

## BIOL 40 FALL 2020 — Biochemistry — Wei-Lih Lee

BIOL 40 involves studies of molecular structure and function from a biochemical point of view, emphasizing the biochemistry of proteins, lipids, and carbohydrates. Topics include protein structure and function, enzymes and enzyme kinetics, lipids and membranes, and carbohydrates and cell walls. The participation of these biomolecules in metabolism is also examined, with an emphasis upon carbohydrate, fatty acid, and amino acid metabolism. The course concludes with an analysis on how metabolism is integrated.

**Lecture (zoom):** MWF 10:20-11:25 AM, X (Th 12:30-1:20 PM) used as indicated in syllabus.

**Discussion (zoom):** W 2:30-3:30 PM or Th 2:30-3:30 PM (you may attend either section)  
Used for going over problem sets. Also used for discussion of relevant research papers.

**Instructor:** Wei-Lih Lee, Life Sciences Center Room 224, Phone: (603) 646-8706  
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Office hours: M 4:00-5:00 PM EST and Fri 4:00-5:00 PM EST

**Teaching Assistant:** Madeline Chrupcala  
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Office hours: Tu 10:00-11:00 AM EST

**Required Textbook:** Fundamentals of Biochemistry by D. Voet, J.G. Voet, and C.W. Pratt (5th edition, 2016) ISBN: 978-1-118-91840-1 hardcover (or binder-ready ISBN: 978-1-118-91843-2; ebook ISBN: 978-1-119-42357-7). (*Please let me know if you encounter financial challenges related to purchasing textbook for this class*)

**Available:** Lecture notes and powerpoint presentations will be posted to Canvas.

**Prerequisites:** BIOL 12/19 (Cell Structure/Function) and CHEM 52/58 (Organic Chemistry)

<b>Exams and grading:</b>	Exam 1	100 points
	Exam 2	100 points
	Exam 3	100 points
	Final exam	120 points
	Problem sets	10 points
	Quizzes	10 points

The first three exams cover lectures for each section (see [Class Schedule](#) for dates and [Exams and Grading Policies](#) for format). The final exam is semi-comprehensive, with emphasis on the last section of the course but it will incorporate major information from earlier in the course. Your grade will be calculated using two different methods and you will receive the highest grade of the two. **Method A:** total out of everything (i.e. a percentage based on a total of 440 available points). **Method B:** dropping the lowest of the first three exams (i.e. a percentage based on a total of 340 points). In both cases, the final exam is always counted.

**Class Schedule:**

<b>Date</b>	<b>Lect #</b>	<b>Topic</b>	<b>Reading</b>
M Sept 14	1	Biochemical evolution	1-11, PDFs
W Sept 16	2	Bonds, properties of water, buffers	23-41
X Sept 17		Buffers (cont)	
F Sept 18	3	Amino acids	80-96
M Sept 21	4	Primary protein structure and purification	97-108, 119-126
W Sept 23	5	Sequencing; protein structure	110-119, 131-179
X Sept 24	6	3-D protein structure	
F Sept 25	7	Proteins: Myoglobin and hemoglobin	180-200
M Sept 28	8	Proteins: Myoglobin and hemoglobin (cont)	
W Sept 30	9	Enzyme Introduction and Kinetics	11-20,322-330,361-382
X Oct 1		Exam Review Session	
<b>X Oct 1</b>		<b>Exam #1, 5:00 PM EST, covers Lectures 1-8</b>	
F Oct 2	10	Enzyme kinetics (cont)	
M Oct 5	11	Enzymatic catalysis	330-339
W Oct 7	12	Enzyme Reaction Mechanisms	345-355
X Oct 8		Enzyme Reaction Mechanisms (cont)	
F Oct 9	13	Enzyme Regulation	355-357, 382-391
M Oct 12	14	Lipids	245-258
W Oct 14	15	Membranes and Membrane Transport	259-276, 293-318
X Oct 15	16	Metabolism and Bioenergetics	
F Oct 16	17	Metabolism and Bioenergetics (cont)	442-477
M Oct 19		Exam Review Session	
<b>M Oct 19</b>		<b>Exam #2, 5:00 PM EST, covers Lectures 9-15</b>	
W Oct 21	18	Carbohydrates	221-244
X Oct 22	19	Glycolysis	478-497
F Oct 23	20	Entry and exit from glycolysis	497-502, 508-512
M Oct 26	21	Gluconeogenesis	544-549
W Oct 28	22	Regulation of Glycolysis and Gluconeogenesis	502-507, 549-551
X Oct 29		Regulation of Gluconeogenesis (cont)	
F Oct 30	23	Glycogen; Pentose Phosphate Pathway	523-544, 512-517
M Nov 2	24	The Citric Acid Cycle	558-587
W Nov 4	25	Oxidative Phosphorylation	588-628
X Nov 5		Exam Review Session	
<b>X Nov 5</b>		<b>Exam #3, 5:00 PM EST, covers Lectures 16-23</b>	
F Nov 6	26	Oxidative Phosphorylation (cont)	
M Nov 9	27	Fatty acid metabolism	664-700
W Nov 11	28	Fatty acid metabolism (cont)	
X Nov 12	29	Amino acid metabolism	718-746
F Nov 13	30	Integration of Metabolism	773-800

