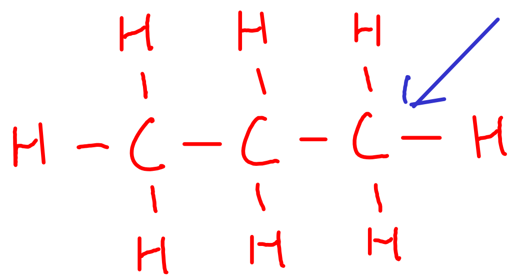
VSEPR and large molecules

- Large molecules have more than one "center" atom

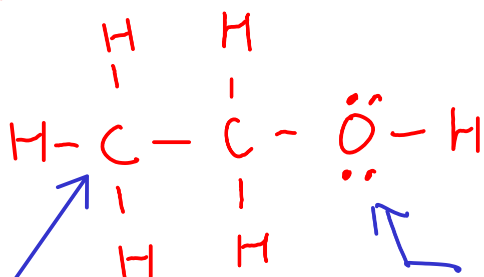
- Describe the molecule by describing the shape around each "center".

C_3H_8:



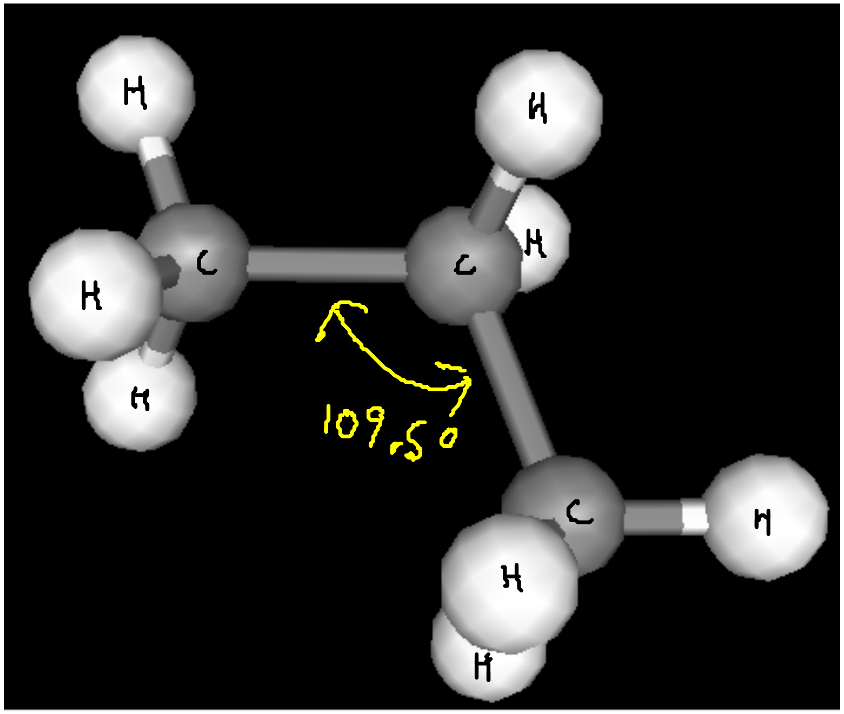
Each of the three carbon centers is TETRAHEDRAL, since each are surrounded by four groups.

CH_3CH_2OH:



The shape around this oxygen atom is BENT.

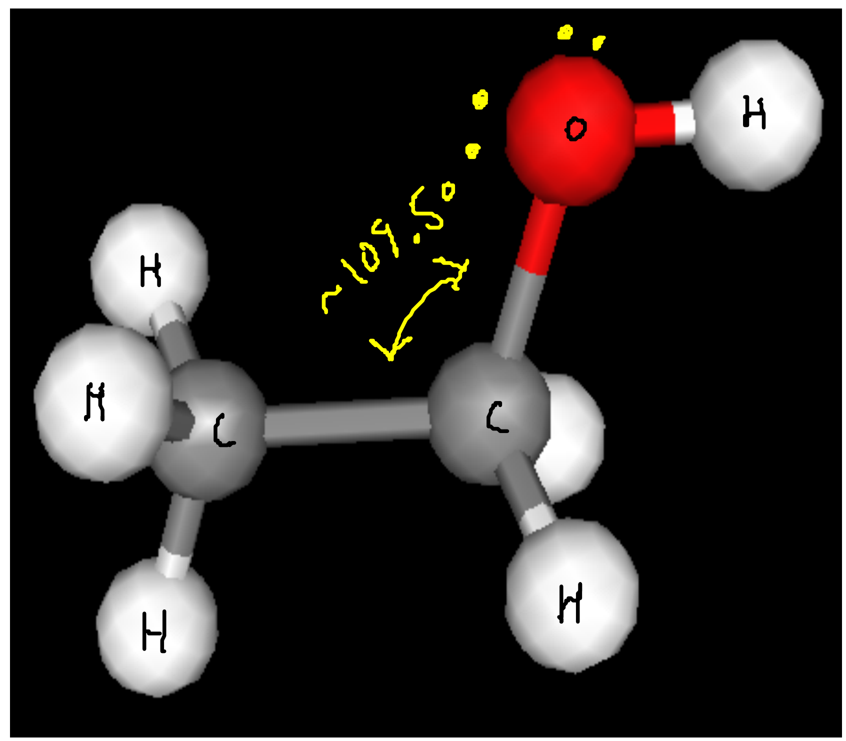
These carbon atoms have TETRAHEDRAL geometry.



