California State University, Los Angeles, Department of Biological Sciences, WINTER, 2011

Course title, number and units: Molecular Genetics, Biology 416 (4)

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Class Location: SHC 164B
Time: MW 9:50 – 11:30 AM
Office hours: MW 3:00 -4:20 PM (Class)
Tu 1:00-2:00PM (General)
Email: hpark8@calstatela.edu

Description: Molecular genetics examines the structure and function of genes and genomes. Topics to be explored include the assembly and analysis of genomes, the regulation of gene expression, the DNA damage response, DNA repair, DNA replication and growth control.

Prerequisites: BIOL100AB, BIOL340, CHEM301A Recommended: BIOL380

Textbook: Brown, Terence A., Genomes 3, 3rd Ed.
Use the emphasis that I place on material in lecture as a guide for the text. Any additional materials will be announced in class and made available on Web CT.

WEB-CT(http://webct6.calstatela.edu/webct/entryPageIns.dowebct)
In order to have access to the course materials and your grading record, you need to establish WebCT 6 userID during the first week of the quarter. Your WebCT userID is the same as your NIS userID. If you do not have an NIS userID, you need to see ITS Help Desk on first floor of the Library. Your lecture instructor will discuss the procedures that you need to follow to have access to your course grading record and course materials during the first week of the quarter. All PowerPoint lecture slides will be posted on the course homepage and all course communications will be done via WebCT. Therefore it is important that you PROPERLY establish your WebCT userID and that you be registered for the course. Students who are not registered for the course will not have access to the course homepage.

Course Requirements:

Attendance: Students are responsible for all material presented in class, including announcements about changes in course procedures. A fair calculation for the time required for this class should take into account the need to spend at least 2 hours of independent study for each class hour.

Reading assignment: The lecture topics, including chapter sections to read, are listed in the syllabus. It is highly recommended that you read the material before the lecture in order to have a complete understanding of the topics being presented.

Journal Review Project: Each student will write a critical review on a primary research article relevant to the topics covered in class. Prepare a two page, ¾ inch margin, single spaced, font size 11pts, critical review on a primary research article. You will choose an article and critique it in the following way:

Introduction – What is the purpose of the study or what problem are they trying to solve? Is a testable scientific hypothesis stated? If not, can you suggest one that their experiments tested? (1/3 page)

Materials and Methods – Describe the method(s) used to monitor the key variables examined in the most important experiment or figure. Do not regurgitate irrelevant experimental detail from the paper (e.g. if you choose to describe the concentration of salt in their solutions or the length of time a certain assay is allowed to proceed be sure to indicate why this is important to the subsequent interpretation). (1/2 page)

Results – Describe the one or two most important findings presented by the authors. (1/2 - 2/3page)

Discussion – Was the original hypothesis supported by the experimental results? Were there any unexpected findings? Were any potential problems or questions related to the interpretation of the results addressed? What is the larger significance of this paper? (1/2 – 2/3 page)

How to proceed:

1. Your article must be a **research article** from either the open access journal "PLOS Biology", "PLOS Genetics", "PLOS Pathogens" or "Journal of Biology". Search or browse for articles on a topic of interest (e.g. transcription, translation, DNA repair, cancer, etc) at the following websites: http://www.plos.org/journals/index.html, http://jbiol.com/. The instructor will guide you to search appropriate article to review.

2. Once you've found a research article of interest, read it thoroughly and begin writing your review of what you deem the most important experimental result in the paper. Minireviews and commentaries may help you understand an article better, but are not acceptable substitutes for an actual research article.
3. Submit electronic version of your review to WebCT along with the article you have chosen (Doc or PDF formats are allowed). Your paper does not need a cover page.

Bioinformatics project: The bioinformatics project is designed to help students better understanding on the new cutting edge tools to study the genome. You will follow the instruction and visit the internet database to complete the bioinformatics project. The project will be further described on a separate handout.

Evaluation:

Tests: There will be three exams. Information given during lecture will be critical to performing well on exams. The tests will be a combination of multiple choices, fill-ins, short answers and essay questions. **A scantron form will be required for the multiple-choice section.** The final exam will be comprehensive. No make-up tests will be scheduled. With an excused (i.e. discussed in advance or doctor's note) absence for a test, the value of the final exam will be increased to compensate for the missed test. If evidence of emergency can be provided for a missed final, an Incomplete will be given.

