Regulation of Eukaryotic Gene Expression (BIMM 112)

James T. Kadonaga – Winter 2023

Tues. & Thurs. 5:00 pm to 6:20 pm; Solis Hall room 107

Note: this syllabus may be updated in the future. Lecture material will be presented in the indicated order, but may not coincide perfectly with the indicated dates.
Specific details about exams, grading, and course policy are described in the following pages.

Date	**Topic**
Jan. 10	1. Introduction and Overview; Scientific Knowledge; Fundamentals of Chromatin Structure
Jan. 12	2. Covalent Modifications of the Histones
Jan. 17	3. Introduction to Genomics; Analysis of the ChIP Assay
Jan. 19	4. Modern Approaches to the Analysis of Gene Expression
Jan. 24	5. Nucleosome Positioning; Linker Histones; Histone Variants; HMG Proteins
Jan. 26	6. CpG Methylation; Heterochromatin
Jan. 30	7. Chromatin Assembly and Analysis
Feb. 2	8. Discussion: Primary Research Paper #1
Feb. 7	9. **Midterm #1** (in-person at Solis 107)
Feb. 9	10. Chromatin Remodeling Factors
Feb. 14	11. The RNA Polymerase II Transcriptional Machinery Simple Kinetics and Thermodynamics
Feb. 16	12. The RNA Polymerase II Core Promoter
Feb. 21	13. Sequence-specific DNA-binding Transcription Factors
Feb. 23	14. Transcriptional Enhancers
Feb. 28	15. Synthesis and Review of Concepts
Mar. 2	16. Discussion: Primary Research Paper #2
Mar. 7	17. **Midterm #2** (in-person at Solis 107)
Mar. 9	18. Role of Nuclear Structure and Chromatin in the Regulation of Gene Activity. (*Lecture by Prof. Bing Ren, UCSD School of Medicine)
Mar. 14	19. Computational Analysis of Genome-wide Data (*Lecture by Prof. Christopher Benner, UCSD School of Medicine)
Mar. 16	20. Future Perspectives
TBD	**Final Exam** (in-person at Solis 107; likely to be 7-10 pm on Thurs. Mar. 23)

BIMM112 Information *(*Please Read Every Detail Carefully*)*

Name of Course

Regulation of Eukaryotic Gene Regulation

Overview of Course

Nearly all biological phenomena involve the proper or improper regulation of gene expression. Each of our tens of thousands of genes has its own unique program of activity. This course explores selected topics on the mechanisms by which gene activity is regulated in animals, with a specific emphasis on chromatin structure and dynamics and the regulation of initiation of transcription by RNA polymerase II. We will begin with the properties of the chromatin template and then move on to the different types of factors that mediate basal and regulated transcription.

BIMM112 is designed to prepare advanced undergraduate students for post-graduate research in graduate school (M.S., Ph.D.), biotech, or a research lab. It is meant to provide a foundation of knowledge in gene expression that would be useful for performing research in a wide range of fields in the biological sciences. Specific topics include chromatin structure, histone modifications, chromatin dynamics, transcription factors, enhancers, CpG methylation, and heterochromatin. Throughout the course, we will incorporate the experimental techniques and strategies that are employed in the study of eukaryotic gene regulation. A key goal of the course is for the students to be able to read and to analyze the current primary scientific literature. BIMM 112 will enable students to refine and to integrate their knowledge of molecular biology, genetics, and biochemistry in the context of the study of eukaryotic gene regulation.

Instructor

Jim Kadonaga
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Office phone: 858-534-4608
Office hours: 2:00-3:00 pm on Fridays via Zoom (https://ucsd.zoom.us/j/3102514133) and by appointment

Instructional Assistants

Brent Chick, Head IA, bchick@ucsd.edu
Rachel Weinstein, rweinstein@ucsd.edu
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Allison Delehoy, adelehoy@ucsd.edu

There are no Discussion Sections in the first week of class (Jan. 9-13).

Discussion Section attendance is strongly recommended, but is not absolutely required.

Students may select a Discussion Section to attend regularly. Students are not restricted to the specific Discussion Section to which they have registered.

There is potential extra credit for perfect or near-perfect (miss only 1) Discussion Section attendance. *If a student attends all discussion sections (or misses 1 at most), they would qualify for an upward boost in their final grade if they should be just below a borderline. For example, 87.6% (B) would become a B+ (88.0%-89.9%). However, 85.8% would remain a B, even with perfect section attendance.*

Administrative Assistant

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Course Location and Time

Main lectures and exams

Solis Hall, room 107; 5:00 to 6:20 pm on Tuesdays and Thursdays

The midterms and final exam will be in-person.

