

## BISC 403 FALL 2024 ADVANCED MOLECULAR BIOLOGY

Lectures: Tues-Thurs 2:00 – 3:20 THH116

Sections: Tues 4-5.50 GFS221 OR Weds 2-3:50 SOSB52

### Professors:

Prof. Irene Chiolo Office: RRI 219A Office hours: Tue 9:30-10:30a email: <a href="mailto:chiolo@usc.edu">chiolo@usc.edu</a>	Prof. Matthew Michael Office: TBD Office hours: TBD email: <a href="mailto:mattm@usc.edu">mattm@usc.edu</a>	TA: Anik Mitra Office: RRI421 Office hours: Mon 9:30-10:30a email: <a href="mailto:anikmitr@usc.edu">anikmitr@usc.edu</a>	TA: Ling Jin Office: RRI313 Office hours: Mon 12-1p email: <a href="mailto:ljin7532@usc.edu">ljin7532@usc.edu</a>
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**Course Objectives:** Our course objective is to consider a few topics in Molecular Biology in depth. Topics are chosen by the faculty and generally represent active areas of current research. A key part of this course develops skills reading primary research papers in discussion.

### Learning Objectives:

Develop the ability to think critically, analyze, synthesize, and use information to solve problems.

Understand and apply the scientific method, including forming hypotheses, designing experiments to test hypotheses, and collecting, analyzing, interpreting, and reporting data.

Develop the ability to evaluate primary scientific literature.

Acquire an appreciation for many levels of biological organization, including the molecular, cellular, and organismal.

Understand the DNA repair response in the context of nuclear architecture and dynamics.

Understand the DNA repair response in the context of chromatin and its crosstalk with transcription.

Understand the impact of DNA repair defects on genome stability of cells and organisms.

**Prerequisites:** BISC 320L (Molecular Biology) is a firm prerequisite for this course. BISC325 (Genetics) is recommended.

**Required and Optional Readings and Supplementary Materials:** There is no required textbook for this course. You will receive digital copies of lecture slides and reading materials. Additional resources and review articles will also be uploaded to Brightspace. Background reading in any general Genetics, Cell Biology, or Molecular Biology textbook may be helpful.

**Participation and Grading Breakdown:** Participation to lectures and discussions is required for full points in the course. Each week the instructor will assign a relevant research papers related to that week's lectures. Students should be prepared to participate in a journal club about that paper, which will require reading the paper and any necessary background prior to discussion. Students should come to section prepared to state the "take home message" of the paper, the background, the questions addressed by individual experiments, methods/results/conclusions of each figure, overall conclusions of the study, strengths and weaknesses. Did they prove their point? Students will be randomly called upon to **present** and points will be awarded for this presentation. Discussions may continue during the lecture section. Discussion sections will account for 20% of your grade.

**Course schedule:** See following Table

Date	Lecturer	Topic
<b>SECTION 1: DSB REPAIR</b>		
<b>Week 1: 27 August</b>	Chiolo	<b>DSB repair. Nuclear architecture. ChIP, site-specific DSB systems.</b>
<b>29 August</b>	Chiolo	Torres-Rosell J et al.. The Smc5-Smc6 complex and SUMO modification of Rad52 regulates recombinational repair at the ribosomal gene locus. <i>Nat Cell Biol.</i> 2007 Aug;9(8):923-31. doi: 10.1038/ncb1619.
<p><b>Week 1 Background reading:</b>  Meaburn, K., Misteli, T. Chromosome territories. <i>Nature</i> <b>445</b>, 379–381 (2007).  <a href="https://doi.org/10.1038/445379a">https://doi.org/10.1038/445379a</a>  Amaral N, Ryu T, Li X, Chiolo I. Nuclear Dynamics of Heterochromatin Repair. <i>Trends Genet.</i> 2017 Feb;33(2):86-100. doi: 10.1016/j.tig.2016.12.004.</p> <p><b>Discussion paper:</b>  Nagai S, et al. Functional targeting of DNA damage to a nuclear pore-associated SUMO-dependent ubiquitin ligase. <i>Science.</i> 2008 Oct 24;322(5901):597-602. doi: 10.1126/science.1162790.</p>		
<b>Week 2: 3 Sept T</b>	Chiolo	<b>Nuclear dynamics. Focus tracking. MSD.</b>
<b>5 Sept Th</b>	Chiolo	Roukos V et. al. Spatial dynamics of chromosome translocations in living cells. <i>Science.</i> 2013 Aug 9;341(6146):660-4. doi: 10.1126/science.1237150.
<p><b>Week 2 Background reading:</b>  Miné-Hattab J, Chiolo I. Complex Chromatin Motions for DNA Repair. <i>Front Genet.</i> 2020 Aug 27;11:800. doi: 10.3389/fgene.2020.00800.</p> <p><b>Discussion paper:</b>  Miné-Hattab J, Rothstein R. Increased chromosome mobility facilitates homology search during recombination. <i>Nat Cell Biol.</i> 2012 Apr 8;14(5):510-7. doi: 10.1038/ncb2472.</p>		
<b>Week 3: 10 Sept T</b>	Chiolo	<b>Heterochromatin organization and repair. Focus clustering. Nuclear F-actin.</b>
<b>12 Sept Thu</b>	Chiolo	Caridi CP, et al., Nuclear F-actin and myosins drive relocalization of heterochromatic breaks. <i>Nature.</i> 2018 Jul;559(7712):54-60. doi: 10.1038/s41586-018-0242-8.
<p><b>Week 3 Background reading:</b>  Caridi CP et al.. Nuclear actin filaments in DNA repair dynamics. <i>Nat Cell Biol.</i> 2019 Sep;21(9):1068-1077. doi: 10.1038/s41556-019-0379-1.</p> <p><b>Discussion paper:</b>  Schrank BR et al. Nuclear ARP2/3 drives DNA break clustering for homology-directed repair. <i>Nature.</i> 2018 Jul;559(7712):61-66. doi: 10.1038/s41586-018-0237-5.</p>		
<b>Week 4: 17 Sept T</b>	Chiolo	<b>MIDTERM 1</b>
<b>19 Sept Thu</b>	Chiolo	<b>Nuclear membrane functions in DSB repair. LINC complex. Microtubules.</b>

