Polarity

Video Workbook with Dr. B

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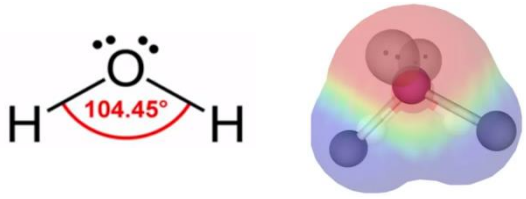
Polarity is a result of a difference in electonegativity (EN) between atoms *and* a result of the geometry (shape) of the molecule.

For example, H_2O is polar due to:

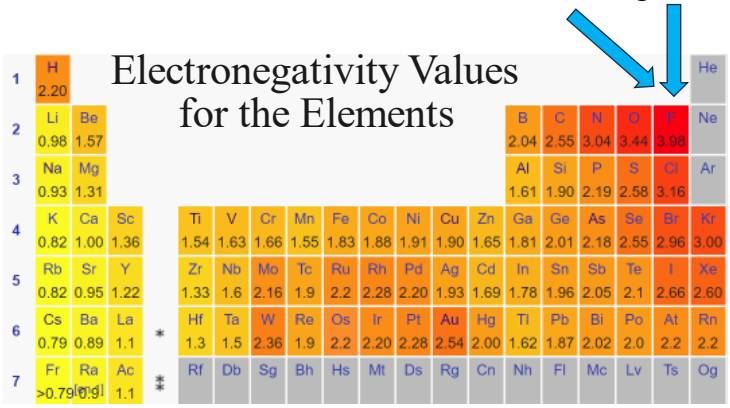
- a large EN difference between H and O.
- an asymmetrical molecular geometry.



Polarity of Water Explained

Polar and Non-Polar Molecules

Fluorine (F) is the most electronegative element. As we move towards F elements are more electronegative.



Electronegativity is how strongly an atom attracts a shared pair of electrons.

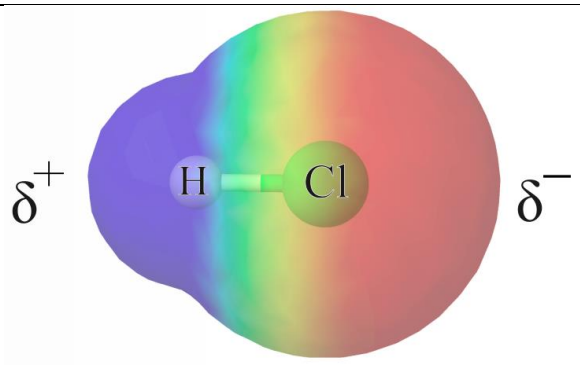
The *difference* is electronegativity (between 0.0 and 4.0) between two atoms allows us to *predict* the type of bond that will form. Note that some books use slightly different numbers.

- A difference is greater than 2.0, the bond is **ionic**.
- A difference is between 0.5 and 2.0, the bond is **polar covalent**.
- The difference is between 0.0 and 0.5, the bond is **nonpolar covalent**.

For polar covalent compounds, the electrons in the bonds are shared **unequally**.

In HCl, the Cl is more electronegative than H. The bonding electrons are more strongly attracted to the Cl atom, away from the H.

With more electron density the Cl has a negative charge. With less, the H is positive.



To Determine if a Molecule is Polar or Non-Polar

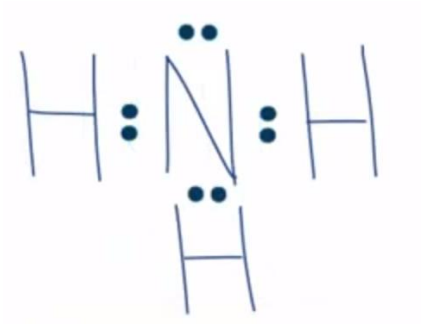
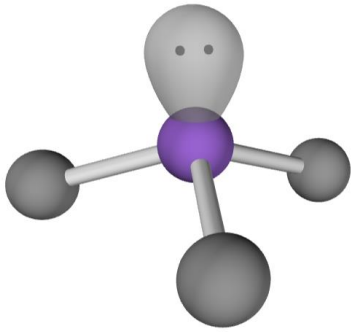
1. Check if you have a covalent compound (made of two non-metals).

2. Draw the correct *Lewis Structure* and look at the difference in electronegativity values for each bond. If the difference is greater than 0.5 the **bonds** are polar.

