Course Syllabus – STBIO 411

Course Information

Course Number: STBIO 411 FA21
Course Name: Structural Biology and Biophysics I
Term: Fall 2021
Start Date: 09/08/2021
End Date: 12/10/2021
Credits: 3.0

Meeting Days / Times

Mondays, Wednesdays, and Fridays, 9:30-11:00am PT / 12:30-2:00pm ET
(See Calendar in Canvas for the most up-to-date schedule.)

Location

Graduate Office Seminar Room (CA) / B382 (FL) / Zoom

Course Managers

Role	Last Name	First Name	Email Address
Course Director	Lander	Gabriel	glander@scripps.edu
Course Director	Ward	Andrew	andrew@scripps.edu
Course Director	Wilson	Ian	wilson@scripps.edu
TA	Cannac	Fabien	fcannac@scripps.edu

Course Description

This course covers all aspects of structural biology from primary to quaternary structure and deals with the 3D structure of proteins and nucleic acids. The enzyme section deals with kinetics, mechanism and drug design. Macromolecular assemblies and higher order structures include oligomers, viruses, molecular machines, metalloproteins, membrane proteins and biological complexity. Homology modeling and molecular docking are covered in lectures and hands-on practicals.

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

By the end of this course, students will be able to:
CLO1: Analyze and evaluate the basic building blocks of biological macromolecules.
CLO2: Consider how structure leads to function.
CLO3: Discuss the evolution of biological structure and function.
CLO4: Understand the architecture and building blocks of proteins.
CLO5: Evaluate protein folds and the nature of the protein universe.
CLO6: Understand protein folding and misfolding.
CLO7: Understand the architecture and building blocks of nucleic acids.
CLO8: Understand how enzymes function and the basis of structure-based drug design.
CLO9: Understand the basics of enzyme kinetics.
CLO10: Construct homology models of proteins.
CLO11: Computationally dock ligands to proteins.
CLO12: Bind models of proteins and nucleic acids.
CLO13: Understand protein-nucelic acid interactions.
CLO14: Understand the structure and function of membrane proteins.
CLO15: Understand the structure of some molecular machines.
CLO16: Understand how viruses assemble.
CLO17: Evaluate biological complexity.

Background Preparation (Prerequisites)

Students are encouraged to review background material relevant to each class that can be found in *Textbook of Structural Biology* by Liljas et al. Students typically have taken an undergraduate-level course in biology or biochemistry, but this is not required.

Course Materials

Required: Liljas et al. (2009). *Textbook of structural biology*. ISBN: 978-9812772084.

Course Requirements

The midterm and final each constitute 30% of the final grade. Group projects/presentations will constitute 35%. Homework assignments will constitute the remaining 5%.

Attendance Statement

Attendance to all lectures is mandatory. The progression of lectures requires consistent attendance, as the course is designed to build on fundamental principles taught in previous lectures. Students are responsible for their own work and must have permission from the instructor if they must miss a class.

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:

- Midterm Exam: 30%
- Final Exam: 30%

- Group Project/Presentation: 35%
- Homework Assignments: 5%

Grade Point	Letter Grade	
4.00	A	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.
3.67	A-	Excellent achievement. Student performance demonstrates thorough knowledge of the course subject matter and exceeds course expectations by completing all requirements in a superior manner.
3.33	B+	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.
3.00	B	Satisfactory work. Student performance meets designated course expectations and demonstrates understanding of the course subject matter at an acceptable level.
2.67	B-	Marginal work. Student performance demonstrates incomplete understanding of course subject matter. There is limited perception and originality.
2.33	C+	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.
2.00	C	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.
0.00	I	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.
0.00	P	Satisfactory work. Student performance demonstrated complete and adequate understanding of course subject matter. Course will count toward degree.
0.00	F	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.
0.00	W	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)

Because students are encouraged to take electives outside their area of expertise, a "C" letter grade is passing.

