

BIOL 40 WINTER 2022 – Biochemistry – Professor Wei-Lih Lee, PhD

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 (LSC 105): MWF 10:10-11:15 AM, X (Th 12:15-1:05 PM) used as indicated in syllabus.

Discussion: W 2:30-3:30 PM (LSC 352) or Th 2:30-3:30 PM (LSC 238).
Used for going over problem sets. Also used for discussion of relevant research papers. May attend either section each week.

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

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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 the instructor 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)

Exams and grading:	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 sections 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:

Date	Lect #	Topic	Reading
W Jan 5	1	Introduction: biochemical evolution	1-11, PDFs
X Jan 6	2	Bonds, properties of water, buffers	23-41
F Jan 7		Buffers (continue)	
M Jan 10	3	Amino acids	80-96
W Jan 12	4	Primary protein structure and purification	97-108, 119-126
X Jan 13	5	Sequencing; protein structure	110-119, 131-179
F Jan 14	6	3-D protein structure	
M Jan 17		No class (MLK day)	
W Jan 19	7	Proteins: Myoglobin and hemoglobin	180-200
X Jan 20	8	Proteins: Myoglobin and hemoglobin (continue)	
F Jan 21	9	Enzyme Introduction and Kinetics	11-20,322-330,361-382
M Jan 24		Exam Review Session	
M Jan 24		Exam #1, 7:00-9:00 PM EST, covers Lectures 1-8	
W Jan 26	10	Enzyme kinetics (continue)	
X Jan 27	11	Enzymatic catalysis	330-339
F Jan 28	12	Enzyme Reaction Mechanisms	345-355
M Jan 31		Enzyme Reaction Mechanisms (continue)	
W Jan 2	13	Enzyme Regulation	355-357, 382-391
X Feb 3	14	Lipids	245-258
F Feb 4	15	Membranes and Membrane Transport	259-276, 293-318
M Feb 7	16	Metabolism and Bioenergetics	442-477
W Feb 9	17	Metabolism and Bioenergetics (continue)	
X Feb 10		Exam Review Session	
X Feb 10		Exam #2, 7:00-9:00 PM EST, covers Lectures 9-15	
F Feb 11	18	Carbohydrates	221-244
M Feb 14	19	Glycolysis	478-497
W Feb 16	20	Entry and exit from glycolysis	497-502, 508-512
X Feb 17	21	Gluconeogenesis	544-549
F Feb 18	22	Regulation of Glycolysis and Gluconeogenesis	502-507, 549-551
M Feb 21	23	Glycogen; Pentose Phosphate Pathway	523-544, 512-517
W Feb 23	24	The Citric Acid Cycle	558-587
X Feb 24	25	Oxidative Phosphorylation Part 1	588-628
F Feb 25	26	Oxidative Phosphorylation Part 2	664-700
M Feb 28		Exam Review Session	
M Feb 28		Exam #3, 7:00-9:00 PM EST, covers Lectures 16-23	
W Mar 2	27	Fatty acid metabolism: Fate of acetyl CoA	
X Mar 3	28	Amino acid metabolism	718-746
F Mar 4	29	Integration of Metabolism	773-800

Final Exam (semi-comprehensive with emphasis on Lectures 24-30, including all pre-lecture material): Saturday, Mar 12, 11:30 AM

Course Goals and Learning Objectives:

1. To 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. To develop quantitative skills needed to understand biochemical reactions in living cells. Quantitative skills are essential to science and many other disciplines. This course will develop and hone your math skills by working on solving biochemical reactions (through problem set questions) relevant to all living organisms.
3. To 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 the structures of amino acids, the glycolytic pathway, and several enzymatic reaction mechanisms (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 lectures and recorded videos
- 2) To attend and participate in W and Th discussions, be 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 the TA and me:

- 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 and Attendance:

We will meet in-person for lectures on MWF and Th (during X-hour) at the normal meeting times for the Period 10 timeslot. Discussion sessions will be led by TA and will also meet in-person on W and Th at 2:30-3:30 PM EST. The discussion sessions will be used for going over the answer key

for problem sets, or for discussion of research papers relevant to the topic of the week or exam unit. You may attend either or both discussion sessions on W and Th. All lectures and discussion sessions will be recorded but will not be simulcast via zoom. All recordings are accessible via Panopto on Canvas. Be sure to read the “Consent to Record” section, since you are agreeing to this by enrolling in the class.

