Course Syllabus – STBIO 411

Course Information

Course Number: STBIO 411 FA20
Course Name: Structural Biology and Biophysics I
Term: Fall 2020
Start Date: 09/09/2020
End Date: 12/11/2020
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

Online via 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: Published research story.
PLO2: Generate creative approaches and methodologies for complex scientific questions.
PLO3: Master a potent set of technical research skills.
PLO4: Possess strong communication skills.

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
Fri Sep 4, 2020	Course Introduction (Ward, Lander)
	Introduction to Biophysical Concepts (Lander)
Mon Sep 7, 2020	Labor Day (No Class)
Wed Sep 9, 2020	Structural Databases (Lander)
Fri Sep 11, 2020	Protein Secondary and Supersecondary Structure (Wilson)
Mon Sep 14, 2020	Intro to CryoEM I (Lander)
Wed Sep 16, 2020	Intro to CryoEM II (Lander)
Fri Sep 18, 2020	Intro to X-ray Crystallography (Roy)
Mon Sep 21, 2020	Intro to X-ray Crystallography II (Roy)
Wed Sep 23, 2020	Electron Diffraction (Jose Rodriguez, UCLA)
Fri Sep 25, 2020	Cutting edge X-ray diffraction methods (Fraser)
Mon Sep 28, 2020	X-ray/Diffraction Journal Club (Ward)
	JC1 Pre-Class Assignment
Wed Sep 30, 2020	EM and X-ray data interpretation and model building (Ward, Lander, Stanfield, Nettles)
Fri Oct 2, 2020	Modeling take-home exam
Mon Oct 5, 2020	Intro to NMR (Dyson)
Wed Oct 7, 2020	Intrinsically Disordered Proteins (Wright)
Fri Oct 9, 2020	Structural Classification of Proteins, Profiles and Protein Families & Introduction to Molecular Modeling (Godzik)
Mon Oct 12, 2020	NMR Journal Club (Berlow)
	JC2 Pre-Class Assignment
Wed Oct 14, 2020	Macromolecular Machines in Protein Folding & Unfolding (Wiseman)
Fri Oct 16, 2020	Protein Misfolding, Disease, in vivo Folding and Degradation (Kelly)
Mon Oct 19, 2020	Cryo-electron tomography (Grotjahn)
	Molecular Modeling "How to" Practical/Tutorial (Ward)
Wed Oct 21, 2020	Midterm Take Home Exam- Due Oct. 21 at 9:45am
	The structure of the cytoskeleton (Milligan)
Fri Oct 23, 2020	Tomography journal club (Grotjahn)
Mon Oct 26, 2020	Introduction to Structure-Based Design (Schief)
Wed Oct 28, 2020	Post-evolutionary Biology (King)
	JC3 Pre-Class Assignment
Fri Oct 30, 2020	Hybrid Modeling and Kinematics (Olson)
Mon Nov 2, 2020	Virus Assembly and Structure (Johnson)
Wed Nov 4, 2020	Large assemblies journal club (Johnson)
	JC4 Pre-Class Assignment
Fri Nov 6, 2020	Membrane Proteins (Ward)
Mon Nov 9, 2020	Membranes meet cytoskeletal proteins (Izard)
Wed Nov 11, 2020	Nucleic Acids - Chemistry and Secondary Structure (MacRae)

Fri Nov 13, 2020	**Tertiary Structure of Nucleic Acids (Williamson)**
Mon Nov 16, 2020	**RNA - Protein Interactions (MacRae)**
Wed Nov 18, 2020	**DNA - Protein Interactions (Wright)**
	JC5 Pre-Class Assignment
Fri Nov 20, 2020	**Nucleic Acids Journal Club (Racki)**
Mon Nov 23, 2020	**Enzyme Kinetics (Wolan)**
Wed Nov 25, 2020	**Enzyme Structures - Mechanism, Inhibition, and Drug Design (Wolan)**
Thu Nov 26, 2020	**Thanksgiving Holiday (No Class)**
Fri Nov 27, 2020	**Thanksgiving Holiday (No Class)**
Mon Nov 30, 2020	**Virtual screening (Forli)**
Wed Dec 2, 2020	**Autodock (Forli, Ward, Goodsell)**
Fri Dec 4, 2020	**Drug discovery journal club (Kojetin)**
	JC6 Pre-Class Assignment
Mon Dec 7, 2020	**Small angle X-ray scattering (Tainer)**
Wed Dec 9, 2020	**Metalloenzymes - Structure & Mechanism (Tainer)**
	Autodock Tutorial
Fri Dec 11, 2020	**Drug discovery practical (Wolan)**
	Virtual screening/docking take-home exam