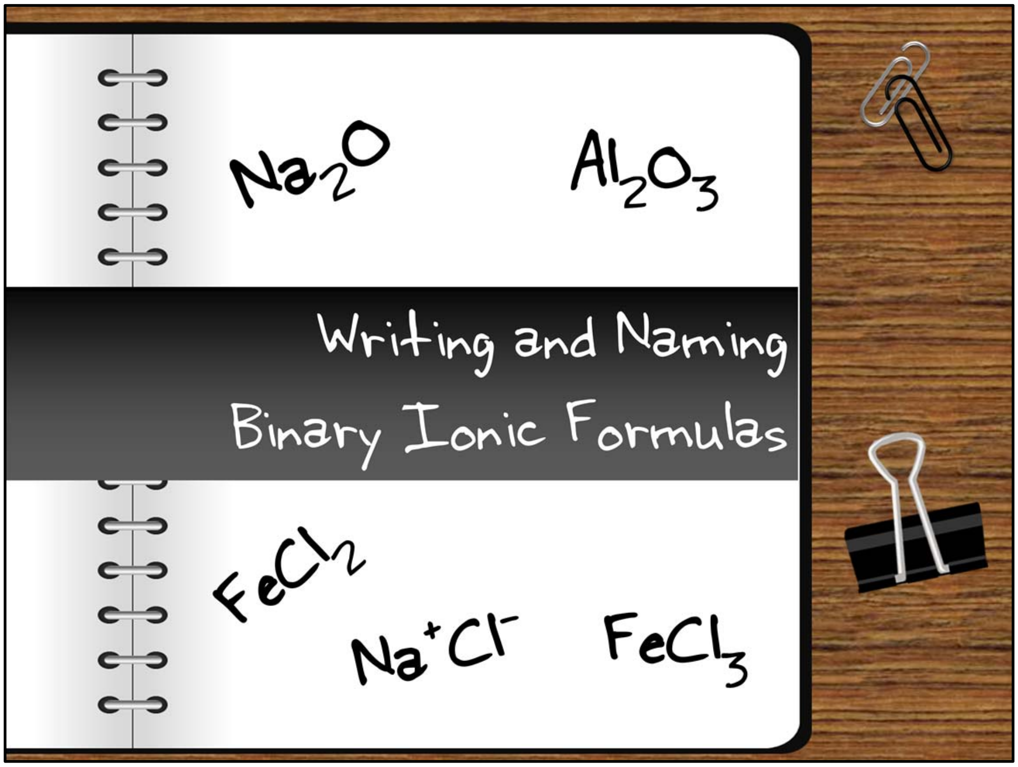
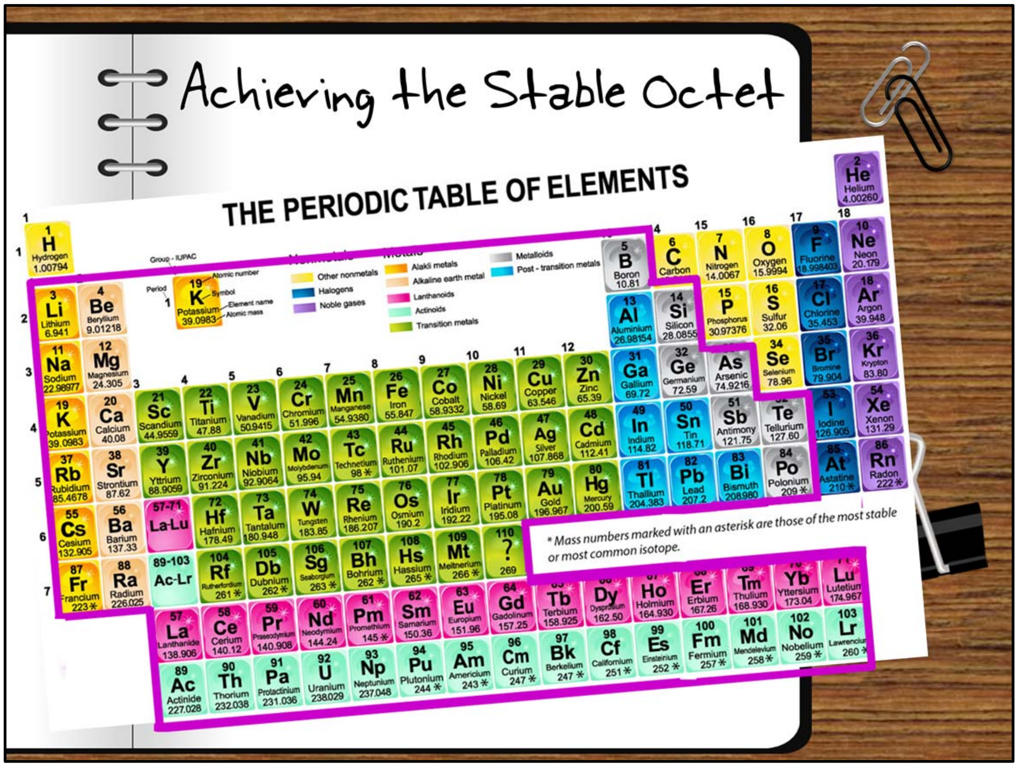
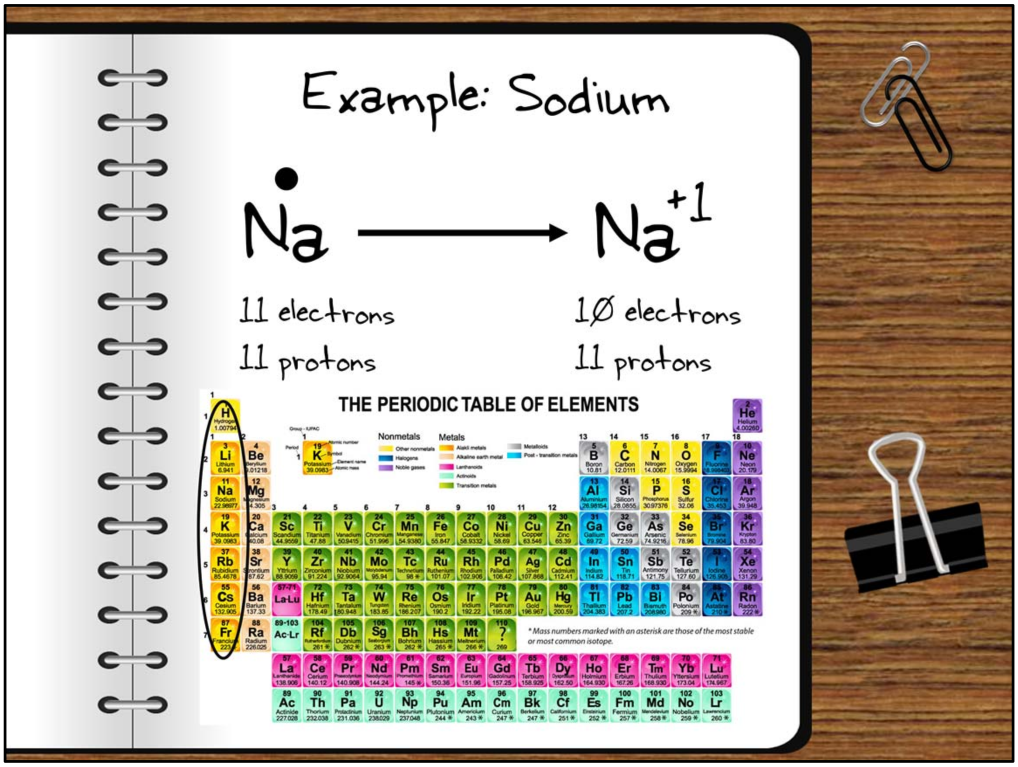
Module 4: Bonding, Formula Writing, and Nomenclature
Topic 3 Content: Writing and Naming Binary Ionic Formulas Presentation Notes



