Biochemistry II Lecture & Lab Schedule

Spring 2021
(BI/CH 422 & 622)

version 9

Lectures: 9:05 – 9:55 am **MWF** **COM-101**
Professor Dean Tolan
email: tolan@bu.edu
Room 702, LSE (24 Cummington)
Office hours: Mon 4:30–5:30, Tue 3:30–5:00, and by appointment

Pre-lab Discussions:			
	C3 12:20 pm – 2:05 pm	**Wed**	LEV 201
	C2 10:10 am – 11:55 am	**Thu**	CAS 502
	C1 10:10 am – 11:55 am	**Fri**	COM 107
	C4 4:30 pm – 6:15 pm	***Fri***	*BRB 122*

Laboratory Coordinators:
Jose Luis Medrano, Ph.D.
email: medrano@bu.edu
Room 344, SCI (590 Comm Ave)
Office hours: Thur 1:00–3:00, Sun 2:00–4:00, and by appointment

Raavi Raavi (for BI/CH 527 A1 and C4 sections only)
email: raavi@bu.edu
Office hours: Wed 3:00–5:00, and by appointment

Laboratory Teaching Fellows:	**Section(s)**	**email**	**Office hours (all Zoom)**
Milad Babaei	B5, B1	miladb@bu.edu	*Tue 10:00 am*
Christine Carroll	B5, B1	carroll8@bu.edu	*Thur 5:00*
Arisdelsy Cervantes	B1, B2	acervan@bu.edu	*Tue 2:30*
Luke Fournier	B1, B3	lukeaf@bu.edu	*Thur 10:05 am*
Hellen Huang	B6, B2	hellenh@bu.edu	*Mon 12:00 noon*
Alex Iocolano	B4	iocolano@bu.edu	*Wed 5:00 pm*
Gyeung Yun Kim	B4, B6	gy0526@bu.edu	*Fri 8:00 am*
Grace Kirkpatrick	B4, B2	kirkgr@bu.edu	*Wed 4:00*
Guangmei Liu	B2, B3	gmliu@bu.edu	*Fri 2:00*
Hannah Sutton	B4	suttonhm@bu.edu	*Mon 5:30 pm*
Mengrui Wang	*B7*	*mrwang@bu.edu*	*Wed 2:00*
Yinze Wu	*B7*	*yinzewu@bu.edu*	*Mon 1:00*

Laboratory Sections:

Sec#	**Time**	**Instructors**	**Room**	**Instructors**	**Room**
B4	Thu 5:30 pm 9:30 pm	Iocolano & Sutton	SCI 162	Kim & Kirkpatrick	SCI 160
B5	Fri 12:20 pm 4:20 pm	Babaei & Carroll	SCI 162		
B6	Fri 5:30 pm 9:30 pm	Huang & Medrano	SCI 162	Kim & Medrano	SCI 160
B1	Mon 12:20 pm 4:20 pm	Cervantes & Babaei	SCI 162	Fournier & Carroll	SCI 160
B2	Mon 5:30 pm 9:30 pm	Cervantes & Huang	SCI 162	Kirkpatrick & Liu	SCI 160
B7	*T/R 8:00 am-12 noon*	*Wu & Wang*	*SCI 162*		
B3	Wed 2:30 pm 6:30 pm	Liu & Fournier	SCI 162		

Registration in Discussion and Lab

The table below shows the appropriate sections that will work for you this semester. If you are in the wrong discussion/lab combination, please drop/add to adjust.

		Appropriate Pre-lab Discussion Section		
Lab Time	Lab Section	C3 (W)	C2 (R)	C1 (F)
R 5:30	B4	YES	OK	NO
F 12:20	B5	YES	YES	OK
F 5:30	B6	YES	YES	OK
M 12:20	B1	YES	YES	YES
M 5:30	B2	YES	YES	YES
W 2:30	B3	NO	YES	YES

Required texts:

1) "Lehninger's Principles of Biochemistry 7th edition" by Nelson and Cox.