← C_3H_8

All bond angles in the propane molecule are 109.5 degrees

CH_3CH_2OH →



Like propane, the bond angles in ethanol are also close to 109.5 degrees.

14 POLARITY and shape:

- A polar molecule has an uneven distribution of electron density, making it have ends (poles) that are slightly charged.

POLARITY influences several easily observable properties.

- Melting point. (Polar substances have higher melting points than nonpolar substances of similar molecular weight.)
- Boiling point. (Polar substances have higher boiling points than nonpolar substances of similar molecular weight.)
- Solubility. (Polar substances tend to dissolve in other polar substances, while being insoluble in nonpolar substances. Nonpolar substances dissove other nonpolar substances, and generally have poor solubility in polar solvents.)

- Polar molecules contain POLAR BONDS arranged in such a way that they do not cancel each other out.

... but how can we tell whether or not a bond will be POLAR? Use experimental data on ELECTRONEGATIVITY!

ELECTRONEGATIVITY:
-A measure of how closely to itself an atom will hold shared electrons

- A bond where there is a LARGE electronegativity difference between atoms will be either POLAR or (for very large differences) IONIC! (chart, p 352)

- A bond with little or no electronegativity difference between atoms will be NONPOLAR

ELECTRONEGATIVITY TRENDS

- You may look up elecronegativity data in tables, but it helps to know trends!

INCREASING ELECTRO-NEGATIVITY

	IA	IIA	IIIB	IVB	VB	VIB	VIIB	VIIIB	VIIIB	VIIIB	IB	IIB	IIIA	IVA	VA	VIA	VIIA
2	Li	Be											B	C	N	O	F
3	Na	Mg											Al	Si	P	S	Cl
4	K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br
5	Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I
6	Cs	Ba	*La	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At
7	Fr	Ra	*Ac	Rf	Db	Sg	Bh	Hs	Mt								

*"inner" transition metals go here

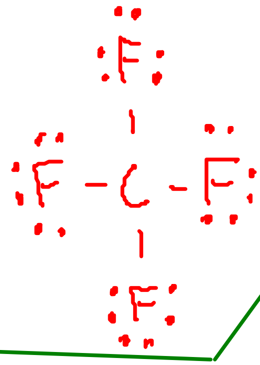
Notes:

1. - FLUORINE is the most elecronegative element, while FRANCIUM is the least!
2. - All the METALS have low electronegativity, and metal/nonmetal combinations form IONIC bonds
3. - HYDROGEN is similar in electronegativity to CARBON, so C-H bonds are considered NONPOLAR

Examples:

CF_4

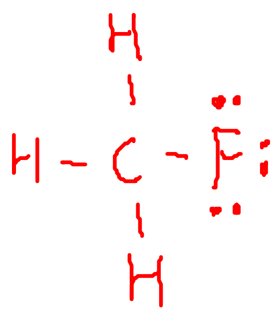
C: 1 x 4
F: 4 x 7
32 e^-



Polar bonds? YES. C-F bonds should be polar.
Shape? Tetrahedral. Also, symmetric (each point of the tetrahedron is identical.) The result is that each fluorine pulls against the others, and the overall molecule is NONPOLAR.

CH_3F

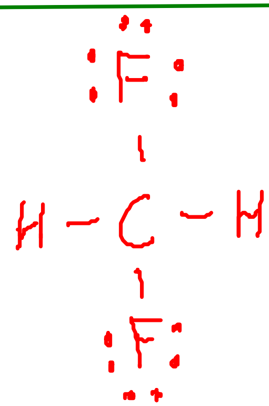
C: 1 x 4
H: 3 x 1
F: 1 x 7
14 e^-



Polar bonds? YES. C-F bonds should be polar, and C-H is nonpolar.
Shape? Tetrahedral. But this time, not symmetric. Electrons are pulled towards the fluorine side of the molecule and away from the hydrogen side. Molecule is POLAR.

