

BIOLOGY 40 FALL 2014—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 100, Oopik): MWF 10-11:05, X (TH 12-12:50) used as indicated in syllabus

Discussion (LSC 201): W or Th 2-3 (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
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Office Hours: MW 4-5 pm (LSC 352), and by arrangement

Teaching Assistant:

Joseph Granger
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Office hours: T 1-3 PM (LSC 336)

Required Text:

Fundamentals of Biochemistry by D. Voet, J.G. Voet, and C.W. Pratt (4th edition, 2013) ISBN 9780470547847 hardcover.

Available:

Lecture notes and powerpoint presentations will be posted to Blackboard. 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

Date	Lect #	Topic	Reading
M Sept 15	1	Introduction	1-11, pdf
W Sept 17	2	Properties of water	22-39
X Sept 18		No class	
F Sept 19	3	Amino acids	76-92
M Sept 22	4	Primary protein structure and purification	93-104, 116-122
W Sept 24	5	Sequencing; 3-D protein structure	105-115, 127-175
X Sept 25	6	3-D protein structure (cont)	
F Sept 26	7	Proteins: Myoglobin and hemoglobin	176-196
M Sept 29	8	Proteins: Myoglobin and hemoglobin (cont)	
W Oct 1	9	Enzyme Introduction and Kinetics	11-19, 315-323, 355-376
X Oct 2		Exam Review Session	
X Oct 2		Exam 1 (7-9 pm) covers Lectures 1-8, LSC 100	
F Oct 3	10	Enzyme Kinetics (cont)	
M Oct 6	11	Enzymatic catalysis	323-332
W Oct 8	12	Enzyme Reaction Mechanisms	339-349
X Oct 9		No class	
F Oct 10	13	Enzyme Regulation	349-351, 376-385
M Oct 13	14	Lipids	241-254
W Oct 15	15	Membranes and Membrane Transport	255-272, 288-314
X Oct 16	16	Metabolism and Bioenergetics	436-471
F Oct 17	17	Metabolism and Bioenergetics (cont)	
M Oct 20		Exam Review Session	
M Oct 20		Exam 2 (7-9 pm) covers Lectures 9-15, LSC 100	
W Oct 22	18	Carbohydrates	217-240
X Oct 23	19	Glycolysis	472-491
F Oct 24	20	Entry and exit from glycolysis	491-496, 502-506
M Oct 27	21	Gluconeogenesis	538-543
W Oct 29	22	Regulation of glycolysis and gluconeogenesis	496-501, 543-545
X Oct 30		No class	
F Oct 31	23	Glycogen; pentose phosphate pathway	517-538, 506-513
M Nov 3	24	The Citric Acid Cycle	551-580
W Nov 5	25	Oxidative Phosphorylation	581-622
X Nov 6		Exam Review Session	
X Nov 6		Exam 3 (7-9 pm) covers Lectures 16-23, LSC 100	
F Nov 7	26	Oxidative Phosphorylation (cont)	

M	Nov 10	27	Fatty acid metabolism	657-694
W	Nov 12	28	Fatty acid metabolism (cont)	
X	Nov 13	29	Amino acid metabolism	712-740
F	Nov 14	30	Integration of Metabolism	767-792
M	Nov 17	31	Integration of Metabolism (cont)	

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

Tuesday, Nov. 25, 8:00 AM

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). I am sometimes asked as to why I 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 clickers in class. Besides allowing for group participation and immediate feedback, the physical act of using the clicker 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 and use Piazza. I approach office hours as a way to have smaller discussions on the areas that you find most important or troublesome. The Piazza Q and A on Canvas offers another way to engage in Discussions with students, the TA, and me.

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.

Disabilities:

Any student with a documented disability needing academic adjustments or accommodations is requested to speak to me by the end of the second week of the term, all discussions will remain confidential, although the Student Disabilities Coordinator may be consulted to verify the documentation of the disability.

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.

Personal response devices (clickers):

We will use Turning Point clickers during the course. These are currently available at computer store for \$30. Once returned you get a \$20 refund, so the actual cost is \$10. The computer store only accepts DASH for the clickers. If you have a clicker from taking a previous Biology course, these will work for Bio40.

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 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. 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 College Committee on Standards.