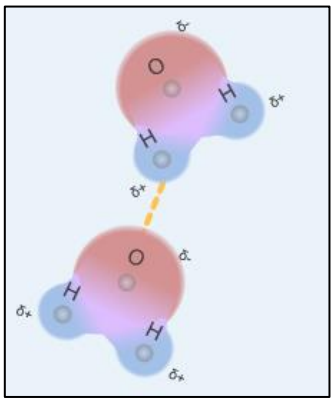
# Vocabulary: Polarity and Intermolecular Forces

## Vocabulary

- Dipole – a molecule containing two "poles," or regions of opposite charge.
  - A polar molecule contains a permanent dipole.

- Dipole-dipole force – an intermolecular force of attraction between two polar molecules.
  - In a dipole-dipole attraction, the partial positive side of one molecule is attracted to the partial negative side of an adjacent molecule. This is the strongest type of intermolecular force.
  - Hydrogen bonds are among the strongest types of dipole-dipole forces. A hydrogen bond forms between a hydrogen atom in one molecule and a highly electronegative atom (such as oxygen) in another molecule, as shown at right.




- Dipole-induced dipole force – an intermolecular force of attraction that occurs when a polar molecule induces polarity in a nonpolar molecule.
  - When the positive side of a polar molecule approaches a nonpolar molecule, the electron cloud of the nonpolar molecule becomes distorted, moving towards the polar molecule. As a result, the nonpolar molecule becomes temporarily polar, and is attracted to the polar molecule.
  - A similar phenomenon occurs when the negative side of a polar molecule approaches a nonpolar molecule. Electrons are repelled from one side of the nonpolar molecule, causing it to become temporarily polar.

- Electronegativity – a measure of how strongly one atom attracts a shared pair of electrons. Electronegativity values range from 0.7 to 4.0, and are unitless.
  - Nonmetals tend to have a greater electronegativity than metals.
  - Electronegativity tends to increase across a period and decrease down a group in the periodic table.

- Intermolecular force – a force of attraction between molecules.
  - Intermolecular forces (IMFs) are also known as van der Waals forces.
  - Intermolecular forces are relatively weak compared to ionic and covalent bonds.

- Ionic bond – a bond formed by the attraction between two oppositely charged ions.
  - Ionic bonds are the most polar type of bond since valence electrons are completely transferred from one atom to another.
  - Ionic bonds occur if the electronegativity difference is greater than/equal to 1.67.

- London dispersion force – an intermolecular force of attraction that occurs when a temporary dipole of one atom induces polarity in a neighboring atom.
    - Temporary dipoles form due to random fluctuations in the density of the electron cloud surrounding the nucleus.
    - While London dispersion forces are the primary type of intermolecular forces between nonpolar molecules, they are also present between polar molecules.
    - London dispersion forces are the weakest type of intermolecular force.

- Molecule – a stable particle composed of two or more atoms.
    - A water molecule ($H_2O$) is made of two hydrogen atoms and one oxygen atom.

- Nonpolar – having an overall even distribution of positive and negative charges.
    - Both bonds and molecules as a whole can be nonpolar.
    - Intermolecular forces between nonpolar molecules tend to be weaker than those between polar molecules.

- Nonpolar covalent bond – a covalent bond characterized by equal sharing of electrons.
    - If the atoms in a bond have the same electronegativity (or a difference less than or equal to 0.4), then the bond is considered to be nonpolar covalent.
    - All diatomic molecules ($O_2$, $Cl_2$, etc.) have nonpolar covalent bonds.

- Partial charge – a charge with an absolute value of less than 1 in regions of polar molecules created by unequal sharing of electron pairs in covalent bonds.
    - Partial charges are represented by the Greek lowercase delta (δ+ or δ–).
    - In a polar molecule, the region where the electron cloud is denser has a δ– charge while the region where the electron cloud is less dense has a δ+ charge.

- Polar – having distinct regions of positive and negative charge.
    - Both individual bonds and molecules as a whole can be classified as polar.
    - IMFs between polar molecules are relatively strong.
    - A polar substance, such as water, will have both a partial positive and a partial negative side but overall will be neutral.

- Polar covalent bond – a covalent bond characterized by unequal sharing of electrons.
    - If the atoms in a bond have an electronegativity difference greater than 0.4 and less than 1.67 then the bond is considered polar covalent.
    - Each of the atoms in a polar covalent bond will either have a partial positive (δ+) or a partial negative (δ–) charge.

- Valence electron – an electron in the outermost energy level of an atom.
    - Valence electrons take part in chemical bonds when they are transferred or shared.