CH_2F_2

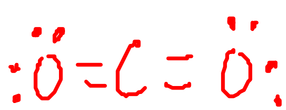
C: 1 x 4
H: 2 x 1
F: 2 x 7
20 e^-



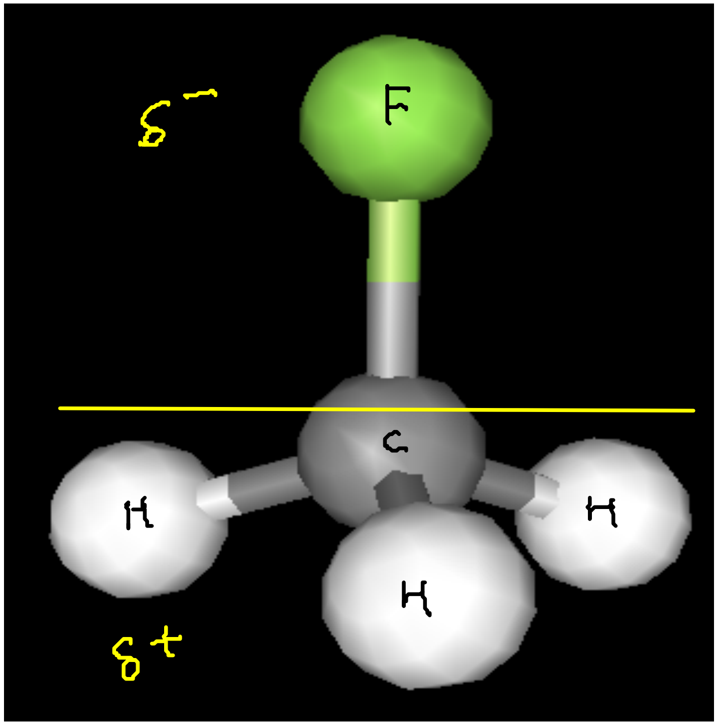
Polar bonds? YES. C-F bonds should be polar, and C-H is nonpolar.
Shape? Tetrahedral. Not symmetric. Electrons are pulled towards the fluorine side of the molecule, and the molecule is POLAR.

CO_2

C: 1 x 4
O: 2 x 6
16 e^-



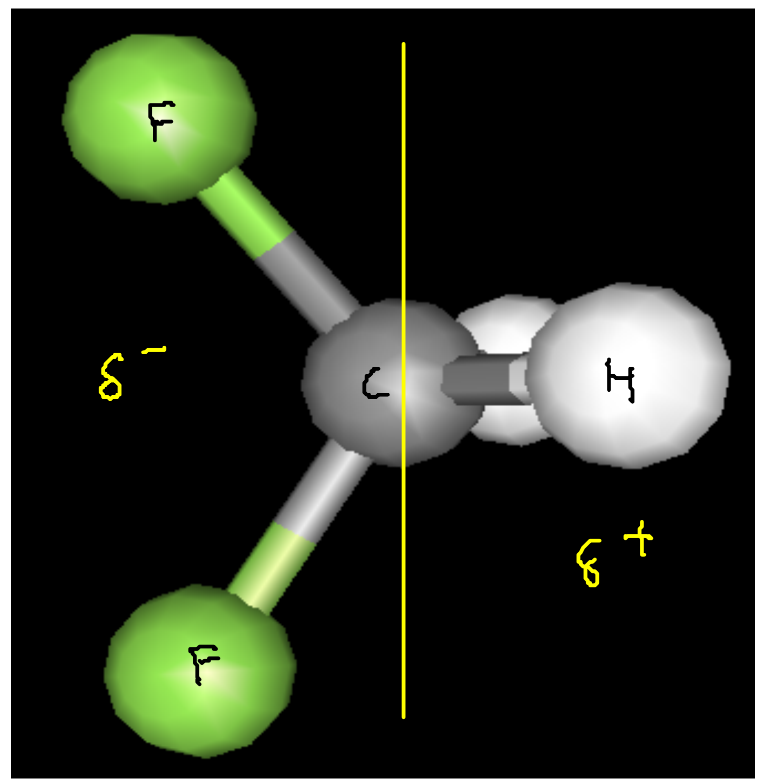
Polar bonds? YES, since C=O bonds are polar.
Shape? Linear, and symmetric. So the oxygen atoms pull against one another, and the molecule is NONPOLAR.



CH_3F "fluoromethane"

Fluorine is able to pull electron density through the molecule, as it is being opposed by much less electronegative hydrogen atoms.

"difluoromethane" CH_2F_2



In 2D, the fluorine atoms appear to be on the opposite sides of the molecule, but in 3D they are on the same side.