

Chemistry 492 – General Biochemistry III

Portland State University, Spring 2008

General Information

Class meetings (**required**) – MWF 11:30 am – 12:35 pm in a location TBD

Text – Voet D, and Voet JG, *Biochemistry*, (3rd edition), Wiley

Dr. Lehman's Office Hours – Mon 10:00 am – 11:00 am; Fri 9:00 – 10:00 am; and by appt.

Best way to contact Dr. Lehman – by email! (niles@pdx.edu)

Information Over the Web

You can obtain much of the information needed throughout this course by accessing the following website:

<http://www.chem.pdx.edu/%7Eniles/pages/biochemistry.html>

Here, you can see general information, gather up-to-date news through the “Current Events in CH492” file, and download selected class notes and required readings as pdf files.

Prerequisites

The prerequisite for enrollment in Chem 492 is completion of Chem 491 at PSU with a grade of C– or better. I will assume you have taken a full year of organic chemistry and at least one term of physical chemistry. The textbook is required. You may use a text from previous years of Chem 492 but you assume all risks of differences; I will not go through various books and point out changes!

Course Overview

Chem 492/592 is the third term in the chemistry majors' sequence in general biochemistry. As such, it is not a stand-alone course; it begins where Chem 491 left off. The theme of this third section of the biochemistry sequence will be the chemical basis of biological information storage and transfer. We will begin by reviewing the “central dogma of molecular biology”, which depicts the basic flow of genetic information in biological systems, from nucleic acids to proteins. We will discuss the structure of nucleic acids, both in their “naked” form and complexed with proteins inside the cell. We will then go back and look at the metabolic pathways that give rise to nucleic acids in contemporary living systems. Then we will proceed to discuss sequentially the components of the central dogma: DNA replication, RNA transcription and reverse transcription, and protein translation. Although the overriding theme will be to become intimately familiar with the flow of biological information, we will strive to examine closely the chemical basis for each stage in this process. Consequently we will frequently and rapidly alternate between biological and chemical principles as if there were no fundamental distinction between the two. It will thus be to your great benefit to review chapters 1, 3, and 5 of the textbook before the end of the first week of class.

Grading

Grading will be done on a straight scale. Your grade will be determined by the total number of points that you accumulate on exams and on the assignments. There are a total of 400 points possible in the course. If you accumulate 340 points or greater (85%) you will receive an "A" or an "A–". If you accumulate 300 points or greater (75%) you will receive a "B–" or a "B" or a "B+". If you accumulate 260 points or greater (65%) you will receive a "C–" or a "C" or a "C+". If you accumulate 200–259 points you will receive a "D". If you accumulate fewer than 200 points you will receive a failing grade.

Plus and minus grade boundaries will be determined at the end of the course, but will generally be reserved for students that are clearly outside the statistical bubbles of most other A, B, and C students. Points can be obtained from the following:

- Midterm I (April 18th) – 100 points
- Midterm II (May 19th) – 100 points
- Reading Assignments (5 x 10 points each) – 50 points
- Final Exam (June 12th) – 150 points

You may take as many or as few of the midterm exams as you like. If you miss one or both midterms, the total points available on the exams that you do take will be scaled so that 400 total points are still possible. If you miss one midterm, the other midterm will be worth 150 points, and the final will be worth 200 points. If you miss both midterms, the final will be worth 350 points. You **MUST** take the final exam, no exceptions. The final will be graded more harshly so that students who take the midterms are not at a disadvantage. (In fact it is clearly in your best interests to take all the tests!)

Course Policies

Being a junior/senior level course (or a course for graduate students), I will treat you like adults and expect that you respond in a similar fashion and approach this course and the other students with respect. For many of you, this will be your final term at PSU, and by now you should have learned proper study habits and a high level of maturity with respect to learning. Some basic principles are:

- Cheating will not be tolerated.
- Plagiarism (passing off someone else's work as your own) will not be tolerated.
- Appropriate classroom behavior will be expected (*e.g.*, no talking during lectures).
- Late assignments (even by one minute) will not be accepted.