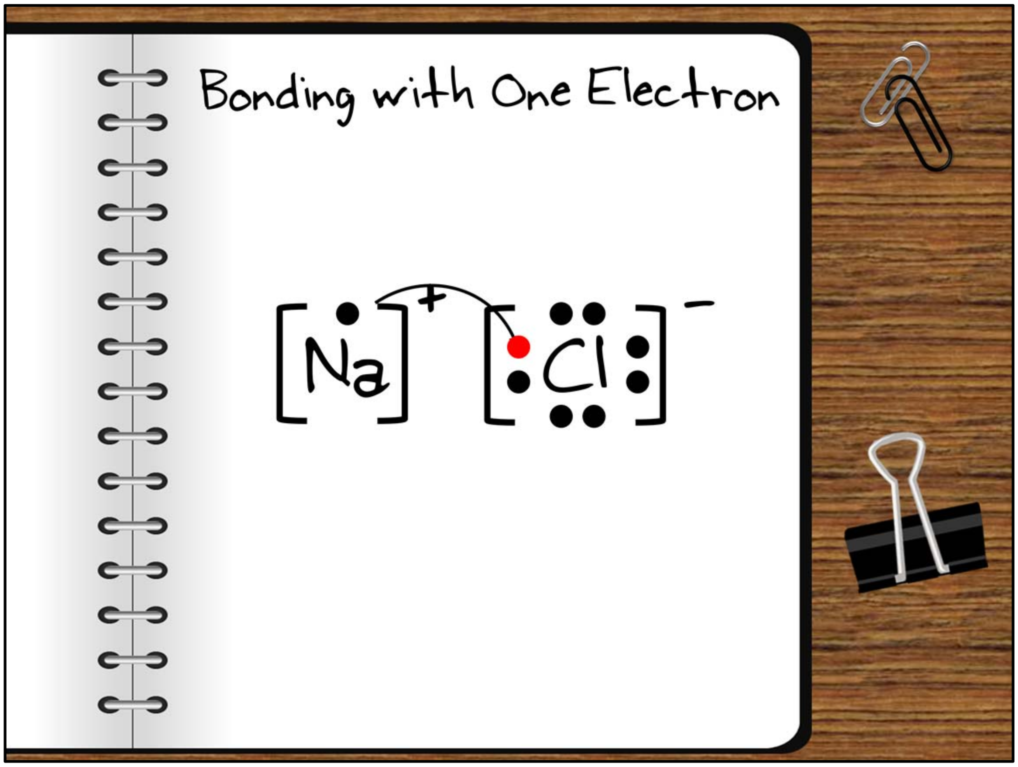
Writing and Naming Binary Ionic Formulas



