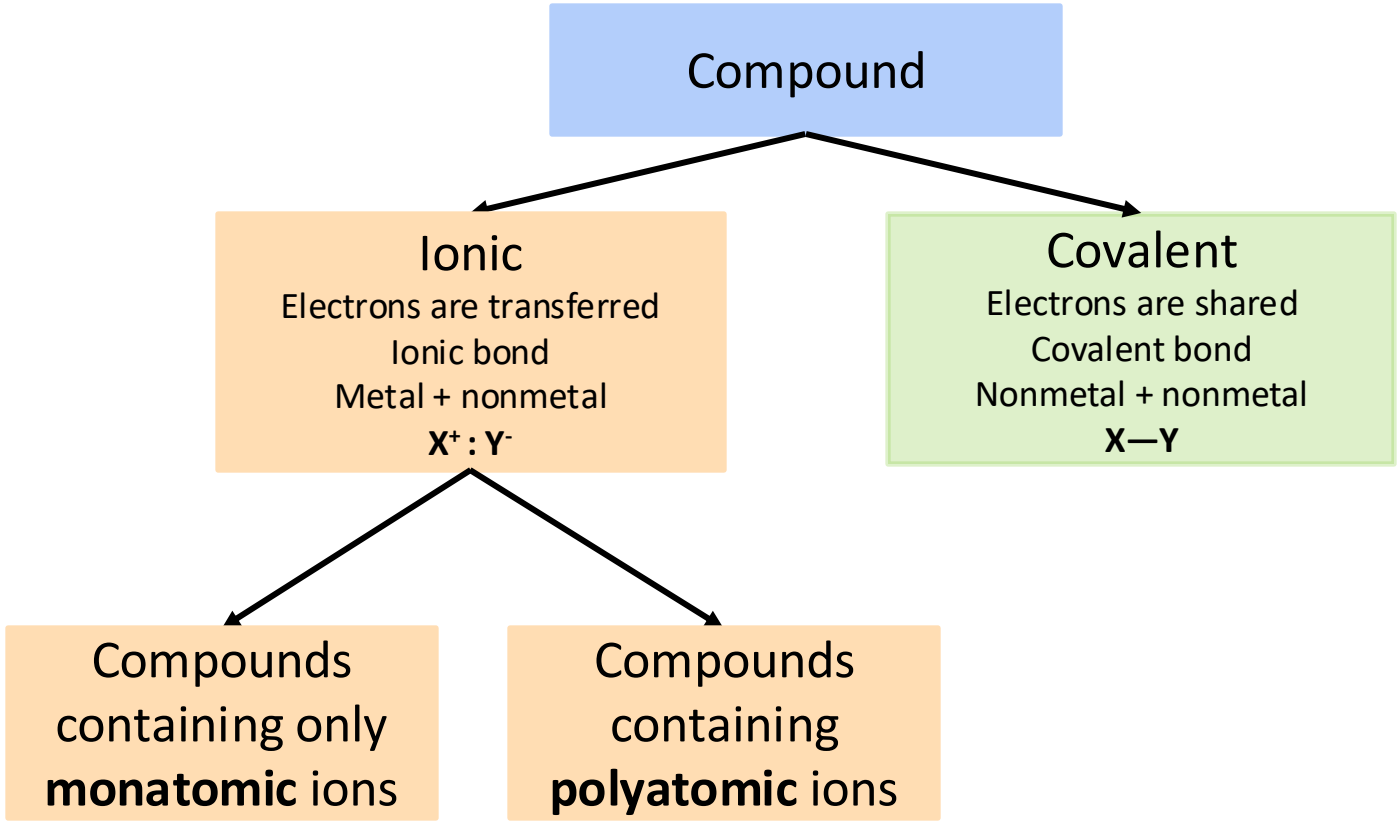
Learning outcomes Topic 5:
The Molecule – Nomenclature

- Use IUPAC rules to name binary ionic and binary covalent (molecular) compounds
- Use accepted names for common polyatomic ions

Why is it important to name compounds?

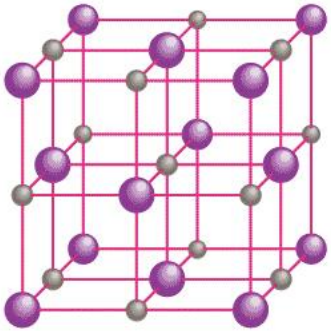
- Learning how to accurately name compounds will save you LOTS of time and hassle later!
- Chemical compounds are on many products we encounter in our lives!