**Final Exam (semi-comprehensive with emphasis on recent material)**

Nov 30, 2020 (tentative)

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**Course Goals and Learning Objectives:**

1. Gain a solid foundation in biochemistry. This course synthesizes material from courses you previously took and will put both biological and chemical aspects of what you have learned into context. Biochemistry provides the background required for upper-level courses (e.g., Biol 69: Cell Signaling, Biol 74: Advanced Neurobiology, and Biol 71: Current Topics in Cell Biology), as well as for medical, dental, and graduate level studies.
2. Develop the quantitative skills needed to understand biochemical reactions in living cells. Quantitative skills are essential to science and many other disciplines. We will develop and hone our math skills by solving biochemical reactions (through practice questions and problem sets) relevant to all living organisms.
3. Become conversant in biochemistry. Like many biology courses, biochemistry requires learning a “vocabulary” and then applying this vocabulary to biological questions. For this reason, you will need to commit to memory structures of amino acids, the glycolytic pathway, and several enzymatic reaction mechanisms for this course (the vocabulary!). Beyond knowing the vocabulary, one has to be able to apply the knowledge in order to gain new insights, and for this reason, exam questions will sometimes go beyond what was directly discussed in class and ask you to apply information from the course to novel questions.

**Expectations:**

Here’s what we expect from you:

- 1) To take detailed notes while you are listening to synchronous lectures and recorded videos
- 2) To attend and participate in W/Th discussions, mentally prepared to think about biochemistry
- 3) To be willing to ask questions and participate in class activities
- 4) To listen to pre-lecture videos and complete quizzes as scheduled
- 5) To utilize active learning techniques to master course material
- 6) To work on the problem set questions and turn them in every week
- 7) To observe and follow the academic Honor Principle

Here’s what you can expect from me and the TA:

- 1) To bring expertise and enthusiasm to the class
- 2) To be willing to answer questions and facilitate discussions
- 3) To challenge you to stretch beyond your comfort zone
- 4) To encourage you to try new approaches for studying and learning that are “active”
- 5) To provide opportunities for you to practice problem solving

**Course Mode:**

Using Zoom, we will meet synchronously for lectures on MWF and Th (during X-hour) at the normal meeting times for the Period C timeslot. The X-hour will be used for lecturing or as office hour. Discussion sessions will be led by TA and will meet synchronously via Zoom on W and Th at 2:30-3:30 PM EST. You may attend either or both discussion sessions. Discussion sessions will be used for going over answer key for problem sets, or for discussion of research papers relevant to the topic of the week or exam unit. All synchronous Zoom lectures and Zoom discussion sessions will

be recorded and posted on Canvas. Be sure to read the “Consent to Record” section, since you are agreeing to this by enrolling in the class.

### **Poll Everywhere:**

I will use Poll Everywhere to present “clicker” questions in zoom lectures. One purpose for polling during class is that it allows me to gauge your understanding in real time. The best way for me to gain an accurate assessment is if the majority of the class answers each of the in-class questions. Additionally, research has demonstrated that in-class questions help students to engage with the course material, and this facilitates learning and synthesis. It will help me if *ALL* of you participate (instead of just the ones who are willing to virtually “raise” their hands). You will be answering anonymously – I will not see what answers you give. Although your grade will not depend on “clicker” question participation, I hope all of you will participate fully throughout the term.

