Bond and Molecular Polarity

Electronegativity is defined as the elements attraction for electrons and is based on a scale of 0-4, just like a GPA.An element with a 4.0 has a great attraction for electrons while an atom with a 0.7 would have little attraction for electrons.

The difference in electronegativity between two elements determines what type of bond will form.

Ionic Bonds

As a metal and a non-metal approach one another, the valence electrons interact and the metal (indicated by the red sphere) transfers its valence electrons to the non-metal (indicated by the blue sphere). This type of bond must have a difference of greater than 1.7 in electronegativity.

Non-metal forming **Anion**

Metal forming **Cation**

Ionic Bond Forming

Non-metal forming **Anion** Metal forming **Cation**

The metal becomes positively charged (through the loss of electrons) and the non-metal becomes negatively charged (through the gain of electrons). In this way, both the metal and the non-metal complete their valence shell to obtain a stable electron configuration.

If an electron is transferred and forms a negative ion, the electron configuration can be shown the same as that of the original atom except that it will have more or less electrons.

Example

$Cl \;\; - \; 1s^2 2s^2 2p^6 3s^2 3p^5$

$Cl^{-1} \; - \; 1s^2 2s^2 2p^6 3s^2 3p^6$

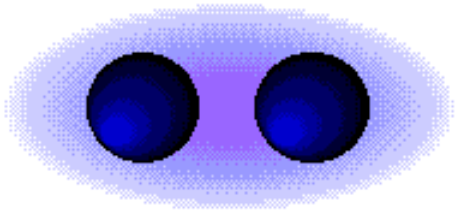
There are two types of covalent bonds. In a **non-polar covalent bond** the electrons are shared equally between the two atoms. (The nuclei and core electrons are indicated by the blue spheres and the bonding electrons are indicated by the lavender dots.) The difference in electronegativity determines which type of bond will form. If the dif. is 0, then the bond is nonpolar covalent.

As two non-metals approach one another, the valence electrons interact and a **nonpolar covalent bond** is formed between the two non-metals which share a pair of electrons so that each obtains a filled valence shell.

Non-metal

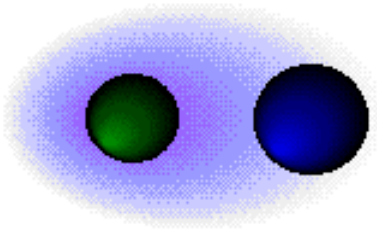
Non-metal

The electrons move around the nuclei with the electrons generating temporary positive and negative charges within the molecule.



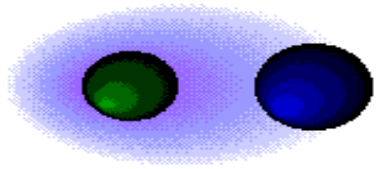
Nonpolar covalent bond

In a **polar covalent bond** the electrons are shared unequally between the two atoms. In this situation, one atom has a greater ability to pull the bonding electrons towards it and is said to be more *electronegative*. (The green sphere represents the more electronegative element.)



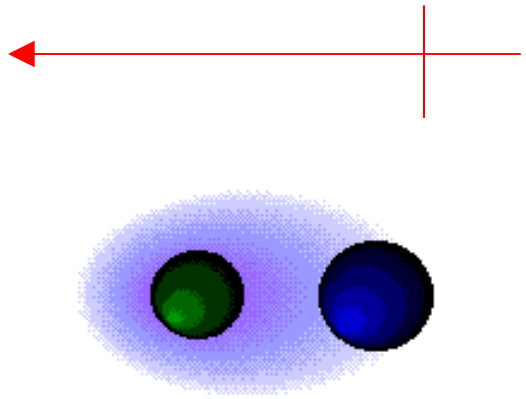
polar covalent bond

Again, the electrons move around the nuclei with the electrons spending the majority of the time near the more electronegative element. This generates a partial negative charge near the more electronegative element and a partial positive charge near the less electronegative element. This is called a dipole moment.



δ^- charge δ^+ charge

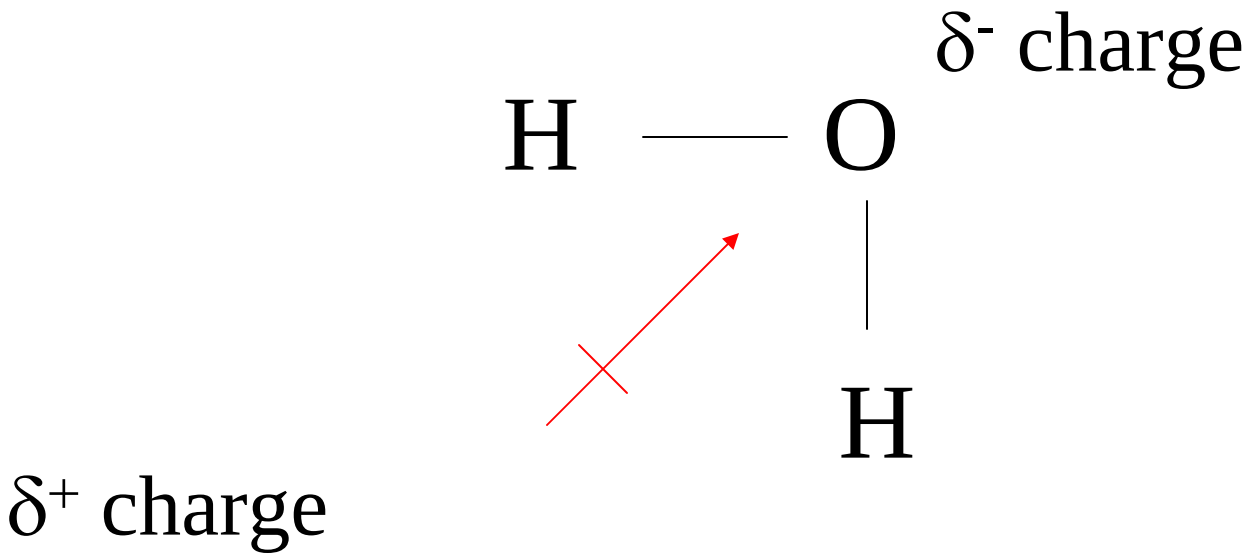
Dipole Moment



δ^- charge δ^+ charge

The arrow on a dipole points to the negative end of the bond.

Molecules that are not linear will still have a dipole moment.



Non linear molecule water/H_2O

Summary of Bond Types

	Ionic	Polar Covalent	Nonpolar Covalent
Electronegativity Difference	Greater than 1.7	Less than 1.7	0
Type of atoms that form this bond	metal and nonmetal	2 nonmetals	2 of the same element. Both nonmetals