UMBC UGC New Course Request: BIOL 421: Topics in Molecular Genetics

Date Submitted: 11/14/2018 Proposed Effective Date: Fall 2019

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COURSE INFORMATION:

Course Number(s)	BIOL 421
Formal Title	Topics in Molecular Genetics
Transcript Title (≤30c)	Topics in Molecular Genetics
Recommended Course Preparation	None
Prerequisite **NOTE:** Unless otherwise indicated, a prerequisite is assumed to be passed with a "D" or better.	You must complete BIOL 302 and BIOL 303 with a grade of "C" or better.
# of Credits Must adhere to the UMBC Credit Hour Policy	4.00
Repeatable for additional credit?	☐ Yes ☒ No
Max. Total Credits	4.00 This should be equal to the number of credits for courses that cannot be repeated for credit. For courses that may be repeated for credit, enter the maximum total number of credits a student can receive from this course. E.g., enter 6 credits for a 3 credit course that may be taken a second time for credit, but not for a third time. Please note that this does NOT refer to how many times a class may be retaken for a higher grade.
Grading Method(s)	☒ Reg (A-F) ☐ Audit ☐ Pass-Fail

PROPOSED CATALOG DESCRIPTION (Approximately 75 words in length. Please use full sentences.):

This advanced seminar-style course explores emerging and recently established topics in molecular genetics, with an emphasis on the experimental basis of current knowledge. The topics covered during any semester will vary according to recent developments in the field, and might include novel subtopics within well-established areas such as functional genetics, regulation of gene expression, and the genetics of human disease. Some emphasis is placed on the application of new basic science advances toward biotechnology development. Integrated into this material is the discussion of concepts that encourage an entrepreneurial attitude and skillset.

RATIONALE FOR NEW COURSE:

Course was previously taught as a topics section of BIOL 420-Advanced Topics in Cell Biology. Due to faculty and student interest, we wish to make this a course that focuses on emerging topics in molecular genetics (as opposed to cell biology) and that can be regularly taught by our department. In addition, the instructor proposing the course has added components that allow the course to be used for the Entrepreneurship minor, whereas other versions of BIOL 420 do not have these components and cannot be used for the Entrepreneurship minor.

ATTACH COURSE SYLLABUS (mandatory):
See attached.

Biology 421/621
Topics in Molecular Genetics

Catalog Description: This advanced seminar-style course explores emerging and recently established topics in molecular genetics, with an emphasis on the experimental basis of current knowledge. The topics covered during any semester will vary according to recent developments in the field, and might include novel subtopics within well-established areas such as functional genetics, regulation of gene expression, and the genetics of human disease. Some emphasis is placed on the application of new basic science advances toward biotechnology development. Integrated into this material is the discussion of concepts that encourage an entrepreneurial attitude and skillset.

Course Overview: This course is designed for graduate students and upper level undergraduate students who have earned a C or better in Biology 303 (or its equivalent) who are interested in learning more about emerging topics in Molecular Genetics. The course will revolve around readings from the primary scientific literature and utilizes team activities, class discussions, mini lectures, and writing exercises to learn the content of those readings and how the process of scientific research works. This semester BIOL 421 will focus on two main topics. First, we will study small regulatory RNAs (RNAs that are ~20-26 nucleotides long), the roles they play in regulating gene expression in eukaryotes, and how they can be manipulated to modify gene expression. Next, we will investigate the new technology of genome editing—how this technology was adapted from a natural bacterial immune system, and how it is being used to make precise changes to the genome. We will explore how these technologies can be used as therapeutic tools and to generate valuable products. As such, we will address the biotechnological applications of these topics and entrepreneurship principles as pertaining to start-up and small biotechnology companies. This is a Writing Intensive course and as a result, you will be doing lots of writing that involves feedback and revisions, including work relating to an entrepreneurship project. The primary research journal articles we read will be the main source of information for these assignments, in addition to some book chapters.

