

UMBC UGC New Course Request: BIOL 306 Molecular Biology

Date Submitted: April 19, 2011

Proposed Effective Date: Spring, 2012

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COURSE INFORMATION:

Course Number(s)	BIOL 326
Formal Title	Molecular Biology
Transcript Title (≤24c)	Molecular Biology
Recommended Course Preparation	CHEM 351, CHEM 352
Prerequisite	BIOL 302 and BIOL 303
Credits	4
Repeatable?	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
Max. Total Credits	4
If yes, how many total credits?	0
Grading Method(s)	<input checked="" type="checkbox"/> Reg (A-F) <input type="checkbox"/> Audit <input type="checkbox"/> Pass-Fail

PROPOSED CATALOG DESCRIPTION:

This is an intermediate level course in molecular biology of prokaryotes, eukaryotes and their viruses. It will cover the principles governing the molecular mechanisms that occur in living cells including regulatory mechanisms. Topics will include the processing of genetic information through the central dogma (transcription, RNA processing and translation), DNA replication, mutation and DNA repair, and genomics.

RATIONALE FOR NEW COURSE:

After completing four common core courses in the new BIOL curriculum, students choose Junior-level elective courses, one in the B.A. or several in the B.S. Current available courses are in the areas of microbiology, physiology, biochemistry, developmental biology and bioinformatics. Molecular biology currently is treated at an introductory level in BIOL 302 Molecular and General Genetics, but not again until several senior-level elective courses. These electives include BIOL 414 Eukaryotic Genetics and Molecular Biology, BIOL 418 Human Molecular Biology, BIOL 426 Approaches to Molecular Biology and BIOL 456 Plant Molecular Biology. Each of these senior/graduate courses level involves reading and analyzing articles from the primary research literature. Because students have only been exposed to molecular biology as sophomores and at the introductory level, these advanced courses must provide background information to help students understand the sophisticated content of the published articles. This is an inefficient method and the result is that students are exposed to a patchwork of advanced molecular biology, often provided on a just-in-time basis. The proposed course would fill the gap between the introductory and advanced courses and provide a more holistic training in the current understanding of molecular biology. It would be an excellent preparation for students interested in specializing in biology at the molecular level in their senior-level electives or planning on graduate training in molecular biology.

ATTACH COURSE OUTLINE (mandatory)

Schedule of classes and readings

Week	Topic	Readings*
1	(Begin Unit 1) Introduction	Chap. 1 (2-11)
	Review: molecular nature of genes & introduction to gene function	Chap. 2-3 (13-48)
2	Molecular cloning methods	Chap. 4 (49-74)
	Tools to study genes I (electrophoresis, blotting, sequencing)	Chap. 5 (75-96)
3	Tools to study genes II (mutagenesis, transcript analysis, knockouts)	Chap. 5 (97-120)
	(Begin Unit 2) Transcription in bacteria	Chap. 6 (122-163)
4	Operons: fine control of bacterial transcription (<i>lac</i> , <i>ara</i> & <i>trp</i> operons)	Chap. 7 (168-193)
	Major shifts in bacterial transcription (sigma switching, phage λ)	Chap. 8 (197-220)
5	DNA protein interactions (λ & <i>trp</i> repressors, <i>gal</i> operon)	Chap. 9 (223-242)
	(Begin Unit 3) Eukaryotic RNA polymerases and promoters	Chap. 10 (245-271)
6	Eukaryotic general transcription factors	Chap. 11 (274-310)
	Transcription activators in eukaryotes	Chap. 12 (315-350)
7	Chromatin structure's effect on transcription	Chap. 13 (356-391)
	Midterm 1	
8	(Begin Unit 4) RNA processing I: RNA splicing	Chap. 14 (395-433)
	RNA processing II: capping and polyadenylation	Chap. 15 (437-467)
9	Other RNA processing events (rRNA processing, editing, mRNA stability)	Chap. 16 (473-488)
	Other RNA processing events (RNA interference, miRNAs, P-bodies)	Chap. 16 (488-519)
10	(Begin Unit 5) Mechanisms of translation I: initiation	Chap. 17 (523-557)
	Mechanisms of translation II: elongation & termination	Chap. 18 (561-598)
11	Ribosomes & transfer RNA	Chap. 19 (602-633)
	DNA replication, damage & repair	Chap. 20 (637-674)
12	DNA replication II: detailed mechanism	Chap. 21 (678-706)
	(Begin Unit 6) Homologous recombination	Chap. 22 (710-730)
13	Transposons & transposition	Chap. 23 (733-756)
	Genomics I: introduction to genomic DNA sequencing	Chap. 24 (760-786)
14	Genomics II: functional genomics, proteomics & bioinformatics	Chap. 25 (790-824)
	Midterm 2	
15	Poster presentations	
	Poster presentations	
	Comprehensive Final Exam	

