Introduction for Module 15 – Intermolecular Forces

Textbook: Open Stax Chemistry 2e

Suggested Reading: Chapter 10.1-10.3 (Especially 10.1)

Learning Objectives:

- **Identify and recognize different types of intermolecular forces**
- **Connect molecular geometry and polarity to physical properties**
- **Appreciate the uniqueness of hydrogen-bonding, and its role in many biological applications**

Captions and Attributions:

1) Intermolecular forces between polar molecules determine physical properties due to providing differences in attraction between molecules. Figure 10.5, Intramolecular forces keep a molecule intact by Open Stax is licensed under CC BY 4.0.

2) London dispersion force results from temporary dipoles, and will be stronger in larger molecules. Figure 10.6, Dispersion forces result by Open Stax is licensed under CC BY 4.0.

3) As molecules acquire more kinetic energy (by a sample increasing in Temperature) phase transitions such as the solid, liquid, gas transition shown will occur. Figure 10.2, Transitions between solid, liquid, and gaseous by Open Stax is licensed under CC BY 4.0.

4) Hydrogen bonding in water is perfectly optimized as each water molecule has two lone pairs on oxygen and two hydrogens, creating the rich hydrogen bonding network shown. Figure 10.1, London Forces and Their Effects by Open Stax is licensed under CC BY 4.0.

5) Changing the size of hydrocarbons greatly impacts boiling point and physical properties. Common alkanes and their uses are shown.

6) The boiling points of alkanes of increasing size can be compared, which demonstrates the connection between intermolecular force increasing and the physical state at room temperature.

7) Based on trends in London dispersion forces, we would predict the following molecules shown with "?" to have the boiling points shown. Figure 10.11, For the group 15, 16, and 17 by Open Stax is licensed under CC BY 4.0.

8) A large diversion from the trend in boiling point is present for the molecules shown, which is a consequence of the intermolecular force hydrogen bonding. Figure 10.12, In comparison to periods 3−5 by Open Stax is licensed under CC BY 4.0.

9) Hydrogen bonding in water is perfectly optimized as each water molecule has two lone pairs on oxygen and two hydrogens, creating the rich hydrogen bonding network shown. Figure 10.10, Water molecules participate by Open Stax is licensed under CC BY 4.0.

10) When matched together, two strands of DNA form the characteristic double helix structure shown. Figure 10.13, Two separate DNA molecules by Open Stax is licensed under CC BY 4.0.

11) The pairing shown by nucleotides are determined by hydrogen bonding, with proper matching of bases resulting in the maximum number of hydrogen bonds formed. Figure 10.14, The geometries of the base molecules by Open Stax is licensed under CC BY 4.0.

The creation of this work, “Open Chemistry Online: Module 15” was supported by Open CU Boulder 2023-2024, a grant funded by the Colorado Department of Higher Education with additional support from the CU Office of the President, CU Office of Academic Affairs, CU Boulder Office of the Provost, and CU Boulder University Libraries.