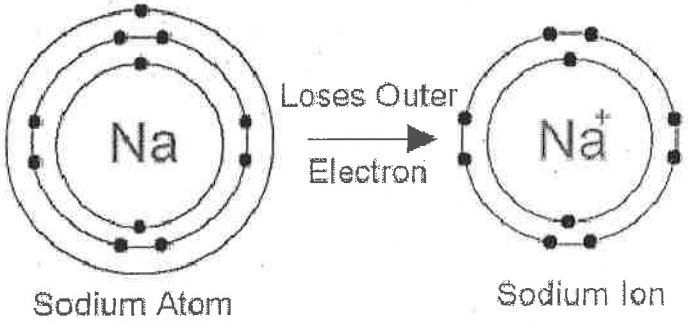
Chemical Bonding – Building Molecules!

As we have already seen, atoms are most stable in their electron configuration when they are isoelectric with a noble gas. In an attempt to achieve that electron configuration, atoms may form a charge (ion) by gaining or losing electrons.

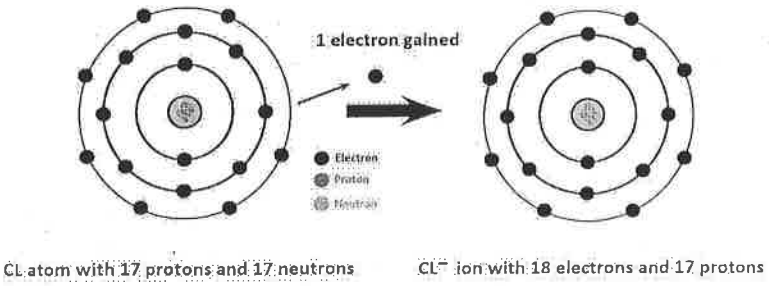
Whether or not an element loses or gains electrons is all dependent upon their ionization energy and electronegativity. When atoms exchange or share valence electrons, a **chemical bond** is formed between them.

The _____ have the lowest ionization energies on the periodic table and therefore typically lose electrons to form positively charged _____.



Notice that when sodium formed a 1+ ion, it lost all of its valence electrons and therefore a whole energy level.

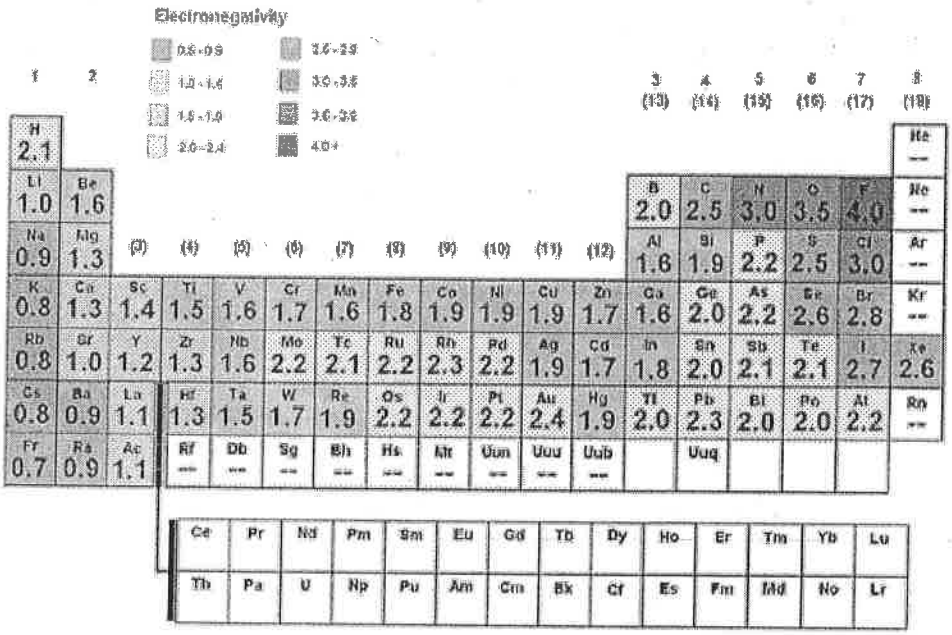
The _____ have the highest electronegativities on the periodic table and therefore typically gain electrons to form negatively charged _____.



Notice that when chlorine formed a 1- ion, it gained valence electrons until the valence energy level had an octet, filling its s and p sublevels.