The easiest and most convenient way to respond to “clicker” questions is to use your smartphone. If this is your first time using Poll Everywhere, please download the app here:

iOS: <https://itunes.apple.com/us/app/poll-everywhere/id893375312>

Android: <https://play.google.com/store/apps/details?id=com.polleverywhere.mobile>

If you are not able to use a smartphone to respond, you may use another internet-enabled device such as a tablet or a laptop. In the app, type [POLLEV.COM/biol40](https://pollev.com/biol40) to join the presentation. If you have any technical questions or problems, please contact [edtech@dartmouth.edu](mailto:edtech@dartmouth.edu) - they will be able to assist.

### **Problem Sets and Research Papers:**

Problem sets will be posted every week to help you develop and hone your skill in solving biochemical questions. Sometimes, questionnaire about relevant research article – selected from the literature to enhance your understanding of relevant biochemical topic - will be posted instead of problem set questions. You will be asked to work on the assigned problem sets or paper-related questionnaire as homework, and submit them in Canvas before going to the Discussion session as part of your participation grade (up to ~3% of the total available points). In order to receive credit, you must submit the homework by the specified date and time. Late submission will not receive any points. These assignments will not be graded, but we will use them 1) to help us assess your understanding of the material and 2) to ensure that you complete the assigned problem set or read the research paper before the Discussion session. For the first week of classes, although we will only have covered two lectures before the W/Th discussion session, we ask that you complete and submit the assigned problem set as a chance for you to “practice” submission. However, this initial submission will not be counted toward your participation grade.

### **Pre-lecture Quizzes:**

I will use short videos to present introductory or supplementary material that is important for in-class Zoom lecture meetings. Part of your participation grade will be based on short quizzes that you will complete after viewing the pre-lecture recordings. In order to receive credit, you must complete the quiz by 11:59 PM EST the day before the specified Zoom lecture class meeting. I will use these quizzes 1) to help me assess your understanding of the material and 2) to ensure that you watch the pre-lecture recordings before class. While taking the quiz you may refer to any notes you took while watching the video.

### **Exams and Grading Policies:**

The exams will be a mixture of testing your mastery of the information and applying your knowledge to problem solving. The exam will be available for you to take on the Canvas site on the day of the exam starting at 5:00 PM EST to the following day at 11:59 AM.

Once you start to work on the exam, it will be timed – you must complete it within 180 minutes.

The following points summarize the grading procedures with respect to exams for BIOL 40:

1. After the exam has been graded and returned, a copy of the answer key will be posted on the Canvas site. Please review the answer key carefully and make sure that you understand the errors in your exam and why you made them.
2. The number of points given for each answer is final. If, after reviewing your answers and comparing them to the posted answer key, you find an arithmetic error or detect an omission by the grader for one of the questions, you must observe the following procedures for error correction:
  - a) Prepare an electronic cover page (file format: Word or PDF) and name the file as “Error correction request – your name”. Specify the page and the question number you are requesting for error correction.
  - b) If you determine that your answer contains all of the information indicated in the answer key, but you did not receive full credit, simply indicate the number of the question to be re-evaluated and state in one or two short, descriptive sentences (must be typed) what makes your answer correct.
  - c) Email your typed cover page to Professor Lee ([wei.lih.lee@dartmouth.edu](mailto:wei.lih.lee@dartmouth.edu)) within 7 days after you receive the graded exam.

We will not accept questions regarding errors in grading after the deadline. The error correction process will take a few days. You will be notified through email after the re-evaluation is completed.

### **Missing an Exam:**

In case of documented illness, family emergency, or academic conflict, special arrangements for taking the examination can be made, but only if 1) you notify me in advance prior to the scheduled time for the exam, and 2) your need to take the exam at other than the scheduled time is clearly justified. Failure to take an exam at the scheduled time, or failure to submit the exam within the allotted time, will result in a grade of zero for that exam. In the event you are ill and unable to prepare for or write an exam, you must seek medical attention to determine if you need treatment; this is for your own health and for the health of others around you.

**A final note about exams and grades:** You are not competing against each other for grades in Biol 40. All grades, up until the final letter grade is decided, are recorded as numerical points. I do not assign letter grades to individual exams. Here are three important points about grades in BIOL 40:

- (a) A grade of 90% or above will always be at least an “A-“. No one will be penalized for learning what I teach them. Thus, it is entirely possible for everyone in the class to receive a grade of “A-“ or better.
- (b) In order to receive a D, you have to achieve a final grade of at least 50%. In other words, a final grade less than 50% is an E.
- (c) The median grade for this course will most likely be a “B”. That means if the median numerical score for the course were 65%, then a grade of 65% is a “B”.

