Matter Links:

Science in Action Textbook (pgs. 139-153)

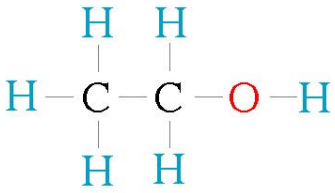
Unit 2 Matter and Chemical Change

3.0 Compounds form according to a set of rules.

3.1 Naming Compounds (pgs. 139-142)

As you learned in the last section (*The Periodic Table*), each element has a chemical name. The combination of elements to form **compounds** has a **chemical name** and a **chemical formula**. The formula identifies which elements and how many of each are in the compound.

For example:
ethanol ($\mathbf{C_2H_6O}$) has **2** carbon atoms, **6** hydrogen atoms and **1** oxygen atom



To determine the name, a standardized chemical naming system, or **nomenclature**, is used. Guyton de Morveau in France developed it in 1787. The metal name is always first. Since 1920, the **IUPAC** (*International Union of Pure and Applied Chemistry*) is responsible for determining the appropriate name for each compound.

Interpreting Chemical Names and Formulas From Compounds
If you know the formula for a compound you can determine its chemical name – if you know its name, you can determine its formula.

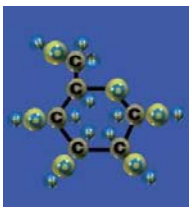
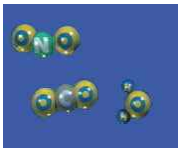
Write the **chemical formula** as determined by the **name** of the compound.
(If a poly atomic ion is part of the formula, keep the poly-atomic ion intact)

Aluminum oxide	2 - Al	3 - O	Al_2O_3
Calcium nitrite	1 - Ca	2 - NO_2	$Ca(NO_2)_2$
Sodium Chloride	1 - Na	2 – Cl_2	NaCl

If the compound contains a metal the compound is ionic.
If the compound does not contain a metal, it is molecular.

Write the **name** of the compound as determined by the **chemical formula**.

Al_2O_3	2 - Al	3 - O	Aluminum oxide
$Ca(NO_2)_2$	1 - Ca	2 - NO_2	Calcium nitrite
NaCl	1 - Na	2 – Cl_2	Sodium Chloride

Chemical Name & Physical State	Atomic model	Chemical Formula
Glucose (s) - solid		**$C_6H_{12}O_6$** The chemical formula for glucose tells us that each molecule is made of 6 carbon atoms, 12 hydrogen atoms, and 6 oxygen atoms.
Nitrogen dioxide (g) - gas **Carbon dioxide** (g) - gas **Water** (l) – liquid		**NO_2** **CO_2** **H_2O**

(aq) – **aqueous solution** This is used when substances are dissolved in water.
A saltwater solution would be **NaCl** (aq)

3.2 Ionic Compounds (pgs. 144-148)

Sodium Chloride (table salt) – **NaCl** – is an **ionic compound**. Ionic compounds are pure substances formed as a result of the attraction between particles of opposite charges, called **ions**.

Properties of **ionic compounds**
- **High melting point**
- **Good electrical conductivity**
- **Distinct crystal shape**
- **Solid at room temperature**

When the ionic compound is dissolved in water, the metal (**Na**) and nonmetal ($\mathbf{Cl_2}$) form an aqueous solution of ions. An ion is an atom or group of atoms that has become electrically charged through ***a loss or gain of electrons***. (see Table **sia** p. 146)

Ion Charges

A superscript (**+**) or a (**–**) are used to indicate the charge. $\mathbf{Na^+}$ and $\mathbf{Cl^-}$

Some ions can also form when certain atoms of elements combine. These ions are called **polyatomic** ions (*poly* meaning "*many*"). Polyatomic atoms are a group of atoms acting as one.

Example:

1 carbon atom reacting with 3 oxygen atoms produces
1 carbonate group of atoms, which act as one. $\mathbf{CO_3^{2-}}$

Then, when carbonate ions react with calcium atoms they produce
calcium carbonate, or limestone. $\mathbf{Ca\ CO_3^{2-}}$

Naming Ionic Compounds

Two rules:

1. The chemical name of the metal or positive ion goes first, followed by the name of the non-metal or negative ion.
2. The name of the non-metal negative ion changes its ending to **ide**.
   NB: *one exception* – Where negative ions are polyatomic ions, the name remains unchanged.

