

## Experiment 2

### Ionic Compounds

#### Things To Know:

Elements can be classified as metals, metalloids, or nonmetals as shown in Figure 4. Metals are shiny materials that conduct electricity. Nonmetals can be gas, liquid, or solids that are brittle and nonconductive. A metalloid is an element that has properties that are between those of metals and nonmetals.

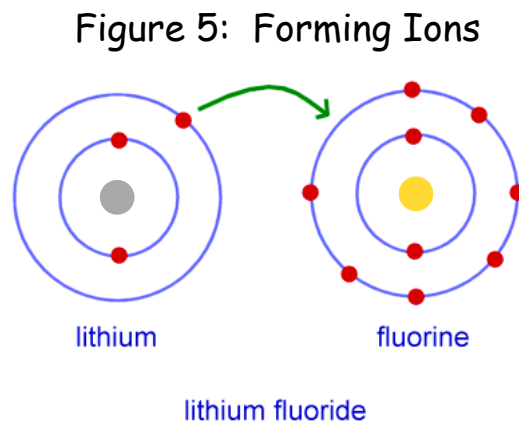
Figure 4: Metals, Metalloids, and Nonmetals

		Metal										Metalloid			Nonmetal								
+1																							
	+2	H																					He
		Li	Be											B	C	N	O	F					Ne
		Na	Mg											Al	Si	P	S	Cl					Ar
		K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br			Kr		
		Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I			Xe		
		Cs	Ba	La-Lu	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At			Rn		
		Fr	Ra	Ac-Lr																			
		La	Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu							
		Ac	Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr							

Ions are atoms that have gained or lost electrons. Metals tend to lose electrons. The positive metal atom is called a cation. Non-metals tend to gain electrons, creating a net negative charge, and are called anions. Ions with opposite charges attract and form an ionic compound. Cations and anions are joined together with ionic bonds.

**Octet Rule:** Elements tend to bond in such a way that each atom has a filled valence level. The first energy level is filled with two electrons, subsequent energy levels have eight valence electrons.

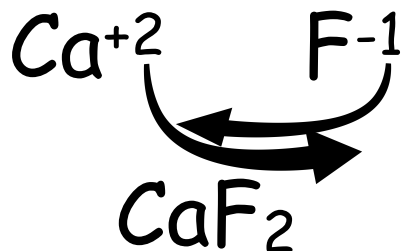
In Figure 5, lithium donates an electron to fluorine and both elements obey the octet rule. To name an ionic compound, write the name of the metal, the root of the nonmetal, and the ending with "ide." This compound is composed of the metal, lithium, and the nonmetal, fluorine, and named lithium fluoride.



Ionic compounds are made of many ions. An ionic formula is called an empirical formula because it is the simplest ratio of cations and anions in the compound.

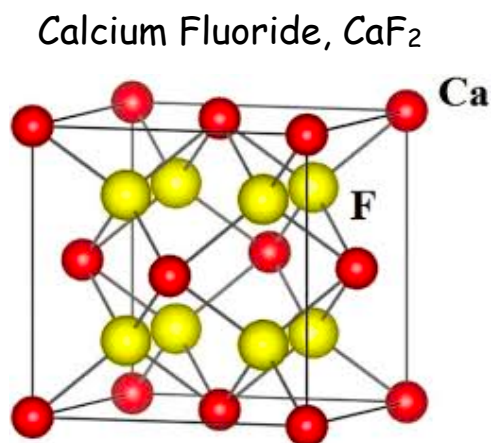
Use Figure 4 to find the symbols and charges for the metal cations and nonmetal anions. For example, the cation for calcium is  $\text{Ca}^{+2}$  and the anion for fluorine is  $\text{F}^{-1}$ . The total charge of the cations and anions must be equal. Use the **criss-cross method** shown in Figure 6 to determine the number of cations and anions required for a neutral compound. If only one ion is required, it is not necessary to write 1 as a subscript. To indicate that two fluorine anions are necessary to produce a neutral compound, write the subscript 2 following the symbol, F.

Figure 6:



$$1 \text{ cation } (+2) \text{ and } 2 \text{ anions } (-1) = 0$$

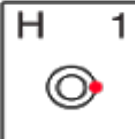


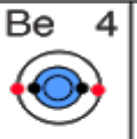
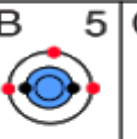
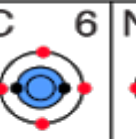
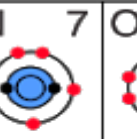
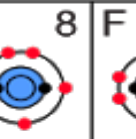
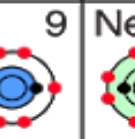
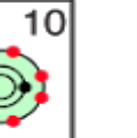
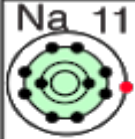







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## What To Do:

1. Use the Introduction to Chemistry Model Set and Figure 7 to complete Activity Table 2 and learn about some of the elements in period 3.
2. Write the symbol and the number of unpaired valence electrons for each element in Activity Table 2. Elements in the same column in the periodic table have the same number of valence electrons and the same model shape. For example, oxygen and sulfur both have six valence electrons. Two of the valence electrons are unpaired and can be used for bonding. Therefore, the atom models for oxygen and sulfur will have the same shape.

Figure 7: Atoms in Period 3 of the Periodic Table

	1A	2A	3A	4A	5A	6A	7A	8A
n 1	H 1 							He 2 
2	Li 3 	Be 4 	B 5 	C 6 	N 7 	O 8 	F 9 	Ne 10 
3	Na 11 	Mg 12 	Al 13 	Si 14 	P 15 	S 16 	Cl 17 	Ar 18 

Activity Table 2: Period (Row) 3 Elements

Element	Symbol	Number of Unpaired Valence Electrons	Number of Poles on Atom Model	Model Color
Sodium				Purple
Magnesium				Blue
Aluminum				Silver
Sulfur				Yellow
Chlorine				Green

- Use the Introduction to Chemistry Model Set to build the ionic compounds in Activity Table 3. Use the white bonds to represent ionic bonds between the metal atoms and nonmetal atoms.
- Write the name of the compound.
- Use the criss-cross method or count the ions of each element in the model to determine the formula of the compound.

**Activity Table 3: Ionic Compounds**

Metal	Nonmetal	Root of Nonmetal	Name of Compound	Formula
Beryllium (Green)	Fluorine (Yellow)	Fluor		
Sodium (Purple)	Sulfur (Yellow)	Sulf		
Calcium (Orange)	Chlorine (Green)	Chlor		
Lithium (Silver)	Oxygen (Red)	Ox		

### Discussion Questions for Experiment 2

- Describe the different particles that make up an atom.
- What makes elements different from each other?
- Give three examples of materials that conduct electricity.
- What is the relationship between the number of unpaired valence electrons and the number of poles on the atom models,
- What do elements in the same column of the periodic table have in common?
- How is an ionic compound formed?
- How can you use the periodic table to predict the shape of a compound?