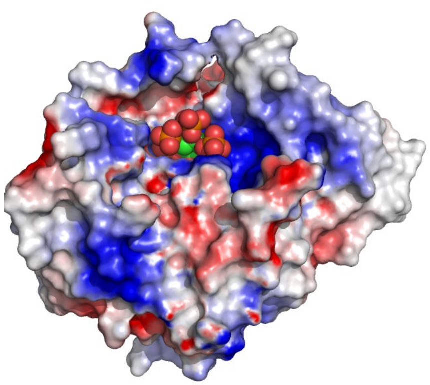
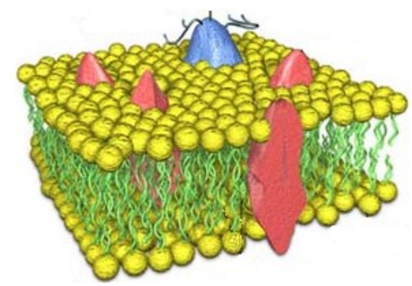
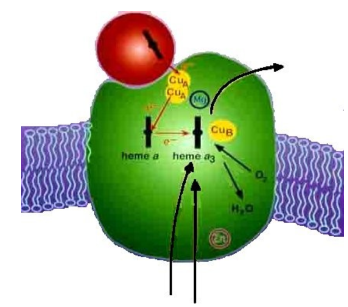
Biochemistry 2000 Spring 2013

Proteins and Nucleic Acids







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Review Material

Chapters 1-3 of Voet & Voet are detailed review and reference materials

Chapter 1: Life

- Biology concepts

Chapter 2: Aqueous Solutions

- Physiochemical properties of water
  (a unique liquid)

Chapter 3: Thermodynamic Principles

- Basic energetics

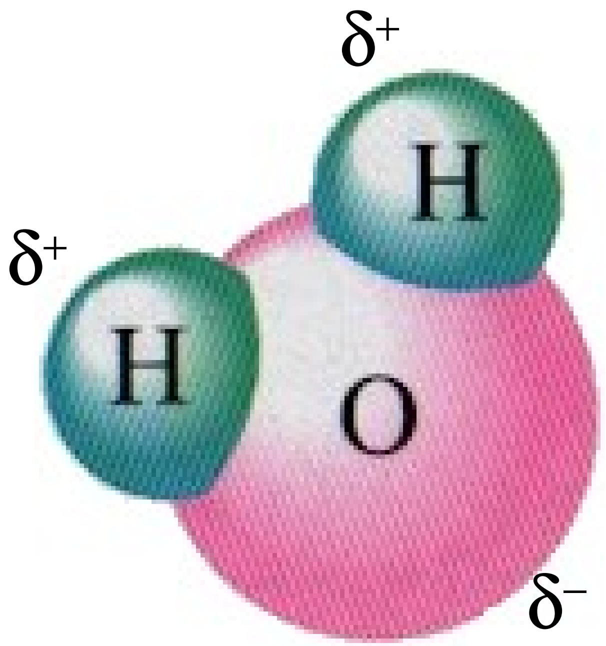
Introduction

***Biochemistry* is the study of the *molecular basis of living systems*.**

When isolated and examined, biomolecules (and all processes in a living organism) conform to all the physical and chemical laws that govern inanimate matter.

Life arises from the collection and interaction of inanimate biomolecules.