2) "The Absolute, Ultimate Guide to Lehninger Principles of Biochemistry 7th edition" by Osgood and Occorr. Importantly, this is a study guide and solutions manual which contains detailed worked solutions to the end of chapter problems in the text.

3) "Biochemistry Laboratory Manual II, 5th Edition" by Dean R. Tolan & Jose L. Medrano

4) OPTIONAL; Sapling Website

Prerequisites: Students are REQUIRED to have taken BI/CH 421/621 or equivalent.

Grading 422: Lab: 32%; Lecture: 68% (Five Exams from which the worst is dropped; each worth 17%).

Grading 622: Lab: 30%; Lecture: 60% (each worth 15%, best 4/5); **Discussion: 10%**

Biochemistry-II Home Page: http://www.bu.edu/aldolase/biochemistry2/

Academic Conduct:

In addition to the policy on academic conduct expressed in the course policy, the following policies are emphasized in the L*f*A era: Unauthorized downloading, uploading, sharing, and/or duplicating course materials including, but not limited to, assignments, exams, quizzes, slides, videos, and any other material created and/or provided by the instructor without the instructor's express permission

SCHEDULE OF EVENTS

Date	Day		Topic	Reading	Problems†	Lab‡
Jan 25	M	1	What's Metabolism about? - *An overview of how nutrients yield both energy and the building blocks for cell syntheses.*	*Chapter 13.1 & 13.3*		
Jan 27	W	2	Bioenergetics	*Chapter 13.2 & 13.4*	17,22,24,25,30; **1,5,6,7,12**; *1,2,3*	
Jan 29	F	3	Bioenergetics	*Chapter 11.1-2*	6,7,14,15,17,18,19, 20,22,23	
Feb 1	M		**SNOW DAY – No Class**			
Feb 3	W	4	Crossing the Berlin Wall of the cell - Membrane Transport *How does food get from outside into the cell?*	*Chapter 11.3*	**10,11,13,14,15,19**; *4, 5*	**Disc starts Lab starts R**
Feb 5*	F	5	**CATABOLISM I: Digestion and utilization of carbohydrates** Glycogen metabolism – *From glycogen to glucose*	*Chapter 15.4 & Chapter 14.2*	Ch15: 7	**Ch 7**
Feb 8	M	6	Glycolysis (1) - *From C_6 to 2 x C_3*	*Chapter 14.1*	1,2,3,5,9,14	
Feb 10	W	7	Glycolysis (2) - *From triose-P to pyruvate (and NAD^+ to $NADH + H^+$)*	*Chapter 14.1*	**1-14**; *1,3,4*	
