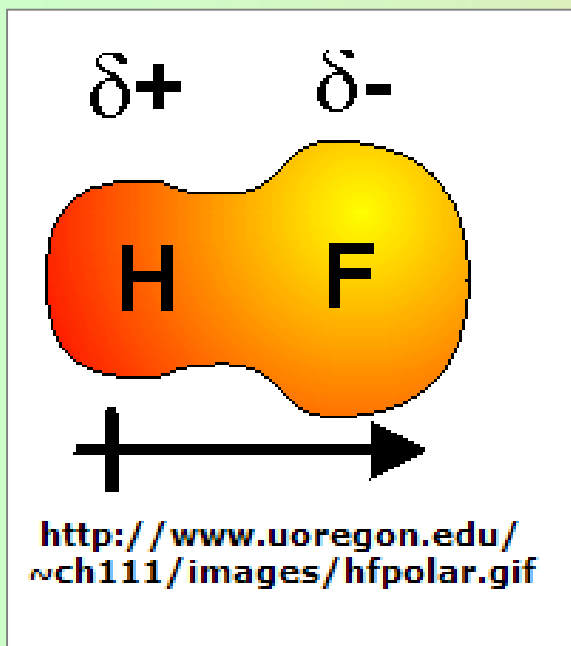
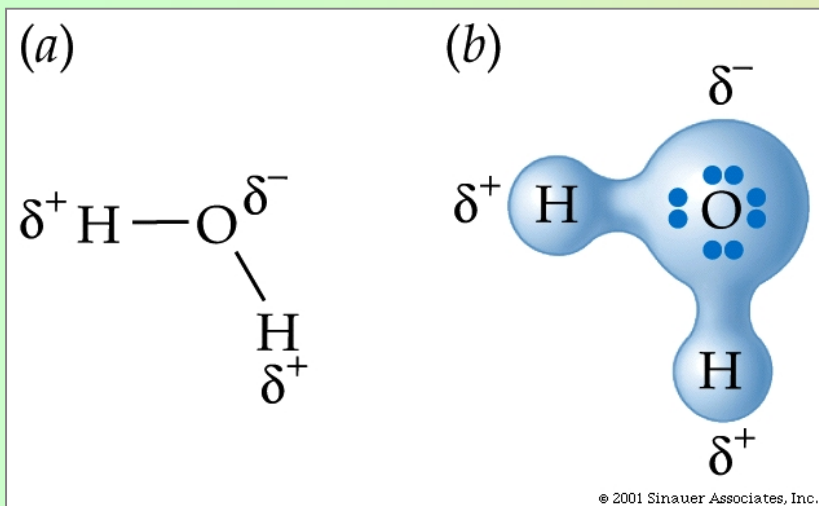


# Molecular Polarity



## Electronegativity and Bond Polarity

Electronegativity (EN) is the relative ability of a bonded atom to attract the shared electrons.

When bonded atoms with different electronegativities form a bond, the bonding pair is shared **unequally**, so the bond has **partially negative** and **positive poles**.