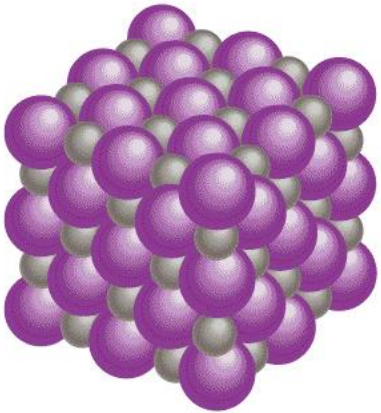
Rules for naming compounds depend on the type of compound



Ionic Compounds

- A **metal cation** (+ charged ion) and a **nonmetal anion** (- charged ion) or any combination of **molecular or elemental ions**
- For an ionic compound to be **stable** its chemical formula must be **neutral**
- Ions combine to form an ionic lattice





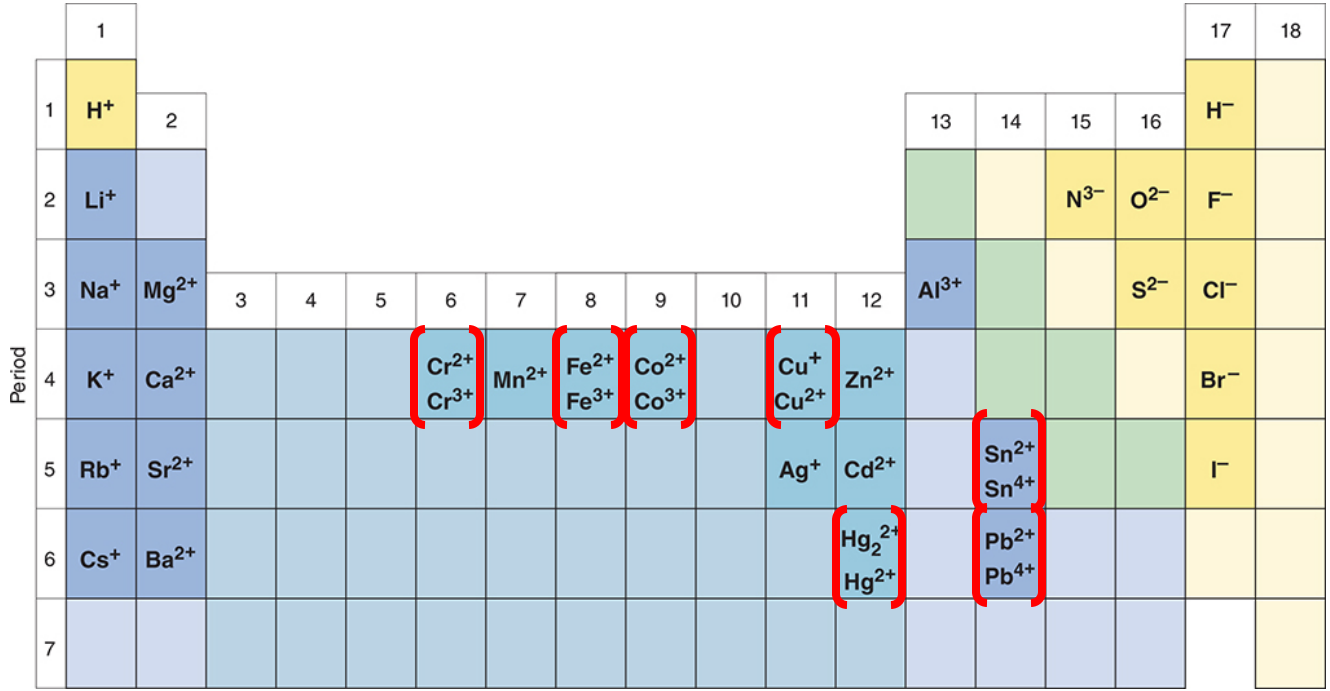
e.g. NaCl is made up of Na^+ and Cl^-
or sodium ion and chloride ion

called: **Sodium chloride**

Each Na^+ is associated with 6 Cl^-
and each Cl^- is associated with Na^+

Binary ionic compounds: only containing monatomic ions

- Contain monatomic metal cations and non-metal anions
- Two types of metals
  - only 1 charge
  - Have more than one stable charge (transition metals)



Metals that form more than one ion

Element	Ion Formula	Systematic Name	Common Name
Chromium	Cr^{2+}	chromium(II)	chromous
	Cr^{3+}	**chromium(III)**	chromic
Cobalt	Co^{2+}	cobalt(II)	
	Co^{3+}	cobalt(III)	
Copper	**Cu^{+}**	**copper(I)**	cuprous
	Cu^{2+}	**copper(II)**	cupric
Iron	**Fe^{2+}**	**iron(II)**	ferrous
	Fe^{3+}	**iron(III)**	ferric
Lead	**Pb^{2+}**	**lead(II)**	
	Pb^{4+}	lead(IV)	
Mercury	Hg_2^{2+}	mercury (I)	mercurous
	Hg^{2+}	**mercury (II)**	mercuric
Tin	**Sn^{2+}**	**tin(II)**	stannous
	Sn^{4+}	tin(IV)	stannic

e.g. CrI_3

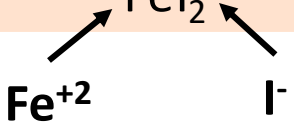
mercuric chloride

Naming binary ionic compounds

1. Name the cation (metal) first, then the anion (non-metal)
2. Name the anion (non-metal) replace its ending with the suffix – *ide*
3. For transition metals with multiple possible charges, write the charge in roman numerals in parenthesis after the name of the metal