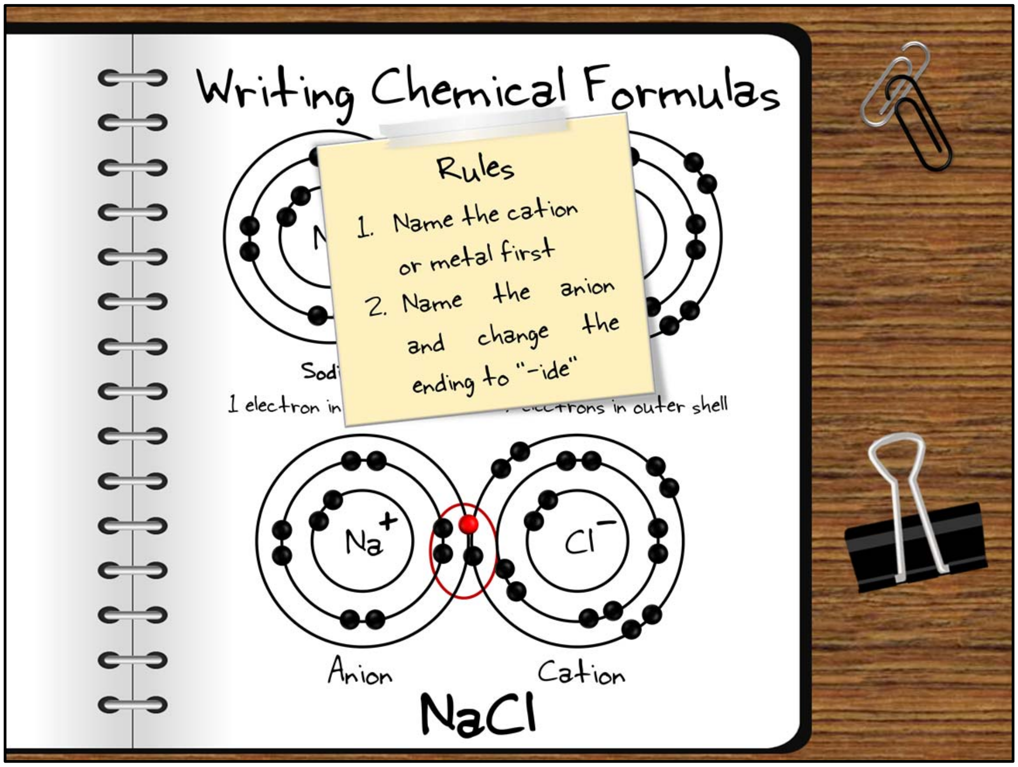
When looking at the periodic table and recalling the number of valence electrons for each group, you should notice that the elements on the far left, or the metals, have only one or two valence electrons. In order for these elements to achieve the stable octet, it is easier for them to lose one or two electrons rather than gain six or seven electrons. It has been observed that atoms always try to do the easiest thing possible to achieve stability.