Water

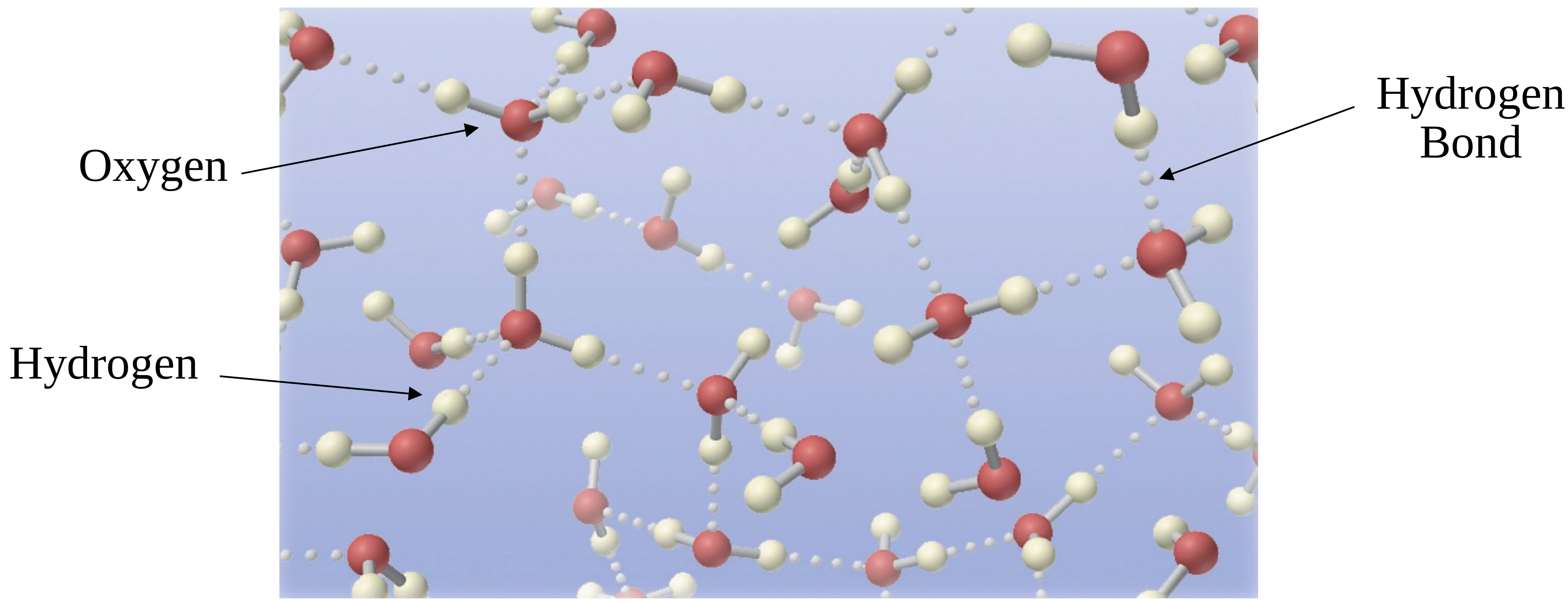


Life (as we know it) occurs exclusively in aqueous solution.

The <u>structures (or shapes)</u> of molecules on which life is based – proteins, nucleic acids, lipids, and complex carbohydrates – result directly from their interactions with their aqueous environment

Structure of Water

Water is a highly polar solvent that forms rapidly fluctuating, extended networks of strong non-covalent interactions (hydrogen bonds).



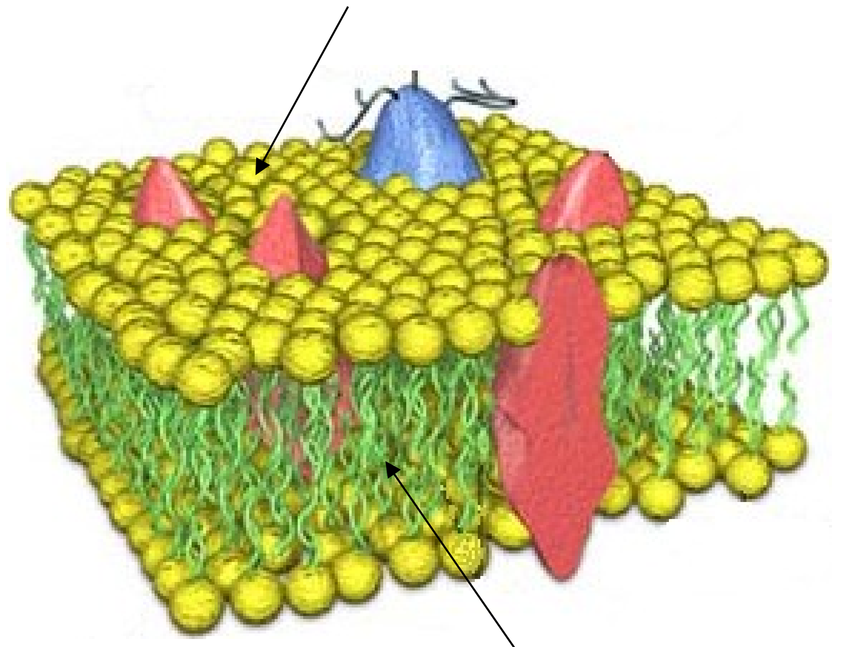
These properties and others are peculiar to water; no other solvent resembles water in this respect.

