Biochemistry
MCDB S 300 01

Description
An introduction to the biochemistry of animals, plants, and microorganisms, emphasizing the relations of chemical principles and structure to the evolution and regulation of living systems. This course will be taught in an active learning format, whereby the typical lecture and homework elements of a course are reversed. Narrated PowerPoint video lectures are viewed by students at home before the class session, while in-class time is devoted to problem-solving exercises, collaborative projects and discussions.

Student’s Learning Objectives
Students will know the chemical structures and chemistry of biological polymers (proteins, carbohydrates, lipids and nucleic acids) and their monomers (amino acids, sugars, fatty acids and other lipid monomers, and nucleotides) as well as the roles of these biological molecules in living cells. Students will be able to solve amino acid sequences of protein, nucleotide sequences of nucleic acids from experimental data and how to determine structures of carbohydrates and lipids. Students will be able analyze enzyme kinetic data as well as the bioenergetics/thermodynamics of biochemical reactions. Students will know the reactions of major metabolic pathways and be able to analyze the regulation of these pathways: Central Metabolism (Glycolysis-Gluconeogenesis, Pentose phosphate Pathway, Citric Acid Cycle), Respiratory Electron Transport System, Glyoxylate Cycle, and Fatty Acid Metabolism (beta-oxidation and synthesis).

Prerequisites
BIOL 101, 102, 103, and 104 or MCDB 120 or MCDB 200; one term of organic chemistry

Days, Time, and Location
MWF, 9.00-11.15, SPL 56

Lecturer
Nicole Clay
Office 734 KBT
E-mail nicole.clay@yale.edu

Required Text
- The text provides a clear introduction to the detailed world of biochemistry.
- The fifth and sixth editions are also fine (NOTE: chapter numbers are not always the same)
- The lectures form the core of the course; they do not always closely follow the text.
- The text is a valuable reference for primary lecture content and for background.

Additional Materials
Narrated lecture videos and homework assignments will be posted on the ClassesV2 server.

Graded Materials
There will be four one-hour examinations (each worth 20% of the final grade). Exam questions will be derived from the lecture material and problem sets. There will be ten graded quizzes (collectively worth 20% of the final grade).

**Academic Integrity**

Academic integrity is the pursuit of scholarly activity free from fraud and deception. All University policies regarding academic integrity apply to this course. Academic dishonesty includes, but is not limited to, cheating, plagiarizing, facilitating acts of academic dishonesty by others, having unauthorized possession of examinations, submitting work of another person or work previously used without informing the instructor, or tampering with the academic work of other students. All exam answers must be the student’s own, and a student must not provide any assistance to other students during exams.

**Schedule**

**I. Background for Biochemistry**

1. May 28. Introduction to Flipped Classroom. Sizes of biological systems; Biochemical building blocks; Time scale of biochemical processes – *Ch 1*. Water; non-covalent bonds; association-dissociation; mass action, pH; titration – *Ch 1*. Thermodynamics and energy – *Ch 1.3, 8.2, and 15.1*.

**II. Structure and Function of Biological Macromolecules**


**III. Synthesis of Biological Macromolecules**


**IV. Enzyme Action**


**V. Metabolism: Enzymes, Coenzymes and Pathways**

7. June 11. **Exam 2.** Glycolysis and NAD⁺ (*Ch 16*)
8. June 13. **Quiz 5.** Glycolysis and Gluconeogenesis – *Ch 16.* Glycogen Metabolism – *Ch 21* (*skip Ch 21.3 hormones and Ch 21.1.5 PLP*)


10. June 18. **Quiz 7.** Ketone body synthesis, fatty acid synthesis and breakdown, Coenzyme B12 – *Ch 22.* Phospholipid and isoprenoid synthesis – *Ch 26* (*skip cholesterol synthesis*).


**VI. Capture of Energy by Coupling to Chemical Gradients**


**VII. Integration of Metabolic Routes**

14. June 27. **Quiz 10.** Glutamate, aspartate and serine families – *Ch 24.2.* Carbamoyl phosphate in pyrimidine biosynthesis and urea cycle – *Ch 25.1 and 23.* Cancer