Sodium is a great example of an element that loses electrons to achieve the stable octet. Sodium has eleven electrons and eleven protons as a neutral element. When it loses its one and only valence electron, it still has ten electrons and eleven protons. Overall, it has one more proton than electron, giving it a net charge of +1. All elements in the same group have the same ionic charge because they have the same number of valence electrons.



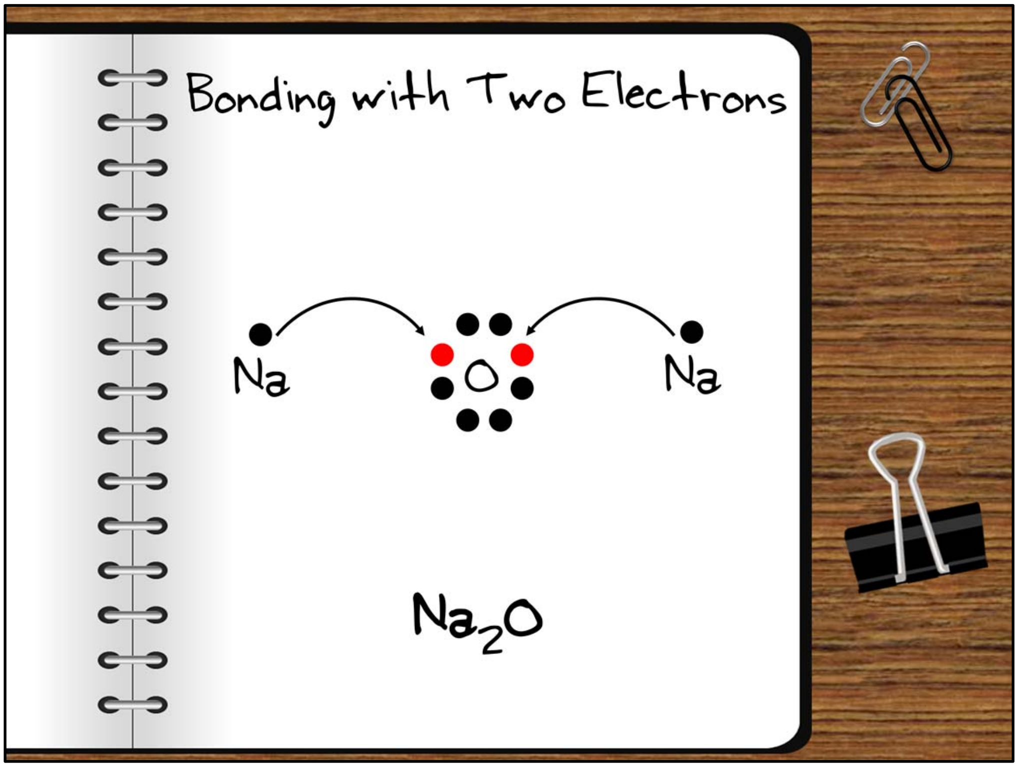
Where does the lost electron go? Chlorine has seven valence electrons. It only needs one more to achieve a stable octet. This sounds like a match made in heaven! Sodium and chlorine react on a one-to-one basis. Each sodium atom readily transfers one electron to chlorine, forming an ionic bond. In order for both elements to achieve the stability of a stable octet, the ratio of sodium atoms to chlorine atoms would be 1:1.



