Biology 482 – Molecular Biology – Syllabus, Spring 2015

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Lecture: Mon Wed Fri, 9:05 – 10:00 AM, Olin Hall (OH) 227

Office Hours: Mon 1–2 PM, Tues 8–10 AM, Wed 10:15-11:15 AM, Thurs 11-12 AM or by appointment. Email is typically an good way to get a quick response to a question – although it is no substitute for one-on-one help with discussion in my office.

Course Home Page: www.sandiego.edu/~cloer/bio482.html

Main text for lecture (required) - *Molecular Biology*, 5th Edition, by Robert Weaver. ©2012 WCB/McGraw-Hill. (Your Bio 225 and 300 texts may also be useful for review.)

Biology 482 Lecture outlines and *Biology 482 Lecture Powerpoint* files (in PDF note-taking format) - both available online by login from Bio 482 website 'announcements/handouts' page.

Items on hard copy reserve -
Molecular Biology: Principles and practice by Cox, Doudna, O'Donnell. ©2012 New York: W. H. Freeman & Co, Ltd.
The Eighth Day of Creation: Makers of the Revolution in Biology by Horace Judson. Expanded edition, ©1996 Cold Spring Harbor Laboratory Press.
The Double Helix: a personal account of the discovery of the structure of DNA by James Watson. Norton Critical Editions ©1980 New York: Norton.
What mad pursuit: a personal view of scientific discovery by Francis Crick. ©1988 New York: Basic Books.

Goals of the Course

This course is about genes - their structure and function - therefore, students will study nucleic acid structure and the mechanics of replication, repair, transcription, and translation in bacteria, archaea and eukaryotes. A central goal is understanding gene regulation at all levels, and the structure-function relationships of nucleic acids and proteins. Critical experiments will be examined to learn how our current understandings have come about. Techniques in molecular biology will be examined in lecture as necessary to understand experiments and concepts. We will also study protein structure and function – especially protein interactions with nucleic acids – and post-translational events since proteins constitute the functional output of genes (with an increasing number of exceptions). We will also pursue a selection of topics which varies from year to year such as the molecular biology of HIV [and other retroviruses], influenza virus, and how current genomics projects (e.g., comparative and functional, and other '-omics') are altering our understanding of molecular biology.

At the end of Biology 482, a student should be able to:

* Explain how the structure and chemistry of nucleic acids relate to their functions, their relative stability, and their interactions with proteins. Understand the regulation of protein and nucleic function by structure-function relationships and macromolecular interactions. Know the complete structures of DNA/RNA components, the different forms of nucleic acids (A, B, Z) and the types of amino acids that mediate backbone and sequence-specific binding. Relate DNA structure to forms of DNA damage.

*Compare & contrast mechanisms of DNA replication, repair, recombination, transcription, gene regulation, RNA processing and translation in bacteria & eukaryotes.
*Interpret the results of experiments using standard molecular techniques such as gel shift, transcription run-on assay, linker scanning promoter analysis, etc. to explain how classic experiments have led to our current understandings about DNA replication, recombination, transcription, gene regulation, etc.
*Explain how recent genomics and functional genomics advances are altering our views of molecular biology in, for example, eukaryotic transcription and chromatin function.
*Apply molecular knowledge to understand and hypothesize about specific complex systems such as the HIV retrovirus and human disease states with underlying molecular dysfunction.

Course Mechanics

Attendance at all lectures is **strongly recommended** (but not required). Attendance at participatory activities such as presentations/discussions, and at any guest lectures is always **required**. Students who miss more than a few lectures often do poorly in class; such students will find little sympathy for their plight. The beginning of class may also include handing in assignments, quizzes, and discussion among the class that will be scored. (Consequently, please be on time.) For any missed lecture, a student should consult a fellow student for notes. Office hours are for further explanation and discussion, not a repeat of material presented in lecture. Lecture materials – outlines and powerpoints – will all be available on the class home page. These materials are meant to assist you in preparation for lecture and studying, but are no substitute for lecture attendance. Note that attendance at any class.

Missed quizzes or tests may be made up only for excused absences (e.g., sickness). Students should inform the instructor of the reason for their absence *as soon as possible* – ideally, *before* the class is missed. Grades on papers, problem sets, or other assignments turned in late may be severely reduced except for excused absences.

Classroom Etiquette

It is expected that you will not create disturbances or distractions during lectures. This includes using a cell phone or electronic device in any way: sending & receiving calls, texting, playing games, etc. If you use a laptop to take notes, then do not engage in activities that are not directly related to lecture such as web-surfing, checking e-mail, other reading, etc. This is rude, distracting and disrespectful to your fellow students and the instructor. Thinking and learning are facilitated by undivided attention, not multi-tasking. Learn to unplug/Unplug to learn!

Similarly, when it is time for class to begin, please stop talking with classmates and cease other activities – rather than forcing the instructor to shout to attract your attention. This begins the class with a pleasant, thoughtful, attentive, and respectful atmosphere.

No electronic devices of any kind (cell or smart phones, MP3 players, calculators, etc.) are permitted during exams or quizzes. If a calculator is needed for a test, one will be provided.

