Course Syllabus – BIOL 410

Course Information

Course Number: BIOL 410 FA22
Course Name: Molecular Biology
Term: Fall 2022
Start Date: 09/07/2022
End Date: 12/09/2022
Credits: 3.0

Meeting Days / Times

Mondays and Wednesdays, 11:30am-1:00pm PT / 2:30-4:00pm ET
(See Calendar in Canvas for the most up-to-date schedule.)

Location

CA: Graduate Office Dining Room (Hazen Theory Building)
FL: C204
Online via Zoom

Course Managers

Role	Last Name	First Name	Email Address
Course Director	Kojetin	Doug	dkojetin@scripps.edu
Course Director	Lamia	Katja	klamia@scripps.edu
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Course Description

This is a hybrid lecture/literature-based course that exposes students to fundamental principles and emerging issues related to molecular biology. An understanding of molecular biology is essential for both the theory and practice of modern science. The class will be presented with specific weekly topics that cover critical or emerging aspects of molecular biology. Each weekly topic will typically be presented on Wednesday (unless otherwise noted in the calendar) by expert faculty to provide context for the students to understand critical aspects of molecular biology. The subsequent topic-specific Manuscript Discussion class (typically held on Monday unless otherwise noted in the calendar) will involve student-led discussion on recent literature

related to the weekly topic, or presentation of projects based on the weekly topic. Students will be asked to identify and discuss the strengths and weaknesses of papers discussed in the class, and to propose "next experiments" that arise from the work and the experimental means to address them. Written assignments will include the "strengths/weaknesses" and the "next experiments" for each paper discussed in class, or homework or a small project for a couple of topics. In addition, students will take a final exam to cover each of the weekly topics as discussed in the faculty lectures.

Broad Objectives:

- Students will gain an appreciation of exciting areas and emerging issues in molecular biology research and the methods used to pursue them.
- Students will be introduced to technical details of two important areas in molecular biology research: a) genome editing using CRISPR/Cas9 technology and b) design and implementation of high throughput sequencing methods.
- Students will learn how to critically and constructively read and review a paper.
- Students will learn how new research projects emerge from existing literature.
- Students will learn how to present critiques of papers from the primary literature, both orally and in writing.

Program Learning Outcomes

By the end of the program, students will have accomplished these objectives:
PLO1: Original Research – graduate students are expected to develop the skills critical for generating high-quality research output. This would include absorbing, recalling, and contextualizing scientific knowledge, evaluating scientific information and data, creating testable hypotheses and investigating hypotheses, mastering scientific tools and techniques, displaying ethical behavior, and receiving and giving feedback.
PLO2: Communication – graduate students are expected to demonstrate the oral, written, and media skills to effectively communicate the impact of a study or a body of work to the greater scientific community and to the public at large using a number of methods.
PLO3: Critical Thinking – graduate students are expected to develop a self-directed process to analyze information, form opinions or judgments, and use this process to improve the quality of their scientific thoughts, navigate problems, and make informed decisions.
PLO4: Intellectual Curiosity – graduate students are expected to acquire the capacity to build their intellectual curiosity and demonstrate problem solving approaches that serve their professional growth and ability to impact a field.
PLO5: Career and Professional Development – graduate students are expected to develop a variety of transferable skillsets throughout their graduate experience, including management and leadership, inclusiveness, resilience, scientific rigor, collaboration, accountability, time management, teamwork, networking, and career planning.

Course Learning Outcomes

By the end of this course, students will be able to:
CLO1: Establish a basic understanding of current emerging scientific fields pertaining to molecular biology and to be able to critically evaluate the literature related to that field.

CLO2: Understand the strengths and limitations of various experimental approaches for studying molecular biology.
CLO3: Judge when the stated scientific conclusions derived from original experimental data are justified, and when they are not justified.
CLO4: Devise alternative scientific approaches to allow more robust conclusions on specific cell biological questions.
CLO5: Identify and formulate important new questions that are inspired by specific scientific results, and design experiments to answer these questions.
CLO6: Design and understand basic strategies for working with nucleic acids in the laboratory.
CLO7: Develop and present succinct oral presentations describing the background of specific molecular biology papers and their relationship to other work in the field.

Background Preparation (Prerequisites)

Most students will have taken a Molecular Biology course (or the equivalent) as an undergraduate, but this is not required. Nonetheless, these students will find it helpful to read relevant background material for each class from the *Molecular Biology of the Cell* textbook (Alberts et al, 6th edition) as a refresher.

Course Materials

Required reading: One recent original research paper in the relevant area of molecular biology will be provided for each Manuscript Discussion (typically to be held on Mondays otherwise noted in the calendar) and will be the basis for the class discussion. The required reading list will be posted on the Graduate Program
Website: www.scripps.edu/phd/biograd/coursedescbio.html

Recommended Reading: One short, topical review to accompany each research paper will also be provided and posted on the website.