The lectures will be available as video recordings. In-person attendance at the lectures is strongly recommended but is not required.

Discussion sections

A01, Wed. 1:00-1:50 pm, SOLIS 110
A02, Wed. 2:00-2:50 pm, SOLIS 110
A03, Wed. 3:00-3:50 pm, SOLIS 110
A04, Wed. 4:00-4:50 pm, SOLIS 110
A05, Fri. 12:00-12:50 pm, WHL 2208
A06, Fri. 1:00-1:50 pm, SOLIS105
A07, Fri. 4:00-4:50 pm, CENTR 217A
A08, Fri. 5:00-5:50 pm, CENTR 217A

Textbook

There is no textbook. This course covers a range of current material that is not available in any textbook.

Only material that is described in the main lectures (5:00-6:20 pm on Tuesdays and Thursdays) will be included on the exams. If something is covered in main lectures, then it could be on an exam. A topic that is not covered in the main lectures will not be on an exam.

For exams, students are only responsible for material that is described in the main lectures.

For reference, a good but somewhat outdated book is as follows:

Title: *Mechanisms in Transcriptional Regulation*
Author: Albert J. Courey
Edition: 1st edition (2008)
Publisher: Blackwell Publishing
ISBN: 978-1-4051-0370-1

The lecture notes will occasionally include suggested readings from this book (Courey, 2008).

Commencement of Academic Activity (U.S. Department of Education Requirement)

Due to a new policy of the U.S. Department of Education, it is necessary to complete the *First Day Survey: Tell Me About Yourself* on the Canvas website.

This survey does not affect your course grade.

The deadline is Jan. 19th. I recommend that you do it soon. It should only take a few minutes.

Exams and Grading

All exams will be in-person.

There will be two midterm exams, but it is necessary to take only one of the two midterm exams. The grade on the midterm exam would count for 50% of the final grade. Many students take only one midterm because of interviews or other circumstances. Students are welcome to take both midterm exams. In that case, the higher midterm score will count for 50% of the final grade. There are no makeup midterms.

The final exam will be held during finals week at the time and location assigned by the UCSD Registrar. The final exam will count for 50% of the final grade.

Therefore, the final grade will be based on the midterm grade (or highest midterm grade if two exams are taken) (50%) and the final exam grade (50%).

The Final Grades for the course will be assigned as follows.

A+ Top 1% (top ~3) students with highest overall combined scores on all three exams. All other grades are based on the best midterm score (50%) and final exam score (50%).

A 92% to 100% Best Midterm score (50%) + Final Exam score (50%)
A– 90% to 92%
B+ 88% to 90%
B 82% to 88%
B– 80% to 82%
C+ 78% to 80%
C 72% to 78%
C– 70% to 72%
D+ 68% to 70%
D 62% to 68%
D– 60% to 62%
F <60%

The course will include the detailed analysis of two primary research papers. Midterm #1 will include specific questions that relate to Primary Research Paper #1. Midterm #2 will include specific questions relate to Primary Research Paper #2. The Final Exam will not include questions that are specifically related to the primary research papers, but it might include general course material that is also discussed in the primary research papers.

Only material that is described in the main lectures (5:00-6:20 pm on Tuesdays and Thursdays) will be included on the exams. If something is covered in main lectures, then it could be on an exam. A topic that is not covered in the main lectures will not be on an exam.

Homework problems will be provided but not graded. The answer keys to the homework problems will be posted on Canvas approximately 1 week prior to each midterm.

There is potential extra credit for perfect or near-perfect (miss only one) Discussion Section attendance. *If a student attends all discussion sections (or misses 1 at most), they would qualify for an upward boost in their final grade if they should be just below a borderline. For example, 87.6% (B) would become a B+ (88.0%-89.9%). However, 85.8% would remain a B, even with perfect section attendance.*

Tips for Studying for BIMM112

• Go to the lectures in person. In the past, there has been a strong correlation between grades and lecture attendance in person.

• Ask questions in the lecture. This will be useful for you and many other students.

• After each lecture, review your notes while viewing the Video recording at 1x speed. Make sure that you understand 100% of what is discussed. If you do not understand any specific point, make a note and ask your IA during discussion section or office hours or ask Jim during office hours or before or after class. Jim will be available for questions at the beginning of each lecture and at the end of each lecture. All course-related questions will be answered.

• Do all of the homework problems. Homework #1 roughly corresponds to Midterm #1. Homework #2 roughly corresponds to Midterm #2. It is important to do the homework problems as if you were doing test questions in an exam. Answer the questions without looking at your notes or an answer key. If you can answer the homework problems without any assistance, you will likely do well on the exams.