

Metabolic Biochemistry

BIBC 102

Spring Quarter 2021

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Office Hours: Office hours will be held during the scheduled Tues/Thurs lecture times from 9:30 – 10:30 AM and from 3:30 – 4:30 PM. These sessions are held on Zoom and can be accessed on the Zoom LTI page on Canvas.

Required Text: D.L. Nelson and M.M. Cox, Lehninger-Principles of Biochemistry, 7th Edition (Freeman). You will automatically have access to the eBook on Canvas through the Inclusive Access Program run by the UCSD Bookstore. This access will be free for the first two weeks of the quarter. After two weeks, your student account will be charged for access through the remainder of the quarter. **If you do not want to purchase access past week 2, you must actively opt out by Friday April 9th, otherwise your account will be charged.** Instructions for opting out are given on the textbook page on Canvas.

Course Objectives:

This course will examine the concepts of energy and metabolism, and how they are harnessed and regulated at the cellular and molecular level. We will start by looking in detail at the action of enzymes. We will examine the kinetics of enzyme-catalyzed reactions, the chemical mechanisms through which enzymes produce catalysis, and the regulation of catalytic activity. The remainder of the quarter will focus on metabolism, the various pathways by which biological molecules are broken down to provide energy for the cell, and by which new biological molecules are synthesized. In our study of metabolism we will try to understand how energy flows in the cell, such as in the oxidation of glucose to produce ATP, and how this energy and energy-containing intermediates are utilized to construct new molecules, as in the synthesis of fatty acids from acetyl-CoA. The various biochemical pathways that accomplish this will be examined in detail. We will also look at how these pathways are regulated so that metabolism occurs in coordinated fashion.

Lectures: Lectures will be prerecorded and available in the Media Gallery on Canvas.

Discussion Sections: Discussion sections will begin in week 1 of the quarter and will be conducted via Zoom. Attendance and participation in the discussion section in which you are enrolled is required on days when an activity is scheduled. You may only attend the discussion section in which you are enrolled. The discussion section activities are a series of problem-solving exercises that are designed to help you master some of the important concepts in the class, and you will work on these exercises in small groups in Zoom breakout rooms. You are required to have your Zoom video on during the discussion sections. This is an important aspect of the group participation in the exercises, and it helps to establish a sense of community with the students you are working with each week during section. Discussion sections will not be recorded.

Discussion Section Schedule:

Week	Activity	Points for	
		Participation	submitted work
1	Form work groups	15	
2	Exercise: Biological oxidation-reduction reactions and the oxidation state of carbon atoms	15	
3	Exercise: Enzyme kinetics and inhibitors; calculation of K_i	15	25
4	Review (attendance not required)		
5	Exercise: Glycolysis 1 – Chemical reactions	15	
6	Exercise: Glycolysis 2 -- Thermodynamics	15	
7	Exercise: Fermentation	15	
8	Review (attendance not required)		
9	Exercise: Oxidative phosphorylation	15	25
10	Exercise: Metabolic flux game	15	30

Quizzes and Final Exam: The quizzes and final exam will be taken through Canvas. They will be asynchronous, and you will have a fixed time window in which to take them (see the schedule on the last page of the syllabus). Once you begin you will have exactly 1-hour to complete each quiz and 2½-hours to complete the final exam. When taking the quizzes and final exam, you may use the textbook and any notes that you have prepared yourself, including your answers to the problem set questions. You may not communicate with other students in any form, and you may not utilize the internet (Canvas should be the only site open on your browser). Once you have completed the quiz or final exam, you are forbidden from discussing it in any way with other students until the window is closed. You are expected to conduct yourself with integrity in completing the quizzes and final exam for the class.

Course Structure and Grade Assignments:

	Point Value
Discussion section participation and submitted work	200
Quizzes 6 x 100 points each	600
Final exam	200
Total	1000

Grade cutoffs: (cutoffs may be lowered at the instructor's discretion)

905-1000	A	780-789	C+
895-904	A-	695-779	C
885-894	B+	675-694	C-
800-884	B	590-674	D
790-799	B-	0-589	F

Lecture Schedule:

You are expected to do all of the assigned reading and media. Doing this is essential for your success in the class, particularly with remote instruction. The problem sets on Canvas will help guide you through the important concepts of the class and help you check your mastery of the material. It is essential that you do these as well.

Week		Reading in Lehninger chapter (pages)	
		7 th ed.	6 th ed.
1	Course introduction; review of protein structure	1(21-29) 13(495-501)	1(20-29) 13(505-511)
	Thermodynamics of chemical reactions and enzyme catalysis	3(75-81;85-88) Review if necessary	3(75-81;85-89) Review if necessary
2	Michaelis-Menten enzyme kinetics Enzyme inhibitors; Regulation of enzyme activity	6(187-213; 225-231)	6(189-213; 226-232)
	Quiz 1 – Chemical reactions and thermodynamics; window Friday (April 9th) 9 am – Saturday (April 10th) 12 noon		
3	Metabolism: Coupling of endergonic and exergonic reactions	13(491-494; 507-524)	13(501-504; 510-511; 517-534)
	Metabolism: Electron carrier cofactors		
Quiz 2 – Enzyme kinetics and enzyme inhibitors; window Friday (April 16th) 9 am – Saturday (April 17th) 12 noon			
4	Glycolysis	14(533-545)	14(543-555)
	Fermentation; alternate fates of pyruvate; alcohol metabolism in animals	14(553-557)	14(563-568)
5	The pyruvate dehydrogenase complex; The citric acid cycle	16 (all)	16 (skip 655-659)
6	The mitochondrial electron transport chain	19(711-727)	19(731-762)
	Quiz 3 – Glycolysis; window Friday (May 7th) 9 am – Saturday (May 8th) 12 noon		
7	Oxidative phosphorylation and ATP synthase	19(728-741)	19(731-762)
	The malate-aspartate shuttle		
Quiz 4 – Glycolysis, fermentation, PDH complex, citric acid cycle; window Friday (May 14th) 9 am – Saturday (May 15th) 12 noon			
8	Gluconeogenesis; The pentose phosphate pathway	14(558-569)	14(568-580)
	Glycogen metabolism	15(601-608)	15(612-620)
9	Oxidation of fatty acids; Ketone bodies	10(361-366) 17(649-657; 668-670)	10(357-361) 17(667-675; 686-688)
	Synthesis of fatty acids; Cholesterol synthesis	21(811-819)	21(833-841)
Quiz 5 – Oxidative phosphorylation, glycolysis, gluconeogenesis; window Friday (May 28th) 9 am – Saturday (May 29th) 12 noon			
10	Amino acid metabolism	18(675-691)	18(695-711)
	The urea cycle		
Quiz 6 – Glycogen metabolism, pentose phosphate pathway, all fatty acid metabolism; window Friday (June 4th) 9 am – Saturday (June 5th) 12 noon			
F	Comprehensive final exam; Wednesday June (9th) 5 pm – Friday (June 11th) 5 pm window		