5.8: Differentiate among dipole-dipole forces, ion-dipole forces, hydrogen bonding, and London dispersion forces
INTERMOLECULAR FORCES

- **Intermolecular forces**: Weak forces of attraction or repulsion between neighboring particles that may be atoms, ions, or molecules.
  - The more polar the molecules, the stronger the intermolecular forces that exist to attract the molecules together
  - Also known as **van der Waal’s forces**

- There are several types of intermolecular forces
  - Hydrogen Bonding
  - Dipole-Dipole Forces
  - Ion-Dipole Forces
  - London Dispersion Forces

5.8: Differentiate among dipole-dipole forces, ion-dipole forces, hydrogen bonding, and London dispersion forces
HYDROGEN BONDING

• The strongest intermolecular force
  • Attractive force caused by hydrogen attracted towards one of following:
    • Fluorine
    • Oxygen
    • Nitrogen
  • The above compounds are highly electronegative elements with large unshared electron clouds, so hydrogen atoms partially share this electron cloud with the molecule next to it.
HYDROGEN BONDING

5.8: Differentiate among dipole-dipole forces, ion-dipole forces, hydrogen bonding, and London dispersion forces.
**DIPOLE-DIPOLE FORCES**

- **Dipole Moment:** Molecules that are polar, which means that one end of the molecule has a different charge, albeit very small, than the other side of the molecule, creating a polarized molecule with a “north” and a “south” pole, or positive and negative ends.
  - Just because a molecule has a polar bond does not automatically mean the molecule is polar!
    - Must consider geometry
    - Polar molecules may cancel each other out
  - Polar molecules will be attracted each other, opposite end to opposite end
    - Slightly negative end will be attracted to slightly positive end
    - Slightly positive end will be attracted to slightly negative end
  - The second strongest intermolecular force

5.8: Differentiate among dipole-dipole forces, ion-dipole forces, hydrogen bonding, and London dispersion forces
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**ION-DIPOLE FORCES**

- An ion can also be attracted to a dipole moment (polar molecule)
  - Cation will be attracted to slightly negative end of dipole
  - Anion will be attracted to slightly positive end of dipole

- The third-strongest (and second-weakest) intermolecular force
ION-DIPOLE FORCES

5.8: Differentiate among dipole-dipole forces, ion-dipole forces, hydrogen bonding, and London dispersion forces
**LONDON DISPERSION FORCE**

- **London Dispersion Force:** A temporary attractive force that results when the electrons in two adjacent atoms occupy positions that make the atoms form temporary dipoles, and the temporary dipoles are attracted to each other in a weaker version of the dipole-dipole force.
  - The weakest intermolecular force
  - Stronger effect on larger molecules
    - The larger the molecules involved become, the larger the London Dispersion Forces attract the molecules together
5.8: Differentiate among dipole-dipole forces, ion-dipole forces, hydrogen bonding, and London dispersion forces.
EXAMPLE PROBLEMS

• Identify the dominant intermolecular force for the following molecules:
  • C₃H₈
  • HCl
  • MgO
  • NaCl
  • O₂
  • CO₂
  • H₂O
EXAMPLE PROBLEM SOLUTIONS

- Identify the dominant intermolecular force for the following molecules:
  - $\text{C}_3\text{H}_8$: Dispersion
  - $\text{HCl}$: Dipole-Dipole
  - $\text{MgO}$: Dipole-Dipole
  - $\text{NaCl}$ in Water: Ion-Dipole
  - $\text{O}_2$: Dispersion
  - $\text{CO}_2$: Dispersion
  - $\text{H}_2\text{O}$: Hydrogen Bonding

5.8: Differentiate among dipole-dipole forces, ion-dipole forces, hydrogen bonding, and London dispersion forces