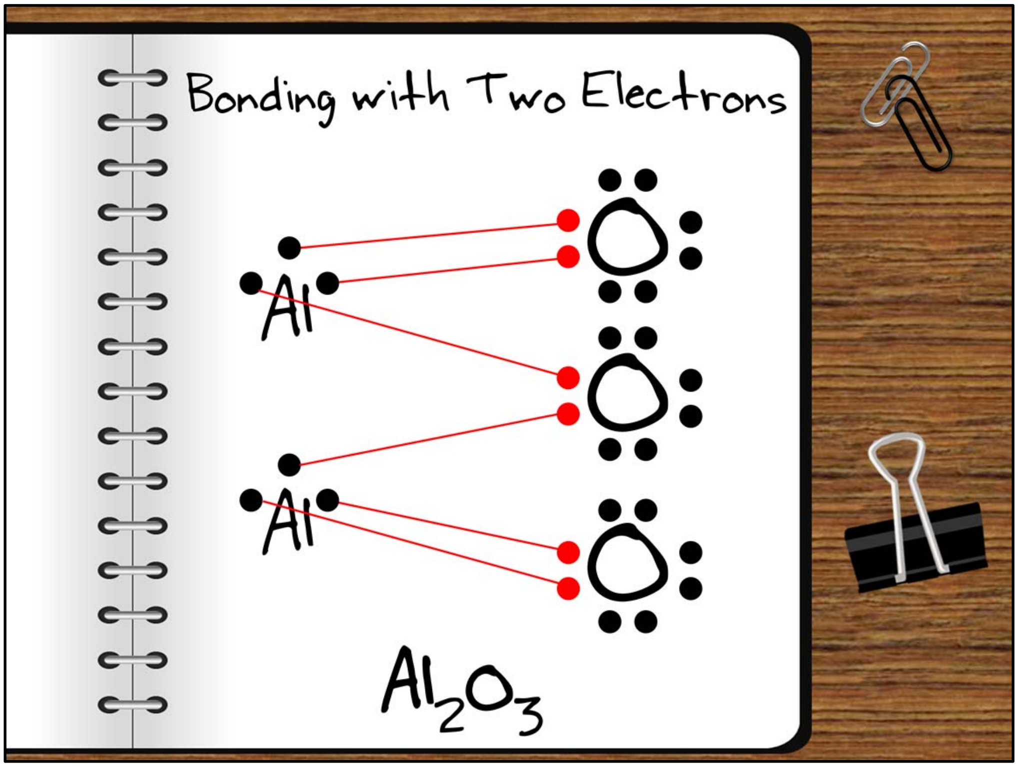
You can now write the chemical formula for the compound formed by the bonding of sodium and chlorine. When naming ionic compounds, make sure to follow the rules set forth by the International Union of Pure and Applied Chemistry, or IUPAC. These rules are:

1. Name the cation or metal first. In this example, it is sodium.
2. Name the anion second, and change the ending of its name to "-ide." In this example, chlorine becomes "chloride" as an ion.

