

BIOL334 Comparative Biochemistry

Course Description

A survey of selected topics including: general principles of enzymology; bioenergetics; metabolism and its control; the importance of proteomic and enzyme research in functional genomics and biotechnology; mechanisms whereby animals and plants acclimate at the biochemical level to environmental stress.

Course Objectives

Biochemistry is the study of the chemical basis of life. Traditional undergraduate courses in biochemistry tend to focus on the conserved aspects of metabolic pathways: those established through studying relatively few "model" organisms, typically mammalian. In contrast, BIOL-334 is intended to give students an appreciation of biochemical adaptation. We survey the myriad of strategies by which diverse organisms from the various kingdoms of life alter the basic biochemical plan to meet the challenges of living in a wide range of environments.

Thus, this course will compare and contrast various aspects of metabolism and its control with an emphasis on: (i) fundamental similarities and distinctions between animal, plant and microbial metabolism, & (ii) examples of how the survival of various species in 'extreme' environments is highly dependent upon key adaptations at the biochemical/ metabolic level of biological organization.

Assumed Background Knowledge

At very least, you should have a 'Biol-102/103' level of understanding' of the following material in the recommended course text (Lehninger Principles of Biochemistry).

- CHPT 1: Basic cell biology (including prokaryotes vs. eukaryotes) & Molecular logic of life including relationship between a gene, & corresponding mRNA transcript & protein (know basics of transcription & translation), & the pivotal importance & major functions of the 4 classes of macromolecules = polysaccharides, nucleic acids, proteins, & lipids = the major components of any cell
- CHPT 2: Roles of H₂O, including types of bonds (covalent, ionic, H-bonds, hydrophobic interactions) & meaning of the pH scale
- CHPTS 3 & 4: Amino acids & primary to quaternary protein structure
- CHPT 5: Protein Function (including the basic concepts of enzymes & metabolism)
- CHPT 11: Membranes – fluid mosaic model of membrane structure & function

Course Topics

1. Metabolism in Animals, Plants & Microbes

Enzymes as protein catalysts; Thermodynamics, free energy & bioenergetics; Overview of metabolic control; "Coarse vs. Fine Metabolic Control"; Stimulus-response coupling by cellular '2nd messengers'; Major similarities & differences between animal vs. plant metabolism

2. Applications of Metabolic Biochemistry

Metabolic Biochemistry Helps to 'Close the Gap' in Functional Genomics; Critical Role of Protein, Enzyme, & Metabolic Biochemistry in Biotechnology

3. Biochemical Adaptation

Overview of Glycolysis, Oxidative Pentose-phosphate Pathway (OPPP), TCA Cycle, & Respiration. Comparative Biochemistry of the Glycolytic Pathway. Metabolic Adaptations of Life without Oxygen (Anaerobiosis). Biochemical Adaptations of Hibernating Mammals, Comparative Biochemistry of Mitochondrial Metabolism. Biochemical Adaptations of Phosphate-starved Plants. Comparative Biochemistry of Lipid Metaboli