You are expected to attend class in-person unless you have made alternative arrangements due to illness, medical reasons, or the need to isolate due to COVID-19. For the health and safety of our class community, **please do not attend lecture or discussion session when you are sick**, nor when you have been instructed by Student Health Services to stay home. You will be able to view recordings of the lecture or discussion session in Canvas if you are unable to attend.

COVID-19 Information and Safety Protocols:

In accordance with current College policy, all members of the Dartmouth community are required to wear a suitable face covering when indoors, regardless of vaccination status. This includes our classroom, discussion sessions, and office hours. If you need to take a quick drink during class, please dip your mask briefly for each sip. Eating is never permitted in the classroom. (The only exception to the mask requirement is for students with an approved disability-related accommodation; see below). If you do not have an accommodation and refuse to comply with masking or other safety protocols, I am obligated to assure that the Covid health and safety standards are followed, and you will be asked to leave the classroom. If you refuse to comply with masking or other safety protocols, and to ensure the health and safety of our community, I am obligated to report you to the Dean’s office for disciplinary action under Dartmouth’s Standards of Conduct. Additional COVID-19 protocols may emerge. Please pay attention to emails from the senior administrators at the College. I will communicate any changes and the resulting implications for our class community via Canvas.

Accommodations:

Students requesting disability-related accommodations and services for this course are required to register with Student Accessibility Services (SAS; student.accessibility.services@dartmouth.edu) and to request that an accommodation email be sent to the course faculty (Professor Lee) in advance of the need for an accommodation. Then, students should schedule a follow-up meeting with the course faculty to determine relevant details such as what role SAS or its Testing Center may play in implementing the accommodations. This process works best for everyone when completed as early in the term as possible. If students have questions about whether they are eligible for accommodations or have concerns about the implementation of their accommodations, they should contact the SAS office. All inquiries and discussions will remain confidential.

In-class Responses via Poll Everywhere:

I will use Poll Everywhere to present “clicker” questions during 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 “raise” their hands). You will be answering anonymously – I will not see what answers you give. The data will be tabulated for the entire class, not for individual students.

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://www.polleverywhere.com/biol40) to join the presentation. If you have any technical questions or problems, please contact edtech@dartmouth.edu as 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 the paper-related questionnaire as homework, and then 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 weekly homework by the specified date and time. Late submission will not receive any points. Please note: the answers you provide on these homework assignments will be checked for completion rather than for accuracy. 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 prior to attending the Discussion session. For the first week of classes, although we will only have covered one lecture 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 lectures. Part of your participation grade will be based on short quizzes that you will complete after viewing the pre-lecture videos. In order to receive credit, you must complete the quiz by 11:59 PM EST the day before the specified 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 videos 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. See [Class Schedule](#) for the date and time of each exam. All exams must be completed in-person within the allotted time.

All completed exams will be uploaded to Gradescope by the course faculty for grading. After the grading is done, you will be able to view your graded exam on Gradescope. The following summarize the main points regarding the grading procedures 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 thoroughly and thoughtfully and make sure that you understand the errors in your exam and why you made them.

2. All exams are graded carefully and consistently. 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 submitting an error correction request:
 - 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 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 the course faculty (Professor Lee) within 7 days after you receive your graded exam.

You should only submit an error correction request *if and only if* you think that the grader has made an arithmetic error OR you have determined that your answer is consistent with the answer key. We will not accept submission regarding error correction after the deadline. The error correction process may take a few days (sometimes longer). You will be notified through email after the re-evaluation is completed.

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".

Missing an Exam:

In case of documented illness, family emergency, or academic conflict, special arrangements for taking the exam 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 a time 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.

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 the exams and pre-lecture quizzes. These include (but are not limited to) the following:

- (a) All exams (including the final exam) are closed-book assessments. All pre-lecture quizzes are open book, but they are not open person or open web. You must complete both the exams and pre-lecture quizzes entirely by yourself, without any assistance from any person 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.
- (b) Our policy permits the re-submission of exams for potential error correction by the instructor. Any alteration of the answers between the time when the graded exams were returned to the student and the time when the exam was submitted for error correction 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.

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.

Wellness Concerns:

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 Safety and Inclusivity:

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 a faculty member, I am 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:

With the evolving COVID-19 situation, there may be a situation that entails a switch to remote instruction. If that is the case, please be mindful of the following:

(1) Consent to recording of lecture and discussion 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 in-person or 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.

Access to Campus Resources:

Many of you may be facing greater challenges than usual given the recent pandemic-related 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 or in-person. 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. 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).