BIOLOGY 40 WINTER 2020—Biochemistry—G. Eric Schaller

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 metabolism. The course concludes with an analysis on how metabolism is integrated.

Lecture (LSC 105): MWF 10:10-11:15, X (TH 12:15-1:05) used as indicated in syllabus

Discussion (LSC 352): W 2:15-3:15 or Th 2:30-3:30 (you may attend either section)
Used for going over methods for biochemical problem solving and problem sets (these are not graded but there will be exam questions based on the problem sets). Also to discuss relevant research papers.

Instructor: G. Eric Schaller, Life Sciences Center Room 339, Phone: 646-2525
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Office Hours: MW 4-5 pm (LSC 339, or next door at LSC336, and by arrangement

Teaching Assistant: Hieu Nguyen
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Office hours: W, Th, 1 hr following Discussion sections (LSC 336)

Recommended Text: 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).

Available: Lecture notes and powerpoint presentations will be posted to Canvas.
A variety of supplemental biochemistry texts are on reserve in Dana.

Prerequisites: Biology 12 (Cell Structure/Function), Chemistry 52 or 58, or permission of instructor

Exams and grading: 3 regular exams scheduled for evenings (7-9 pm) (see Schedule for rooms), each worth 100 points.
A semi-comprehensive final exam (emphasis is on last section of the course but it will incorporate major information from earlier in the course), worth 120 points.
Your grade will be calculated using two different methods and you will receive the highest grade of the two. Method 1: total out of all three exams and the final (i.e. a percentage based on a total of 420 available exam points). Method 2: dropping the lowest of the in-class exam grades (i.e. a percentage based on a total of 320 points). **The final exam is always counted.**
Missed exams can be made up in the case of health or family emergency, as described later in this handout.

Grading Scale: A:93-100; A-:90-92; B+:85-89; B:80-84; B-:75-79; C+:70-74; C:65-69; C-:60-64; D:50-59; E:49 and below

Lectures and Exams:

Date	Lect #	Topic	Reading
M Jan 6	1	Introduction	1-11, pdf
W Jan 8	2	Properties of water	23-41
X Jan 9	3	Amino acids	80-96
F Jan 10	4	Primary protein structure and purification	97-108, 119-126
M Jan 13	5	Sequencing; 3-D protein structure	110-119, 131-179
W Jan 15	6	3-D protein structure (cont)	
X Jan 16	7	Proteins: Myoglobin and hemoglobin	180-200
F Jan 17	8	Proteins: Myoglobin and hemoglobin (cont)	
M Jan 20		No class (MLK Jr Day)	
W Jan 22	9	Enzyme Introduction and Kinetics	11-20,322-330,361-382
X Jan 23		Exam Review Session	
X Jan 23		**Exam 1 (7-9 pm) covers Lectures 1-8, LSC 105**	
F Jan 24	10	Enzyme Kinetics (cont)	
M Jan 27	11	Enzymatic catalysis	330-339
W Jan 29	12	Enzyme Reaction Mechanisms	345-355
X Jan 30	13	Enzyme Regulation	355-357, 382-391
F Jan 31	14	Lipids	245-258
M Feb 3	15	Membranes and Membrane Transport	259-276, 293-318
W Feb 5	16	Metabolism and Bioenergetics	442-477
X Feb 6		No class	
F Feb 7	17	Metabolism and Bioenergetics (cont)	
M Feb 10		Exam Review Session	
M Feb 10		**Exam 2 (7-9 pm) covers Lectures 9-15, LSC 105**	
W Feb 12	18	Carbohydrates	221-244
X Feb 13	19	Glycolysis	478-497
F Feb 14	20	Entry and exit from glycolysis	497-502, 508-512
M Feb 17	21	Gluconeogenesis	544-549
W Feb 19	22	Regulation of glycolysis and gluconeogenesis	502-507, 549-551
X Feb 20		No class	
F Feb 21	23	Glycogen; pentose phosphate pathway	523-544, 512-517
M Feb 24	24	The Citric Acid Cycle	558-587
W Feb 26	25	Oxidative Phosphorylation	588-628
X Feb 27		Exam Review Session	
X Feb 27		**Exam 3 (7-9 pm) covers Lectures 16-23, LSC 105**	
F Feb 28	26	Fatty acid metabolism	664-700

M	Mar 2	27	Fatty acid metabolism (cont)	
W	Mar 4	28	Amino acid metabolism	718-746
X	Mar 5	29	Integration of Metabolism	773-800
F	Mar 6	30	Integration of Metabolism (cont)	

Final Exam (semi-comprehensive with emphasis on recent material)
Monday March 9, 8:00-11:00 AM. TBA

Advice about learning, from Leonardo da Vinci:

We know for certain that sight is one of the most rapid actions we can perform. In an instant, we see an infinite number of forms; still, we only take in thoroughly one object at a time.

Suppose that you, Reader, were to glance rapidly at this entire written page. You would instantly perceive that it was covered with various letters; but you could not, in that short time, recognize what the letters were, or what they were meant to tell. Therefore, you would need to see them word-by-word, line-by-line, to be able to understand the letters. Again, as another example, if you wish to go to the top of a building, you must go up step by step; otherwise, it will be impossible for you to reach the top.

