

# Biochemistry

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## Syllabus

### I. Water

- A. Noncovalent interactions - intermolecular forces
- B. Hydrogen bonding and the hydrophobic effect
- C. Acid-base chemistry
- D. Buffer solutions

### II. Amino Acids, Peptides, and Proteins

- A. Structure and chemistry of amino acids
- B. The peptide bond and primary protein structure
- C. Peptides - oligopeptides, peptides, polypeptides, and proteins
- D. Protein sequence alignments, mutations, natural selection, and evolution

### III. Three-Dimensional Structure of Proteins

- A. Protein characterization
- B. Four levels of protein structure
- C. Protein folding, native conformation, and denaturation
- D. Post-translational modifications

### IV. Protein Function

- A. Binding proteins - reversible molecular binding of ligand
- B. Myoglobin and hemoglobin
- C. Multimeric proteins and protein cooperativity

## V. Enzymes

- A. Enzyme catalysis, mechanisms, and strategies
- B. Enzyme cofactors, apoenzymes, and holoenzymes
- C. Christian Anfinsen experiment
- D. Enzyme kinetics and enzyme inhibition

## VI. Carbohydrates and Glycobiology

- A. Monosaccharides and disaccharides
- B. Polysaccharides
- C. Proteoglycans, glycoproteins, and glycolipids

## VII. Nucleotides and Nucleic Acids

- A. Bases, nucleosides, and nucleotides
- B. Nucleic acid primary structure and the double helix
- C. Unusual secondary structures of nucleic acids
- D. RNA molecules and their diversity in structure and function
- E. Central dogma of molecular biology
- F. DNA-RNA technologies

## VIII. Lipids, Membranes, and Membrane Transport

- A. Energy-storage lipids - fats and oils
- B. Membrane lipids
- C. Lipids as chemical signals and enzyme cofactors
- D. Membrane proteins - receptors, transport proteins, and solute channels

## IX. Bioenergetics and Metabolism

- A. Cellular energy and thermodynamics
- B. ATP, phosphoryl-group transfers, and redox reactions
- C. Glycolysis, gluconeogenesis, and the pentose phosphate pathway
- D. Metabolic regulation
- E. Citric acid cycle and  $\beta$ -oxidation
- F. Oxidative phosphorylation and the electron transport chain

## X. Amino Acid and Nucleic Acid Metabolism

- A. Amino-acid catabolism and urea production
- B. Biosynthesis of amino acids
- C. Nucleotide catabolism and uric acid production
- D. Biosynthesis of nucleotides

## XI. Hormonal Regulation and Mammalian Metabolism

- A. Hormones - structure and function
- B. Tissue-specific metabolism
- C. Hormonal regulation of biological fuel metabolism
- D. Obesity and regulation of body mass