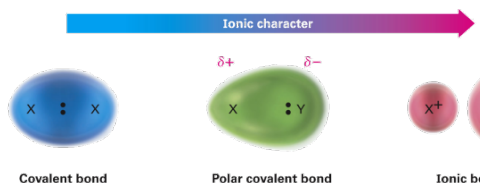


- Covalent bonds can have ionic character
- These are **polar covalent bonds**
 - Bonding electrons attracted more strongly by one atom than by the other
 - Electron distribution between atoms is not symmetrical



- ❑ **Electronegativity (EN):** intrinsic ability of an atom to attract the shared electrons in a covalent bond
- ❑ Differences in EN produce bond polarity
- ❑ Arbitrary scale.
- ❑ F is most electronegative (EN = 4.0), Cs is least (EN = 0.7)
- ❑ Metals on left side of periodic table attract electrons weakly, lower EN
- ❑ Halogens and other reactive nonmetals on right side of periodic table attract electrons strongly, higher electronegativities
- ❑ EN of C = 2.5

H 2.1																	He						
Li	Be																	B	C	N	O	F	Ne
1.0	1.6																	2.0	2.5	3.0	3.5	4.0	
Na	Mg																	Al	Si	P	S	Cl	Ar
0.9	1.2																	1.5	1.8	2.1	2.5	3.0	
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr						
0.8	1.0	1.3	1.5	1.6	1.6	1.8	1.9	1.9	1.9	1.9	1.6	1.8	1.8	2.0	2.4	2.8							
Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe						
0.8	1.0	1.2	1.4	1.6	1.8	1.9	2.2	2.2	2.2	2.1	1.7	1.7	1.8	1.9	2.1	2.5							
Cs	Ba	La	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn						
0.7	0.9	1.0	1.3	1.5	1.7	1.9	2.2	2.2	2.2	2.2	1.9	1.8	1.9	2.1	2.0	2.1							

- **Nonpolar Covalent Bonds:** atoms with similar EN difference < 0.5
- **Polar Covalent Bonds:** Difference in EN of atoms < 1.7
- **Ionic Bonds:** Difference in EN > 1.7
 - C-H bonds, relatively nonpolar
 - C-O, C-X bonds (*more* electronegative elements) are polar
- Bonding electrons toward electronegative atom
 - C acquires partial positive charge, δ^+
 - Electronegative atom acquires partial negative charge, δ^-

- Electrostatic potential maps show calculated charge distributions
- Colors indicate electron-rich (red) and electron-poor (blue) regions
- Arrows indicate direction of bond polarity

Predicting the Polarity Bonds

- Predict the polarization of the O-H bonds in water.
- Strategy – Look at the electronegativity table to see which atoms attract the electrons more strongly.
- Oxygen (EN = 3.5) is more electronegative than Hydrogen (EN = 2.1) and it therefore attracts electrons more strongly. The difference is 1.4 so O-H bond is strongly polarized.