MCDB S300: Biochemistry
(BIOL S300)
Yale Summer Session A
May 27 - June 28, 2024
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Class Meeting Time and Location: M,W,F 9:00 AM-11:15 AM. Location TBD
Office Hours: After class, and by appointment on Zoom

This course will be offered on-ground. Students must attend each class. Per Yale Summer Session policies, the class may not be completed asynchronously. MCDB S300 does not fulfill the biochemistry requirement of the MB&B major.

CATALOG 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.

Prerequisite of BIOL 101 or equivalent and one term of organic chemistry. For college students and beyond.

GOALS: Students will: know the structures, chemical features and biological roles of the principal classes of biomolecules in life: amino acids, proteins, carbohydrates, DNA, RNA, and lipids, as well as the roles of these biological molecules in living cells.

-develop an understanding of the principles of chemical and enzyme kinetics, including types of enzyme inhibition in sufficient depth to identify kinetic types of inhibition from primary data.

- develop an understanding of the fundamentals of biochemical thermodynamics including the principles of chemical equilibrium and coupled reactions.

- develop an understanding of the structure of biological membranes and establish the structure-and-function relationship of membrane transport processes.

-know the key reactions of major metabolic pathways and be able to analyze their regulation: Glycolysis/Gluconeogenesis, Citric Acid Cycle, Respiratory and Photosynthetic Electron Transport, the Urea Cycle and Fatty Acid Metabolism and transport.

TEXTS: Biochemistry, 10th Edition, by Jeremy Berg, John Tymoczko, Gregory Gatto, and Lubert Stryer (W.H. Freeman and Co.). An ebook is available from the publisher, if you prefer that format.

Other readings and videos will be posted online.

CLASS DYNAMICS:
1) Complete textbook readings and view narrated video lectures before the class session. Only certain classes will have a video lecture—see modules for daily details.

2) In-class time is devoted to answering student questions, clarifying misunderstandings, problem-solving exercises, data interpretation and starting the class projects. Additional practive problems (ungraded) will be posted online.

3) Students will complete two class projects. The first involves in silico drug design, and the second involves homology modelling of distant relatives of actin. The goal is to reinforce key concepts of the course and expose you to the drug research and development process.

ASSESSMENT: (100 points total)

Computer-Aided Drug Design project: 25 points (progress checks due each Sunday by end of day, final report due 6/16 by end of day).

Bioinformatics/Homology modelling project: 20 points (due end of day, 6/28)

Midterm Exam: 20 points; Administered on 6/14/24

Cumulative Final: 35 points; Administered on 6/28/24

Exams will be open-book open-note timed exams. The exams will focus on application of knowledge towards solving problems or interpreting data. Please study as if these were closed book exams—do not fall into the trap of thinking that you will have the time to look everything up or understand what is being asked without a firm grasp of the key concepts. Application of knowledge is a higher-order skill than memorization. Practice exams will be posted to Canvas.

Academic Integrity: Students are expected to read and understand "Appendix A" as outlined in the Yale Summer Session Handbook. A student violating the terms outline Appendix A of the Yale summer session handbook in any assignment, test, or examination in this class will receive a minimum penalty of a zero (0) for that exam, quiz or assignment, and may receive a grade of "F" for the course at the discretion of the instructors, following the procedures and policies of the YSS handbook.

All students will conform to Yale policies regarding inclusion and respect in the classroom.

Preliminary Schedule

Please note that below is a tentative schedule of topics that will be covered. Topics are categorized into 5 distinct units, and relevant chapter readings are indicated. **Daily details and due dates can be viewed in the unit modules on canvas.** Textbook readings and pre-recorded lectures should be viewed before class. Alterations to the schedule may be made based on the progress of the students and unforeseen circumstances. This is a general plan, schedule changes will be announced in class, via email and on Canvas.

WEEK 1:
Principles of Biochemistry (water, pH, thermodynamics (Chp. 1)

Amino Acids, Protein Structure, Hemoglobin (Chp. 2, 3)
Due: Structure exploration of Native Ligand/Inhibitor progress report (end of day Sunday)

WEEK 2:
Protein methods (Chp. 4)
Basic Concepts of Enzyme Action/Inhibitors/Drug Design (Chp. 5, 32)
Enzyme mechanisms (Chp. 6)
Enzyme Regulation (Chp. 7)
Due: Novel inhibitor docking/ADME report (end of day Sunday)

WEEK 3:
Nucleic acids (Chp. 8)/Bioinformatics (Chapter 10)
Replication of DNA (Chp. 28), Synthesis of RNA (Chp. 29).
Protein synthesis and degradation (Chp. 30, selections from Chp. 23)
Carbohydrates: (Chp. 11)
Lipids, Membranes: (Chp. 12)
Due: Drug Design report (end of day Sunday)
Midterm Exam: 6/14, Covers through Nucleic Acids (Chp 29).

WEEK 4:
Membrane Channels and Pumps (Chp. 13)
Signal Transduction (Chp. 14)
Metabolism: Basic Concepts and Design (Chp. 15)
Glycolysis/Gluconeogenesis (Chp. 16)
Glycogen metabolism (Chp. 21)
Citric Acid Cycle (Chp. 17)
Mitochondrial Electron Transport Chain and ATP Synthesis (Chp. 18)
Photosynthesis: Light reactions (Chp. 19)
Due: Bioinformatics progress report (end of day Sunday)

WEEK 5:
The Calvin Cycle/ Pentose Phosphate Pathway (Chp. 20)
Fatty Acid Degradation /Fatty Acid Synthesis / Ketone body synthesis (Chp. 22)
Cholesterol synthesis and Lipid Transport (Chp. 27)
Urea Cycle (Chp. 23)
Metabolism: Integration (Chp. 24)
Due: Bioinformatics final report (end of day Friday)

Final Exam: 6/28, Comprehensive (all topics weighted evenly)