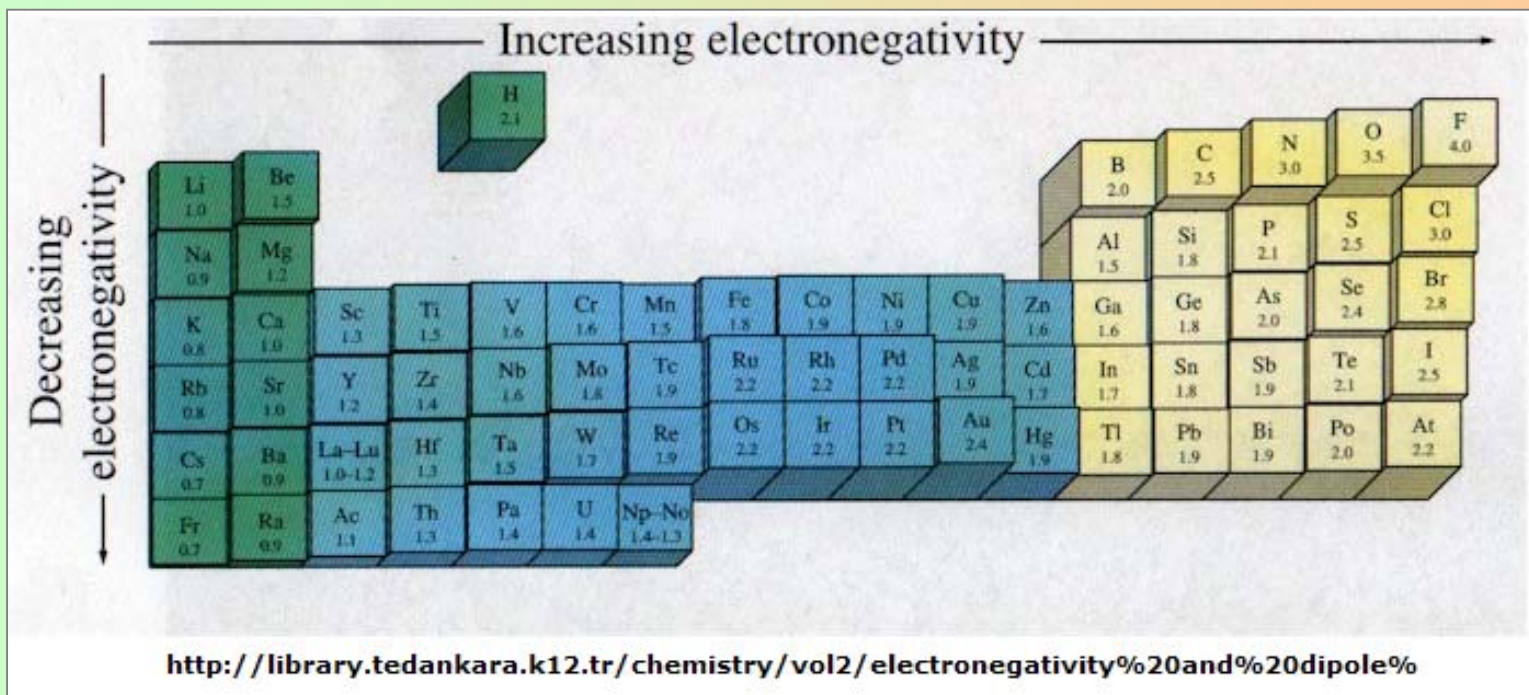
This type of bond is called a polar covalent bond and is depicted by a polar arrow pointing toward the negative pole, or by  $\delta^-$  and  $\delta^+$  symbols, where the lower case delta,  $\delta$ , represents a partial charge.

# Molecular Polarity

## Electronegativity and Bond Polarity

In the H-H and F-F bonds the atoms are identical, so the bonding pair is shared equally and the bond is called a **nonpolar covalent bond**.

Thus, by knowing the EN values of the atoms in a bond, you can determine the direction of the bond polarity.

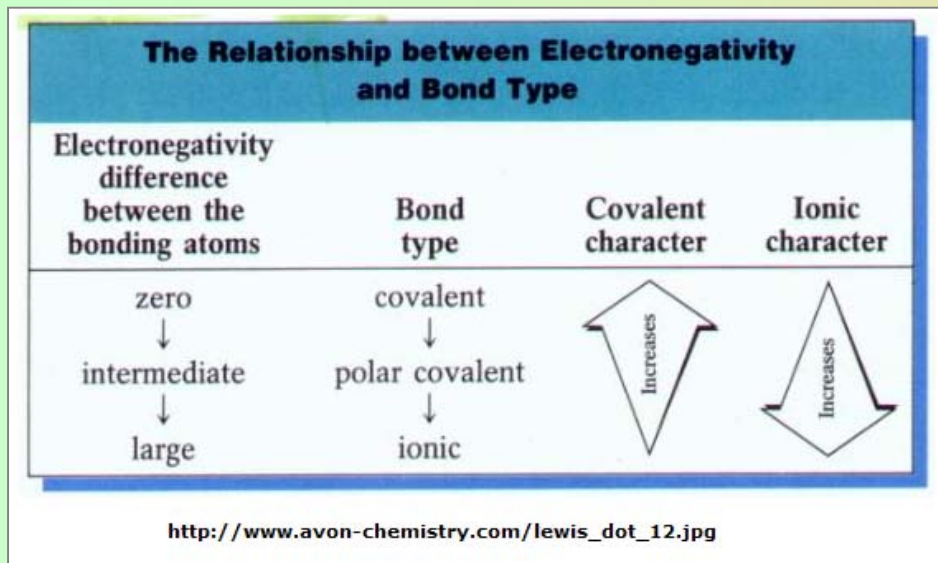


# Molecular Polarity

## The Partial Ionic Character of Polar Covalent Bonds

The existence of partial charges means that a polar covalent bond behaves as if it were partially ionic.