The midterm grading policy described above reflects this expectation to behave as independent, mature adults. If you feel, for whatever reason, you are not in a position to take a midterm exam, simply don't. Please do not feel the need to explain to me the reason why you missed the exam; I will trust your decision as a responsible adult. Whether you had a death or illness in the family, or whether the MAX line broke down on the way in from Beaverton, or whether you didn't study for the exam, or whether you simply overslept, the result is the same for me. The only requirement is that you take the final exam. You may, by at least one-week prior arrangement with me, take the final exam early, should you anticipate some conflict with the scheduled final exam time (Thursday, June 12, 2008 A.D. from 12:30 to 2:30 pm Pacific Daylight Time in same room as lecture). You may not take the final exam late (this time slot is the very last of all the possible time slots and I need to compile the grades later the same day. Moreover, the writing assignments (see below) will be expected (in hard copy on the lecture podium or by email in my "IN" box) by the beginning (*i.e.*, 11:30 am) of class on the day that they are due. Late assignments will be graded for helpful comments, but will receive a zero point score.

Writing Assignments

In this course we will place an emphasis on your ability to read and interpret the primary literature and communicate your learning through effective writing. There will be five writing assignments (see below) due on Wednesdays throughout the term (the first being on the second Wednesday of class!). Each assignment will be worth 10 points possible. For each assignment, an article from the primary (*i.e.*, non-review) literature will be assigned that you will have to read carefully and critically. To convey your understanding of these articles, you will write and turn in a one-page paper that summarizes the **hypotheses tested**, **methods**, **findings**, and **future work needed** of each article. More details on the format of these one-page papers will be forthcoming.

2008 Writing Assignments (papers will be available as pdf files at the course website, see above):

April 4 – Meselson C, Stahl F (1958). *Proc. Natl. Acad. Sci. USA* **44**: 671–682.

April 14 – Martin A, Horton NC, Lusetti S, Reich NO, Perona JJ (1999). *Biochemistry* **38**: 8430–8439.

April 30 – Amosova O, Coulter R, Fresco JR (2006). *Proc. Natl. Acad. Sci. USA* **103**: 4392–4397.

May 14 – Winkler WC, Nahvi A, Roth A, Collins JA, Breaker RR (2004). *Nature* **428**: 281–286.

June 4 – Weigner JS *et al.* (2004). *Nature Struct. Mol. Biol.* **11**: 1101–1106.

Grades will be assigned for each on a scale in 2-point increments (10 points = excellent job interpreting the paper and conveying your understanding; 8 points = good job, some minor flaws; 6 points = good job, at least one major flaw; 4 points = fair job, some misunderstandings regarding the paper and major flaws in interpreting it or presenting your interpretation; 2 points = poor job, little demonstration that you understand the paper and/or failure to convey in writing your understanding; 0 points = assignment turned in late or not at all).

Examination Policies

The Midterm and Final exams in Chem 492 will be, unlike previous terms, 65 minutes and 2 hours long, respectively, taken during the regular class times. The exams will consist primarily of essay, short-answer, calculation, and matching questions. In general the questions themselves will not be too difficult, but you will be pressed for time in answering them. This will require you to know the subject matter thoroughly, and I recommend active studying as opposed to passive studying for these exams. I would not recommend coming to class late on exam days! You may not use any books, notes, or text-storing calculators during the exams. You should come to the exams with several pens or pencils and a calculator. Because the exams are torn apart during the grading process, you must write your name on every page of the exam to receive credit for that page.