Required Textbook: Alberts et al. (2014). *Molecular Biology of the Cell* (6th Edition). ISBN: 978-0815344322.

Course Requirements and Assignments

1) Class Paper Discussions: All students, not just the presenters, will be responsible for reading the discussion paper prior to class and should be prepared to discuss each figure and the strengths and limitations or weaknesses of the paper. Strengths might be important new insights emerging from the results, new methodologies and/or innovative application of existing methodologies, an innovative approach to addressing the question, the importance of the question being addressed, the integration of current and existing results to present a new model, etc. Weaknesses might be mis- or over-interpretation of presented data, lacking control experiments, sub-optimal choice of methodology. Limitations may include questionable translation of findings from model organisms, remaining open questions about a very novel conceptual advance, or other issues that don't indicate a flaw but limit the implications of the findings presented in the paper. Note that a substantial portion of your grade will be based on class discussion and a demonstration that you a) have read and attempted to understand the

paper, b) thought about the implications of the results and next experiments, and c) can articulate your thoughts on the paper's experiments and results.

2) Student Paper Discussion Team Presentations: Student teams will be responsible for leading the Paper Discussion for each class; the number of students per team and the number of presentations required of each student will depend on enrollment. Each team will prepare a short Powerpoint Presentation for the class. These presentations will be prepared with advice from the assigned faculty mentor. ***Each student team should plan meeting with the faculty mentor ~2 weeks prior to the assigned presentation date to discuss the paper and to prepare the presentation.*** Subsequent meetings will be defined by the faculty mentor and the students. The students' presentation will include an Introduction to the manuscript including previous work, the key Figures related to the manuscript, and discussion of the primary conclusions from the manuscript. The student team will lead the class discussion, eliciting comments from all members of the class to evaluate the data, its interpretation, the experimental approaches, validity of conclusions, etc. Using the Zoom platform with assistance of the teaching assistants, the student teams will design questions for discussion in smaller groups that will then report back to the whole group.

3) Written assignments due for the Manuscript Discussion class (except for the Introductory class): Each student will submit a written document briefly summarizing the assigned research article, describing the strengths and limitations of the study, and a "next experiment" inspired by the paper of the week. The next experiment should produce an amount of data that would be expected to fit into one panel of one manuscript figure. The short description of your "next experiment" should include: a) a **rationale** for doing the experiment, b) a brief **description** of the experiment, including experimental methods, and c) the **possible outcome(s) and interpretations**. Each of these items should be short so that the entire assignment should fit on one page of single-spaced printed text (11 point, Arial). Concise, focused descriptions that cover the points above will be rewarded. Inclusion of a diagram may be helpful but is not required.

4) Final Exam: A final, in class, exam will be given on the last day of the course. The questions from this exam will be derived from the faculty lectures given on the Monday of each week and may include key concepts highlighted in the assigned papers.

Molecular Medicine Seminars

TSRI has a "Distinguished Molecular Medicine Lecture Series". This is a major biweekly seminar series bringing eminent national and international scientists who speak about diverse topics. These seminars provide the very latest and most exciting developments in Molecular and Cell Biology, many of which are still unpublished. Seminars are held on the second and fourth Wednesday of each month from 1-2pm (pacific) and will be conducted over Zoom until further notice. Attendance is strongly recommended and will be encouraged in class.

Expectations and Logistics

1) Student Paper Discussion Teams: The class will be divided into teams of two or three students each, who will present papers on specific weekly topics. *The student team assigned to each paper will meet with the relevant faculty discussant as a team at least 1-2 weeks before*

the paper is presented to get help and suggestions in identifying and understanding the literature that will be used to prepare the "Introduction" and the "Conclusions", and to select the key figures or parts of figures to present for class discussion. It is critical that students contact the faculty moderator early in the course to coordinate schedules as faculty can have busy schedules – the graduate office staff can assist with making contact and arranging meetings. The student teams will prepare the paper discussion presentation for each class (see below), and should plan to send their Powerpoint presentation to the faculty discussant at a prearranged time before their presentation (at least 3 days), so the faculty can give them feedback for modifying it, if necessary.