### **Note to students with physical or learning disabilities:**

Students requesting disability-related accommodations and services for this course are encouraged to schedule a phone/video meeting with me as early in the term as possible. This conversation will help to establish what supports are built into our online course. In order for accommodations to be authorized, students are required to consult with Student

Accessibility Services (SAS; [student.accessibility.services@dartmouth.edu](mailto:student.accessibility.services@dartmouth.edu); SAS website; 603-646-9900) and to email us their SAS accommodation form. We will then work together with SAS if accommodations need to be modified based on the online learning environment. If students have questions about whether they are eligible for accommodations, they should contact the SAS office. All inquiries and discussions will remain confidential.

### **Religious Observances:**

Some students may wish to take part in religious observances that occur during this academic term. If you have a religious observance that conflicts with your participation in the course, please speak with me as soon as possible to discuss appropriate accommodations.

### **Academic Honor Principle:**

The Dartmouth College Student Handbook states "Fundamental to the principle of independent learning are the requirements of honesty and integrity in the performance of academic assignments, both in the classroom and outside. Dartmouth operates on the principle of academic honor, without proctoring of examinations. Students who submit work which is not their own or who commit other acts of academic dishonesty forfeit the opportunity to continue at Dartmouth."

The Honor Principle (<http://www.dartmouth.edu/judicialaffairs/honor/index.html>) as applied to BIOL 40 affects exams and quizzes.

- (a) All quizzes and exams (including the final exam) are open book, but they are not open person or open web. They must be completed independently by yourself, without any assistance from any human being or the internet. The answers that you provide must be entirely your own work. Any communication prior to the examination, or during the examination, with anyone having knowledge about the content of the exam would constitute a breach of the Academic Honor Principle.

Honesty is the foundation of the academic pursuit of knowledge. In recognition of this, I will not overlook any violations of the Academic Honor Principle. Violations of any of the above will result in a grade of zero for the exam, with the exam also counted toward your final grade in the course. Potential honor code violations will also be reported to the Dartmouth College Committee on Standards.

### **Mental Health:**

I recognize that academic terms at Dartmouth are challenging and intensive, and that classes are not the only demanding part of your life. There are a number of resources available to you on campus to support your wellness, including:

Your undergraduate dean (<http://www.dartmouth.edu/~upperde/>),  
Counseling and Human Development (<http://www.dartmouth.edu/~chd/>),  
and the Student Wellness Center (<http://www.dartmouth.edu/~healthed/>).

We want you to be aware of these resources and encourage you to use them as needed.

### **Title IX:**

At Dartmouth, we value integrity, responsibility, and respect for the rights and interests of others, all central to our Principles of Community. We are dedicated to establishing and maintaining a safe and inclusive campus where all have equal access to the educational and employment opportunities Dartmouth offers. We strive to promote an environment of sexual respect, safety, and well-being. In its policies and standards, Dartmouth demonstrates unequivocally that sexual assault, gender-based harassment, domestic violence, dating violence, and stalking are not tolerated in our community.

The Sexual Respect Website (<https://sexual-respect.dartmouth.edu>) at Dartmouth provides a wealth of information on your rights with regard to sexual respect and resources that are available to all in our community. Please note that, as faculty members, we are obligated to share disclosures regarding conduct under Title IX with Dartmouth's Title IX Coordinator. Confidential resources are also available, and include licensed medical or counseling professionals (e.g., a licensed psychologist), staff members of organizations recognized as rape crisis centers under state law (such as WISE), and ordained clergy (see <https://sexual-respect.dartmouth.edu/reporting-support/all-resources/confidential-resources>). Should you have any questions, please feel free to contact Dartmouth's Title IX Coordinator or the Deputy Title IX Coordinator for the Guarini School. Their contact information can be found on the sexual respect website at: <https://sexual-respect.dartmouth.edu/reporting-support/all-resources/campus-resources>

### **Consent to Recording:**

#### (1) Consent to recording of lecture and group meetings

- a) By enrolling in this course, you affirm your understanding that this course and any associated group meetings involving students and the instructor, including but not limited to scheduled and ad hoc office hours and other consultations, may be recorded within any digital platform used to offer remote instruction for this course;
- b) You further affirm that the instructor owns the copyright to their instructional materials, of which these recordings constitute a part, and distribution of any of these recordings in whole or in part without prior written consent of the instructor may be subject to discipline by Dartmouth up to and including expulsion;
- c) You authorize Dartmouth and anyone acting on behalf of Dartmouth to record your participation and appearance in any medium, and to use your name, likeness, and voice in connection with such recording; and
- d) You authorize Dartmouth and anyone acting on behalf of Dartmouth to use, reproduce, or distribute such recording without restrictions or limitation for any educational purpose deemed appropriate by Dartmouth and anyone acting on behalf of Dartmouth.