Some elements with *more than one ion charge* use a roman numeral in its chemical name to clearly show which ion is being used. $\mathbf{Cu(II)SO_4}$ (Copper II Sulfate)

Using Ion Charges and Chemical Names To Write Formulas

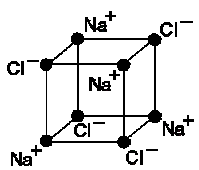
Step 1 – Print the metal element's name, symbol and ion charge, then the non-metals name, symbol and ion charge
Step 2 – Balance the ion charges (the positive ion must balance with the negative ion
Step 3 – Write the formula by indicating how many atoms of each element are in it.

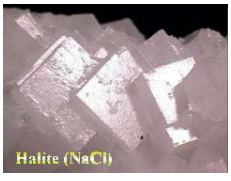
$\mathbf{Ca^{2+}}$	$\mathbf{Cl^{1-}}$
$\mathbf{Ca^{2+}}$	$\mathbf{Cl^{1-}}$ $\mathbf{Cl^{1-}}$
$\mathbf{CaCl_2}$	

Ion Charges and the Periodic Table

Patterns:	**ion charge**
Alkali metals	1+
Halogens	1 -
Generally elements in a group all have the same ion charge (most consistency at either end of the table)	

All ionic compounds model ***distinct*** (different) ***crystal shapes***.





3.3 Molecular Compounds (pgs. 150-153)

When ***non-metals*** combine, they produce a pure substance called a **molecule**, or **molecular compound**. They can be solids, liquids, or gases at room temperature.

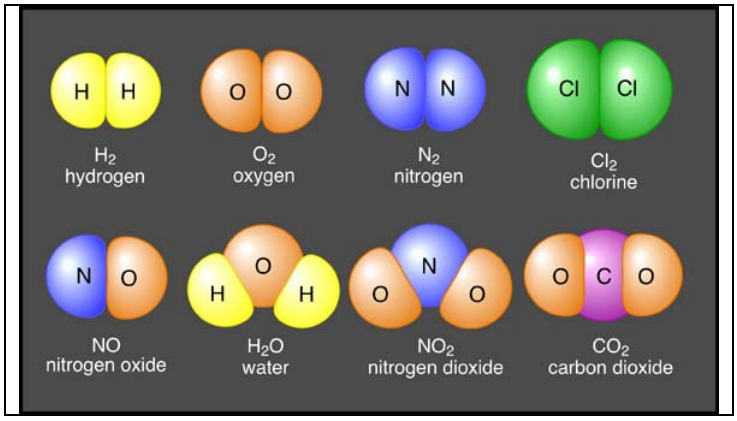
Examples: sugar ($C_{12}H_{22}O_{11(s)}$)
acetylene, water

Properties of **molecular compounds**
- **Low melting point**
- **Low boiling point**
- **Good insulators**
- **Poor conductors**
- **Distinct crystal shape**

Of the 10 million compounds discovered so far, about 9 million are molecular compounds.

Writing Formulas For Molecular Compounds

It is similar to the way it is done in ionic compounds, except that no ions are present and the ion charge is not used in the formulas. This makes it difficult to predict how the non-metals will combine. The formulas do tell how many of each type of atom is present in the molecule.



Naming of Molecular Compounds

Rules:

1. The first element in the compound uses the element name (just like the ionic compounds do).
2. The second element has a suffix – **ide** – (like the ionic compounds).
3. When there is more than 1 atom in the formula, a prefix is used which tells how many atoms there are:

Number of Atoms	Prefix
1	mono
2	di
3	tri
4	tetra
5	penta

4. Exception to #3 above – when the first element has only 1 atom the prefix mono is not used.

Examples: CO_2 carbon **di**oxide CCl_4 carbon **tetra**chloride

Comparing Ionic And Molecular Compounds

Use a cover card to begin listing the comparison attributes for both the ionic and molecular compounds. This technique will be discussed in class.

Assess Your Learning p. 136-137