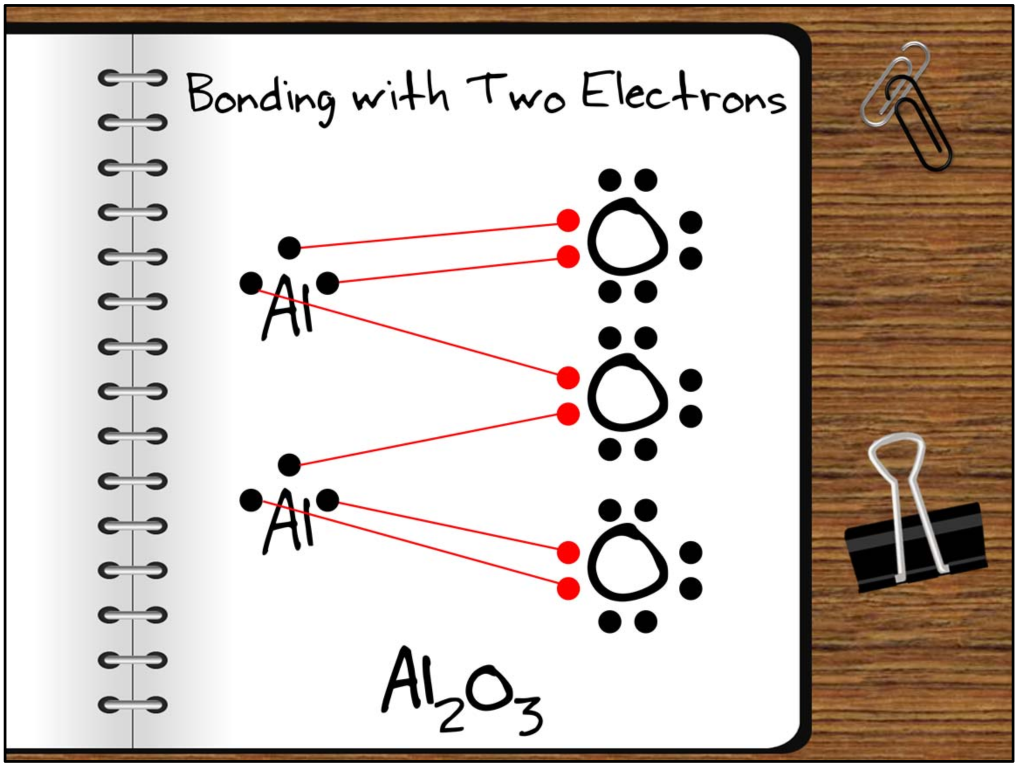
As you can see here, the bonding of sodium and chlorine created sodium chloride, or NaCl.