2) Class Format: At the beginning of the Wed discussion, one member of each student team will give an Introduction (~10-20 minutes; Powerpoint format) to provide the specific background material for the discussion paper and frame the problem being studied (i.e., the preceding experiments leading to this particular study and the relevance of this problem to the Molecular Biology topic of the week). Next, the student team will project slides of selected figures or parts of figures from the paper and lead the class discussion. All students should be prepared to actively contribute to this ~60 min discussion, including identifying the main strengths and limitations of the experiments. After the figures have been discussed, the second member of the student team will make a short (~10 min) presentation of the Conclusions, in which the overall conclusion, approaches used, and conflicting conclusions from other studies will be presented. Class TAs will serve as the student team members for the Model Paper Discussion Class so that students will have an example of the format (see below). Student teams should implement polls, breakout rooms, or other activities within their presentations to encourage active participation by all class members. ***Encouraging discussion and engagement among your classmates will benefit your presentation grade.***

3) Class Preparation: Every student in the class will be responsible for reading the day's discussion paper prior to class. Every student should be prepared to discuss each figure. Each student must also submit a written assignment prior to the start of class via the course site in Canvas (see below). **If not received prior to the start of class the assignment will be considered missing and a zero score will be received for that assignment**. A short review(s) related to the topic of the discussion paper will be provided for most papers on the reading list. More basic background may be obtained by reading relevant sections of the textbook, *Molecular biology of the Cell* (Alberts et al, 6th edition).

Written assignments: For every Wed class, students will submit a written document described in detail above. These will be graded by the TAs in collaboration with the faculty discussant for that class, and the composite scores from these assignments will comprise this portion of the course grade. *No late submission of these assignments will be allowed, except under extenuating circumstances approved, in advance, by the course director.*

4) First Two Classes of the Course: The goal of these first two classes is 1) to provide an Introduction to the field of Molecular Biology and to define the expectations of the course, and 2) to provide a clear sense of the class format by providing a guided template of a Paper Discussion Class and a written homework assignment. The first class will be didactic, and the second class will be a Model Paper Discussion presented by the two TAs. A discussion paper

will be assigned for the Model Paper Discussion Class (to be read by all class members beforehand), but our two student TAs (instead of class members) will perform the job of the student team. *However, all students will still be required to submit their written assignment at the beginning of class*. Feedback will be provided on this first written assignment to clarify the expectations but scores will not be included in final grades.

5) Selection of Papers/Student Teams: Student teams will be assigned by Friday September 9.

Course Requirements

Final grades will be determined as follows based on the points obtained in the following categories:

- Written text for "Strengths/Weaknesses" and "Next Experiments" for each class discussion paper = 25%
- Participation in class discussion of each paper (This will be evaluated based on participation in discussions and group exercises, and responses to polls during faculty lectures) = 25%
- Short PowerPoint presentations for each Discussion Paper (Student Teams) (Each student will work as part of a team to lead a discussion of one of the assigned papers during the course as described below) = 25%
- Final exam = 25%

Late submissions of weekly written assignments will be not be accepted.

Attendance Statement

Attendance is mandatory and a portion of the grade is based upon class participation.

Weekly written assignments must be submitted prior to the presentation of the paper to which they pertain. No late submission will be allowed, except under extenuating circumstances approved in advance by the course director.

All students will be required to make a Zoom/Powerpoint presentation to lead a paper discussion.

Scientific and Professional Ethics

The work you do in this course must be your own. Feel free to build on, react to, criticize, and analyze the ideas of others but, when you do, make it known whose ideas you are working with. You must explicitly acknowledge when your work builds on someone else's ideas, including ideas of classmates, professors, and authors you read. If you ever have questions about drawing the line between others' work and your own, ask the course professor who will give you clear guidance. Exams must be completed independently. Any collaboration on answers to exams, unless expressly permitted, may result in an automatic failing grade and possible expulsion from the Graduate Program.

Technology Requirements and Support

For issues related to Canvas, please contact the Graduate Office by email at: gradprgm@scripps.edu or by phone at: 858-784-8469.

Course Grading

Grading is in accordance with the academic policies of the Skaggs Graduate School. The breakdown of grading is as follows:

- Next Experiments: 25%
- Participation: 25%
- Final Exam: 25%
- Presentations: 25%

Letter Grade	Percent	GPA	Description
A	93-100	4.00	Outstanding achievement. Student performance demonstrates full command of the course subject matter and evinces a high level of originality and/or creativity that far surpasses course expectations.
A-	90-92	3.67	Excellent achievement. Student performance demonstrates thorough knowledge of the course subject matter and exceeds course expectations by completing all requirements in a superior manner.
B+	87-89	3.33	Very good work. Student performance demonstrates above-average comprehension of the course subject matter and exceeds course expectations on all tasks as defined in the course syllabus. There is notable insight and originality.
B	83-86	3.00	Satisfactory work. Student performance meets designated course expectations and demonstrates understanding of the course subject matter at an acceptable level.