Course Schedule:

Date	Details
Mon Sep 6, 2021	Labor Day (No Class)
Wed Sep 8, 2021	Introduction to Biophysical Concepts & Structural Databases (Lander)
Fri Sep 10, 2021	Graduate Student Symposium (No Classes)
Mon Sep 13, 2021	Protein Secondary and Supersecondary Structure (Wilson)
Wed Sep 15, 2021	Intro to CryoEM I (Lander)
Fri Sep 17, 2021	Intro to CryoEM II (Lander)
Mon Sep 20, 2021	Intro to X-ray Crystallography (Roy)
Wed Sep 22, 2021	Intro to X-ray Crystallography II (Roy)
Fri Sep 24, 2021	Electron Diffraction (Jose Rodriguez, UCLA)
Mon Sep 27, 2021	Cutting edge X-ray diffraction methods (Fraser)
Wed Sep 29, 2021	X-ray/Diffraction Journal Club (Ward)
	JC1 Pre-Class
Fri Oct 1, 2021	EM and X-ray data interpretation and model building (Ward, Lander, Stanfield, Nettles)
Mon Oct 4, 2021	Structural Classification of Proteins, Profiles and Protein Families & Introduction to Molecular Modeling (Godzik)
Wed Oct 6, 2021	Intro to NMR (Dyson)
Fri Oct 8, 2021	Intrinsically Disordered Proteins (Wright)
Mon Oct 11, 2021	Modeling take-home
	Molecular Modeling "How to" Practical/Tutorial (Ward)
Wed Oct 13, 2021	NMR Journal Club (Otomo)
	JC2 Pre-Class
Fri Oct 15, 2021	Macromolecular Machines in Protein Folding & Unfolding (Wiseman)
Mon Oct 18, 2021	Protein Misfolding, Disease, in vivo Folding and Degradation (Kelly)
Wed Oct 20, 2021	Midterm Take Home Exam- Due Oct. 23 at 9:30am
	Cryo-electron tomography (Grotjahn)
Mon Oct 25, 2021	Midterm Take Home Exam- Due Oct. 26 at 9:30am
	Tomography journal club (Grotjahn)
	JC3 Pre-Class
Wed Oct 27, 2021	Introduction to Structure-Based Design (Schief)
Fri Oct 29, 2021	Post-evolutionary Biology (King)
Mon Nov 1, 2021	Virus Assembly and Structure (Johnson)
Wed Nov 3, 2021	Large assemblies journal club (Johnson)
	JC4 Pre-Class
Fri Nov 5, 2021	Hybrid Modeling and Kinematics (Olson)
Mon Nov 8, 2021	Nucleic Acids - Chemistry and Secondary Structure (MacRae)
Wed Nov 10, 2021	Tertiary Structure of Nucleic Acids (Williamson)

Fri Nov 12, 2021	**RNA - Protein Interactions (MacRae)**
Mon Nov 15, 2021	**DNA - Protein Interactions (Wright)**
	JC5 Pre-Class
Wed Nov 17, 2021	**Nucleic Acids Journal Club (Racki)**
Fri Nov 19, 2021	**Membrane Proteins (Cannac)**
Mon Nov 22, 2021	**Membrane Proteins II (Mravic)**
Fri Nov 26, 2021	**Thanksgiving Holiday (No Class)**
Mon Nov 29, 2021	**Small angle X-ray scattering (Tainer)**
Wed Dec 1, 2021	**Metalloenzymes - Structure & Mechanism (Tainer)**
Fri Dec 3, 2021	**Drug discovery journal club (Kojetin)**
	JC6 Pre-Class
Mon Dec 6, 2021	**Virtual screening (Forli)**
Wed Dec 8, 2021	**Autodock (Forli, Ward, Goodsell)**
	Autodock Tutorial
Fri Dec 10, 2021	**Drug discovery practical (Ward, Lander)**