Online Pop up Quizzes: The reading assignment will be assessed by online pop up quizzes. Pop-up quiz will be available from a day ahead of the lecture to right before the lecture beginning. You will need to visit Web CT and solve the quizzes during the opening of the quizzes to get credit. The quizzes will be graded online and posted on your grading book. 12 quizzes will be given and two quiz scores will be used for extra credit.

Grading:		
	First Exam	20% (100 pts)
	Second Exam	20% (100 pts)
	Final Exam	40% (200 pts)
	Journal Project	5% (25 pts)
	Bioinformatics project	5% (25pts)
	Pop up quiz	10% (50pts, 10 times, 5pts/each)
	Total points	100% (500pts)

Grades in this course are not curved. Course grades will be assigned as follows:

A:	90% - 100%	B-:	71% - 75%	D+:	51% - 55%
A-:	86% - 89%	C+:	66% - 70%	D:	46% - 50%
B+:	81% - 85%	C:	61% - 65%	F:	below 45%
B:	76% - 80%	C-:	56% - 60%		

General Advice: Lecture attendance is mandatory. A "0" will be assigned for any missed exams, etc. unless the absence is satisfactorily justified (e.g. doctors report). Students are responsible for acquiring the missed material. No make-up assignments. **Assignments turned in late will not be accepted**!
The Drop/Incomplete and Academic/Honesty policies explained in the University General Catalogue will be strictly followed. Students are expected to read and abide by the University's Academic Honesty Policy, which can be found at http://www.calstatela.edu/academic/senate/_handbook/ch5a.htm. Students who violate this policy will be subject to disciplinary action, and may receive a failing grade in the course for a single violation.

You are responsible for the prerequisites for this course and are encouraged to discuss any questions regarding the policies and prerequisites with the instructors.

Students with disabilities Please contact the instructors ASAP to arrange appropriate accommodations!

Office hours Mon/Wed office hours are reserved specifically for the students in this class and no appointment is necessary. Tuesday Office hour is reserved for the students who need to get general academic advisement, which requires an appointment through the department office. If you are unable to meet with me during regular office hours, make an appointment with me directly (either in person or through e-mail).

If you put in the effort required, you should learn a lot from this course. If you are having trouble, or are not learning what you hoped to learn, talk to me. I benefit from your feedback.

Course Schedule:

Week	Day	Date	Subject	Reading assignment
1	M	Jan 3	1. Genomes Intro	1
	W	Jan 5	2. Studying DNA	2
2	M	Jan 10	3. Mapping Genome	3(except pp72-82)
	W	Jan 12	4. Sequencing Genomes	4
3	M	Jan 17	Martin Luther King Day **(No Class)**	
	W	Jan 19	5. Understanding a Genome Sequences	5
4	M	Jan 24	6. Understanding How a Genome Functions /First exam review/**Prmary research article choices due, 1 email per student, 5PM**	6
	W	**Jan 26**	**First Exam**	**1-6**
5	M	Jan 31	7. Eukaryotic Nuclear Genomes/**Bioinformatics project begins**	7
	W	Feb 2	8. Organelle and 9. Virus Genomes	8, 9
6	M	Feb 7	10. Accessing the Genome	10
	W	Feb 9	11. Transcript Initiation	11
7	M	Feb 14	12. Synthesis and processing of RNA-1	12
	W	Feb 16	12. Synthesis and processing of RNA-2 /Lecture review/**Critical review of the article due, 5PM**	
8	**M**	**Feb 21**	**Second Exam**	**7-12**
	W	Feb 23	13. Synthesis and processing of the Proteome	13
9	M	Feb 28	13. Synthesis and processing of the Proteome /15. DNA replication-1	15
	W	Mar 2	15. DNA replication-2	
10	M	Mar 7	16. Mutations and DNA repair / **Bioinformatics project due, 5PM**	16
	W	Mar 9	16. Mutations and DNA repair /LECTURE REVIEW	16
11	**M**	**Mar 16**	**Final exam 8:30-10:30 AM**	

Learning Objectives:

Chapter 1 Basics: Nucleic acid structure and function. Know the chemical properties of the bases and the forces that stabilize nucleic acid (DNA and RNA) interactions. Know the five functional RNAs. For protein structure and function, also know the chemical properties and forces stabilizing protein folding. Know how to use the codon table and the concept of codon reassignment.