Feb 12	F	8	How do sucrose, fructose, and lactose enter glycolysis? Anaerobic fate of pyruvate *: from C_3 to $C_2 + CO_2$*	*Chapter 14.3*	Ch15 #3	**Ch 8-A** *Ch 7 due*
Feb 15	M		**HOLIDAY**			
Feb 16	T (sub M)	9	Anaerobic fate of pyruvate*: from C_3 to $C_2 + CO_2$* Aerobic fate of pyruvate: formation of acetyl-S-CoA	*Chapter 16.1*	1-4,6-12,15,16, 18,19	
Feb 17	W	10	Tricarboxylic acid cycle (1) - Evidence for the cycle	*Chapter 16.2*	30-33,35; **1-10,12, 15,27**; *2,3,4*	
Feb 17	**W** eve	–	**Exam #1** (covers 1-8 (Feb 12)) (8) 7:00-9:00 PM MOR-101			
Feb 19	F	11	Tricarboxylic acid cycle (2) - Burning 2C's to CO_2	*Chapter 16.3*	13,17,20,21,24,25, 28,29; **13**	**Ch 8-B**
Feb 22	M	12	Tricarboxylic acid cycle (3) - regenerating the C_4 acceptor	*Chapter 16.3*	**14, 16-22, 23-26**	
Feb 24	W	13	Oxidative phosphorylation (1) - *Electron Transport*	*Chapter 19.1*	2,3,4,10,11,16,19	
Feb 26	F	14	Oxidative phosphorylation (2) - *Electron Transport*	*Chapter 19.2*	6,7; **1,2**; *1*	**Ch 9A**
Mar 1**	M	15	Oxidative phosphorylation (3) - *The chemiosmotic theory and ATP synthesis.*	*Chapter 19.2*		
Mar 3	W	16	Oxidative phosphorylation (4) - *The chemiosmotic theory and ATP synthesis.*	*Chapter 19.2*	18,25; **3,4,6**;	
Mar 5	F	17	**CATABOLISM II: Digestion and utilization of fat** Lipids; fatty acid degradation (1) - *How are fats broken down to intermediates of glycolysis and the TCA cycle?*	*Chapter 17.1-17.2*	1,2,3,4,5,9,13,22, 23	**Ch 9B**
Mar 8	M	18	Lipids; fatty acid degradation (2) - saturated, *unsaturated, and other fatty acids*	*Chapter 17.2-17.3*	6,7,10,12,29	
Mar 10	W	19	Lipid degradation (3) - *ketone bodies and acidosis* **CATABOLISM III: Digestion and utilization of proteins and nucleic acids –** Protein degradation (1)	*Chapter 27.3 Chapter 18*	Ch18: 1,2,4,8; **2,4**; *2*	
Mar 10	**W** eve	–	**Exam #2** (covers 9-16 (Mar 3)) (8) 7:00-9:00 PM MOR-101			
Mar 12	F	20	*How is the N of amino acids liberated and eliminated?* Protein degradation (2) – - the ubiquitin pathway & the Transaminase reaction	*Chapter 18*	5,6,7,15,16; **1,3,5**	**Ch 9C** *Ch 8 due*
Mar 15	M	21	Protein degradation (3) – Urea cycle Elimination of Ammonia-N by fish, flesh and fowl	*Chapter 18*	3,9,10,11,18,21; **6,7,8;** *3*	

