Course Syllabus – BIOL 520

Course Information

Course Number: BIOL 520 SP25
Course Name: Protein Folding in the Cell
Term: SP 2025
Start Date: 04/07/2025
End Date: 06/27/2025
Credits: 3.0

Meeting Days / Times

Mondays and Wednesdays, 10:30a-12:00p PT / 1:30-3:00p ET
(See Calendar in Canvas for the most up-to-date schedule.)

Location

CA: Graduate Office Dining Room (Hazen Theory Building)
FL: B387

Course Managers

Role	Last Name	First Name	Email Address
Course Director	Deniz	Ashok	deniz@scripps.edu
Course Director	Powers	Evan	epowers@scripps.edu
Course Director	Wiseman	Luke	wiseman@scripps.edu
TA	Blomqvist	Ebba	kblomqvist@scripps.edu
TA	Reeves	Abbey	areeves@scripps.edu

Course Description

This is a hybrid lecture/literature based course designed to highlight the importance of biologic mechanisms involved in regulating protein homeostasis (or proteostasis) in the crowded intracellular environment. Specifically, we will focus on the biological and chemical factors that mediate protein folding, trafficking, and degradation in vivo, the intracellular signaling cascades that regulate cellular protein folding efficiency, and the involvement of protein folding in human diseases. The class will be presented with specific weekly topics that cover critical or emerging aspects of protein folding (see Scheduled Lecture Topics below). Each weekly topic will be presented on Monday by expert faculty in a formal lecture to provide context for the students to understand critical aspects of the given topic. Wednesday classes will involve student-led discussion on recent literature related to 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. Furthermore, students will take a midterm and a final exam that covers the basics from each of the weekly topics as discussed in the faculty lectures.

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

Upon completion of this course students will be able to:
CLO1: Establish a basic understanding of current emerging scientific fields pertaining to protein folding and proteostasis maintenance 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 proteosasis both in vitro and in vivo.
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 scientific questions related to proteostasis maintenance.
CLO5: Identify and formulate important new questions that are inspired by specific scientific results, and design experiments to answer these questions.
CLO6: Develop and present succinct oral presentations describing the background of specific papers and their relationship to other work in the field.

Background Preparation (Prerequisites)

Basic understanding of the principles involved in protein folding in vitro (e.g., amino acids structures/properties, protein secondary/tertiary structures, etc.).

Course Materials

No textbook required. Scientific papers will be referenced throughout the course providing further reading for specific topics discussed.

Expectations and Logistics

1) Student Paper Discussion Teams: The class will be divided into teams of one or two students each, who will present papers on specific weekly topics. These teams will rotate over the duration of the course, such that every team will lead at least 1 discussion. *<u>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</u>* 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 travel schedules. The student teams will prepare the Powerpoint slides of the Introduction, Figures, and Conclusions 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 Wednesday 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 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 weaknesses 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).

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 "next experiments" document to Canvas before arrival to class (see below). Submission is available under the "Assignments" tab or under the Module for the corresponding week. 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.

<u>**Strengths/Weaknesses and Next Experiments**</u>: For every Wednesday class, students will submit a written document describing the strengths/weaknesses of the manuscript and one "next experiments" that are suggested by the paper of the day (see below for details). These will be graded by the TAs and/or 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 "next experiments" will be allowed, except under extenuating circumstances approved, in advance, by the course director (see grading).* If you do not submit the "next experiments" page for a particular class your grade will be diminished by $1/11^{th}$.

4) Selection of Papers/Student Teams: The discussion paper for each class (together with a related short review) will be posted in Canvas. Student teams and assigned papers will be determined in the first class. Everyone will have the chance to present ~1 time, depending on enrollment.

Course Requirements and Assignments

1) Class Paper Discussions: All students, not just the presenters, will be responsible for reading the Wednesday discussion paper prior to class and should be prepared to discuss each figure and the strengths and 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. 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 (1 or 2 students each) will be responsible for leading the Paper Discussion for ~1 class (depending on enrollment numbers). 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.