Thus I say to you, whom nature prompts to pursue this art, if you wish to have a sound knowledge of the forms of objects, begin with the details of them, and do not go on to the second step until you have the first step well fixed in memory and in practice. And if you do otherwise, you will throw away your time, or certainly greatly prolong your studies.

Course goals:

1. To provide a solid foundation in biochemistry. Biochemistry synthesizes material from courses you previously took and should put both biological and chemical aspects of these courses into context (e.g. suddenly the phrase "nucleophilic attack upon a carbonyl" will assume an unprecedented relevance to your life). Biochemistry provides the background required for upper-level courses (e.g. BIOL69: Cell Signaling and BIOL78: Molecular Mysteries of Human Biology). Biochemistry provides the background for medicine and graduate studies.

2. To improve quantitative skills. Math skills are essential to science and many other disciplines, but it was discovered that these skills had been waning in recent years because not adequately emphasized at the college level. A student once asked me why I took off points for an exam answer when s/he had set up the answer correctly but had "just made a math error." An example of why such an error is important can be found at http://abcnews.go.com/Health/Story?id=4299616&page=1. You can find other similar stories by performing a Google search with keywords such as 'baby' 'error' and 'dose'.

3. To improve learning skills. Like many biology courses, biochemistry requires learning a 'vocabulary' and then applying this vocabulary to scientific questions. For example, you will need to memorize structures of amino acids, the glycolytic pathway, and several enzymatic reaction mechanisms for this course (the vocabulary). We are sometimes asked as to why we consider such memorization an important skill. For those going on the medical school, memorization is a key skill to develop, and is emphasized in medical programs, again for the obvious reason that one has to know what to do in immediate response to a crisis, without losing the time it would take to look something up in a text or on-line. Beyond that one has to have information in mind in order to be able to make the mental connections that lead to new insights. Applying the biochemical vocabulary is the next step 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.

Ten recommendations for taking the course:

1. Keep up with readings in the text. Read the text before class. Do problem sets and recommended problems in the text. 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 text. 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. Use PollEverywhere in class. Besides allowing for group participation and immediate feedback, the physical act of responding with your device has been shown to improve comprehension and learning of material. Make it work for you.

5. Attend discussion. The recitation will be used to go over problems and discussion papers not covered in the lecture. You will not necessarily be able to do every problem in the problem sets before discussion, but examples of the most important problems will be gone over in the discussion section.

6. Come to office hours. I approach office hours as a way to have smaller discussions on the areas that you find most important or troublesome. Essentially, this is like a smaller class driven by your questions and interests.

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 (Powerpoints, Class notes, and sample Exam questions), and Problem Sets (Problem sets, Readings).
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. Think about how the material applies to your own life. Some examples will be brought up in class, but you may find other examples at home and play. Feel free to share these with me.

Student Accessibility Needs:
Students with disabilities who may need disability-related academic adjustments and services for this course are encouraged to see me privately as early in the term as possible, preferably before the end of the second week of classes. Students requiring disability-related academic adjustments and services must consult the Student Accessibility Services office (Carson Hall, Suite 125, 646-9900). Once SAS has authorized services, students must show the originally signed SAS Services and Consent Form and/or a letter on SAS letterhead to me. As a first step, if students have questions about whether they qualify to receive academic adjustments and services, they should contact the SAS office. All inquiries and discussions will remain confidential.

Wellness concerns:
We recognize that the academic environment at Dartmouth is challenging, that our terms are 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/). I encourage you to use these resources and come speak with me to take care of yourself throughout the term.

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

Missing an exam:
In case of a health problem, family emergency, or academic conflict special arrangements for taking the examination can be made, but only if Prof. Schaller is notified prior to the exam and your need to take the exam at other than the appointed time is clearly justified. In the event you are ill and unable to prepare for or write an exam, you must contact Dick's House to determine if you need treatment; this is for your own health and for the health of others around you.

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 meet with me before the end of the second week of the term to discuss appropriate accommodations.

Personal response devices:
We will be using a technology called PollEverywhere in our course this term. If you are able to respond to polls with a smartphone, this will be easiest and most convenient. Please download the Poll Everywhere app to do this.
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. Our class response URL will be: POLLEV.COM/bio40 If you have any technical questions or problems, please contact edtech@dartmouth.edu - they will be able to assist.

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 as applied to BIOL40 affects exams and exam regrades. Examinations must be completed without reference to written materials other than those provided with the exam paper and must be completed without communication with anyone or anything else (the only permissible exception is that students may request clarification of any exam question from the course instructor who is present expressly for that purpose). **The answers that you provide must be entirely your own work.**

I allow for re-submission of exams for potential re-grading within one week of when they are returned to the class. 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 re-grading constitutes a breach of the Academic Honor Principle. **To deter this possibility, we copy exams after grading them.**

Violations of any of the above will result in a grade of zero for the exam with the exam also counting toward your final grade in the course. Potential honor code violations will also be reported to the Dartmouth Committee on Standards.