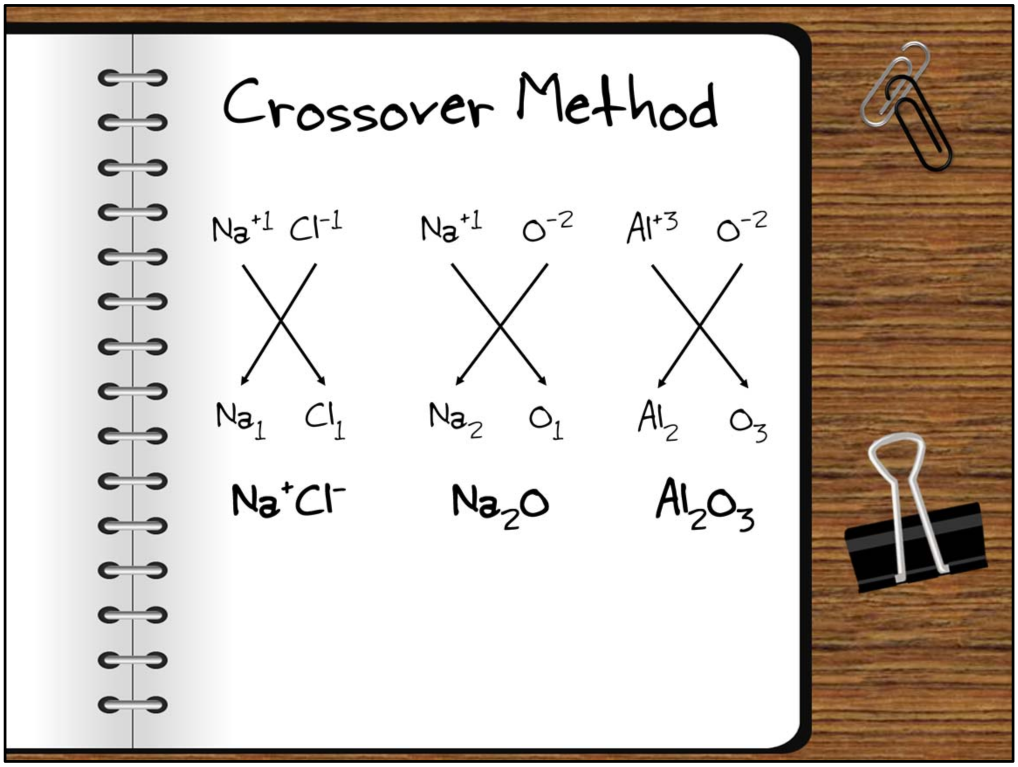


What happens when sodium forms a compound with an element that requires two electrons to achieve stability, like oxygen? Remember, sodium has one valence electron and oxygen has six valence electrons. In this case, oxygen will need two sodium atoms to achieve a stable octet. Once oxygen has acquired the two sodium atoms, the newly formed compound is sodium oxide, or Na_2O.

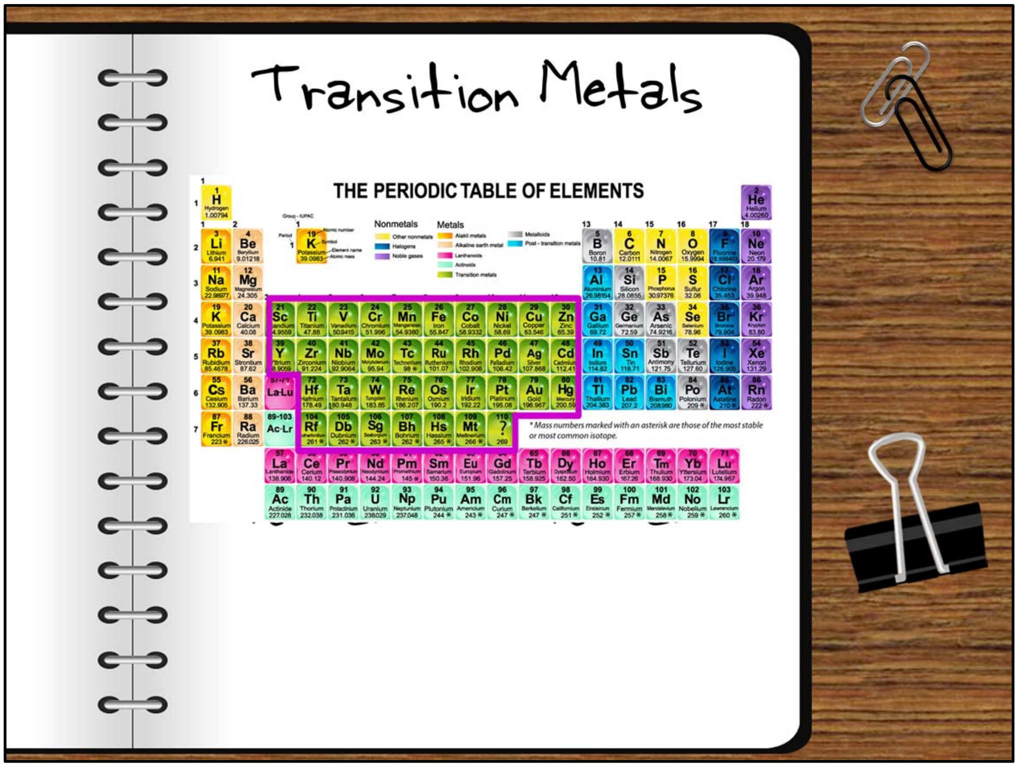


Look at what happens when aluminum and oxygen form a compound. As you can see from the image, two aluminum atoms are needed to balance the three oxygen atoms. The end result is the compound aluminum oxide, or Al_2O_3.