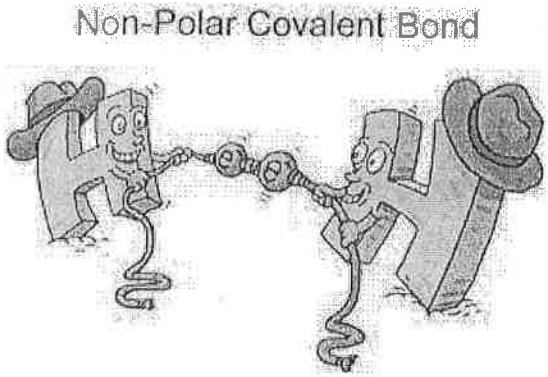
Try It! Show the charges elements take on using the Lewis Dot practice packet.

Electrons can be completely given away or shared to help elements reach a noble gas state. How evenly electrons are shared is all based upon their relative electronegatvities.



Electronegativity describes the "pull" an atom has on others valence electrons. So when atoms attempt to share valence electrons to achieve a noble gas state, their relative pulls will determine whether they are shared evenly, unevenly, or whether one completely steals the electrons away!

An electronegativity difference of 0-0.35 predicts even sharing of electrons because the pulls are so similar. This even sharing of electrons is called a **non-polar covalent** bond.



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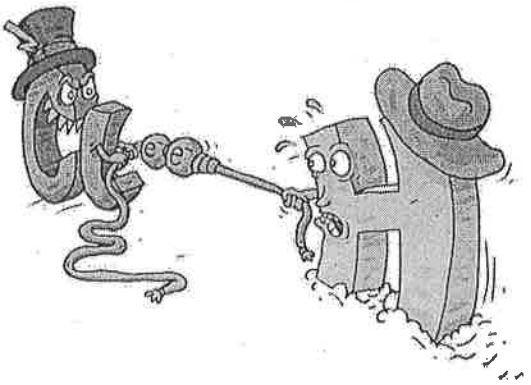
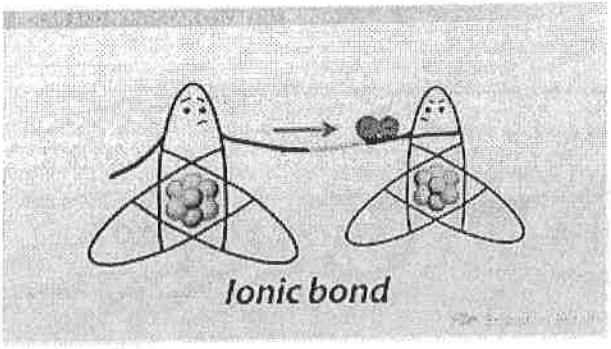
An electronegativity difference of 0.35-1.7 predicts uneven sharing of electrons because the pulls are off balanced, causing the more electronegative element to hog the electrons. This uneven sharing of electrons is called a **polar covalent** bond. The uneven distribution of electrons causes ***partial charges*** to form on each element. The more electronegative element has extra electrons spending more time near it and takes on a partial negative charge. The less electronegative element is having its electrons partially stolen, giving it a partial positive charge.

Polar Covalent Bond



δ^- δ^+

If the difference in electronegativity is large enough between the elements (>1.7), the more electronegative element may completely steal electrons rather than share. This complete donation of electrons is called an **ionic** [redacted] bond. The complete transfer of electrons causes each element to take on full positive/negative charges (forms ions).



2+ **2-**

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Turns out, if we can predict the number of electrons an element needs to gain or lose to reach a noble gas configuration, through sharing or donation, we can predict how many of each element will bond with each other.

Steps to predicting bonding with Lewis dot structures:

1) Predict the type of bond by calculating the difference in electronegativity.
   - Covalent will share (circle pairs of electrons)
   - Ionic will donate (use arrows to show electron transfer)

   Ex: Rb and S

   Ex: P and O

2) Identify how many electrons the element would give/receive to reach a noble gas configuration (full octet). (Remember, metals will give e- and non-metals will typically take them)
   - That is how many bonds it will make (either how many e- are transferred or how many pairs it will share

   Ex: Rb and S

   Ex: P and O

3) Draw the Lewis dot structures and use arrows or circled pairs to show bonding. Double check that every element reached its octet.

   Ex: Rb and S

   Ex: P and O

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