Chapter 2 Tools: Know the major enzymes as tools: DNA polymerases (Klenow, Taq and reverse transcriptase), nucleases (exo-, endo-, and restriction), ligases, and end-modifying enzymes (kinases, phosphatases). Know the major cloning vectors and associated features (plasmids, bacteriophages, BACs). Know how to use these tools to generate a cDNA library.

Chapter 3 Maps: Know the types of landmarks on genetic maps (genes, rflp, sslp, snp) and physical maps (restriction, optical, sts). Know how they are different and what purposes they can serve.

Chapter 4 Sequencing & Assembly: Understand the Sanger sequencing and pyrosequencing methods and be able to read a sequence trace. Understand the shotgun method, clone contig method and whole-genome shotgun method for genome sequence assembly.

Chapter 5 Understanding Content: Know the bioinformatics and experimental methods for locating genes (orf detection, homology search, cDNA sequencing) and assigning function (homology, knock-outs, insertional mutagenesis, RNAi, overexpression, expression analysis).

Chapter 6 Understanding Function: Know the methods for genome-wide analysis (SAGE, DNA chip) and proteome-wide analysis (protein profiling – 2D gels, mass spec; protein interaction – phage display, yeast 2-hybrid, tandem affinity purification)

Chapter 7 Nuclear Genomes: Know the structure of chromatin and chromosome architecture (centromere, telomere). Know about gene families, pseudogenes, and the various types of repetitive DNA (interspersed and tandem).

Chapter 8 Prokaryotic Genomes: Know the roles of the Hu tetramer and nucleoid region. Know the various genome architectures circular, linear, multipartite. Know that genes are organized into operons and the problems with the species concept in many prokaryotes.

Chapter 9 Viruses: Know the bacteriophage lifecycle and the different possible arrangements of their genomes. Know the relationships between retroviruses and mobile genetic elements.

Chapter 10 Access: Understand nuclear architecture (double membrane, nuclear pore, nuclear matrix, nucleolus) and chromatin states (constitutive vs facultative heterochromatin, euchromatin). Know insulators, LCRs and the roles of histone/DNA modifications (acetylation, methylation). Know the enzymes (HAT, HDAC, HMT, DNMT) and interacting factors (bromodomains, chromodomains, MeCPs). Know the functions of nucleosome remodeling complexes.

Chapter 11 Transcript Initiation: Know the bacterial and eukaryotic RNA polymerases and mechanisms. Bacterial: constitutive vs regulatory. Eukaryotic: core elements, response elements, enhancers, silencers, activators, co-activators.

Chapter 12 Synthesis and Processing of RNA: Bacterial elongation and termination (pausing, intrinsic terminators, Rho-dependent termination, anti-termination, attenuation). Bacterial RNA processing, nucleotide modifications (methylation, deamination), and degradation. Eukaryotic coupling of elongation to processing (promoter clearance, mRNA capping, escape, elongation factors). Eukaryotic termination requires CPSF and CstF. Know GU-AG introns and splicing mechanism. Know roles of RNA editing. Know mechanisms of RNA degradation in eukaryotes (deadenylation-dependent decapping, NMD). Know RNAi and miRNA processing.

Chapter 13 Synthesis and Processing of Protein: Know tRNA structure and function (codon, anticodon interaction, wobble hypothesis). Know structure and function of ribosome. Know eukaryotic mechanism for initiation of translation. Know special role of IRES. Know regulation of translation initiation (global vs transcript-specific). Know general bacterial mechanism of elongation and termination. Post-translational processing, folding (molecular chaperones), proteolytic processing, chemical modifications (acetylation, methylation, phosphorylation), protein degradation (PEST, ubiquitin ligase enzymes).

Chapter 15 DNA replication: Know roles of topoisomerases and understand the Meselson-Stahl experiment. Know prokaryotic replication initiation, elongation and termination mechanisms and regulation of initiation. Know eukaryotic regulation of initiation (Licensing: ORC, CDC6, MCM2-7). Know eukaryotic mechanism for telomere length maintenance.

Chapter 16 Mutations and DNA repair: Know types of mutations (point, insertions/deletions) and causes (spontaneous, chemical, physical) as well as the effects mutations can have on genomes (CDS, non-CDS, frameshifts, loss/gain of function). Know difference between reversion and suppression. Know mechanisms of direct repair, excision repair, mismatch repair, and non-homologous end-joining.