Introduction

We've discussed how to tell the difference between molecular and ionic compounds. We've also discussed how to name ionic compounds. We'll now discuss how to name molecular compounds. Molecular compounds, unfortunately for budding chemists, don't form according to rules as simple as the rules that describe how ionic compounds form. Carbon and oxygen, for example, form at least **two different simple compounds** - CO_2 and CO. Fortunately for us, though, the naming system accounts for this - and you will be able to distinguish which of the two carbon/oxygen compounds someone is talking about by their names. We will also talk about how to name an important class of molecules - the acids.

What we'll discuss

We will only discuss a few simple molecular compounds - mainly those with only two kinds of element in them. These are the so-called **binary molecular compounds**. These are named using a simple prefix system. More complex molecular compounds are named using more complex naming systems such as the IUPAC naming system for **organic** compounds - which we won't discuss here. The IUPAC naming system is used for quite complex molecules such as drugs and can generate some **very long** names – like ethyl 4-(8-chloro-5,6-dihydro-11H-benzo[5,6]cyclohepta[1,2-b]pyridin-11-ylidene)-1-piperidinecarboxylate. You probably know that molecule by the trade name Claritin, or by the generic name Loratadine.

Naming binary molecular compounds - step 1

The first thing you need to do to name a **binary molecular compound**, assuming you know it's a molecule in the first place (see the first nomenclature note pack), is to **obtain the molecular formula**. For ionic compounds, you could write a formula based on the rules for finding the charge on ions which we discussed earlier. But you can't do that with a molecular compound. At this point, the **formula of a molecular compound must be given to you**. You wouldn't know, if someone told you to name "the molecular compound made of carbon and oxygen" whether they were talking about CO or CO_2 (or maybe something else entirely)!

Note that if you're writing a chemical formula based on the name of a molecular compound, there's a standard ordering of elements that you will follow. Basically, the elements are (by convention) written by group number, with lower groups written first. Carbon is written before oxygen in CO. An exception to this ordering is hydrogen, which is usually (but not always) written after carbon. Another exception to the ordering is that oxygen and fluorine are generally written last (after any other elements). The ordering of elements in a molecular formula is not as rigid as the rule of "cation before anion" in ionic formulas.

Step 2: Name the compound

Once you have a molecular formula, naming the compound is easy -even easier than naming ionic compounds! You name the compound in the same order as the elements are written in the formula, and you use a Greek prefix to indicate how many atoms of that element are in the molecule. Here are the Greek prefixes to use. These are the same prefixes we used to number water molecules in hydrates.

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

If there's only one of the **first** element (so the prefix would be *mono-*), we generally just drop the *mono-* prefix.

Then, we name the second element in the compound. We name the second element in the compound much like we'd name an anion - take the **stem name of the compound**, and add "-ide" to the end. Unlike anions, we then add a Greek prefix to the second element's name to indicate how many atoms of the second element are in the compound.

The *mono*-prefix is usually not omitted for the second element.

Here are some examples.

Chemical formula	***Compound name***	***Notes***
CO	carbon **mono**xide	The *mono*- prefix is omitted for carbon since it's first.
CO_2	carbon **di**oxide	The *mono*- prefix is omitted for carbon since it's first.
SF_6	sulfur **hexa**fluoride	The *mono*- prefix is omitted for sulfur since it's first.
S_2Cl_2	**di**sulfur **di**chloride	
N_2F_4	**di**nitrogen **tetra**fluoride	

You'll eventually need to memorize the Greek prefixes. Once you have those memorized, naming binary molecular compounds is easy.

<u>Special case #1: the binary acids</u>

An important class of binary molecular compounds is the **binary acids**. **Binary acids** are compounds containing hydrogen and one other nonmetal - typically a group VIIA element. They are molecular (and named as such), but when dissolved in water form acidic solutions containing the H^+ cation and an anion.

When dissolved in water, these binary acids are named this way: "hydro-" plus the **stem name of the element combined with hydrogen** plus "-ic acid". Here are the four most common binary acids – likely the only ones you'll encounter in your chemistry classes.

Chemical formula	***Name of compound***
HCl(aq)	hydro**chlor**ic acid
HBr(aq)	hydro**brom**ic acid
HF(aq)	hydro**fluor**ic acid
HI(aq)	Hydro**iod**ic acid

Even if they're not dissolved in water, the acid name is typically used for these compounds. HCl is called “hydrochloric acid” more often than it's called “hydrogen monochloride”.

<u>Special case #2: the oxoacids</u>

Another very important class of simple molecular substances is the **oxoacids**. Like the binary acids, oxoacids form acidic solutions when dissolved in water. As you might expect from the name, these oxoacids all contain **oxygen**. Typically, oxoacids contain three elements - hydrogen, oxygen, and a third nonmetal.

How can you recognize and name oxoacids? Oxoacids are oxygen-containing **polyatomic ions** combined with hydrogen. You name oxoacids based on the name of the polyatomic ion that they contain. There are two simple naming rules.

1. Polyatomic ions ending in *-ate* form oxoacids ending in *-ic*. .
2. Polyatomic ions ending in *-ite* form oxoacids ending in *-ous*.

Here are some examples.

Ion formula	***Ion name***	***Oxoacid formula***	***Oxoacid name***
SO_4^{2-}	sulf**ate** ion	H_2SO_4	sulfur**ic** acid
SO_3^{2-}	sulf**ite** ion	H_2SO_3	sulfur**ous** acid
NO_3^-	nitr**ate** ion	HNO_3	nitr**ic** acid
NO_2^-	nitr**ite** ion	HNO_2	nitr**ous** acid
PO_4^{3-}	phosph**ate** ion	H_3PO_4	phosphor**ic** acid

If you're given the name of an oxoacid and need the formula, treat hydrogen as if it had a +1 charge and the oxoacid was an ionic compound. For example, the formula for phosphor**ic** acid is H_3PO_4. The *-ic* suffix indicates that the polyatomic ion the oxoacid is based on is phosph**ate**. Phosphate ion is PO_4^{3-} (-3 charge), so three hydrogen atoms (at +1 each) are necessary in the formula.

Oxoacids are often called **oxyacids**. The two terms are used interchangeably.

<u>Summary</u>

In this note pack, we've learned to name several classes of simple (but important) molecular compounds. We've discussed binary molecular compounds, which are named with the prefix system. We've then discussed the naming of two important kinds of acids - the binary acids and the oxoacids (both of which are important to chemists **and** industrialized society as a whole). You should now be able to name these compounds given a formula or extract the formula of these compounds given their chemical names.