The partial ionic character of a bond is related directly to the electronegativity difference ( $\Delta EN$ ): a greater  $\Delta EN$  results in larger partial charges and a higher partial ionic character.

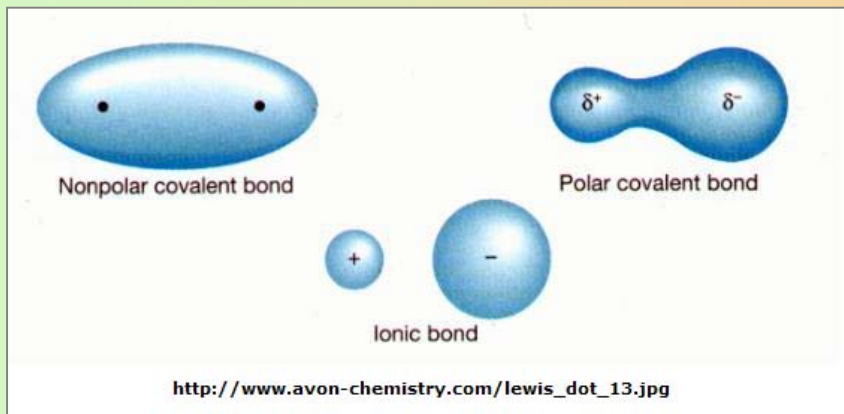


# Molecular Polarity

## The Partial Ionic Character of Polar Covalent Bonds

In order to determine the character of a bond we can follow these rules:

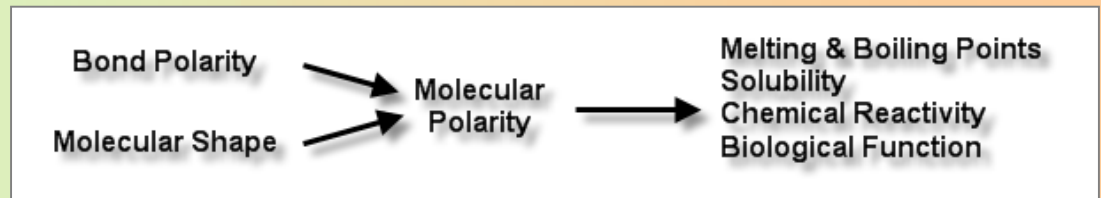
- If the electronegativity difference is less than 0.4 then the bond is nonpolar covalent
- If the electronegativity difference is between 0.4 and 1.7 the bond is considered polar covalent
- If the electronegativity difference is greater than 1.7 the bond is ionic.