3) Written "Strengths/Weaknesses" and "Next Experiments" due at each Wednesday class (except for the Introductory class): Each student will submit a written document describing the strengths/weaknesses of the manuscript and one "next experiments" from the manuscript to be discussed. Each next experiment should produce an amount of data that would be expected to fit into one manuscript figure. The short description of each "next experiment" should include: a) a rationale for doing the experiment, b) a brief description of the experiment, including experimental methods, and c) the expected outcome(s) and reasons why they are expected. The description of the "next experiments" should be short so that together, the text for the "next experiment" is about ½ - ¾ 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.

Attendance Statement

Attendance is mandatory and a portion of the grade is based upon class participation. Unjustified class absence will be appropriately factored into the grade representing "participation in class discussions." *The "next experiments" 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. If a student does not submit the "next experiments" page for a particular class, the points for that portion of the material will be lost.

All students will be required to make the designated number of PowerPoint presentations (~1-2 depending on enrollment).

Scientific and Professional Ethics

Work presented 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:

- 25%: Written text for "Strengths/Weaknesses" and "Next Experiments", for each class discussion paper.
  Learning Purpose: Supports points 1-5 of learning outcomes, and allows assessment of mastery of course material
- 25%: Participation in class discussions of each paper.
  Learning Purpose: supports points 1-5 of learning outcomes, involves active learning, and allows assessment of mastery of course material.
- 25%: Short PowerPoint presentations for each Discussion Paper (Student Teams): Each student will make 1 or 2 presentations during the course as described above.
  Learning Purpose: supports points 1-6 of learning outcomes, involves active learning and allows assessment of mastery of course material.
- 25%: Final Exam
  Learning Purpose: Supports point 1 of learning outcomes, demonstrating a clear understanding of emerging topics related to proteostasis and the capacity to apply these concepts to address important scientific questions.

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
Mon Apr 7, 2025	Fundamentals of Protein Folding/Misfolding (Deniz)
Wed Apr 9, 2025	Manuscript Discussion (Deniz)
	Strengths/Weaknesses and Next Experiments 1
Mon Apr 14, 2025	Membrane Protein Folding (Mravic)
Wed Apr 16, 2025	Manuscript Discussion (Mravic)
	Strengths/Weaknesses and Next Experiments 2
Mon Apr 21, 2025	Phase Separation (Lasker)
Wed Apr 23, 2025	Manuscript Discussion (Lasker)
	Strengths/Weaknesses and Next Experiments 3
Mon Apr 28, 2025	ATP-dependent chaperoning pathways #1 – HSP70/HSP104 (Powers)
Wed Apr 30, 2025	Manuscript Discussion (Powers)
	Strengths/Weaknesses and Next Experiments 4
Mon May 5, 2025	ATP-dependent chaperoning pathways #2 – HSP60/HSP90 (Powers)

Wed May 7, 2025	Manuscript Discussion (Powers)
	Strengths/Weaknesses and Next Experiments 5
Mon May 12, 2025	Chaperone-dependent protein folding (ATP-independent chaperones) (Powers)
Wed May 14, 2025	Manuscript Discussion (Powers)
	Strengths/Weaknesses and Next Experiments 6
Fri May 16, 2025	Commencement
Mon May 19, 2025	Special topics in protein folding (including ribosomal protein folding) (Deniz)
Wed May 21, 2025	Manuscript Discussion (Deniz)
	Strengths/Weaknesses and Next Experiments 7
Mon May 26, 2025	No Class (Memorial Day)
Wed May 28, 2025	Translocation and Trafficking of Cellular Proteins (Wiseman)
Fri May 30, 2025	Manuscript Discussion (Wiseman)
	Strengths/Weaknesses and Next Experiments 8
Mon Jun 2, 2025	Proteolytic Machines and Cellular Proteostasis (Wiseman)
Wed Jun 4, 2025	Manuscript Discussion (Wiseman)
	Strengths/Weaknesses and Next Experiments 9
Mon Jun 9, 2025	Stress-Responsive Regulation of Cellular Proteostasis (Wiseman)
Wed Jun 11, 2025	Manuscript Discussion (Wiseman)
	Strengths/Weaknesses and Next Experiments 10
Mon Jun 16, 2025	Targeting Proteostasis to Ameliorate Human Disease (Wiseman)
Wed Jun 18, 2025	Manuscript Discussion (Wiseman)
	Strengths/Weaknesses and Next Experiments 11
Thu Jun 19, 2025	No Class (Juneteenth)
Mon Jun 23, 2025	Final Exam