<b>Background reading Week 4</b>		
<b>Discussion paper:</b> Shokrollahi et al., DNA double-strand break-capturing nuclear envelope tubules drive DNA repair. bioRxiv 2023.05.07.539750; doi: <a href="https://doi.org/10.1101/2023.05.07.539750">https://doi.org/10.1101/2023.05.07.539750</a>		
<b>Week 5: 24 Sept T</b>	Chiolo	<b>Phase separation of repair sites</b>
<b>26 Sept Thu</b>	Chiolo	Spegg V. et al. Phase separation properties of RPA combine high-affinity ssDNA binding with dynamic condensate functions at telomeres. Nat Struct Mol Biol. 2023 Apr;30(4):451-462. doi: 10.1038/s41594-023-00932-w.
<b>Background reading Week 5</b> Aguzzi A, Altmeyer M. Phase Separation: Linking Cellular Compartmentalization to Disease. Trends Cell Biol. 2016 Jul;26(7):547-558. doi: 10.1016/j.tcb.2016.03.004.		
<b>Discussion paper:</b> Altmeyer M, et al. Liquid demixing of intrinsically disordered proteins is seeded by poly(ADP-ribose). Nat Commun. 2015 Aug 19;6:8088. doi: 10.1038/ncomms9088.		
<b>Week 6: 1 Oct T</b>	Chiolo	<b>Transcription, ncRNAs</b>
<b>3 Oct Thu</b>	Chiolo	Pessina F, et al. Functional transcription promoters at DNA double-strand breaks mediate RNA-driven phase separation of damage-response factors. Nat Cell Biol. 2019 Oct;21(10):1286-1299. doi: 10.1038/s41556-019-0392-4.
<b>Background reading Week 6</b> d'Adda di Fagagna F. A direct role for small non-coding RNAs in DNA damage response. Trends Cell Biol. 2014 Mar;24(3):171-8. doi: 10.1016/j.tcb.2013.09.008		
<b>Discussion paper:</b> Michelini F. et al.. Damage-induced lncRNAs control the DNA damage response through interaction with DDRNAs at individual double-strand breaks. Nat Cell Biol. 2017 Dec;19(12):1400-1411. doi: 10.1038/ncb3643.		
<b>Week 7: 8 Oct T</b>	Chiolo	<b>Loop extrusion. HiC</b>
<b>10 Oct Thu</b>	<b>Fall Break</b>	
<b>Background reading Week 7</b> Rowley MJ, Corces VG. Organizational principles of 3D genome architecture. Nat Rev Genet. 2018 Dec;19(12):789-800. doi: 10.1038/s41576-018-0060-8.		
<b>Discussion paper:</b> Arnould C, et al. Loop extrusion as a mechanism for formation of DNA damage repair foci. Nature. 2021 Feb;590(7847):660-665. doi: 10.1038/s41586-021-03193-z		
<b>Week 8: 15 Oct</b>	Chiolo	Review day, no class
<b>17 Oct</b>	Chiolo	<b>MIDTERM II</b>
<b>Background reading Week 8</b>		
<b>Discussion paper:</b>		
<b>Week 9:</b>	Michael	

