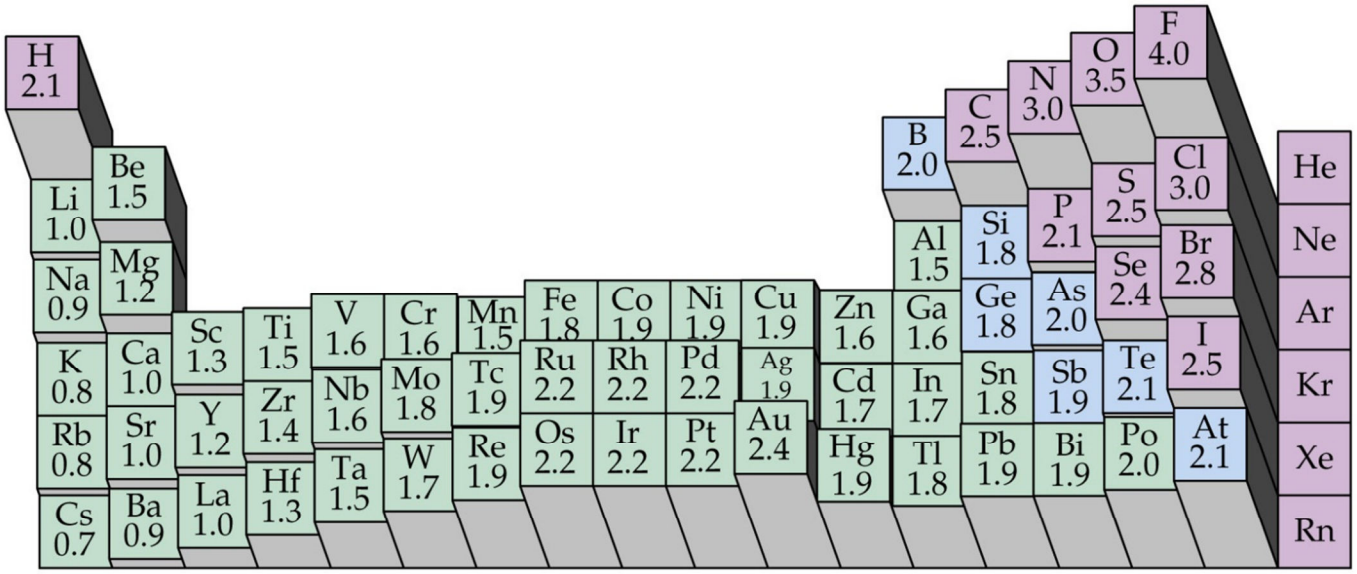
# *Polarity*

Molecular compounds are not easily identified by their properties alone. You may have noticed that some molecular compounds, like sugars for instance, behave in ways nearly identical to ionic compounds. Observing sugar beside salt, you may be tempted to believe that they are closely related, or at least possess the same type of chemical bonding. This assumption however would be incorrect. As you well know, salts are ionic compounds and sugars are molecular. You may also have noticed that molecular compounds often have properties unmatched by ionic compounds. For instance, at room temperature, methane is a gas and water is liquid. What accounts for these similarities and difference? A critical part of the answer to this question begins with understanding the nature of polar bonds and polar molecules. This will become a key concept in your understanding of the properties and behaviours of all substances.

## *Electronegativity*

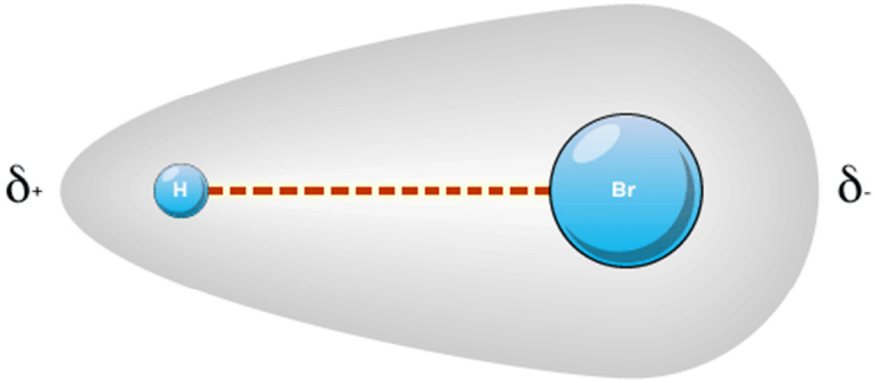



As we explored in our investigation of periodic trends, the effective nuclear charge of an atom affects its pull for electrons. As you might imagine, when atoms are bonded together, different atoms will have a slightly different strength of its pull for shared electrons. The ability of an individual atom, when bonded, to attract bonding electrons to itself is known as its _____**.** This is a relative scale without units. As you can see, electronegativity increases as we move up and to the right of the periodic table.

