

## Course Syllabus – CHBIO 440

### Course Information

Course Number: CHBIO 440 FA22

Course Name: Chemical Biology I

Term: Fall 2022

Start Date: 09/07/2022

End Date: 12/09/2022

Credits: 3.0

### Meeting Days / Times

Mondays and Wednesdays, 9:45-11:15am PT / 12:45-2:15pm ET  
(See Calendar in Canvas for the most up-to-date schedule.)

### Location

CA: Keck Amphitheater

FL: A116

Online via Zoom

### Course Managers

Role	Last Name	First Name	Email
Course Director	Erb	Michael	<a href="mailto:michaelerb@scripps.edu">michaelerb@scripps.edu</a>
Course Director	Lairson	Luke	<a href="mailto:llairson@scripps.edu">llairson@scripps.edu</a>

### Course Description

This course is designed to give a broad overview of the fields of bioorganic chemistry and chemical biology. We discuss the structure and chemistry of the major classes of biomolecules (protein, nucleic acids, carbohydrates and lipids). We cover some modern methods of chemical biology, including evolutionary strategies in protein engineering, activity-based protein profiling, and mass-spectrometry-based proteomics. We also describe modern methods of drug discovery for both small molecule and biologic drugs.

### 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: Understand the structure and chemistry of the major classes of biomolecules: proteins, nucleic acids, carbohydrates, and lipids.

CLO2: Understand the state of the art methods in chemical biology.

CLO3: Understand the basic aspects of drug discovery and development.

### **Background Preparation (Prerequisites)**

Undergraduate level organic chemistry and biochemistry.

### **Course Materials**

Required: Van Vranken & Weiss (2012). *Introduction to bioorganic chemistry and chemical biology*. ISBN: 978-0815342144.

Useful to consult: Voet & Voet (2010). *Biochemistry*. ISBN: 978-0470917459.

Useful to consult: Cantor & Schimmel (1980). *Biophysical chemistry: Part I: The conformation of biological macromolecules*. ISBN: 978-0716711889.

Useful to consult: Cantor & Schimmel (1980). *Biophysical chemistry: Part III: The behavior of biological macromolecules*. ISBN: 978-0-716711926.

Useful to consult: Walsh (1978). *Enzymatic reaction mechanisms*. ISBN: 978-0716700708.

Useful to consult: Branden & Tooze (1999). *Introduction to protein structure*. ISBN: 978-0815323051.

Useful to consult: Fersht (2017). *Structure and mechanism in protein science: A guide to enzyme catalysis and protein folding*. ISBN: 978-9813225190.

Useful to consult: Kuriyan, Konforti & Wemmer (2012). *The molecules of life: Physical and chemical principles*. ISBN: 978-0815341888.

### **Expectations and Logistics**

Understanding how chemical principles can be applied to elucidate biological processes requires expertise in both chemistry and biology. Since this course is to serve primarily as a

survey of bioorganic chemistry and chemical biology, we encourage students to learn more about specific topics by reading the primary literature. References will be provided for each of the lectures, and we would be happy to provide further reading to those interested in specific topics.

### **Course Requirements**

The midterm and final each constitute 50% of the final grade.

### **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](mailto: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: 50%
- Final Exam: 50%

<b>Grade Point</b>	<b>Letter Grade</b>	
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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.
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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:**

<b>Date</b>	<b>Details</b>
<b>Mon Sep 5, 2022</b>	<b>Labor Day (No Class)</b>
<b>Wed Sep 7, 2022</b>	<b>Essential Physical Chemistry Concepts (Powers)</b>
<b>Fri Sep 9, 2022</b>	<b>Graduate Student Symposium (No Classes)</b>
<b>Mon Sep 12, 2022</b>	<b>Protein Structure and Visualization (Forli)</b>
<b>Wed Sep 14, 2022</b>	<b>Chemical Synthesis of Proteins, PTMs and Therapeutic Proteins (Dawson)</b>
<b>Mon Sep 19, 2022</b>	<b>Protein Folding in vitro, Pharmacologic Chaperoning (Kelly)</b>
<b>Wed Sep 21, 2022</b>	<b>Natively Unfolded Proteins (Deniz)</b>
<b>Mon Sep 26, 2022</b>	<b>Protein Folding in the Cell (Kelly)</b>
<b>Wed Sep 28, 2022</b>	<b>Cellular Proteomes (Wiseman))</b>
<b>Mon Oct 3, 2022</b>	<b>Chemical Proteomics (Parker)</b>
<b>Wed Oct 5, 2022</b>	<b>Bioorthogonal Chemistry (Carroll)</b>
<b>Mon Oct 10, 2022</b>	<b>Nucleic Acids: Structure, Function and Therapeutics (Powers)</b>
<b>Wed Oct 12, 2022</b>	<b>Transcription: Mechanisms and Chemical Regulation (Erb)</b>
<b>Fri Oct 14, 2022</b>	<b>Chemical Biology I - MidTerm Review Session</b>
<b>Mon Oct 17, 2022</b>	<b>Midterm Exam</b>
<b>Wed Oct 19, 2022</b>	<b>Nucleic Acids: Modern Molecular Biology (Miller)</b>
<b>Mon Oct 24, 2022</b>	<b>Evolution of Macromolecules (Badran)</b>
<b>Wed Oct 26, 2022</b>	<b>Enzymes I: Essential Concepts (Lairson)</b>
<b>Mon Oct 31, 2022</b>	<b>Enzymes II: Mechanisms (Lairson)</b>
<b>Wed Nov 2, 2022</b>	<b>Carbohydrates: Structures and Functions (Lairson)</b>
<b>Mon Nov 7, 2022</b>	<b>Chemical Glycobiology (Huang)</b>
<b>Wed Nov 9, 2022</b>	<b>Chemical Microbiology (Hang)</b>
<b>Mon Nov 14, 2022</b>	<b>Lipids and Membranes (Saghatelian)</b>
<b>Wed Nov 16, 2022</b>	<b>Metabolism (Bollong)</b>
<b>Thu Nov 24, 2022</b>	<b>Thanksgiving Holiday (No Class)</b>
<b>Fri Nov 25, 2022</b>	<b>Thanksgiving Holiday (No Class)</b>
<b>Mon Nov 28, 2022</b>	<b>Biological compartmentalization (Wiseman)</b>
<b>Wed Nov 30, 2022</b>	<b>Small Molecule Probes and Drug Discovery (Lairson)</b>
<b>Mon Dec 5, 2022</b>	<b>Final Exam</b>