22 Oct		
24 Oct	Michael	
<b>Background reading Week 10</b>		
<b>Discussion paper:</b>		
Week 10: 29 Oct	Michael	
31 Oct	Michael	
<b>Background reading Week 8</b>		
<b>Discussion paper:</b>		
Week 11: 5 Nov	Michael	
7 Nov	Michael	<b>MIDTERM III</b>
<b>Background reading Week 8</b>		
<b>Discussion paper:</b>		
Week 12: 12 Nov	Michael	
14 Nov	Michael	
<b>Background reading Week 8</b>		
<b>Discussion paper:</b>		
Week 13: 19 Nov	Michael	
21 Nov	Michael	
<b>Background reading Week 8</b>		
<b>Discussion paper:</b>		
Week 14: 26 Nov	Michael	
28 Nov	<b>Thanksgiving</b>	
<b>Background reading Week 8</b>		
<b>Discussion paper:</b>		
Week 15: 3 Dec	Michael	
5 Dec	Michael	
<b>Background reading Week 8</b>		
<b>Discussion paper:</b>		
<b>FINAL</b>		<b>FINAL</b>

**Grading:**

Midterm I 100 pts

Midterm II 100 pts

Midterm III 100 pts

Final 100 pts (non-cumulative)

Discussion participation: 100 pts

TOTAL = 500 pts

Letter grades are based upon total points. We do not generally curve the course.

**Other Policies:**

1. Exam dates are firm. If a student misses an exam due to a true emergency (with an acceptable written excuse; written information concerning a death in the family must be provided), we MAY schedule a make-up exam, or at our discretion MAY permit the use of the average of other exams in determining the course grade. No one will be admitted to an exam after the first student has left the exam.
2. Regrading will only be done for obvious mistakes in point assignments. Regrading can only be done within one week of the day the exam is initially returned to the class. We do not re-grade exams written in pencil.
3. No special assignments for extra credit are given.
4. Final exams will be kept in Dr. Michael's office for the required period.
5. It may be necessary to make some adjustments in the syllabus during the semester.

**Please advise the faculty ASAP of any known conflicts, any DSP provisions, or other relevant information.**

**Academic Integrity:**

The University of Southern California is foremost a learning community committed to fostering successful scholars and researchers dedicated to the pursuit of knowledge and the transmission of ideas. Academic misconduct is in contrast to the university's mission to educate students through a broad array of first-rank academic, professional, and extracurricular programs and includes any act of dishonesty in the submission of academic work (either in draft or final form).

This course will follow the expectations for academic integrity as stated in the [USC Student Handbook](#). All students are expected to submit assignments that are original work and prepared specifically for the course/section in this academic term. You may not submit work written by others or "recycle" work prepared for other courses without obtaining written permission from the instructor(s). Students suspected of engaging in academic misconduct will be reported to the Office of Academic Integrity.

Other violations of academic misconduct include, but are not limited to, cheating, plagiarism, fabrication (e.g., falsifying data), knowingly assisting others in acts of academic dishonesty, and any act that gains or is intended to gain an unfair academic advantage.

The impact of academic dishonesty is far-reaching and is considered a serious offense against the university and could result in outcomes such as failure on the assignment, failure in the course, suspension, or even expulsion from the university.

For more information about academic integrity see the [student handbook](#) or the [Office of Academic](#)

[Integrity's website](#), and university policies on [Research and Scholarship Misconduct](#).

Please ask your instructor if you are unsure what constitutes unauthorized assistance on an exam or assignment, or what information requires citation and/or attribution.

### **Use of AI Generators is not allowed**

Since creating, analytical, and critical thinking skills are part of the learning outcomes of this course, all assignments should be prepared by the student working individually or in groups as instructed. Students may not have another person or entity complete any substantive portion of the assignment. Developing strong competencies in these areas will prepare you for a competitive workplace. Therefore, using AI-generated tools is prohibited in this course, will be identified as plagiarism, and will be reported to the Office of Academic Integrity.

### **Course Content Distribution and Synchronous Session Recordings Policies**

USC has policies that prohibit recording and distribution of any synchronous and asynchronous course content outside of the learning environment.