B-	80-82	2.67	Marginal work. Student performance demonstrates incomplete understanding of course subject matter. There is limited perception and originality.
C+	77-79	2.33	Unsatisfactory work. Student performance demonstrates incomplete and inadequate understanding of course subject matter. There is severely limited or no perception or originality. Course will not count toward degree.
C	73-76	2.00	Unsatisfactory work. Student performance demonstrates incomplete and inadequate understanding of course subject matter. There is severely limited or no perception or originality. Course will not count toward degree.
P	73-100	0.00	Satisfactory work. Student performance demonstrated complete and adequate understanding of course subject matter. Course will count toward degree.
F	0-72	0.00	Unacceptable work/Failure. Student performance is unacceptably low level of knowledge and understanding of course subject matter. Course will not count toward degree. Student may continue in program only with permission of the Dean.
I		0.00	Incomplete is assigned when work is of passing quality but is incomplete for a pre-approved reason. Once an incomplete grade is assigned, it remains on student's permanent record until a grade is awarded.
W		0.00	Withdrew from the course with Dean's permission beyond the second week of the term.

- All courses will be recorded and maintained in the student's permanent academic record; only courses that apply towards the degree will appear on the academic transcript. Non-credit or audited courses will not appear on the transcript.
- 4 core courses taken for a letter grade (pass = B- or higher for a core course)
- 2 elective courses taken pass/fail (pass = A, B, C for an elective)

Course Schedule:

Date	Details
Mon Sep 5, 2022	Labor Day (No Class)
Wed Sep 7, 2022	Molecular Biology-INTRO
	Introduction (Lamia and/or MacRae), and Genes and Genomes (Torkamani)
Fri Sep 9, 2022	Grad Student Symposium (No Class)
Mon Sep 12, 2022	Manuscript Discussion (Mello/Bronkema) [Genes and Genomes]
	Molecular Biology - JC #1 (Genes and Genomes)
Wed Sep 14, 2022	Next Experiment 1
	DNA Repair and Recombination (Wu)
	Molecular Biology - Lecture 2
Mon Sep 19, 2022	Manuscript Discussion
	Molecular Biology - JC #2
	Next Experiment 2
Wed Sep 21, 2022	Molecular Biology-Genome Editing
	Genome Editing (Bollong)
Mon Sep 26, 2022	Molecular Biology-Journal Club
	Manuscript Discussion
	Next Experiment 3
Wed Sep 28, 2022	Molecular Biology - Chromatin, Transcription, and Transcriptome
	Chromatin (Erb)
Mon Oct 3, 2022	Molecular Biology - JC #4
	Manuscript Discussion (Erb)
	Next Experiment 4
Wed Oct 5, 2022	Molecular Biology-Lecture 5
	Next-Gen Sequencing, Library Preparation (Head)
Mon Oct 10, 2022	Molecular Biology- JC #5
	Next-Generation Sequencing, project/disc. (Head)
	Next Experiment 5
Wed Oct 12, 2022	Molecular Biology - Control of Gene Expression Lecture
	Control of Gene Expression (Kojetin)
Mon Oct 17, 2022	Molecular Biology - JC #6
	Manuscript Discussion
	Next Experiment 6
Wed Oct 19, 2022	Molecular Biology Lecture 7
	Post-transcriptional & RNA world (MacRae)
Mon Oct 24, 2022	Manuscript Discussion
	Molecular Biology-JC #7
	Next Experiment 7
Wed Oct 26, 2022	Molecular Biology - tRNA Lecture 8
	Diverse functions of tRNA (Xiang-Lei Yang)
Mon Oct 31, 2022	Molecular Biology - JC #8
	Manuscript Discussion

	Next Experiment 8
Wed Nov 2, 2022	**Molecular Biology-Lecture 9**
	Translation (Karbstein)
Mon Nov 7, 2022	**Manuscript Discussion**
	Molecular Biology-JC #9
	Next Experiment 9
Wed Nov 9, 2022	**Molecular Biology - PTMs**
	Post-Translational Modification of Proteins (Lamia)
Mon Nov 14, 2022	**Molecular Biology - JC #10**
	Manuscript Discussion (Lamia)
	Next Experiment 10
Wed Nov 16, 2022	**Molecular Biology-Lecture #11**
	Protein Ubiquitylation and Turnover (Joazeiro)
Mon Nov 21, 2022	**Manuscript Discussion**
	Molecular Biology-JC #11
	Next Experiment 11
Thu Nov 24, 2022	**Thanksgiving Holiday (No Class)**
Fri Nov 25, 2022	**Thanksgiving Holiday (No Class)**
Mon Nov 28, 2022	**Molecular Biology - Autophagy**
	Molecular Biology of Autophagy (Otomo)
Wed Nov 30, 2022	**Molecular Biology - JC #12**
	Manuscript Discussion
	Next Experiment 12
Mon Dec 5, 2022	**Single Molecule & Fluorescence Techniques II (Deniz)**
Wed Dec 7, 2022	**Molecular Biology - Final Exam**