Mar 17	W	22	Protein degradation (4) – Urea bi-cycle and control of nitrogen catabolism	*Chapter 18*	12,13,14;**9-12**; *1* Ch19: #13,9	Ch 11 Disc & assignment *posted*
Mar 18	R		**PROVOST'S DAY – No Class**			
Mar 19	F	23	Protein degradation (5) - Amino acid degradation *How are Carbon Skeletons of Amino acids metabolized?*	*Chapter 18*	Ch17: #7,24,27	No labs
Mar 22	M	24	Protein degradation (6) - Amino acid degradation *How are Carbon Skeletons of Amino acids metabolized?*	*Chapter 18*	Ch22: #7,8	No labs
Mar 24	W	25	Nucleic acid degradation (7); uric acid formation	*Chapter 18* *Chapter 22.4*	Ch22: #15,16	No labs
Mar 24	**W** eve	–	**Exam #3** (covers 17-24 (Mar 22)) (8) 7:00-9:00 PM MOR-101			
Mar 26	F	26	**ANABOLISM I: Biosynthesis of carbohydrates** **Photosynthesis (1)** – *How does light power anabolism?*	*Chapter 20.1-20.3*	1,2,5,6,7,8,9,11,12, 14,15,18; **1,2,3,4**	No labs
Mar 29	M	27	**Photosynthesis (2)** – *How does* CO_2 *get fixed?* – Calvin cycle – *How is the net formation of glucose from* CO_2 *achieved?*	*Chapter 20.5-20.8*	19,20,23; **7,8,9;** *1*	No labs *Ch 11 due*
Mar 31	W		**PROVOST'S DAY – No Class**			
April 2***	F	28	**Photosynthesis (3)** – Calvin cycle – completing the cycle; C_4 & Kornberg cycles	*Chapter 20.5-20.8*	26,27,34**; 10,11;** *2,3*	**Ch 10A** *Ch 9 due for R*
April 5	M	29	– Gluconeogenesis – *From pyruvate to glucose* – Glycogen metabolism – *From glucose to glycogen* – Pentose-P Pathway (1) – *generation of NADPH*	*Chapter 14.4* *Ch 15.4* *Ch 14.5*	Ch14: 20,21,22,24, 25,26,27,30; **17,18, 19,20**;*5.* Ch15: **13, 14**	*Ch 9 due*
April 7	W	30	– Pentose-P Pathway (2) – *generation of* C_5*-sugars* – Glucose metabolism Regulation (1)	*Chapter 14.5* *Ch 15.3&15.5*	Ch15: 4,7,8,9,11, 12,14,15;**1,2,3,4,5, 6,7,8,9**; *2*	*Ch 9 due*
April 9	F	31	– Glucose metabolism Regulation (2)**;** Anaplerosis – *How can the TCA cycle supply both energy and synthetic precursors?*	*Chapter 15.3 &15.5* *Ch 16.2(end)*	Ch17: #16,17 Ch19:#17 Ch21: *3*	**Ch 10BC**
April 12	M	32	**ANABOLISM II: Biosynthesis of Fatty Acids & Lipids** –Fatty acid synthesis – *biosynthesis versus catabolism?*	*Chapter 21.1*	1,2,3,4,5,6,7; **1,2,3,4,5,6;** Ch17;#20,21	
April 14	W	33	– Fatty acid diversification; – Eicosanoids & prostaglandins – Lipid synthesis – *How are phospholipids and fats formed?*	*Chapter 21.1-21.3*	8,9,10,11,12, **10,11,12,13,14**; *2,6* Ch14;#17	
April 14	**W** eve	–	**Exam #4** (covers 25-31 (Apr 9)) (7) 7:00-9:00 PM MOR-101			
April 16	F	34	Cholesterol & Steroid synthesis (1) – *From* C_2 *units to a complex polycyclic.*	*Chapter 21.4*	13,14,15,16,19; **8,9;** *1,4,5*	**Ch 10D**
Apr 19	M		**HOLIDAY PATRIOT'S DAY**			
April 21	W (sub M)	35	Cholesterol & Steroid synthesis (2) – *From* C_2 *units to a complex polycyclic.*	*Chapter 21.4*		*(re-sched. W)*
April 23	F	36	**ANABOLISM III: Biosynthesis of Nitrogen Compounds** N Fixation & assimilation; – *How is atmospheric* N_2 *fixed and then assimilated into amino acids?* – Amino-acid biosynthesis – Non-essential Amino acids	*Chapter 22.1-22.2*	1,2,3,4,6,9,10; **1,2,3,4,5,6,7,8**	**Ch 10E** *Ch 10 due*
April 26	M	37	– Nucleoside & nucleotide biosynthesis (1) – *Biosynthesis of purines &* pyrimidines: *How are the building blocks for Nucleic Acids formed?*	*Chapter 22.4*	11,12,13,14,17; **9,10,12,13,14,15**; *1*	
April 28	W	38	– Nucleoside & nucleotide biosynthesis (2) –*How is deoxyribose formed?* Control of nitrogen biosynthesis; feedback inhibition & isozymes. – Biosynthesis and degradation of Heme	*Chapter 22.3*		
May 6	**R**		**Exam #5** (covers 32-38 (Apr 28)) (7) 9-11 AM (Tsai)			

