

BIOLOGY 412 MOLECULAR BIOLOGY

Capstone Course for Biology, Biochemistry and Neuroscience Majors

Fall 2008
WF 12-1:15 pm
NSB 314

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BIO 412 is an advanced capstone course covering modern molecular biology, especially gene regulation, and the process of science. We have two major goals: First, we will explore the techniques and applications of recombinant DNA research, and second, we will examine the practice of science itself. We will focus primarily on the extensively studied area of gene regulation, with occasional forays into selected topics of cell biology such as signal transduction, development and cancer. We will not attempt to treat molecular biology comprehensively, but rather explore a few selected topics in some detail. We will also attempt to connect discoveries in molecular biology to larger issues in biology, such as evolution, biophysics, implications for human nature, and society. The course content is organized into two halves: first, recombinant DNA strategies, and second, genes and gene regulation.

Our second goal is to explore the nature of the scientific process. Your introductory experience covered genetics, molecular biology and biochemistry in a single semester. In order to cover all that material, we treated science as if it was static, or at best a progression of “facts” that lead to our current understanding of “truth.” Many of the science courses you’ve had may have worked this way. However, science is really another method of inquiry, performed by fallible people, with its own rules, strengths, and weaknesses. Therefore, it’s often wrong. For example, for the first third of the 20th century, most biologists were quite certain that genes were made of proteins rather than DNA. How could so many smart people be so wrong about such an important thing for so long? In BIO 412 we will discuss not only the “facts,” but also how we get there. How do biologists reach conclusions? How do they communicate them to one another? How do they (and perhaps how should they) communicate them to the layperson?

An exploration of the process of scientific inquiry demands a more interactive course format. We will emphasize the development of analytical and communication skills in science. A major focus of the course is reading primary literature. In order to begin thinking like a molecular biologist, you need to be able to read, analyze and discuss the descriptions of real experiments. Therefore, your participation in BIO 412 is essential. The course is organized to allow you to have ample opportunity to learn and develop skills through writing assignments and class discussion. Thus the inquiry focus required of a 400-level Biology course consists of investigation and analysis of primary scientific literature. There’s no lab, but come to class every day prepared to talk about science!

COURSE SCHEDULE

DATE	TOPICS	READING	ASSIGNMENTS
	MOLECULAR TECHNOLOGY		
AUG 27	Introduction; science as a process		
29	Review: molecular biology	Ch 1,2	
SEP 3	Subcloning strategies	Ch 4	
5	Discussion #1	<i>Wedekind et al.</i>	Assignment #1 due
10	Subcloning strategies: mutagenesis	Ch 4, 6	Essay topics due
12	Reading primary scientific literature	<i>Yin et al.</i>	
17	Gene cloning (molecular)	Ch 4	
19	Discussion #2	<i>Kozak</i>	
24	Gene cloning (genetic/positional)	Ch 4	Assignment #2 due
26	Transformation technology	Ch 6, 9	
OCT 1	Molecular interactions	Ch 13	
3	Discussion #3	<i>Buck and Axel</i>	Assignment #3 due
8	Analytical techniques	Ch 4	Essay outline due
15	Genomics	Ch 11	
17	Discussion #4 (student led)	TBA	
22	Applied molecular biology	Ch 14, 16	Assignment #4 due
24	<i>Discussion #5</i> (student led)	TBA	
29	<i>Discussion: Biomedicine and society</i>		Review essays due
	GENES AND GENE REGULATION		
31	Genome organization	Ch 5	
NOV 5	<i>Mid-Semester Exam</i>		
7	Gene regulation: transcription	Ch 3	
12	Gene regulation: transcription	Ch 3	
14	<i>Discussion #6</i> (student led)	TBA	
19	Gene regulation: post-transcriptional	Ch 3, 5, 9	
21	<i>Discussion #7</i> (student led)	TBA	Essay revisions due
DEC 3	Gene regulation: post-transcriptional	Ch 3, 5, 9	
5	Cancer	Ch 15	Fictional paper due
TBA	<i>FINAL EXAM</i>		

EVALUATION

Written and oral work constitutes the bulk of the student output that will be evaluated in this course. Attendance and participation in every class is expected. Note that attendance at department seminars is also expected (see below). I will determine final grades based on the following breakdown:

- 20% Review Essay
- 30% Discussion and participation
- 30% Take-home assignments and fictional paper
- 8% Mid-term quiz
- 12% Final exam

ASSIGNMENTS

I will assign four relatively short take-home writing projects throughout the semester. Each is due at the beginning of class on the date indicated on the course schedule. These are written problems and prompts that are to be addressed by each student working alone. They are open-book. I will evaluate the accuracy of your answer, the thoughtfulness and creativity of your analysis, and the quality of your written work.

In addition, every member of the class must hand in one written question relating to each of the 7 scheduled discussions. The question must be written before coming to class and must be **emailed to me before 11:30 AM** on the day of the relevant discussion. Additional instructions will be provided in class.