Water as a Solvent

The high polarity of water makes it an excellent solvent for polar and ionic (hydrophilic) materials AND a poor solvent for non-polar (hydrophobic) substances.

Most biological molecules have both polar and non-polar segments.

In aqueous solution, the polar segments are hydrated (contact water) and the non-polar segments are excluded (do not contact water)



Acids and Bases

Water is a weak acid/base and the properties of biological molecules typically vary with pH

- **Acids donate and bases accept protons***

*** This definition (Bronsted acid/base) serves for Bchm2000**

Equilibrium expression for an acid-base reaction

$$HA + H_2O \rightleftarrows A^- + H_3O^+$$

Equilibrium (dissociation) constant K is typically combined with the [H_2O] and written as K_a (where 'a' refers to acid)

$$K = \frac{([A^-][H_3O^+])}{([HA][H_2O])} \qquad K_a = \frac{([A^-][H_3O^+])}{([HA])}$$

pH (or -log [H^+])

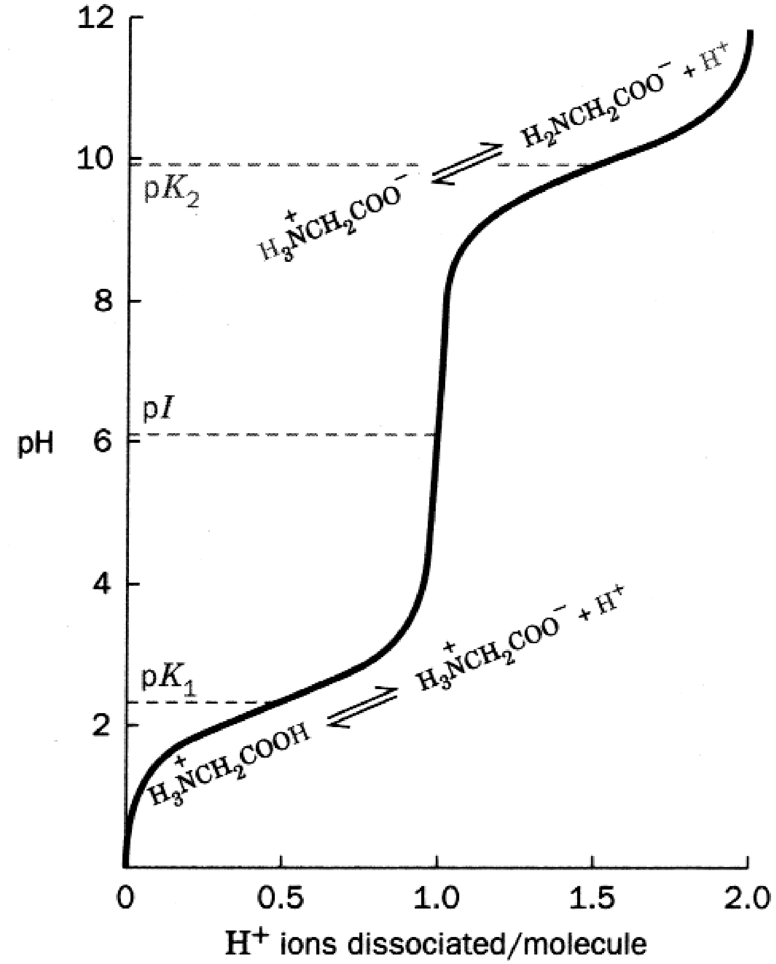
The pH of a solution is determined by the relative concentrations of acids and bases

- **K_a is the acid dissociation constant in the following <u>equivalent</u> expressions**

$$[H^{+1}] = K_a\left(\frac{[HA]}{[A^{-1}]}\right)$$

$$pH = -\log K_a - \log\left(\frac{[HA]}{[A^{-1}]}\right)$$

$$pH = pK_a + \log\left(\frac{[A^{-1}]}{[HA]}\right)$$



H^+ ions dissociated / molecule of glycine
(Equivalent to OH^- equivalents added)

pK_a of a functional group is defined as the <u>pH at which exactly half is protonated</u>.