Examples:

Chemical Formula	Name
KBr	Potassium brom**ide**
$CaCl_2$	Calcium chlor**ide**
Al_2O_3	Aluminum ox**ide**
CrI_3	Chromium **(III)** iod**ide**
FeI_2	Iron **(II)** iod**ide**



Compounds containing polyatomic ions

- Sometimes, the anion or cation is polyatomic
- Polyatomic ions stay together as a charged unit

Polyatomic Cations

NH_4^+	**Ammonium**
H_3O^+	**Hydronium**
Hg_2^{2+}	**Mercury(I)**

Polyatomic Anions

CH_3COO^- (or **$C_2H_3O_2^-$**)	**Ethanoate (or Acetate)**	**HCO_3^-**	**Hydrogen carbonate** (or **bicarbonate**)
CN^-	Cyanide	CrO_4^{2-}	Chromate
OH^-	**Hydroxide**	**$Cr_2O_7^{2-}$**	**Dichromate**
ClO^-	Hypochlorite	O_2^{2-}	Peroxide
ClO_2^-	Chlorite	**PO_4^{3-}**	**Phosphate**
ClO_3^-	**Chlorate**	HPO_4^{2-}	Hydrogen phosphate
ClO_4^-	**Perchlorate**	$H_2PO_4^-$	Dihydrogen phosphate
NO_2^-	Nitrite	SO_3^{2-}	Sulfite
NO_3^-	**Nitrate**	**SO_4^{2-}**	**Sulfate**
MnO_4^-	**Permanganate**	HSO_4^-	Hydrogen sulfate (or bisulfate)
CO_3^{2-}	**Carbonate**		

Naming compounds containing polyatomic ions

- Compounds containing polyatomic ions are named similarly to those containing only monatomic ions, except there is no need to change to an *–ide* ending, since the suffix is already present in the name of the anion
- Identify which are **monatomic ions** and **polyatomic ions**

Examples:

Chemical Formula	Name
$KC_2H_3O_2$	Potassium **acetate**
NH_4Cl	**Ammonium** chloride
$NaHCO_3$	Sodium **Bicarbonate**
$Mg_3(PO_4)_2$	Magnesium **phosphate**
$Al_2(CO_3)_3$	Aluminum **carbonate**

Learning check!

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Name the following ionic compounds:

a) Mn_2O_3

b) $CrCl_3$

c) $Cu_3(PO_4)_2$

OH^-	hydroxide ion
CH_3COO^-	acetate ion
NO_3^-	nitrate ion
CO_3^{2-}	carbonate ion
SO_4^{2-}	sulfate ion
PO_4^{3-}	phosphate ion

Name to chemical formula?

Write the chemical formula for the following compounds:

a) Lead (IV) sulfide

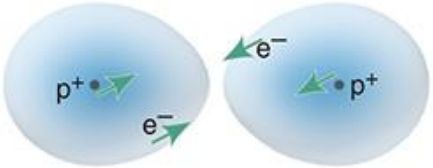
a) Magnesium hydroxide (active ingredient in antacids)

OH^-	hydroxide ion
CH_3COO^-	acetate ion
NO_3^-	nitrate ion
CO_3^{2-}	carbonate ion
SO_4^{2-}	sulfate ion
PO_4^{3-}	phosphate ion

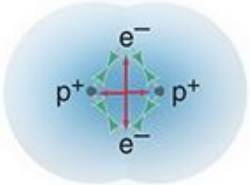
Covalent (molecular) Compounds

- Atoms bonded covalently form individual, discrete assemblies called **molecules**

Atoms far apart: *No interactions occur.*



Atoms closer: *Attractions (green arrows) between nucleus of one atom and electron of the other increase. Repulsions between nuclei and between electrons are very weak.*



Optimum distance: *H_2 molecule forms because attractions (green arrows) balance repulsions (red arrows).*

- Some compounds have common names:

  H_2O = water

  NH_3 = ammonia

Naming Covalent (molecular) Compounds

1. Name the **lower group number** or **lower electronegative** element first, using its element name unchanged
2. Name the second element using the suffix ***–ide***
3. Add ***g*reek prefixes** to indicate the numbers of each element in the compound

Number	Prefix	Example
1	mono-	NO – nitrogen **mono**xide
2	di-	CO_2 – carbon **di**oxide
3	tri-	BCl_3 – boron **tri**chloride
4	tetra/tetr-	CCl_4– carbon **tetra**chloride
5	penta/pent-	N_2O_5 – **di**nitrogen **pent**oxide
6	hexa/hex-	SF_6 – Sulfur **hexa**fluoride
7	hepta/hep-	IF_7– iodine **hepta**fluoride
8	octa/oct	P_4O_8– **tetra**phosphorous **oct**oxide
9	nona/non	P_4S_9– **tetra**phosphorous **nona**sulfide
10	deca/dec	P_4O_{10}– **tetra**phosphorous **deca**oxide

Learning check!

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Write the name for the following covalent compounds:

a) Cl_2O_7

b) H_2O (IUPAC name not common name)