Course Syllabus – BIOL 531

Course Information

Course Number: BIOL 531 SP24
Course Name: Biophysics of Condensates - Function and Disease
Term: SP 2024
Start Date: 04/02/2024
End Date: 06/21/2024
Credits: 3.0

Meeting Days / Times

Tuesdays and Thursdays, 12:00-1:30pm PT /3:00-4:30pm ET
(See Calendar in Canvas for the most up-to-date schedule.)

Locations

CA: Graduate Office Dining Room (Hazen Theory Building)
FL: B214

Course Managers

Role	Last Name	First Name	Email Address
Course Director	Deniz	Ashok	deniz@scripps.edu
Course Director	Lasker	Keren	klasker@scripps.edu
TA	Avni	Anamika	aavni@scripps.edu

Course Description

In this class, students will learn about the biophysics of biomolecular condensates and key related aspects of states of matter, phase transitions and polymer physics. The material covered represents a rapidly expanding research area with wide implications for biological processes and disease. Key examples of cellular condensates and their links to function and disease will be discussed, with a focus on mechanistic understanding.

In the first weeks of the class, we will discuss key aspects of the chemical and physical mechanistic basis of cellular condensation, including fundamental concepts about states of matter, phase transitions, phase separation, polymer physics and relevant chemical

interactions. We will also discuss methods used to study these condensates. In the subsequent part of the class, we will discuss several important cellular condensates and engineering of condensates. We will emphasize mechanistic understanding and links to biological function and disease. Topics will include the nucleolus and stress granules, and condensation as it relates to transcription, chromatin, bacteria, viruses, cancer and neurodegenerative disease. For most weeks, we will alternate between a lecture and a student-led discussion of a related paper. The final exam will include developing a short research proposal, which can be related to the student's thesis project, and presenting the proposal in class.

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.

For a detailed description of each outcome and specific success indicators, please refer to this web page: https://education.scripps.edu/graduate/doctoral-program/.

Course Learning Outcomes

Upon completion of this course students will be able to:
CLO1: Gain an understanding of the research field with a focus on mechanistic thinking.
CLO2: Think critically about research in the field.
CLO3: Develop a proposal to study a key aspect of this developing area (potentially can be related to the students' current research).
CLO4: Explore different interdisciplinary and mechanistic perspectives that will be considered in the class.
CLO5: Generate new ideas in the field by building on CLOs 1-4.

CLO6: Incorporate the identification and selection of methodologies for the proposed studies during the development of the students' proposals.
CLO7: Practice organization of written work (as well as other aspects of written communication) during the students' proposal writing.
CLO8: Respond thoughtfully and critically to questions (as well as other aspects of oral communication).
CLO9: Critically analyze assumptions encouraged by the mechanistic focus of the class.
CLO10: Practice organization of oral presentations.

Background Preparation (Prerequisites)

N/A

Course Materials

Useful to Consult: Biomolecular condensates: Organizers of cellular biochemistry. *Nature Revs Mol Cell Biol* (2017). 18:285. https://doi.org/10.1038/nrm.2017.7.
Useful to Consult: Considerations and challenges in studying liquid-liquid phase separation and biomolecular condensates. *Cell* (2019). 176:419. https://doi.org/10.1016/j.cell.2018.12.035.
Useful to Consult: States of Matter. David Goodstein. 2014 Edition, Dover Books. ISBN 9780486649276
Useful to Consult: The Theory of Polymer Dynamics. Doi and Edwards, 1988. ISBN 9780198520337

Attendance Statement

Students are expected to attend all classes. Students who are unable to attend class must seek permission for an excused absence from the course director or teaching assistant. Unapproved absences or late attendance for three or more classes may result in a lower grade or an "incomplete" for the course. If a student has to miss a class, he or she should arrange to get notes from a fellow student and is strongly encouraged to meet with the teaching assistant to obtain the missed material.

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:

- Paper Presentations: 20%
- Strengths/Weaknesses/Future Work: 10%
- Class Discussion and Participation: 10%
- Midterm: 20%
- Final Proposal and Presentation: 40%

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 Summary

Date	Details
Thu Apr 4, 2024	Introduction to Class. Basics I - States of Matter. Presenter: Keren Lasker
Tue Apr 9, 2024	Paper discussion by students
	Week 1 Strengths/Weaknesses/Future Work
Thu Apr 11, 2024	Basics II. Phase Transitions. Presenter: Ashok Deniz
Tue Apr 16, 2024	Paper discussion by students
	Week 2 Strengths/Weaknesses/Future Work
Thu Apr 18, 2024	Basics III. Polymer physics. Presenter: Guest Lecturer Prof. Jeremy Schmit (Department of Physics, Kansas State University)
Tue Apr 23, 2024	Basics III. Polymer physics lecture 2. Presenter: Guest Lecturer Prof. Jeremy Schmit (Kansas State University)
Thu Apr 25, 2024	Paper discussion by students (receive take-home midterm exam)
	Week 4 Strengths/Weaknesses/Future Work
Tue Apr 30, 2024	Stress Granules. Presenter: Keren Lasker
Thu May 2, 2024	Paper discussion by students
	Week 5 Strenghts/Weaknesses/Future Work
Fri May 3, 2024	Take-Home Midterm Exam
Tue May 7, 2024	Nuclear condensates. Presenter: Ashok Deniz. Discuss and begin development of proposal.
Thu May 9, 2024	Paper discussion by students
	Week 6 Strengths/Weaknesses/Future Work
Tue May 14, 2024	Aggregation and neurodegenerative disease. Presenter: Sandra Encalada

Thu May 16, 2024	Paper discussion by students
	Week 7 Strengths/Weaknesses/Future Work
Fri May 17, 2024	Commencement (No Class)
Tue May 21, 2024	Autophagy. Presenter: Keren Lasker. Submit proposal title/outline.
Thu May 23, 2024	Paper discussion by students
	Week 8 Strengths/Weaknesses/Future Work
Fri May 24, 2024	Title/Specific Aims Draft
Mon May 27, 2024	No Class (Memorial Day)
Tue May 28, 2024	Condensates in bacteria. Presenter: Keren Lasker
Thu May 30, 2024	Paper discussion by students
	Week 9 Strengths/Weaknesses/Future Work
Tue Jun 4, 2024	Engineering condensates and Cancer. Presenter: Keren Lasker
Thu Jun 6, 2024	Paper discussion by students
	Week 10 Strengths/Weaknesses/Future Work
Tue Jun 11, 2024	Special topics - Condensates and Nucleic acid processing, Viruses, Active matter, Origins of life. Presenter: Ashok Deniz and Keren Lasker. Submit written proposal + start preparing presentation.
Thu Jun 13, 2024	Paper discussion by students
	Week 11 Strengths/Weaknesses/Future Work
Tue Jun 18, 2024	Special Topics continued or Final Exam: Short Proposal/Presentation
Wed Jun 19, 2024	No Class (Juneteenth)
Thu Jun 20, 2024	Final Exam: Short Proposal/Presentation
	Final Proposal Presentation
	Final Proposal Specific Aims Write-up