Instructor: Stephen Miller, BS 417; 5-3381; stmiller@umbc.edu

Course Objectives: Students who successfully complete this course will be able to:

a. describe the different major classes of small RNA molecules, how they are generated, and how they regulate gene expression
b. explain how genome editing technologies work and how they may be used in research, biotechnology, and medicine
c. organize and express ideas about scientific issues efficiently and effectively in written form.
d. read, critique, and discuss scientific papers well enough to explain their significance, strengths, and weaknesses to both professional and lay audiences.
e. Use critical and innovative thinking skills to solve problems
f. Work as part of a team to develop a biotechnology start up concept

Content Organization

Unit Number and Name	Dates
Introduction to gene expression, small RNAs, and genome editing; techniques review (2)	8/28, 9/4
01. The discovery of RNAi and CRISPR (4)	9/9, 9/11, 9/16, 9/18
Introduction to Entrepreneurship principles and group project planning; peer review of RNAi/CRISPR paper	9/23
02. siRNAs, dicer, and slicer (3)	9/25, 9/30, 10/2
03. small RNAs and transcriptional regulation (3)	10/7, 10/9, 10/14
Biotech start-up group project discussion (1)	10/16
04. microRNAs (4)	10/21, 10/23, 10/28, 10/30
05. small RNA applications: therapeutics and biotech (4)	11/4, 11/6, 11/11, 11/13
06. CRISPR applications: therapeutics and biotech (4)	11/18, 11/20, 11/25, 12/2
07. Project presentations (3)	12/4, 12/9, 12/11

Web based resources

http://www.nature.com/scitable/topicpage/small-non-coding-rna-and-gene-expression-1078
http://www.nature.com/nrg/multimedia/rnai/animation/index.html
http://www.abcam.com/index.html?pageconfig=resource&rid=10787&pid=10007
http://en.wikipedia.org/wiki/MicroRNA
http://en.wikipedia.org/wiki/Small_interfering_RNA

Grading Policies

Class participation	20%
Technique description/definition	5%
Techniques quiz	5%
Discovery of CRISPR paper (BIOL420)	10%
NSF mini proposal (BIOL620)	10%
Biotech commercialization plan	15%
Commercialization plan presentation	10%
Regular Quizzes (4% each)	15%
Final exam (take home)	20%

Course Policies

Class participation accounts for a substantial portion of your grade in this course. Therefore, class attendance is mandatory. Class participation will include an attendance component (includes being in class on time) and a contribution component (speaking up in class to ask questions or answer questions asked by others). Participation grades will be determined and reported quarterly.

Cell phones must be turned off during class. Use of laptops and iPads is also banned in class, unless otherwise sanctioned, such as during work on the techniques assignment and during the peer-review writing workshop days.

Except for a quiz on techniques, quizzes will be unannounced. There will be no make-ups. You can drop one regular quiz, but not the techniques quiz. If you miss class for any reason and a quiz was given that day, you will have to drop that quiz.

Generally, each unit will begin with a brief overview introducing/summarizing the topic. After the initial overview, we will spend the rest of the time for that unit discussing current literature papers relating to that topic.

The paper discussions will be done as an entire class. You will be assigned into semester-long teams of 4 students and teams will generally be assigned the background/rationale, a figure, or a table from that day's paper, or will be assigned to ask questions of the presenters. For some papers, ONE member of the team (chosen by me) may be asked to explain the assigned element to the class as a whole. It is therefore, to your advantage, to be a prepared and active participant and to also make sure your teammates are prepared.

The papers and book chapters we discuss in class will be uploaded as PDFs into the appropriate folders at least a week before we discuss them. It is your job to print them out. For the first several weeks of the semester, I will also provide guiding questions for you to help you understand the papers as you read them.

Entrepreneurship-related assignments

Book chapters. Chapters excerpted from the book listed below will be used to provide students some case studies/real world examples of how markets are analyzed, how new products are designed, developed, and marketed, and how start-up companies are structured:

Biotechnology Entrepreneurship: Starting, Managing and Leading Biotech Companies. 2014. C. Shimasaki, ed., Academic Press, Waltham, MA. ISBN 978-0-12-404730-3

Commercialization plan. Teams will work together on a semester-long entrepreneurship project to develop a biotechnology start-up business plan for a small RNA/CRISPR-related product. Students will work in teams of 4 that function as biotech start ups that will analyze markets for small RNA/genome editing related products, develop those products, and describe marketing strategies, as part of a semester-long group project that will culminate in the writing of an 8-10-page (single spaced) commercialization plan document. Team members will be assigned 4 different parts to write and present: Market Opportunity, Business Model (marketing), The

Product, and Financial Model. Teams will present their commercialization plans to the rest of the class.

Teams will submit a written draft of that business plan 2 weeks before the end of the semester then a revised version a week after the last day of class. Teams will also present their business plans to the rest of class in the final 2 classes of the semester.

Alex. Brown Center events. All students will attend one or more Sponsored Events by the Alex. Brown Center of Entrepreneurship, including one or more Speaker Series events and one or more Entrepreneurship Workshops. These activities will count toward the class participation grade. A calendar of Alex. Brown Center events will be posted on Bb.