†These are only suggested problems. Those in the textbook are normal font, **problems in the Ultimate Guide under "Facts" are bold font**, *problems in the Ultimate Guide under "Applying" are italics font.* ‡This schedule of labs only applies to 422 B1-6 sections

***ADD deadline: F Feb 5** **DROP deadline: M Mar 1** ***W deadline: F Apr 2**

General Education: The BU HUB

Teamwork & Collaboration (TWC)

The teaching and implementation of teamwork and collaboration is key, actually critical, to BOTH semesters of the laboratory. Both semesters will teach these skills of proper teamwork and collaboration, and then allow students to act it out week after week, thus seeing the value in this skill. In the second semester, larger groups of teams are brought together in organized efforts to get complementary experiments accomplished. In addition, the group project for the spring semester for solving problems of biosynthesis, metabolism, or enzyme mechanisms will be done in groups of 6-8 students, which will foster working together in an intellectual context outside the laboratory. This skill is also taught in the first weeks and evaluated as a group at the end of the semester.

Teamwork Outcome 1

As a result of explicit training in teamwork and sustained experiences of collaborating with others, students will be able to identify the characteristics of a well-functioning team. In lecture and pre-lab discussion sections, successful teamwork strategies will be taught and emphasized as the only way to get through the laboratory exercises. Aspects of a well-functioning team are described and identified, as well as the lessons teamwork teaches; innovation, leadership development, and fostering knowledge of one's own strengths and appreciation for those of others. In addition, there it's explained that success in the laboratory will rely on effective collaboration with others, most importantly is the sustained interactions with their lab partner. All lab exercises are performed with a lab partner(s). Partners work closely the entire semester in preparation, performance, and analysis. The biochemistry laboratory aims to mimic a real-world situation wherein you have several overlapping objectives that all must be completed in the allotted four hours. This can only be accomplished if there is cooperation. Moreover, there are several exercises that require the cooperation among the pairs, so teams and tasks expand and contract during the semester. During the end of the semester, in the prelab discussion sections, an evaluation of how well the partners and teams worked together and what worked for success and what interfered with success.

Teamwork Outcome 2

Students will demonstrate an ability to use the tools and strategies of working successfully with a diverse group, such as assigning roles and responsibilities, giving and receiving feedback, and engaging in meaningful group reflection that inspires collective ownership of results. Students are assessed on a regular basis on how well they are functioning as a team and as a member of that team. They learn teamwork by performing all data collection and analysis working with a lab partner throughout the semester and with other groups at various points when data comparisons warrant. Students will demonstrate an ability to work successfully with diverse groups in which they may have different roles. Final assessment of achieving this teamwork learning outcome, will include submission of both a self-evaluation and team-evaluation to their instructor at the end of the semester. The instructor will consider these evaluations in the context of the team contract when assigning final grades for teamwork, attitude, attendance, safety, and communication, all of which comprises 10% of their lab grade.

Research Information Literacy (RIL)

The teaching of Research Information Literacy is a year-long process in the biochemistry for majors courses. Throughout the course, the lectures refer to various publicly available biochemical and molecular data bases and analytical resources. At various times, the class is lead to those sites on the Internet, and lessons proceed using them. Moreover, during a continuous laboratory exercise that begins in the fall and finishes in the spring, students get hands-on training in using several of these publicly available databases for asking a basic research question: How do pharmaceutical companies analyze targets for drug development? For this, several hypotheses are posed and students are lead to the information sources to help test these ideas. They finally communicate their findings in the lab write-ups for these two exercise, call bioinformatics exercises.

Research Outcome 1

Students will be able to search for, select, and use a range of publicly available and discipline-specific information sources ethically and strategically to address research questions. This HUB unit is one taught and earned throughout the two-semester course and awarded with successful completion of 422. For teaching literacy in information technology in biochemistry, there are rich and varied collections of data about which students will be introduced in lectures. Furthermore, through constant reference and attribution in the lectures, as well as a purposefully sequenced laboratory exercise for hands on use of many of these information databases in the laboratory sections of both 421 and 422, students will learn of the content and sources of such biochemical information. Furthermore, students will learn how to use primary literature sources to support and report their findings as they write their lab reports.

Research Outcome 2

Students will demonstrate understanding of the overall research process and its component parts, and be able to formulate good research questions or hypotheses, gather and analyze information, and critique, interpret, and communicate findings. Again, throughout the two-semester course, both in lecture and laboratory, students learn the use of these databases as tools in a laboratory setting; learning the quality and analyze the validity of data from many of these informational databases; report and communicate what they know about informational databases in their laboratory write-ups; and apply such information for addressing the problem posed, culminating with a discussion section in the laboratory write up that requires students to formulate a subsequent hypothesis based on their observations, specifically using informational databases as a tool.

PLEASE NOTE THAT THE POLICIES THAT WERE IN PLACE FOR THE FALL 2020 ARE CONTINUING T FOR THE SPRING 2021 (SEE WEB SITE).