BGGN 283 / BIMM 194: Chromatin Structure & Dynamics
Spring Quarter 2023
Location: York Hall 3010
Time: Fridays, 1:00 – 2:20 PM

Course Description

The DNA inside a eukaryotic cell is organized into a substance known as chromatin. A rapidly growing body of research shows that chromatin is an intricately organized structure, shaped by molecular interactions, chemical processes, and physical forces. Through the lens of emerging technologies, we are also learning about the shape and the movements of our genetic material, and how this dynamic system can control the fate of every cell in our body. This course will cover the technologies that enable us to see chromatin, and some of the most groundbreaking studies that have shaped our current understanding of what happens in the cell nucleus.

Instructors

Dmitry Lyumkis, Associate Professor: dlyumkis@salk.edu
Pallav Kosuri, Assistant Professor: pkosuri@salk.edu

Prerequisites

Molecular Biology (BIMM 100)

Literature

Journal articles from the primary literature will form the majority of the course material. Assigned articles for Article discussion sessions will be posted on the course website at least one week in advance of the class. No textbooks will be required for the course.

Course materials on Canvas

The following information will be found on Canvas:

- Lecture Slides: Slides from each lecture and reference list will be posted on canvas shortly after each lecture.
- Articles: PDFs of articles for Article discussion sessions will be posted on the course website at least one week in advance of the class.

<u>Class Schedule</u>
Location: York Hall 3010
Time: Fridays, 1:00 – 2:20 PM
All Canvas Assignments are due by 11:59 pm Thursday before class

WEEK 1 | April 7
Overview of the course
Lecture: Chromatin function, structure, and dynamics
Instructors: Dmitry Lyumkis and Pallav Kosuri

WEEK 2 | April 14
Article discussion: Nucleosome structure
Discussion leader: Zelin Shan

BEFORE CLASS:

1. *<u>Read article:</u>*
   Crystal structure of the nucleosome core particle at 2.8 Å resolution.
   Luger K, Mäder A, Richmond R, Sargent D & Richmond T
   Nature (1997). https://doi.org/10.1038/38444
2. *<u>Turn in Article Review Assignment in Canvas</u>*

WEEK 3 | April 21
Lecture: Epigenetic marks; readers, writers, and erasers
Instructor: Tim Strutzenberg

BEFORE CLASS:

1. *<u>Turn in Experiment Proposal Assignment in Canvas</u>*

WEEK 4 | April 28
Article discussion: Epigenetic marks; readers, writers, and erasers
Discussion leader: Dmitry Lyumkis

BEFORE CLASS:

1. *<u>Read article</u>: TBD*
2. *<u>Turn in Article Review Assignment in Canvas</u>*

WEEK 5 | May 5
Lecture: Chromatin remodelers
Instructor: Pallav Kosuri / Sriram Aiyer

BEFORE CLASS:

1. *Turn in Experiment Proposal Assignment in Canvas*

WEEK 6 | May 12

Article discussion: Chromatin remodelers
Discussion leader: Sriram Aiyer and Jocelyn Olvera

BEFORE CLASS:

1. *Read article:*
   Dynamics of nucleosome remodelling by individual ACF complexes.
   Blosser T, Yang J, Stone M, Narlikar G & Zhuang X
   Nature (2009). https://doi.org/10.1038/nature08627
2. *Turn in Article Review Assignment in Canvas*

WEEK 7 | May 19

Lecture: Higher-order chromatin, topologically-associated domains (TADs), territories
Instructor: Jesse Dixon (Salk Institute)

BEFORE CLASS:

1. *Turn in Experiment Proposal Assignment in Canvas*

WEEK 8 | May 26

Article discussion: Higher-order chromatin, topologically-associated domains (TADs), territories
Discussion leader: Jesse Dixon

BEFORE CLASS:

1. *Read article: TBD*
2. *Turn in Article Review Assignment in Canvas*

WEEK 9 | June 2

Lecture: NETosis
Instructor & Discussion leader: Hawa Racine Thiam (Stanford University)

WEEK 10 | June 9

Lecture & Article discussion: Using DNA origami to visualize protein-DNA interactions.
Instructor & Discussion leader: Pallav Kosuri

BEFORE CLASS:

1. *Read article:*

Rotation tracking of genome-processing enzymes using DNA origami rotors
Kosuri P, Altheimer BD, Dai M, Yin P & Zhuang X
Nature (2019). https://doi.org/10.1038/s41586-019-1397-7

2. *Turn in Article Review Assignment in Canvas*

AFTER CLASS (following Thursday at 11:59 pm):

1. *Turn in Experiment Proposal Assignment in Canvas*

Class format

Lectures

During lectures, instructors will present the topics covered in class and give background information for the following article discussion session. Students are expected to stay engaged and are encouraged to ask questions.

Article discussions

During article discussion sessions, the assigned article will be shown on the screen. Come prepared to discuss the article, eg. explain the methods, main figures, conclusions, and limitations. The instructors and discussion leader(s) will help guide the discussion and will answer questions. After the article discussion, students will break out into their small group and discuss the Experiment Proposal Assignment related to the current article. One pre-selected member of each group will then write up the Experiment Proposal Assignment and upload it to Canvas the following week. The group member to write up the assignment will rotate, such that each group member will only turn in one Experiment Proposal Assignment during the course. *All group members will be evaluated based on every assignment from their group*.

Assignments

All Canvas assignments are due by 11:59 pm Thursday before class.

Article Review Assignments

For each Article Review Assignment, students will be expected to read the assigned paper and submit brief written answers to the following questions:

1. What are 2 major conclusions of the paper?
2. What are 2 major limitations of the work?
3. What would be the 2 most meaningful experiments to do next?

Please be concise. Answers to each question should be no more than a few sentences. Aim for ½-⅔ page total (11pt Arial, 1 inch margins, 1.15 line spacing). Responses to these questions must be submitted as an uploaded document in Canvas, and are due by 11:59 pm Thursday before class. The assignments will be evaluated and graded by the instructors and/or discussion leaders.

Grading rubric (6 points max per assignment; each question is 2 points max):

- 0.5 points for a correct conclusion (1 max per question)
- 0.5 points for a correct limitation (1 max per question)
- 0.5 points for an appropriate experiment (1 max per question)
- 1 point per question extra for an insightful and/or original answer in each question

Experiment Proposal Assignments

Each group must submit a half-page written proposal (11pt Arial, 1 inch margins, 1.15 line spacing) after each of the 4 first article discussion sessions. Figures and/or drawings can be included in addition to the half page of writing, but in total everything must fit on a single page. The proposal needs to outline an experiment that can answer a meaningful question related to the paper most recently discussed. To help develop these proposals, students will be assigned to small groups and will have the chance to discuss experiment ideas at the end of Article discussion sessions.

Grading rubric (6 points max per assignment):

- 2 points for identifying a meaningful question
- 2 points for formulating a well-motivated hypothesis
- 2 points for designing an experiment that could prove or disprove the hypothesis

Grading

Course grades will be determined as follows:

Article Review Assignments:	6 points x 5 assignments	= 30 points	37.5%
Experiment Proposal Assignments:	6 points x 5 assignments	= 30 points	37.5%
In-class participation:	2 points x 10 classes	= 20 points	25%