Graduate Credit (Chem 592)

If you are a graduate student and taking this course for graduate credit, in addition to the above assignments, you will need to write a 10-page report on one topic chosen from the following list:

1. fluorescent dyes for nucleic-acid labeling
2. nuclear magnetic resonance (NMR) of nucleic acids
3. electron paramagnetic resonance (EPR) analysis of nucleic acids
4. infrared (IR) analysis of nucleic acids (1-dimensional and 2-dimensional)
5. electrospray (ESI) and matrix (MALDI) mass spectrometry (MS) analysis of nucleic acids
6. denaturing gradient gel electrophoresis (DGGE) analysis of nucleic acids
7. “locked” nucleic acids
8. homing endonucleases
9. RNA interference (RNAi)
10. riboswitches

This report must contain both background information on the topic as well as recent discoveries in the field. For the latter, the report must draw heavily on at least two, and preferably three recent (2005–2008) papers from *Biochemistry*, *Journal of Biological Chemistry*, *Chemistry & Biology*, *Nature*, *Science*, *Nature Structural Biology*, or *Cell*. No two students can choose the same topic, so discuss the issue with fellow graduate students in the class and with me early in the quarter. The reports can be handed in anytime during the term prior to the final exam (12:30 pm on June 12, 2008). The reports will be graded by triage: **excellent** (your grade will go up by 1/3 compared to your point total; *e.g.*, A– to A), **good** (your grade will remain the same as your point total), or **fair** (your grade will go down by 1/3 compared to your point total; *e.g.*, A– to B+).

2008 Lecture Schedule

Date	Reading	Topic
Mon, Mar 31	Ch. 5, all	Introduction; information flow in life
Wed, Apr 2	Ch. 29, pp. 1107-1115	Information theory; DNA geometry
Fri, Apr 4***	Ch. 29, pp. 1122-1133	DNA geometry; topoisomerases
Mon, Apr 7	Ch. 29, pp. 1116-1118	Nucleotide structure
Wed, Apr 9	Ch. 29, pp. 1118-1122	Base pairing
Fri, Apr 11	Ch. 34, pp. 1459-1465	Base stacking; DNA-protein interactions
Mon, Apr 14***	Ch. 28, pp. 1069-1092	Overview of nucleotide metabolism
Wed, Apr 16	Ch. 28, pp. 1069-1092	Purines and pyrimidines
Fri, Apr 18	MIDTERM I (covering chapters 28, 29, and part of 34)	
Mon, Apr 21	Ch. 30, pp. 1136-1151	Overview of DNA replication
Wed, Apr 23	Ch. 30, pp. 1152-1162	Prok. replication initiation/elongation
Fri, Apr 25	Ch. 30, pp. 1162-1173	Prok. replication termination; Euks. & RTs
Mon, Apr 28	Ch. 30, pp. 1173-1184	DNA damage and mutation
Wed, Apr 30***	Ch. 30, pp. 1184-1204	DNA repair: direct reversal, NER, BER
Fri, May 2	Ch. 30, pp. 1204-1209	SOS repair, MMR, DNA recombination I
Mon, May 5	Ch. 31, pp. 1216-1226	Recombination II; transcription overview
Wed, May 7	Ch. 31, pp. 1226-1231	RNA polymerase elongation & termination
Fri, May 9	Ch. 31, pp. 1232-1254	Eukaryotic trx & transcription regulation
Mon, May 12	Ch. 31, pp. 1254-1259, 1276-1279	RNA processing
Wed, May 14***	Ch. 31, pp. 1259-1264	RNA editing; self-splicing introns
Fri, May 16	Ch. 31, pp. 1264-1275	Catalytic RNA; RNA structure-function
Mon, May 19	MIDTERM II (covering chapters 30 and 31)	
Wed, May 21	Ch. 32, pp. 1285-1291	Translation overview; the genetic code
Fri, May 23	Ch. 32, pp. 1306-1309	The evolution of the genetic code
Mon, May 26	HOLIDAY – NO CLASS	
Wed, May 28	Ch. 32, pp. 1292-1306	tRNA structure and aminoacylation I
Fri, May 30	Ch. 32, pp. 1309-1318	Aminoacylation II and aaRS enzymes
Mon, June 2	Ch. 32, pp. 1318-1326	Protein synthesis – initiation
Wed, June 4***	Ch. 32, pp. 1326-1347	Protein synthesis – elongation/termination
Fri, June 6	MAKE-UP LECTURE	
Thu, June 12	FINAL EXAM (covering the entire course)	

{ *** denotes that a writing assignment is due that day **before** class begins: prior to 11:30 am *sharp* }