* All readings are from *Molecular Biology* (fifth edition), Robert F. Weaver (McGraw-Hill, New York, 2012) ISBN 978-0-07-352532-7.

Style of instruction

The class will be taught in a student-centered fashion in a large lecture hall (e.g., LH1) but it would be most effective if it were taught using the CASTLE facility of the College of Mathematical and Natural Sciences (<http://www.umbc.edu/CNMS/CASTLE.html>). CASTLE accommodates ~90 students who work in-class in hierarchical triads. Students will be expected to come to class having completed the assigned readings and the online quiz based on the readings and having posted questions about the content for classroom discussion. The class meetings (two 100 minute classes per week) will involve a variety of learning modalities. During each class meeting, the faculty instructor(s) and teaching assistant(s) would work intensively with student groups. If CASTLE is not available, the course could be taught by providing two 75 minute lectures involving active learning approaches and supplementing those with one 50 minute discussion section of about 30 students taught by a graduate teaching assistant. In the discussion sections students could work in small groups on problems posed by the TA.

Learning modalities

Reading quizzes. A quizzes based on the readings for each of the six units will be posted to Blackboard and students will be required to complete them before coming to class. This will assure that students have done the reading and will provide an assessment of their level of understanding of the material that will guide plans for classroom work.

Lecture. Although students will have read the material for a given class, it may be necessary to supplement those readings with short (15-25 minute) lectures, which would be presented by the faculty member(s).

Problem solving. Students will work in triads or higher groupings on problem solving. Some of these problems would involve computer analysis, for which the CASTLE environment will be essential; if the course is taught without using CASTLE problems could be assigned as homework and students asked to present solutions in discussion section. The problems will be based either on the readings from the textbook or on supplemental articles from the scientific literature (published for example in *Scientific American*, *Science* and *Nature*).

Short writing assignments. Five-minute writing assignments will be used to assess knowledge and comprehension and to encourage higher-level analysis of class material (the higher levels of Bloom's Taxonomy including application, analysis, synthesis and evaluation).

Clickers. In association with most of the other learning modalities, clickers will be used to assess learning during class.

Group project. Six or nine-student groups will be formed from triads for a year-long investigative project. This project will be centered on a family of "favorite genes/proteins" chosen by the group. For example, a group may chose to study a family of actin-binding proteins and their encoding genes. Each member of the group will be responsible for a unique gene and protein from the family with each being differentiated by detailed cellular function and/or phylogeny (that is, by the species from which the gene/protein derives). Examples of possible species include the bacterium *Escherichia coli*, a lower eukaryote like the yeast *Saccharomyces cerevisiae*, the fruit fly *Drosophila melanogaster* or the nematode *Caenorhabditis elegans*, or a higher eukaryote like the mouse *Mus musculus* or human. The groups will apply skills learned in the classroom (or discussion section) to analysis of their favorite gene with the ultimate goal of producing a group poster that will be presented to the classroom in the last two class meetings.

Semester writing projects. Students in the groups will also have individual incremental writing assignments based on the group project building to a final written project paper. The writing project will be constructed to satisfy the Writing Intensive (WI) requirement and the class will have WI general education status. Provision will be made for critiques by peers and/or the faculty and TAs followed by revision as specified by the WI program.

Assessment

Course grades will be based on the student's performance in class in the two midterms and one comprehensive final examination, quizzes, short writing assignments, problem sets and clickers. In addition, the students will be graded as a group for the required poster and individually for the semester writing project, including the incremental writing assignments and final written project.

Assessment	Percent of grade
Midterm 1	15%
Midterm 2	15%
Final	20%
Reading quizzes	10%
Problem solving worksheets	10%
Short writing assignments	7.5%
Clickers	7.5%
Poster	5%
Semester writing project	10%
Total	100%