Problem Sets

Throughout the course, sets of problems and questions similar to those that will be on exams (or harder) will be handed out. Students are encouraged to treat these as practice exams. Many of these will be problems involving molecular data to be analyzed and explained. Some exercises or sections will be collected and graded. Answers will be posted about a week later.

Tests and Grading

There will be three hourly tests during the semester covering material in lectures preceding them. A cumulative final exam will cover previously untested material and major concepts from the entire course. [The final (25%) is like a 4th hourly test (16%) plus 9% covering cumulative concepts addressed throughout the course.] Other graded items may include quizzes, short papers, answers to problems, presentations, participation, etc.

Assigned readings contain more material than will be covered in lecture. Tests will emphasize lecture material as found in the lecture outlines. The quality of your writing on exams is important. Your answer to a question must be clear (and legible) to be correct. Spelling of new words you are adding to your biological vocabulary must also be correct.

Note that modifications to grading percentages may be necessary, depending on alterations in assignments, or unforeseen changes in the class schedule. As much as possible, grading will follow the outlines indicated.

Grading Summary:

Hourly tests (3, ea. 16%)	48%
Final (semi-cumulative)	25%
Presentations	12%
Quizzes, problem sets, short assignments	10%
Participation	5%

Provisional Lecture Schedule (subject to change)

	Topics	**Readings**
Jan. 26, 28, 30	Introduction, course syllabus & mechanics. History of 20th & 21st century molecular biology, Genomics & 'Post-Genomics.' DNA as the genetic material, nucleotides, solving DNA/ nucleic acids structure, supercoiling, hybridization. Protein structure review; in-class exercise on protein post-translation (covalent) modifications.	Chapters 1 - 3
	Molecular methods will not be covered as a separate unit in lecture, but will be reviewed and discussed as necessary during the semester. Read now, and review as needed. Much should be review from Cell Processes (Bio 225) and Genetics (Bio 300), esp. Chapter 4.	Chapters 4, 5
Feb. 2, 4, 6 Feb. 9, 11	DNA Replication: Basic mechanism & enzymology. Semi-discontinuous replication, replication strategies, bacterial and eukaryotic DNA polymerases, priming, elongation, DNA Pol III subunit functions, termination. DNA damage and repair. [Slide for Feb 13 presentation due Wed. Feb. 11 by 5 PM by email.]	Chapters 20, 21
Friday, Feb. 13	1st presentations: 'My favorite DNA-handling protein'	
Feb. 16, 18	Intro to Retroviral & HIV molecular biology. Retroviral (esp. HIV) replication, reverse transcriptases. [Lecture catch-up & review]	see outline, websites
Friday, Feb. 20	**FIRST EXAM**	
Feb. 23, 25, 27	Homologous recombination, Holliday junctions, RecA, RecBCD, RuvAB functions. Site-specific & illegitmate recombination. DNA transposons, retrotransposons, retroviral integration.	Chapters 22, 23
March 2, 4, 6	Gene structure and transcription in bacteria, *E. coli* RNA polymerase, Initiation, functions of σ, elongation, termination.	Chapter 6
March 9, 11, 13	λ phage life cycle in *E. coli*: lysis vs. lysogeny. DNA-protein interactions in bacteria, helix-turn-helix DNA binding motif.	Chapters 7, 8
March 17, 19, 21	Operons, Major shifts in bacterial transcription, *E. coli* σ subunits.	Chapters 8, 9

March 23, 25	Eukaryotic transcription: RNA polymerases, promoters & enhancers. RNA Pol II structure and subunit functions.	Chapter 10
Friday, March 27	**SECOND EXAM**	
Mar. 30 – Apr. 6	**SPRING BREAK / EASTER HOLIDAY**	
April 8, 10, 13	Eukaryotic transcription: General transcription factors, basal transcription complex formation. Eukaryotic transcriptional activators: specific TF structural classes. Chromatin structure & regulation, histone modifiers, coactivators & corepressors.	Chapters 11 - 13
April 15, 17, 20, 22	RNA Processing: exons & introns, splicing, spliceosomes, snRNPs, self-splicing introns, capping, polyadenylation. RNA editing, trans-splicing, RNA intereference, siRNAs, miRNAs, other ncRNAs.	Chapters 14 - 16
Fri., April 24	**THIRD EXAM**	
Sat., April 25 **Remembrance**	**DNA DAY** - Anniversary of Watson & Crick publication of DNA structure in *Nature* - April 25, 1953	Celebrate!
April 27, 29	Translation: initiation, elongation and termination, ribosome structure & function, genetic code	Chapters 17, 18
Fri., May 1; Mon., May 4	2nd presentations & discussions: BRCA1 protein functions (Horwitz et al., 2007), HIV protein functions (Zhou et al., 2004; Bennasser et al., 2006) primary literature articles	Horwitz 2007; Zhou 2004; Bennasser 2006
May 6, 8, 11	Special topic(s) – More virus molecular biology (? retrovirus/HIV, influenza, filovirus/Ebola-Marburg ?) as time allows	Supplemental readings
May 12 - 13	**STUDY DAYS** [Review session(s) TBD]	
May 14 - 20	**FINALS**	
Wed., May 20	**Final Exam, 8:00 AM – 10:00 AM**	