

## **BIOLOGY 412**

## **MOLECULAR BIOLOGY**

Spring 2005  
MWF 10:30 am  
Shankweiler 120

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Biology 412 is an advanced 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 as they are currently practiced. 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. 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 Biology 412 we will discuss not only the “facts”, but 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 nature of the scientific method 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 Biology 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 orientation 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	Day	Subject	Reading (in <i>Miesfeld</i> )	Assignments
<b>PART ONE: Molecular Technology</b>				
19-Jan	W	Introduction; science as a process		
21-Jan	F	Review: molecular biology	3-12	
24-Jan	M	Subcloning strategies	12-20, 32-44	
26-Jan	W	Subcloning strategies: PCR	143-51, 161-3	
28-Jan	F	<i>Discussion #1: Wedekind</i> (Handout)		Assignment #1 due
31-Jan	M	Subcloning strategies: mutagenesis	69-78; 163-5	
2-Feb	W	<i>Reading primary scientific literature: Yin</i> (1)		Essay topics due
4-Feb	F	<i>Discussion #2: Gillies</i> (3)		Assignment #2 due
7-Feb	M	Gene cloning (libraries)	44-9, 96-102; 115-23	
9-Feb	W	Gene cloning (molecular)	123-31, 151-9	
11-Feb	F	<i>Discussion #3: Kozak</i> (4)		Assignment #3 due
14-Feb	M	Gene cloning (genetic/positional)	88-95, 109-11	
16-Feb	W	Gene cloning (genetic/positional)		
18-Feb	F	<i>Discussion #4: Lee and Goldfarb</i> (2)		Assignment #4 due
21-Feb	M	Transformation technology	205-8, 214-23, 229-30	
23-Feb	W	Gene therapy	183-191, 253-8	
25-Feb	F	<i>Discussion #5: TBA</i>		
28-Feb	M	Molecular interactions	128-31, 199	
2-Mar	W	Analytical techniques	131-4	Essay outline due
4-Mar	F	<b>Mid-Semester Exam</b>		
<b>SPRING BREAK</b>				
14-Mar	M	Genomics	237-50	
16-Mar	W	Applied molecular biology	159-6, 250-3	
18-Mar	F	<i>Discussion #6: TBA</i> (student led)		
<b>PART TWO: Gene Regulation</b>				
21-Mar	M	<i>Computer practical</i>		Review essays due
23-Mar	W	Applied molecular biology	208-14, 223-9	
30-Mar	W	Genome organization	83-88	
1-Apr	F	<i>Discussion: Ethics and molecular biology</i>		
4-Apr	M	Gene regulation: transcriptional initiation	22-7, 102-9, 175-81	
6-Apr	W	Gene regulation: transcriptional initiation	151-9	
8-Apr	F	<i>Discussion #7: TBA</i> (student led)		
11-Apr	M	Regulation: transcription factors		Assignment #5 due
13-Apr	W	Regulation: elongation and termination		
15-Apr	F	<i>Discussion #8: TBA</i> (student led)		
18-Apr	M	Regulation: RNA processing		
20-Apr	W	Regulation: RNA stability and translation		
22-Apr	F	<i>Discussion #9: TBA</i> (student led)		
25-Apr	M	Regulation: small RNA's		Assignment #6 due
27-Apr	W	Cancer		
29-Apr	F	<i>Discussion #10: TBA</i> (student led)		
2-May	M	Cancer		
4-May	W	Conclusion; molecular biology and society		Grant proposal due
<b>FINAL EXAM (TBA)</b>				

## EVALUATION

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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:

- 15% Review Essay
- 20% Grant Proposal
- 25% Discussion and participation
- 20% Take-home assignments
- 8% Mid-term exam
- 12% Final exam

## ASSIGNMENTS

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I will assign seven 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 that are to be answered by each student working alone. They are open-book. I will evaluate both the accuracy of your answer and the quality of your written work.

In addition, every member of the class must hand in one written question relating to a discussion or presentation on the day of the discussion or presentation. The question must be written before coming to class and must be handed in at the beginning. Additional instructions will be provided in class.

## REVIEW ESSAY

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One of the requirements for Biology 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 thorough review and critique of the subject from primary sources. The paper will be between 6 and 10 pages long. Details, including sample topics, will be provided later. Note that the topic of the paper is due in early February (see schedule) and must be approved by me.

## **GRANT PROPOSAL**

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The ultimate assignment for the course will be the preparation of a mock grant proposal related to the topic of your review essay. The proposal will be a 10-15 page document. It will begin with a rewritten, condensed, and (hopefully) improved background/significance section drawn from your review essay. The proposal will then propose a series of three to five logically-related experiments to test specific hypotheses related to your topic. Details of this assignment will be provided separately.

## **DISCUSSION**

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Each student will also 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 35-minute discussion. 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**

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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 Department seminar. This does not mean you have to attend every seminar. If you have a recurring commitment that will prevent you from attending any Department seminars, you will need to discuss this with me at the beginning of the semester. Biology Department seminars are held at 4:30 PM in Shankweiler 109 or 130. I will announce specific dates in class.

## TEXTBOOKS

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*The following texts are required for the course:*

Miesfeld, Roger L., 1999, *Applied Molecular Genetics*, New York: Wiley.

Reader for Biology 412.

This collection of reprints will be used for the presentation and discussion segments of the course. It contains a number of articles of historic and current interest in molecular biology, selected from the leading biology journals. The cost of this text covers reproduction and copyright fees.

*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. *On Reserve at the library.*

## BLACKBOARD

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Much 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

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My nominal office hours will be Tu/Th from 11AM -12:30PM and F 1-2PM. I'm likely to be in my office or nearby in one of the labs Tu-F between 9:30 AM and 4:30 PM. I'm also available Monday morning, but not afternoon. I also encourage you to email me with questions.

## POLICIES

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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.

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.