Lecture 12, Feb 6, 2023

Hydrogen Bonds

- Hydrogen atoms are bonded to oxygen, nitrogen or fluorine
  - The hydrogen is partially positive; the other atom is partially negative due to electronegativity differences
  - Chlorine does not form hydrogen bonds because it's screened due to ionic bonding
- This force imposes directions on biological molecules
- Typically denoted with a hashed line
- Only a hydrogen bonded to oxygen, nitrogen or fluorine can hydrogen bond
- Carbon doesn't form hydrogen bonds because its typical high valence of 4 contributes to more screening
- Hydrogen bonds give water special properties:
  - higher boiling point and melting point relative to its degree of hydrogen bonding
  - Higher density in liquid phase and anomalous negative thermal expansion
  - High heat of fusion and heat of vaporization
  - High specific heat – drives the Gaia effect
  - High dielectric constant (critical to hydrogen transfer)
  - Anomalous long-range correlations in its liquid structure
  - Anomalous high surface tension, yet low bulk viscosity
    * This is due to the fluctuation of hydrogen bonds
- Water has the most hydrogen bonding per unit mass than anything else – why is it a liquid at room temperature with such low viscosity?