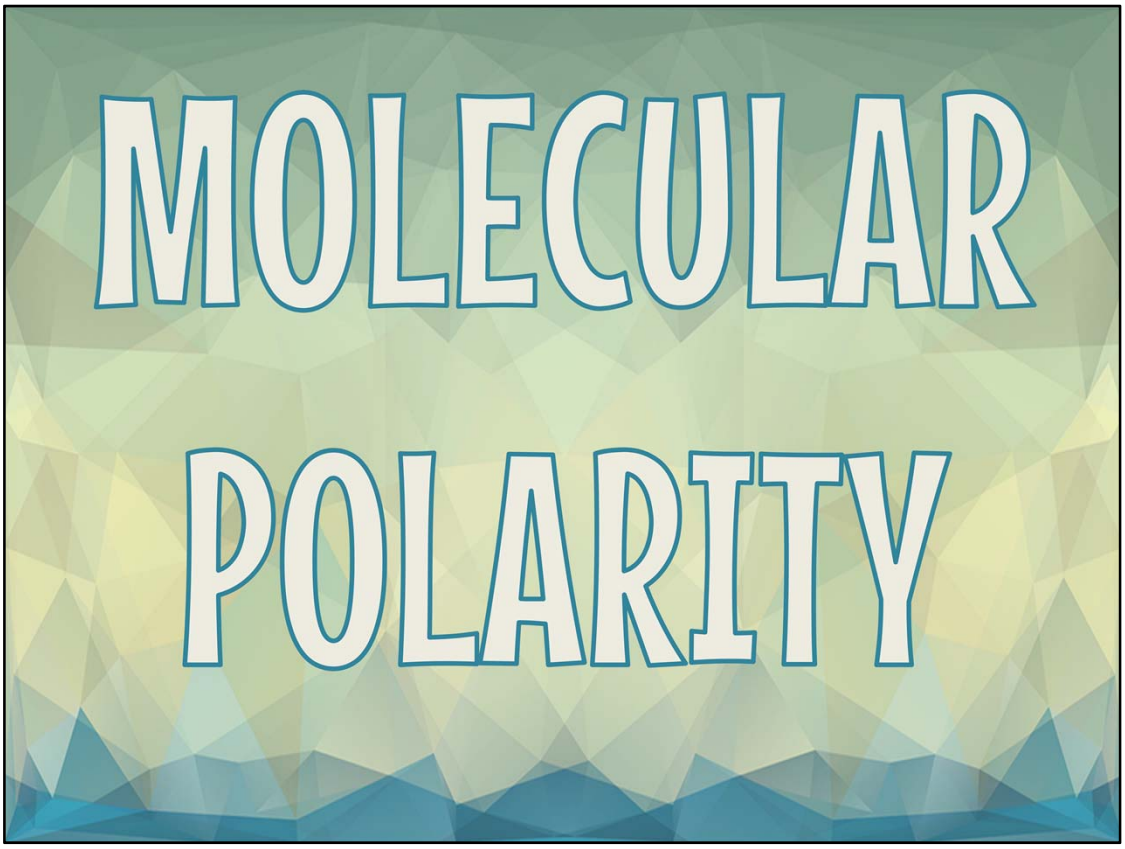
Module 4: Bonding, Formula Writing, and Nomenclature
Topic 7 Content: Molecular Polarity Presentation Notes



Molecular Polarity

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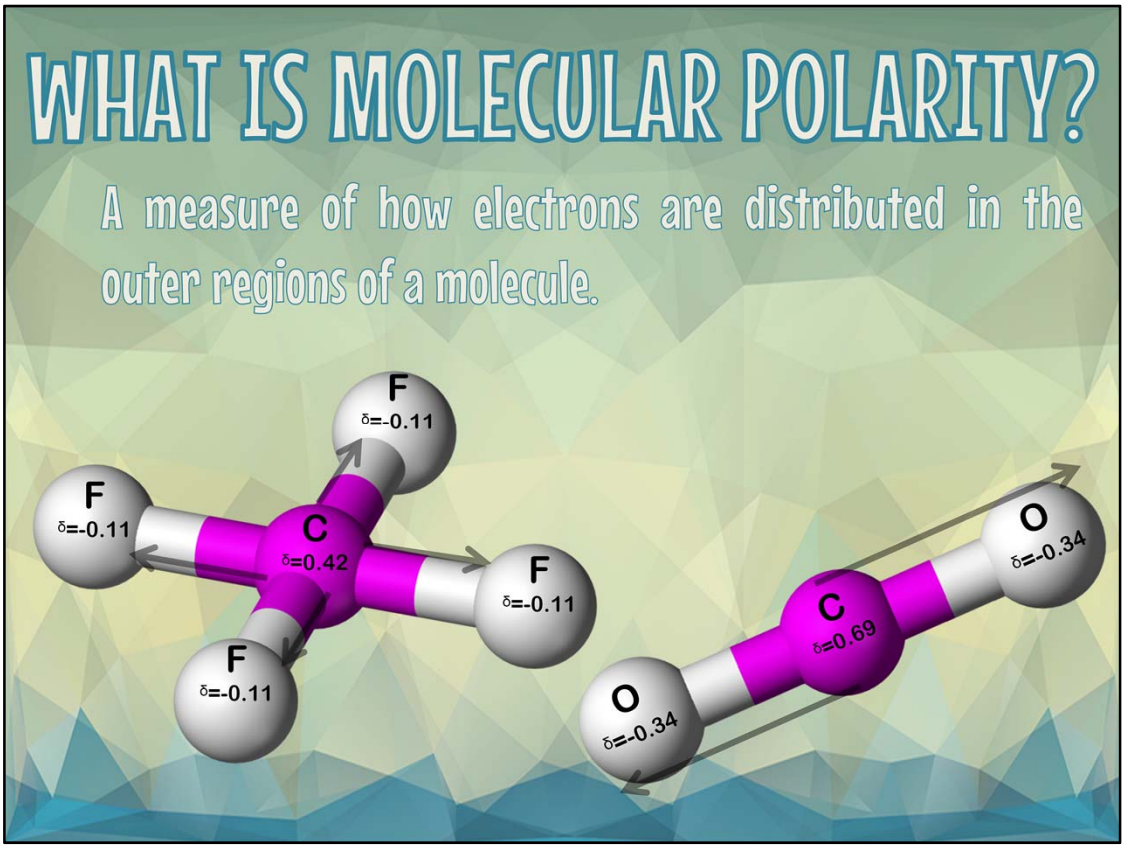
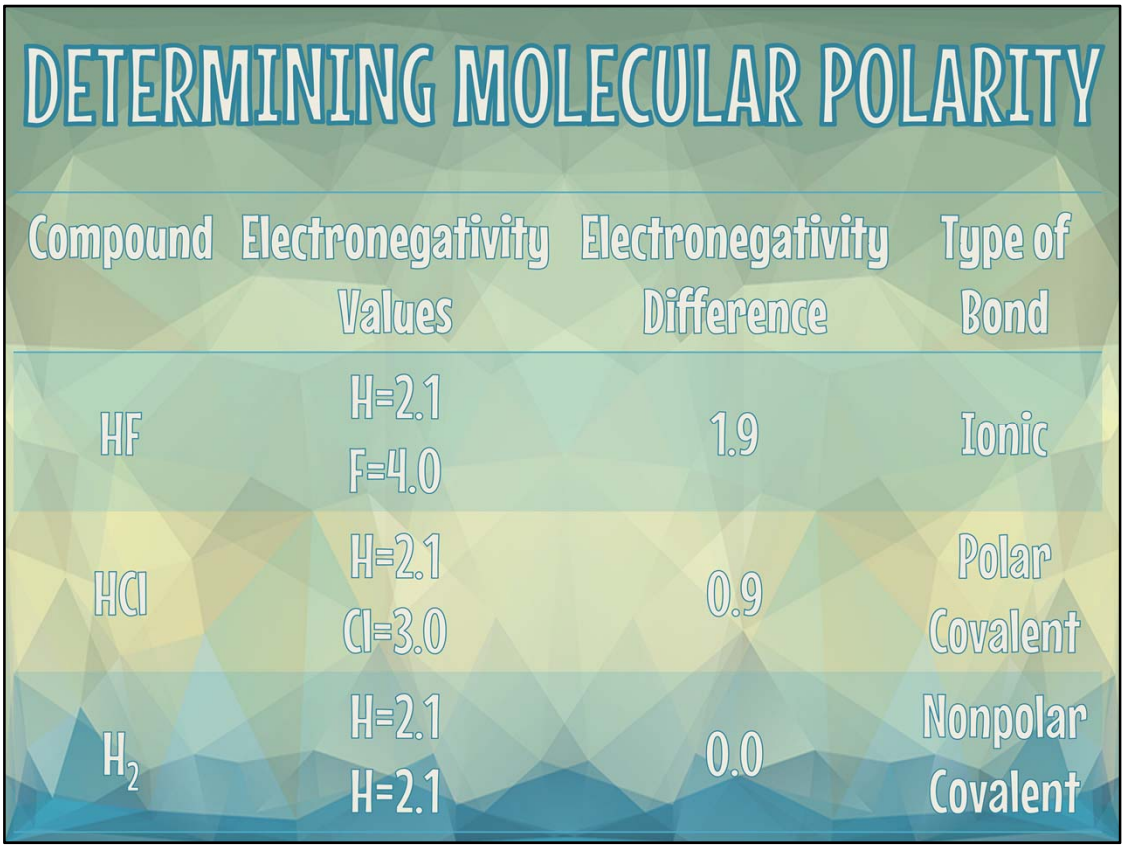


Molecular polarity is a measure of how electrons are distributed in the outer regions of the molecule. How is the molecular polarity of a molecule determined? Would you be able