*Can you explain this trend?*

# *Covalent Bonds: Non-polar or Polar?*

Now that you understand electronegativity, it follows that when a covalent bond forms, electrons shared in the chemical bond will not always be shared evenly between the bonded elements. Electrons will be held closer to the more electronegative element.

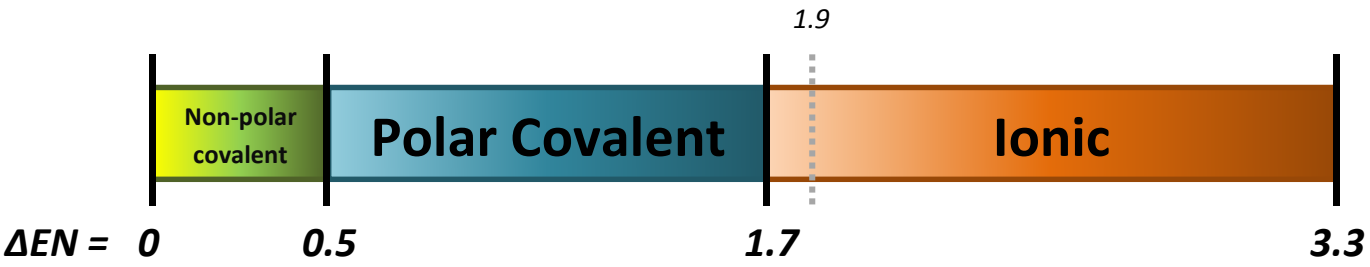



This slight shift of electrons toward one side over the other in a chemical bond creates a slight separation of charge. The more electronegative element becomes slightly negative, and the less electronegative element becomes slightly positive. Charges that result in this way are called _____. Dipoles are denoted with the symbols $\delta^+$ and $\delta^-$ (sigma plus and sigma minus).

Not all bonds will have this polar character. The more similar the electronegativity between two bonded elements, the more evenly electron pairs will be shared. In the case of diatomic elements, each atom is identical, hence electrons are shared completely evenly.


To decide whether or not a bond will be polar or non-polar, we must look at the _____ between the bonded elements.

## *The Electronegativity Scale – What type of bond?*



## *Practice:*

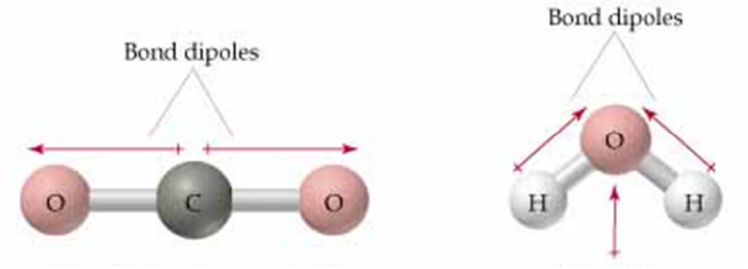
*Complete the table below*

| Bond | Electronegativity Difference (ΔEN) | Type of Bond |
|---|---|---|
| C—H | 2.5 - 2.1 = 0.4 | Non- polar covalent |
| N—H | | |
| H—H | | |
| O—H | | |
| C—O | | |
| Mg—Cl | | |
| Na—Cl | | |
| Ca—F | | |
| Mg—S | | |

## *Polarity of Whole Molecules*

A molecule containing polar covalent bonds will not necessarily have polar characteristics. Molecules that are symmetrical often orient equal bond dipoles in such a way as to cancel each other out. The details of this type of whole molecule polarity we be discussed in future courses. For molecules containing polar bonds, a useful acronym to remember this is:

**SNAP** (**S**ymmetrical **N**on-polar, **A**symmetrical **P**olar)

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