Writing Assignments

#1: Work in teams to describe/define important biological techniques and explain how they are used—as a class we will refine and revise
#2: Discovery/development of RNAi/CRISPR paper (800-1000 words; undergrads only)
#2: NSF mini-grant (5 pages, single spaced; grads only)
#3: Biotech commercialization plan (4000 words total, 1000 words per student)

Rubrics for writing assignments will be provided at least two weeks before the DRAFT is due

Undergraduate writing assignment timeline

8/28, 9/4	small groups assigned and work on definitions/descriptions of important biological techniques used to study small RNAs and genome editing
9/9	revision/discussion on technique definition/descriptions
9/23	**Discovery of RNAi/CRISPR DRAFT due in class—peer review during class**
9/30	**Revised RNAi/CRISPR DRAFT due to S. Miller**
10/9	Comments on Discovery of CRISPR draft returned to you
10/16	**FINAL version of Discovery of RNAi/CRISPR paper due by 9 am**
10/21	**Outline of Biotech project commercialization plan due**
12/2	**Business Plan DRAFT due to S. Miller**
12/9	Comments on Business Plan returned to you
12/16	**FINAL version Business Plan due by 1 pm**

Graduate writing assignment timeline:

10/9	Outline of NSF mini-grant due in class
10/21	Draft of NSF mini-grant due for peer review
10/28	Peer reviews due
11/5	Draft of NSF mini-grant due to S. Miller
11/19	S. miller comments on NSF mini-grant returned to you
12/2	Final version of mini-grant due to S. Miller

Learning objectives for the writing assignments are:

Learn to write with clarity and conciseness.
Learn how to synthesize what you learn from your readings into new ideas and express those ideas effectively
Learn how to critically assess effective writing.

Only a very small (3-5%) part of your paper grade will be based on spelling and grammar, but in cases where grammar and spelling are so problematic as to obscure the meaning of the writing, you will be instructed to use the writing center for individualized instruction in this area (http://www.umbc.edu/lrc/writing_center.htm). Failure to make your work understandable at this level will negatively impact your grade. It is also an EXCELLENT idea to have fellow BIOL420 students, friends, or family members read your papers and give you advice about your writing.

Late Penalties for writing assignments:

A 1% per-day penalty will be assessed for any writing assignment (draft or final version) that is not submitted on time. No exceptions.

Academic Integrity:

All of your individual written assignments are to be in YOUR OWN WORDS. Please refer to the following links for information plagiarism and how to avoid it. I have downloaded a PDF copy of UMBC student academic policy and placed it into "Important Documents" on BB. The Indiana site has very useful information regarding good writing practices.
The penalty for plagiarism is a ZERO for that assignment, whether it occurs in a rough draft or the final product.

http://www.umbc.edu/provost/integrity_policy.html
http://www.indiana.edu/~wts/pamphlets.shtml
http://www.ariadne.ac.uk/issue16/digital/

Research article assignments

Unit 1:

1. 2/6: Fire et al. 1998, Nature, 391:806-811
2. 2/8: Hamilton & Baulcombe 1999, Science, 286:950-952
3. 2/13: Barrangou et al. 2007, Science 315:1709-1712
4. Jinek et al. 2012, Science 337:816-821

Unit 2:

5. Zamore et al. 2000, Cell 101:25-33
6. Bernstein et al. 2001, Nature 409:363-366
7. Liu et al. 2004, Science 305:1437-1441

Unit 3:

8. Hall et al. 2002, Science, 297:2232-2237
9. Verdel et al. 2004, Science 303:672-676
10. Qi et al. 2006, Nature 443:1008-1012

Unit 4:

11. Lee et al. 2003, Nature 425:415-419
12. Wang et al. 2001, PLoS Genetics, 7:1-8
13. Gao et al. 2010, Nature 466:1105-1110
14. Issler et al. 2014, Neuron 83:344-360

Unit 5

15. Zovoilis et al. 2011, EMBO J. 30:4299-4308
16. Kota et al. 2009, Cell 137:1005-1017
17. Janssen et al. 2013, N. Engl. J. Med. 368:1685-1693
18. Gratz et al. 2014, Genetics 196:961-971

Unit 6

19. Gilbert et al. 2013, Cell 154:442-451
20. Kaminski et al. 2015, Scientific Reports 6:1-15
21. Hammonds et al. 2016, Nature Biotech. 34:78-85
22. Liang et al. 2015, Protein Cell 6: 6(5): 363–372