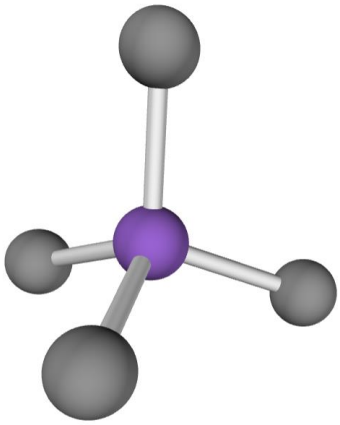
3. Determine the *molecular geometry* for the molecule. If it is not symmetrical and the EN difference between bonds is 0.5 or greater it is considered a polar molecule.

Important: Even if the EN differences are less than 0.5 but greater than 0.0, the molecule is asymmetrical, it will have a dipole moment.

Example: NH_3 (video explanation)

		**Polar or Non-Polar?** The EN difference between N and H is: 3.04 – 2.20 = 0.84. The molecule is asymmetrical. Because the EN difference is over 0.5 and the molecule is not symmetrical NH_3 is **polar**.

Example: CH_4 (video explanation)

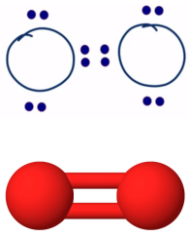
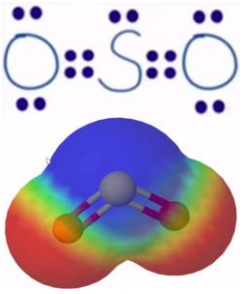
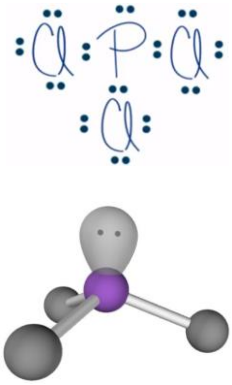
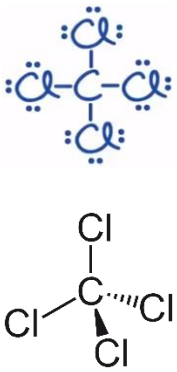
		**Polar or Non-Polar?** The EN difference between C and H is: 2.55 – 2.20 = 0.25 The molecule is symmetrical. Because the EN difference is less than 0.5 and the molecule is symmetrical CH_4 is **non-polar**.

Visualizations Tools

Molecular Geometry: PhET App Polarity: MolView app Note: under *Jmol* menu, choose *MEP surface lucent*)

Practice Set #1

Given the Lewis Structure and Molecular Geometry, determine whether the molecule is polar or nonpolar.

O_2	SO_2	PCl_3	CCl_4	CH_3Cl
				

Answers

O_2 = Non-Polar (see https://youtu.be/BZfZjyTczoA)
SO_2 = Polar (see https://youtu.be/dyahYHp-2qE)
PCl_3 = Polar (see https://youtu.be/lm4tSYpG2M
CCl_4 = Non-Polar (see https://youtu.be/gyRczfT-gFEgFE)
CH_3Cl = Polar (see https://youtu.be/VU0l_v1Ai-E)

Practice Set #2

Draw the Lewis Structure, determine the molecular geometry, and decide whether each molecule is polar or non-polar.

HCl	CO_2	BF_3	NO_2	SF_6

HCl = Polar
Lewis Structure: https://youtu.be/Kj1lx-qHmgA
Molecular Geo: https://youtu.be/-whWRPFVPhA
Polar/Non-Polar: https://youtu.be/uo5rQb1ZcMw

CO_2 = Non-Polar
Lewis Structure: https://youtu.be/Kj1lx-qHmgA
Molecular Geo: https://youtu.be/Vn9RrXO-z1A
Polar/Non-Polar: https://youtu.be/fn45Y-KcVoQ

BF_3 = Non-Polar
Lewis Structure: https://youtu.be/tXA-1n8PzOM
Molecular Geo: https://youtu.be/f7VW2ZXBqlU
Polar/Non-Polar: https://youtu.be/BYU

NO_2 = Polar
Lewis Structure: https://youtu.be/8hrfeynMZXA
Molecular Geo: https://youtu.be/cNbUYF17deQ
Polar/Non-Polar: https://youtu.be/wsI1v-SRqc8

SF_6 = Non-Polar
Lewis Structure: https://youtu.be/EYjWJLsMd3A
Molecular Geo: https://youtu.be/pacGFbPCbdPc
Polar/Non-Polar: https://youtu.be/A5q87QAZy9

Help with Lewis Structures and Molecular Geometry

- Lewis Structures Made Simple: https://youtu.be/1ZlnzyHahvo
- More Lewis Structures Practice: https://youtu.be/DQclmBeIKTc
- Molecular Geometry: https://youtu.be/Moj85zwdULg

Report errors and suggestions to DrB@breslyn.org