#### (2) Requirement of consent to one-on-one recordings

By enrolling in this course, you affirm that you will not under any circumstance make a recording in any medium of any one-on-one meeting with the instructor without obtaining the prior written consent of all those participating, and you understand that if you violate this prohibition, you will be subject to discipline by Dartmouth up to and including expulsion, as well as any other civil or criminal penalties under applicable law.

### **Remote Learning Plan - Canvas and Zoom:**

We have created a Remote Learning Plan for this course, available on Canvas. This document outlines the expected changes to our course content and structure this term, describes the methods and technologies we will use to support online learning (and how to get them installed and running on your devices), and explains what good participation looks like in a remote learning context. Please review this document as soon as you can and follow the steps for technological onboarding before our first class meeting.

Course materials will be made available and assignments will be submitted via Canvas, as usual. Class meetings and office hours will be held via Zoom. You may need to use Dartmouth's VPN client to access campus resources. If you have any difficulties accessing these technologies or are unsure of how to use their necessary features, please reach out.

### **Access to Campus Resources:**

Many of you may be facing greater challenges than usual given the sudden changes to your living and learning environment, public health concerns, and a host of other factors (e.g., housing or food

insecurity, new or changing caregiving responsibilities, visa and accessibility concerns, access to health and mental health support, and so on). We want you to be aware of the campus resources available to support your needs. While the situation is constantly evolving, many offices are prepared to meet with you via phone or Zoom. For concerns about health and wellness, you may reach out to the [Dartmouth Health Service](#) (603-646-9400 or Secure Message in DartHub), [Counseling Services](#) (603-646-9442), and the [Student Wellness Center](#). For academic needs, you may contact your [undergraduate dean](#) (603-646-2243), [Student Accessibility Services](#) (603-646-9900), and the [Academic Skills Center](#) (603-646-2014). Students with concerns related to campus employment may connect with the [Student Employment Office](#) (603-646-3641). Those with visa-related concerns may reach out to the [Office of Visa and Immigration Services](#) (603-646-3474). We encourage you to take advantage of these resources, and to speak with us if you need support in the class.

### **Top 10 suggestions for surviving BIOL 40:**

1. Keep up with the assigned readings. Read the text before class, or soon after class. Work on the posted problem sets. Go over the material again the same day as covered in lecture.
2. Attend lectures. The lectures do not simply re-iterate material from the textbook. Exams are primarily based on material from the lectures and problem sets.
3. Ask questions in class. If you have a question, someone else probably also has the same question.
4. Response to Poll Everywhere questions during class. Besides allowing for group participation and immediate feedback, the physical act of responding to polls may stimulate thinking and improve comprehension and learning of new materials. Make it work for you.
5. Attend discussion sessions. The weekly discussion session (run by TA) will be used to go over problems and to discuss papers not covered in the lecture. You might not necessarily be able to do every problem in the posted problem sets before discussion, but answers to the most important problems will be covered in the discussion sessions.
6. Come to office hours and use Piazza. I use office hours as a way to have smaller discussions on the areas that you find most important or troublesome, especially relating to lecture slides. Piazza on Canvas offers another way to engage in discussion with other students and TA.
7. Form study groups. Studying and working with other people on problems and concepts invariably helps with learning the material.
8. Use information on Canvas. Posted under Syllabus, Lectures, and Problem Sets.
9. Be well rested before taking the exams. When tired, one can sometimes remember information memorized from an all-nighter, but it will be almost impossible to apply that to a novel situation.
10. Review your own exams. The exams will build on each other in terms of the types of material one needs to master, so it is important to stay on top of the material in order to do well on the subsequent exam. I recommend that, after the exam has been graded and returned to you, work through the questions again so that you can effectively review the material in preparation for the next exam(s).