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Biochemistry

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Overview

- Structural features of proteins and nucleic acids.
- Non-linear (allosteric) behavior of proteins.
- Technological uses of immunogloblins.
- Biochemical catalysts (enzymes).
- Rational design of enzyme inhibitors and drugs.
- Energy generating metabolic pathways and their regulation.
- Production of proteins using modern recombinant DNA techniques.

Content Outline

Introduction

- Functional groups
- Molecular forces
- Water structure and hydrogen bonds

Acids and Buffers

- Acid-base behaviour
- Effect of pH on charge

- Buffers

Protein Structure

- Amino acids
- Structural Hierarchy
- Protein stability
- Case study: Immunoglobulins and Drug detoxification

Binding & Allosteric Effects

- Quantitative analysis of ligand binding
- Case study: Oxygen transport
- Allosteric effects and Cooperative binding

Enzymes

- Catalysts
- Case Study: Serine proteases
- Enzyme kinetics and inhibitors
- Case Study: HIV protease inhibitors

Protein Purification

- Purification methods
- Determination of Quaternary structure
- Structure determination by X-ray diffraction

Carbohydrates

- Mono- and disaccharides
- Polysaccharides

Lipids

- Fatty acids, triglycerides, phospholipids
- Biological membranes
- Case study: Ion channels

Metabolism

- Energetics - Gibbs free energy
- Central pathways in energy generation
- Oxidation of lipids
- Regulation of carbohydrate metabolism

DNA

- Nucleic acid structure and stability
- DNA-protein interactions
- DNA polymerases
- PCR and DNA sequencing
- Properties of expression vectors
- Control of mRNA synthesis in prokaryotes
- Control of protein synthesis in prokayrotes

- Expression of recombinant proteins
- DNA replication

Modern Biology

http://oli.web.cmu.edu/openlearning/forstudents/freecourses/biology

Course Description

This introductory course in "Modern Biology" covers topics found in the fields of cellular biology, molecular biology, biochemistry, and genetics. It does not cover organismal biology or taxonomy. This course is a requirement for biology majors at Carnegie Mellon University. The course is carefully planned to provide the background biology students will need for advanced biology classes. Non-biology majors will also find this course useful as it explains many of the concepts and techniques currently discussed in the popular press.

This Modern Biology course is built around six Key Concepts that provide unifying explanations for how and why structures are formed and processes occur throughout your study of biology. Because it is not possible to cover the breadth of modern molecular biology in one semester, an understanding of these Key Concepts will provide a basis for extension of your knowledge to biological systems beyond the specifics covered in this course. One of the major goals of the course therefore is for you to not only learn the definitions of the concepts but also learn to recognize when they are operating the process being studied.

Key Concepts

- Bioselectivity
- Energy
- Equilibrium
- Ionic State
- Rate Control
- Solubility

Course Structure

Unit 1: Modern Biology

Unit 2: Biological Chemistry

- Atoms, Functional Groups, and Water
- Equilibrium and pH
- Carbohydrates and Polysaccharides
- Amino Acids and Proteins
- Enzymes and Regulation

Unit 3: Cell Biology Module

- Lipids and Membranes
- Membrane Transport

Unit 4: Basis of Molecular Biology

- DNA and RNA
- DNA Replication
- DNA Transcription
- RNA Translation
- Protein Synthesis

Unit 5: Metabolism

- Pathways

- Energetics
- Enzyme Nomenclature
- Glycolysis
- TCA Cycle
- Electron Transport and Ox. Phos.
- Integrated Metabolism

Appendix: Glossaries

- Instructions for Activities
- Tutorial Animations
- Functional Groups
- Structure and Function of the Cell Membrane
- Images of Living Cells