REVIEW ESSAY

One of the requirements for BIO 412 is the completion of Review Essay on a topic relevant to molecular biology. You will identify an area of interest in molecular biology and provide a brief review and analytical critique of the subject from primary sources. The paper will be between 8 and 12 pages long. Details, including sample topics, will be provided later. Note that the topic of the paper is due in early September (see schedule) and must be approved by me.

FICTIONAL PAPER

The final assignment for the course will be the preparation of a mock research paper. The fictional experiments described in your “paper” may emerge from your review essay or other inspirations. The paper should include at least two figures and tables of data and include all sections found in a normal published research article (Introduction, Methods, Results, Discussion, Figure and Table Legends, References). Details of this assignment will be provided separately.

DISCUSSION

Each student (usually working with a partner) will be assigned to lead one class discussion. Students who lead discussions will have the responsibility of preparing a 15-minute introduction to the paper and lead the rest of the class in a discussion for the remainder of the 75-minute period. All members of the class will read each paper before coming to class on the day of a presentation. Everyone is expected to participate in the discussion segment. While I realize that some students are quiet by nature (I was one), this is something you need to start getting over now. If you don’t participate, I have no way of learning what you’ve thought about the paper. Having said that, however, questions on the exams will make reference to papers we have discussed in class, so be sure to take notes on other students’ papers.

BIOLOGY DEPARTMENT SEMINARS

I assume that if you are taking this course it means you have a serious interest in biology. Therefore, it is an *expectation* that all students enrolled in this course will attend Biology, Chemistry, and/or Neuroscience seminars. This does not mean you have to attend every seminar. If you have a recurring commitment that will prevent you from attending any seminars, you will need to discuss this with me at the beginning of the semester. Biology Department seminars are usually held at 4:30 PM. I will announce specific dates and locations in class.

TEXTBOOKS

The following text is required for the course:

Watson, J. D., Caudy, A. A., Myers, R. M., and Witkowski, J. A., *Recombinant DNA: Genes and Genomes—A Short Course, 3rd Edition*, 2007, WH Freeman/ Cold Spring Harbor Press.

The following texts provide additional resources that may be useful in research for assignments and presentations.

Web texts

Several useful resources, including Lodish et al.'s *Molecular Cell Biology* (see below) are available online at NCBI's bookshelf resource:

<http://www.ncbi.nlm.nih.gov:80/entrez/query.fcgi?db=Books>

You can also reach this by going to NCBI's main page (<http://www.ncbi.nlm.nih.gov/>) and clicking on "Books". The on-line versions do not include the print page numbers, so you will have to find the information you want based on topic. Most, but not all, figures from the texts are available on-line.

Sambrook et al., *Molecular Cloning: A Laboratory Manual*, vol. 1-3.

This three volume set is a standard resource for laboratory protocols in molecular biology. In addition to detailed protocols, it also includes extensive, accurate and well-written background material on each procedure. These volumes are an excellent source for information on why and how molecular procedures are performed. It may prove very useful when encountering an unfamiliar technique during your research. *Available at the library.*

BLACKBOARD

Some of the essential and supplementary material for this class will be posted on-line on our Blackboard page. If for some reason you do not have a Blackboard account, please see OIT promptly to arrange an account.

OFFICE HOURS

My nominal office hours will be Tu 12:30-1:30, and ThF 9:30-10:30. I'm likely to be in my office or lab Tu and Th between 9:30 AM and 3 PM, and on Wednesday and Friday mornings. I will not be on campus most Mondays. I also encourage you to email me with questions or to make an appointment.

POLICIES

All assignments are due on the date indicated. Late assignments will result in a significant penalty. Each exam must be taken on the date and time scheduled. Exceptions to these policies will be allowed only in the case of serious illness or family emergency. All exceptions must be pre-approved by the instructor and documented by a physician or other official.

Cheating will not be tolerated in any form. Trying to obtain “answers” from students who took this course in years past is an ABC violation, and in any case will hurt you in the long run (this is really a course about questions!). Keep in mind that all written work handed in for this course must be your own. You may discuss assignments with your peers or me, but the written work submitted must be your work alone. Plagiarism will be taken VERY seriously and is potentially a major problem in a class of this sort. Please review what constitutes plagiarism (for example copying someone else’s idea without proper attribution) and write carefully when you are working close to your sources.

Attendance is expected at every class. If you cannot attend a particular class, it is your responsibility to obtain notes from a classmate. Note that you must attend all discussion sections. Another student cannot “cover” for you. While I understand that you might have to miss a class due to an interview or other compelling reason, you will need to let me know ahead of time. If you expect to miss more than one or two classes, you should discuss with me whether this class is appropriate for you to take this semester.

It is important that students with documented disabilities discuss appropriate accommodations with me as soon as possible.