to determine the polarity of carbon tetrafluoride and carbon dioxide?



The type of bond between atoms is determined by the difference in electronegativity. View this table that shows three different compounds, their electronegativity differences, and the resulting bonds. Hydrogen fluoride, or HF contains an electronegativity difference of 1.9. The result is an ionic bond. Hydrochloric acid has an electronegativity difference of 0.9. The resulting bond is polar covalent. Hydrogen gas has no electronegativity difference. The result is nonpolar covalent.

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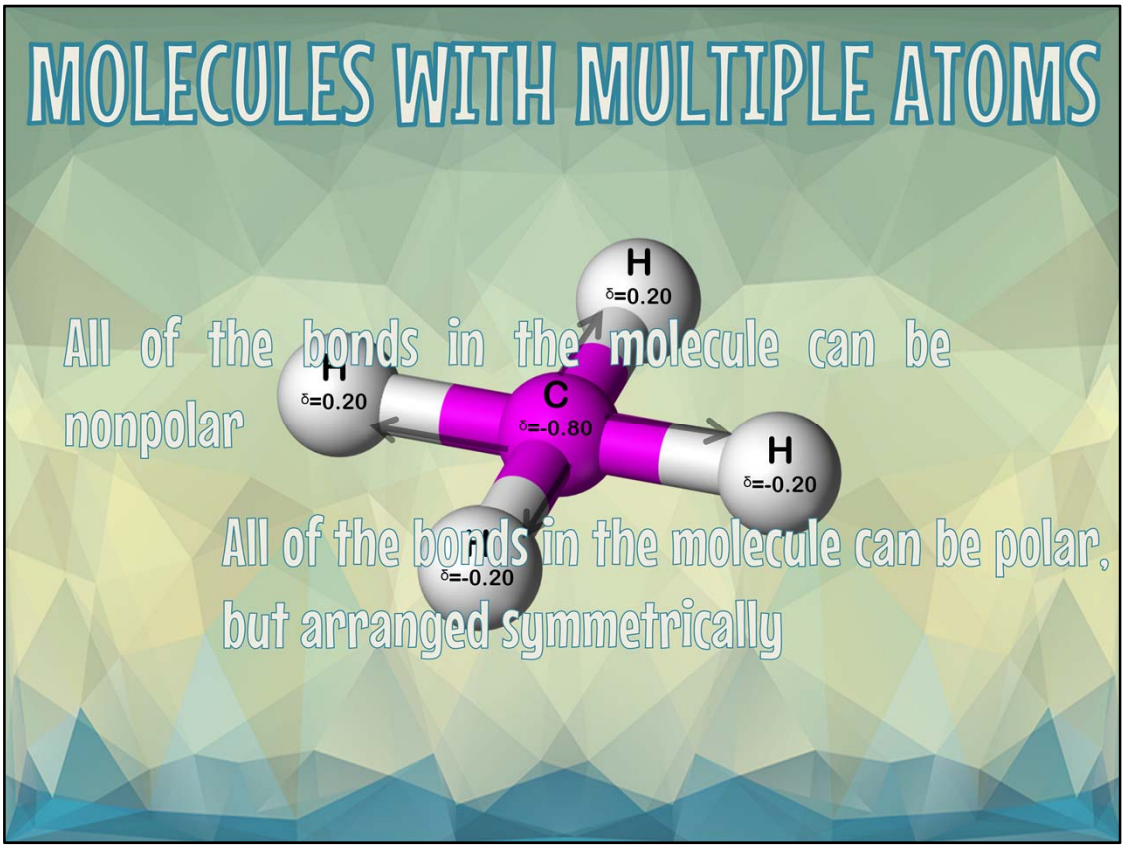
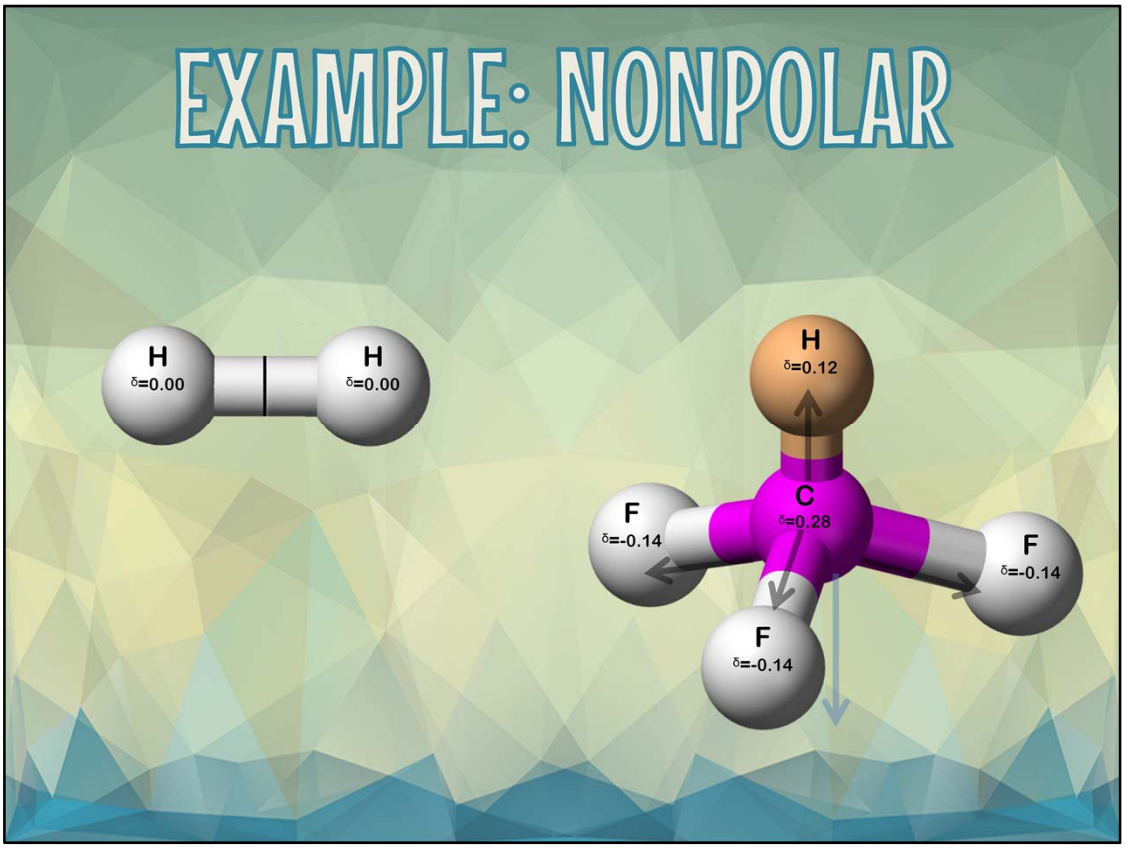
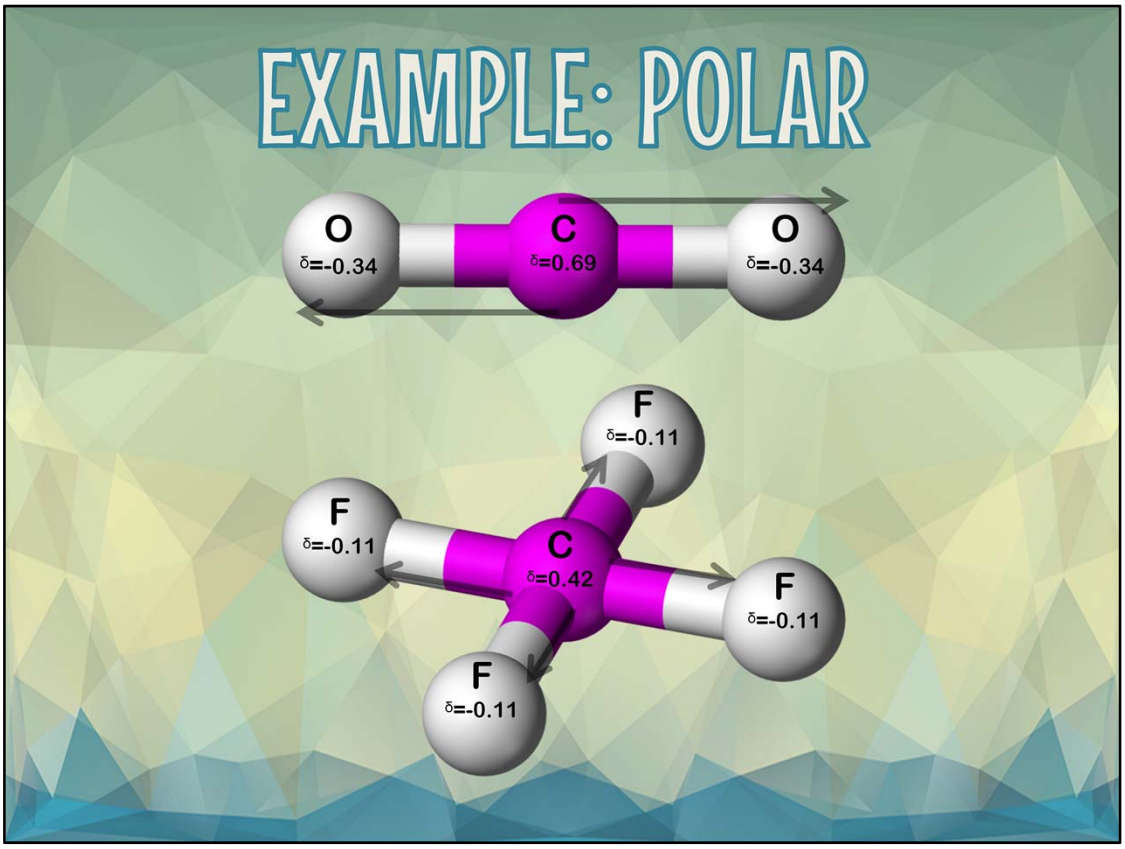


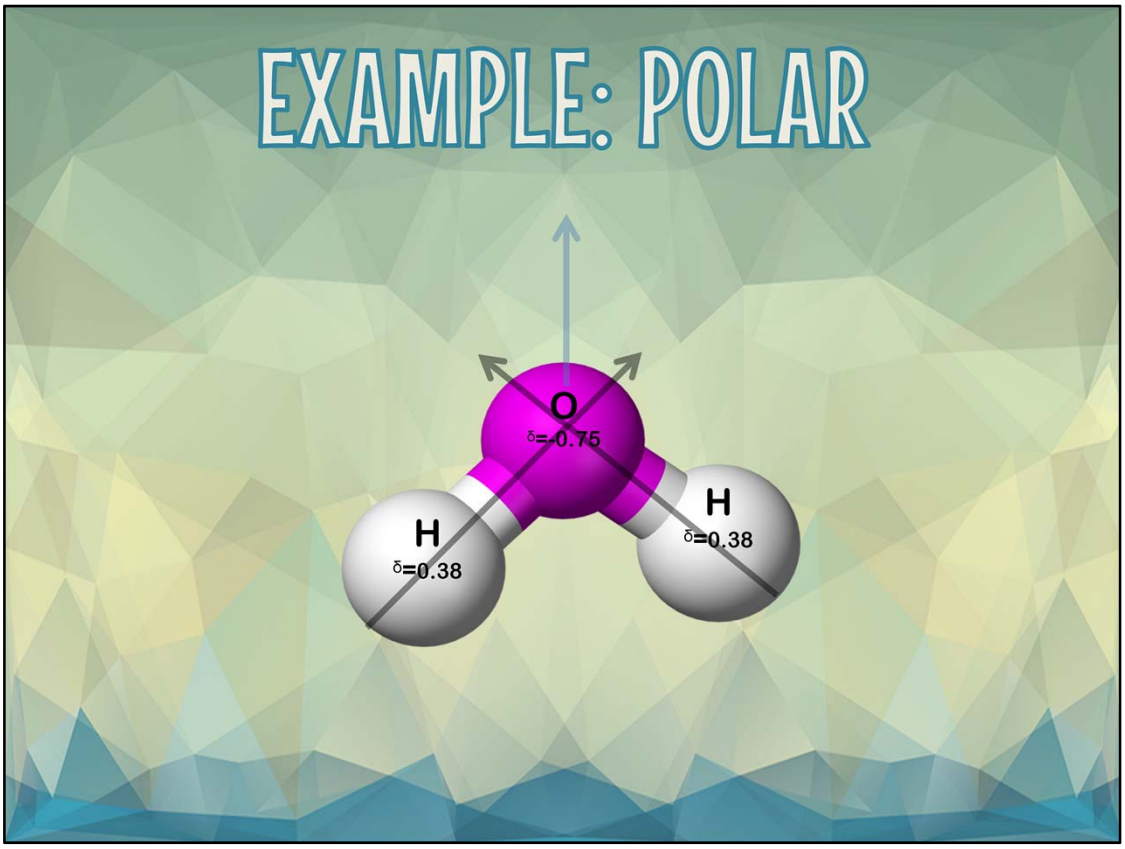
For molecules with three or more atoms, the polarity of the individual bonds, as well as the overall molecular geometry, is considered in determining molecular polarity. There are two ways that a molecule can be nonpolar, or have its electrons distributed equally throughout the molecule. First, all of the bonds in the molecule can be nonpolar. Second, all of the bonds in the molecule can be polar, but arranged symmetrically so that the dipole moments cancel each other. Please view the example of methane, or CH_4. How would you determine the polarity of this molecule? In this example, all of the bonds are polar but they cancel each other out. This is indicated by the arrows pointing in opposite directions.



Hydrogen and trifluoromethane are shown here. The bonds in these two examples are nonpolar. Both of these compounds have no net charge.



Carbon dioxide, or CO_2, and tetrafluoromethane, or CF_4, are shown here. The bonds in these two examples are polar, but arranged symmetrically. You can see that the charge of the atoms is not equal to zero.



In all other molecules, a polar molecule will result. The overall polarity of the molecule is shown with an arrow pointing upwards from the central atom. Take a moment to view the polarity of the water molecule, or H_2O. Notice the bent shape of the water molecule. Water has an angle of around 105° between its bonds. Why does this occur? A water molecule has two pairs of bonded electrons and two unshared lone pairs. This bent shape causes water's polarity and creates hydrogen bonding. Water's shape causes it to have extreme surface tension and stability as a molecule.