Recording a university class without the express permission of the instructor and announcement to the class, or unless conducted pursuant to an Office of Student Accessibility Services (OSAS) accommodation. Recording can inhibit free discussion in the future, and thus infringe on the academic freedom of other students as well as the instructor. ([Living our Unifying Values: The USC Student Handbook](#), page 13).

Distribution or use of notes, recordings, exams, or other intellectual property, based on university classes or lectures without the express permission of the instructor for purposes other than individual or group study. This includes but is not limited to providing materials for distribution by services publishing course materials. This restriction on unauthorized use also applies to all information, which had been distributed to students or in any way had been displayed for use in relationship to the class, whether obtained in class, via email, on the internet, or via any other media. ([Living our Unifying Values: The USC Student Handbook](#), page 13).

### **Students and Disability Accommodations:**

USC welcomes students with disabilities into all of the University's educational programs. [The Office of Student Accessibility Services](#) (OSAS) is responsible for the determination of appropriate accommodations for students who encounter disability-related barriers. Once a student has completed the OSAS process (registration, initial appointment, and submitted documentation) and accommodations are determined to be reasonable and appropriate, a Letter of Accommodation (LOA) will be available to generate for each course. The LOA must be given to each course instructor by the student and followed up with a discussion. This should be done as early in the semester as possible as accommodations are not retroactive. More information can be found at [osas.usc.edu](https://osas.usc.edu). You may contact OSAS at (213) 740-0776 or via email at [osasfrontdesk@usc.edu](mailto:osasfrontdesk@usc.edu).

### **Support Systems:**

[Counseling and Mental Health](#) - (213) 740-9355 – 24/7 on call

Free and confidential mental health treatment for students, including short-term psychotherapy, group counseling, stress fitness workshops, and crisis intervention.

[988 Suicide and Crisis Lifeline](#) - 988 for both calls and text messages – 24/7 on call

The 988 Suicide and Crisis Lifeline (formerly known as the National Suicide Prevention Lifeline) provides free and confidential emotional support to people in suicidal crisis or emotional distress 24 hours a day, 7 days a week, across the United States. The Lifeline is comprised of a national network of over 200 local crisis centers, combining custom local care and resources with national standards and best practices. The new,

shorter phone number makes it easier for people to remember and access mental health crisis services (though the previous 1 (800) 273-8255 number will continue to function indefinitely) and represents a continued commitment to those in crisis.

[Relationship and Sexual Violence Prevention Services \(RSVP\)](#) - (213) 740-9355(WELL) – 24/7 on call  
Free and confidential therapy services, workshops, and training for situations related to gender- and power-based harm (including sexual assault, intimate partner violence, and stalking).

[Office for Equity, Equal Opportunity, and Title IX \(EEO-TIX\)](#) - (213) 740-5086  
Information about how to get help or help someone affected by harassment or discrimination, rights of protected classes, reporting options, and additional resources for students, faculty, staff, visitors, and applicants.

[Reporting Incidents of Bias or Harassment](#) - (213) 740-5086 or (213) 821-8298  
Avenue to report incidents of bias, hate crimes, and microaggressions to the Office for Equity, Equal Opportunity, and Title for appropriate investigation, supportive measures, and response.

[The Office of Student Accessibility Services \(OSAS\)](#) - (213) 740-0776  
OSAS ensures equal access for students with disabilities through providing academic accommodations and auxiliary aids in accordance with federal laws and university policy.

[USC Campus Support and Intervention](#) - (213) 740-0411  
Assists students and families in resolving complex personal, financial, and academic issues adversely affecting their success as a student.

[Diversity, Equity and Inclusion](#) - (213) 740-2101  
Information on events, programs and training, the Provost's Diversity and Inclusion Council, Diversity Liaisons for each academic school, chronology, participation, and various resources for students.

[USC Emergency](#) - UPC: (213) 740-4321, HSC: (323) 442-1000 – 24/7 on call  
Emergency assistance and avenue to report a crime. Latest updates regarding safety, including ways in which instruction will be continued if an officially declared emergency makes travel to campus infeasible.

[USC Department of Public Safety](#) - UPC: (213) 740-6000, HSC: (323) 442-1200 – 24/7 on call  
Non-emergency assistance or information.

[Office of the Ombuds](#) - (213) 821-9556 (UPC) / (323-442-0382 (HSC)  
A safe and confidential place to share your USC-related issues with a University Ombuds who will work with you to explore options or paths to manage your concern.

[Occupational Therapy Faculty Practice](#) - (323) 442-2850 or [otfp@med.usc.edu](mailto:otfp@med.usc.edu)  
Confidential Lifestyle Redesign services for USC students to support health promoting habits and routines that enhance quality of life and academic performance.