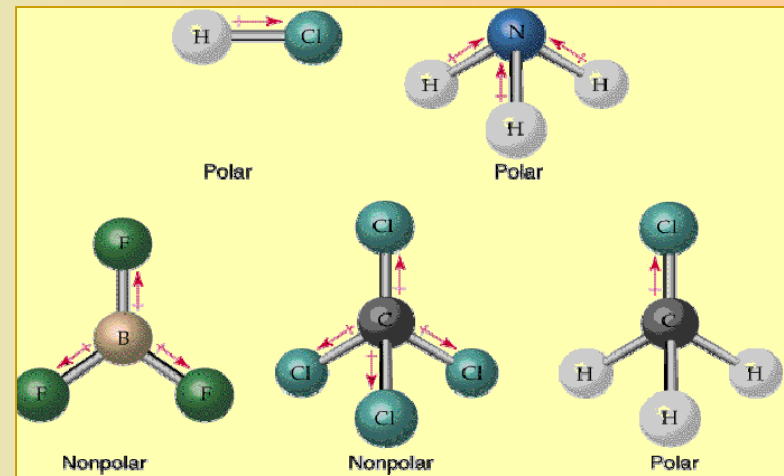
# Molecular Polarity

## Molecular Polarity

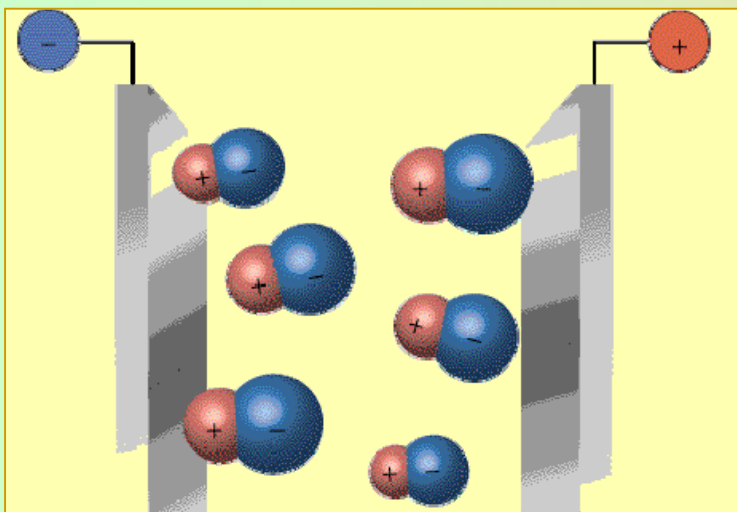
Knowing the shape of the molecules is a key to understanding its physical and chemical behavior. One of the most important and far-reaching effects of molecular shape is molecular polarity, which can influence melting and boiling points, solubility, chemical reactivity, and even biological function.



In molecules with more than two atoms, both **shape and bond polarity** determine the molecular polarity.



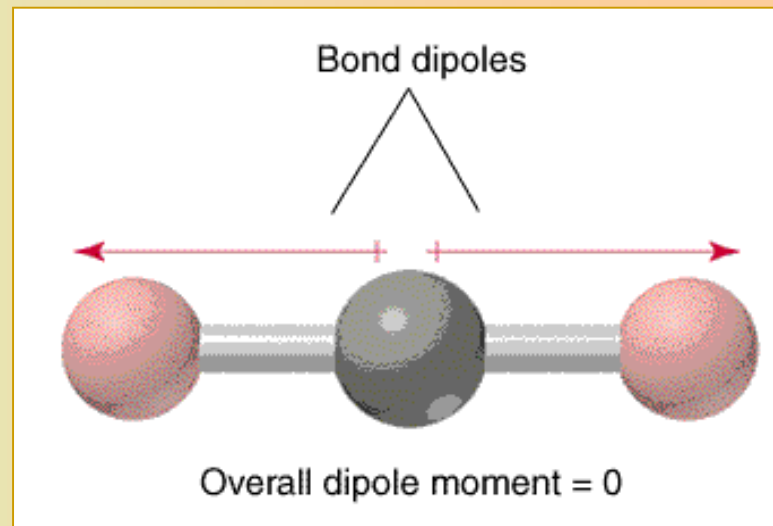
# Molecular Polarity



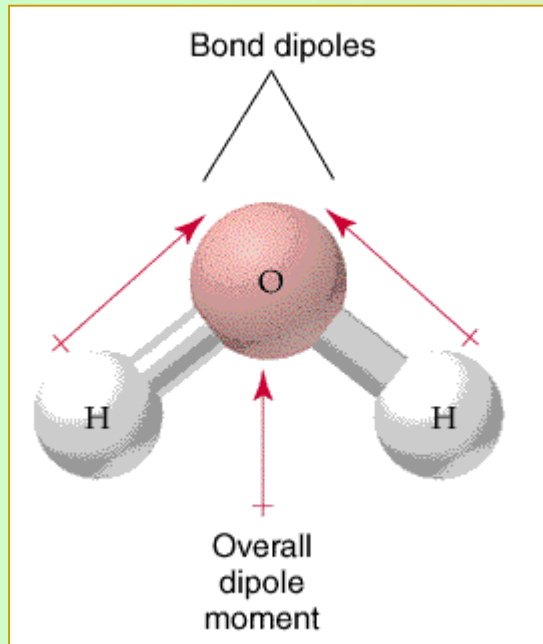
## Molecular Polarity

In an electric field, polar molecules become oriented with their partial charges pointing toward the oppositely charged electric plates.

Each  $C=O$  bond is quite polar. However,  $CO_2$  is linear, so its bonds point  $180^\circ$  from each other. As a result, these identical bond polarities are counterbalanced and give the molecule no net polarity.