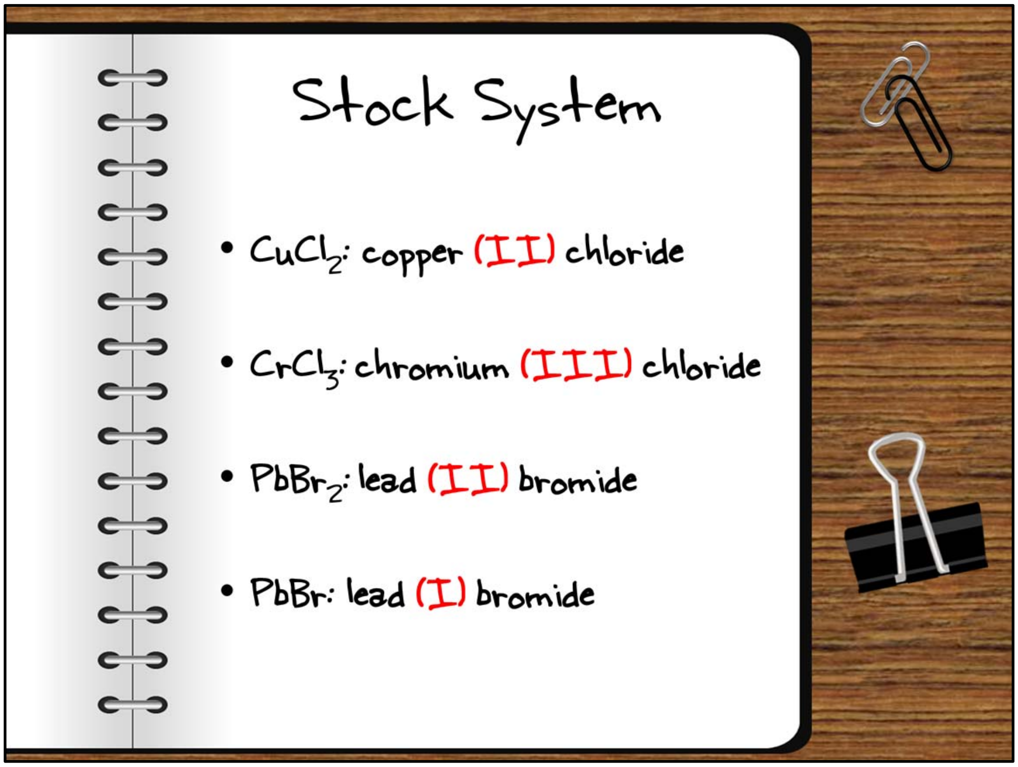

Bonding with Two Electrons
Al
Al
O
O
O
Al2O3



When you look at the ionic charges for elements, you may start to see a pattern. The charges for the ions can be switched to use as the subscripts when you are writing the chemical formula. Remember, there is no such thing as a negative number of atoms. Therefore, all subscripts are written as positive numbers. This method is known as the crossover method. The crossover method works because when electrons are transferred, the charge is conserved between the elements. In other words, the sum of all of the positive charges is equal to the sum of all of the negative charges. The result is a net charge of zero, which means the compound is neutral.



The transition metals are in Groups Three through Twelve. Most of the transition metals have more than one common ionic charge. You can easily figure out their charge from the chemical formula using the crossover method, but in reverse. You can see from the image that after balancing, the new compound has a net charge of zero.



When writing out the names of these compounds, the Stock System is used. In the Stock System, a Roman numeral in parentheses is used after the name of the metal. The Roman numeral indicates the charge of the metal. Again, the writing and naming of compounds is determined according to IUPAC rules. Some examples are shown here:

- Copper (II) chloride
- Chromium (III) chloride
- Lead (II) bromide
- Lead (I) bromide