# CHE 1020: Exploring molecular formulas and names[1]

Most students know that $CO_2$ is called carbon dioxide before taking a chemistry class. Some know that the related compound, CO, is called carbon monoxide. Both are common, mundane and dangerous: we exhale $CO_2$ and it causes global warming; CO is toxic if inhaled.

This activity focuses on naming molecular compounds. Grab a periodic table and please work in groups!

**Part A: Exploring names and formulas of molecular compounds**

| molecular formula | Number of atoms of the first element | Number of atoms of the second element | Compound name |
|---|---|---|---|
| ClF | | | chlorine monoxide |
| $ClF_3$ | 1 | 5 | chlorine pentafluoride |
| CO | | | carbon monoxide |
| $CO_2$ | | | carbon dioxide |
| $Cl_2O$ | | | dichlorine monoxide |
| $PCl_5$ | | | phosphorus pentachloride |
| $N_2O_5$ | | | dinitrogen pentoxide |

**1.** Complete the table by adding the number of each atom in the compound.

**2.** How many different elements are there in each compound?

**3.** What is the combination in these compounds?
(a) metal and nonmetal
(b) metals only
(c) nonmetals only

**4.** Based on your answer to (3), what type of bonding must occur in molecular compounds?

**5.** How many compounds in the table contain only chlorine and fluorine? Why isn't the name 'chlorine fluoride' sufficient?

[1] Adapted from a POGIL activity

**6.** Assuming the name of the compound gives a clue to its molecular formula, predict how many atoms each of these prefixes indicates and provide two examples from the table.
(a) mono-
(b) di-
(c) penta-

**Part B: Prefixes and suffixes**

| prefix | numerical value |
|---|---|
| mono- | |
| di- | |
| tri- | |
| tetra- | |
| penta- | |
| hexa- | |
| hepta- | |
| octa- | |
| nona- | |
| deca- | |

| molecular formula | name |
|---|---|
| $BCl_3$ | boron trichloride |
| $SF_6$ | sulfur hexafluoride |
| $IF_7$ | iodine heptafluoride |
| $NI_3$ | nitrogen triiodide |
| $N_2O_4$ | dinitrogen tetroxide |
| $Cl_2O$ | dichlorine monoxide |
| $P_4O_{10}$ | tetraphosphorus decoxide |
| $B_5H_9$ | pentaboron nonahydride |
| $Br_3O_8$ | tribromine octoxide |
| ClF | chlorine monofluoride |

**7.** Fill in the values for the numerical values for the first table above.

**8.** What do the suffixes of all the names in the second table have in common?

**9.** Look carefully. When do names not have prefixes in front of the first element?

**10.** Consider the compound NO.
(a) Which element requires a prefix in the name? Why?
(b) Name NO.

**11.** Propose a definition for the term 'binary molecular compound'. All of the formulas shown above are binary, but $CH_3OH$ and $PF_2Cl_3$ are not.

**12.** Write a rule for (1) recognizing and (2) naming binary molecular compounds from their formulas.

**13.** Will your rules work to name these compounds? If not, explain why.
(a) $FeI_3$
(b) $ICl_5$
(c) $H(BrO_4)$

**14.** Use your rules to name these molecular compounds.

| formula | name |
|---|---|
| $PBr_3$ | |
| $SCl_4$ | |
| $N_2F_2$ | |
| $SO_3$ | |
| BrF | |

**15.** Write the formulas for these molecular compounds.

| formula | name |
|---|---|
| | disulfur decafluoride |
| | carbon tetrachloride |
| | oxygen difluoride |
| | dinitrogen trioxide |
| | tetraphosphorus heptasulfide |

**16.** Comparing molecular and ionic naming systems. Have a look at this mixture of types of compounds and their names.

| formula | type of bonding | compound name |
|---|---|---|
| $MgF_2$ | ionic | magnesium fluoride |
| $CuF_2$ | ionic | copper (ii) fluoride |
| $SF_2$ | covalent (molecular) | sulfur difluoride |
| NaBr | ionic | sodium bromide |
| AuBr | ionic | gold (i) bromide |
| IBr | covalent (molecular) | iodine monobromide |

(a) Find two difference between naming systems for ionic and binary molecular compounds.
(b) Find two similarities between naming systems for ionic and binary molecular compounds.

**17.** Why is $AlCl_3$ called aluminum chloride while $BCl_3$ is called boron trichloride?

**18.** Fill in the table below to review what you've learned about naming molecular compounds.

| formula | type of bonding | compound name |
|---|---|---|
| $CS_2$ | | |
| $PbI_2$ | | |
| $BaCl_2$ | | |
| $Se_2S_6$ | | |
| | | xenon tetrafluoride |
| | | sodium phosphide |
| | | dinitrogen pentoxide |
| | | cobalt (III) bromide |