# Molecular Polarity

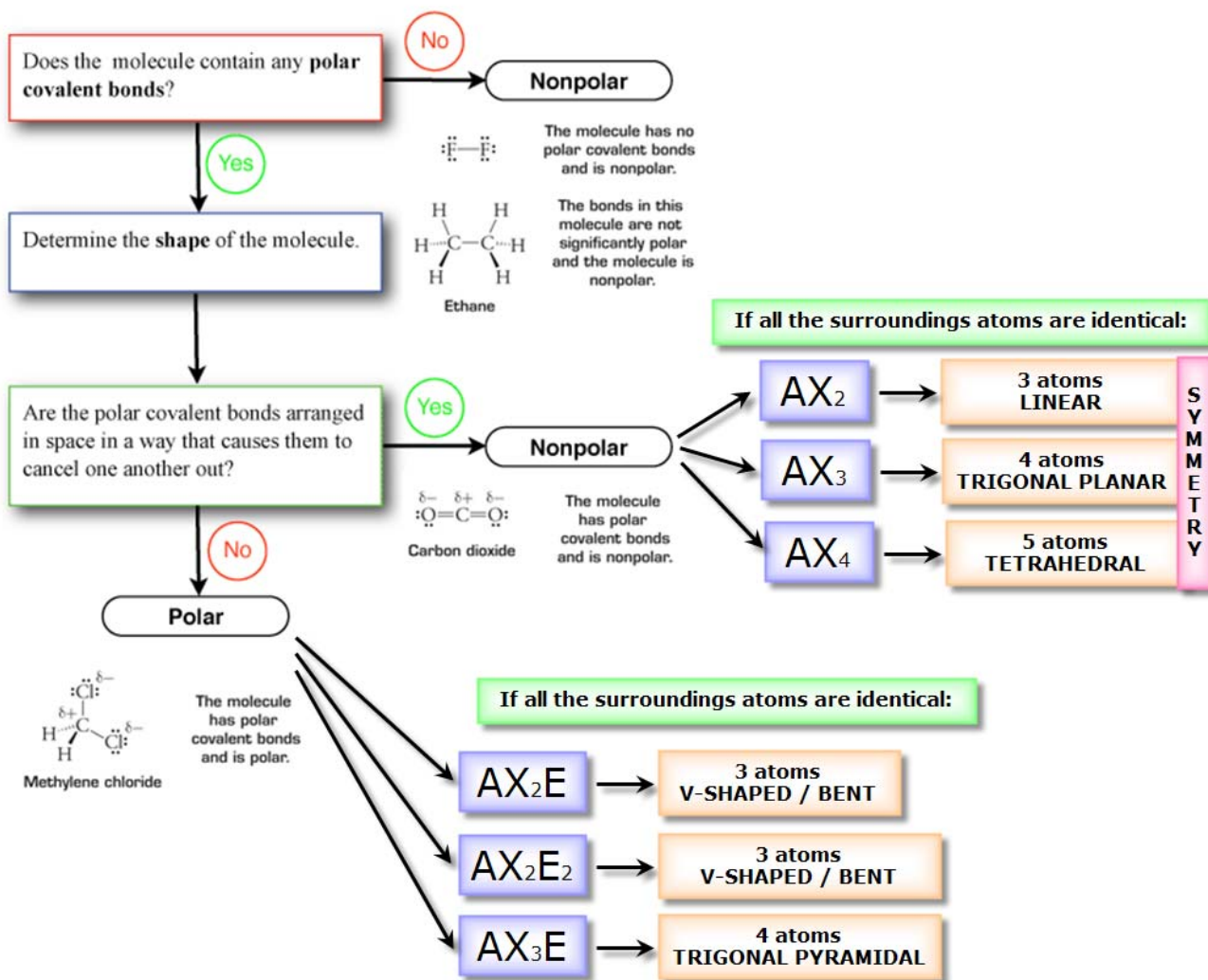


## Molecular Polarity

In the case of water the bond polarities are not counterbalanced because the water molecule is V shaped.

Thus, the O end of the molecule is more negative than the other end.

# Molecular Polarity



## Molecular Polarity

As a general rule, we can apply the following criteria in order to decide if a molecule is polar or nonpolar.