



## BISC 330L: Biochemistry

4 units

Fall 2022

Monday, Wednesday and Friday—12-12:50 p.m.

Room: ZHS 252

Instructor: Christa Bancroft, Ph.D.

Office: ZHS 252

Office Hours:

Monday: 10:45-11:45 a.m. (office)

Wednesday: 2-3 p.m (Zoom) and by Appointment

Contact Info:

Email: cbancrof@usc.edu (best choice)

Phone number: 213-740-5553

I will typically reply to emails within 24 hours during the workweek and 48 hours over the weekend.

Lab Manager: Xiaojun Zhang, Ph.D.

Office: SGM304

Office Hours:

Contact Info:

Email: xiaojunz@usc.edu

Phone number: 213-740-4109

Teaching Assistant: TBD

Office:

Office Hours:

Contact Info:

### Course Topics and Goals

Biochemistry integrates an introduction to the structure of macromolecules and a biochemical approach to cellular function. Topics include: Biochemical bonds and reactions. Interactions of molecules with water. Energetics of biochemical reactions. Structure and function of DNA, RNA, proteins, lipids and carbohydrates. Enzyme kinetics and mechanisms. Enzyme cofactors and vitamins. Enzyme regulatory strategies. Glucose oxidation and ATP production: glycolysis, citric acid cycle & oxidative phosphorylation. Glucose and O<sub>2</sub> production by photosynthesis in plant chloroplasts. Ribose biosynthesis from glucose by pentose phosphate pathway. Lipid catabolism by beta-oxidation. Coordination of metabolism by hormonal signals. An exploration of simple cells (red blood cells) to more complex tissues (muscle and liver) will be used as a framework to discuss the progression in metabolic complexity. Techniques used to study biochemical pathways will be presented in the context of these major biological mechanisms. Learners will also develop problem solving and analytical skills that are more generally applicable to the life sciences.

### Learning Objectives

1. Relate covalent and non covalent interactions to their importance in biological interactions and structures.
2. Identify the amino acids and their chemical properties. Analyze how their presence in a protein changes its overall characteristics.
3. Identify the levels of structure in proteins and describe the stabilization of these structures.
4. Describe the structure and mechanism of representative enzymes in biochemical pathways.
5. Interpret plots of enzyme kinetic data both with and without inhibitors.

- Describe the primary catabolic and anabolic pathways pertaining to the following molecular classes (Glycolysis, Citric Acid Cycle, Electron Transport, Oxidative Phosphorylation, Pentose Phosphate Pathway, Light and Dark Photosynthetic Reactions, Calvin Cycle, Gluconeogenesis, Glycogenesis, Glycogenolysis and Beta-Oxidation):
  - Carbohydrates
  - Lipids
- For each pathway in 6, identify the key regulatory points, the energetics of the reactions, the enzymes and the chemical transformations involved. Analyze how energetic changes and hormonal signals modify the reactions and change the active pathways.
- Identify important characteristics of lipid membrane structure and compare mechanisms of molecular transport across membranes.
- Evaluate how organismal energy state and hormonal signals modify activation and inhibition of different biochemical pathways.
- Compare major cellular signaling pathways (Tyrosine kinase receptors, G-protein coupled receptors and steroid receptors).
- Interpret biochemical data tables

Prerequisite: CHEM 322A or CHEM 325A (Organic Chemistry)

### Course Notes

Lectures: The lecture slides posted on the course Blackboard internet site (<https://blackboard.usc.edu>). All lectures will have an audio and written transcript section that should be read or listened to at home before coming to lecture that day. It is also recommended to read the corresponding section of the textbook in preparation for in-class problem sets. There will be at-home quiz questions associated with the at-home portion of the lecture on the Blackboard course website under "Assignments". The remainder of the lecture slides will be presented in class.

It is important to attend all of the lectures during the course and to take good notes for study. Prior to attending each lecture, it is also recommended to read the appropriate portions of the textbook. Examinations will be based on application of material from lecture slides, verbal information conveyed during lecture, at-home quiz material, and in-class problem sets. Material from the textbook that is not presented in lecture slides or in the lecture presentation will not be included in examination material. All course material, information, announcements and grades will be posted on Blackboard until the end of the semester.

### Email Communication:

To ensure privacy, only student's USC email accounts may be used for email communications. Students are responsible for understanding the content of email messages that the instructor sends to their USC accounts. Therefore, each student must check their USC email regularly and make sure their account is not over quota, so new messages can be received.

### Recommended Readings and Supplementary Materials

Appling, Anthony-Cahill, Mathews, Biochemistry: Concepts and Connections (2015, 1st edition) or (2018, 2nd edition). Can be purchased in the bookstore in hardback or loose-leaf. Alternatively, you may buy on-line Mastering Chemistry access via the Pearson website.

Primary research articles for Discussions will be posted as .pdfs on Bb for students to read before coming to the lecture discussion period.

### MCAT Practice Materials (in-class problem sets):

7 Full-Length Practice Tests for the MCAT: 5 in the Book and 2 Online. Ruvenco Publishing, 2019. "AAMC MCAT Official Prep Sample Test." Official MCAT Sample Test (Online), <https://store.aamc.org/official-mcat-sample-test-online.html>.

AAMC MCAT Section Bank (Online). <https://store.aamc.org/aamc-mcat-section-bank-online.html>. "Biological and Biochemical Foundations of Living Systems Passages." Khan Academy, Khan Academy, <https://www.khanacademy.org/test-prep/mcat/biological-sciences-practice>

MCAT Practice Tests: Biological & Biochemical Foundations of Living Systems. Sterling Test Prep, 2020.

MCAT: Organic Chemistry & Biochemistry Practice Questions with Detailed Explanations. Sterling Test Prep, 2020.

MCAT® Biology & Biochemistry: Practice Questions. Sterling Test Prep, 2020.

Schnedeker, Bryan, and Anthony Lafond. "MCAT Biology and Biochemistry: Strategy and Practice." Amazon, Next Step Pre-Med, LLC, 2016, <https://www.amazon.com/MCAT-Biology-Biochemistry-Strategy-Practice/dp/1944935029>.

### Description and Assessment of Assignments

Midterms will include multiple choice, short answer and mathematical problems that can be done without a calculator.

Midterm 1 will cover material for Learning Objectives 1, 2, 3, 4, 5 and 11

Midterm 2 will cover material for Learning Objectives 6, 7, 8, 9 and 11

Midterm 3 will cover material for Learning Objectives 6, 7, 9, 10 and 11

Quizzes will be on material from the at-home portion of the lecture material and should be answered individually prior to coming to class. Points will be given both for participation and correctness.

Problem sets will be on material from the entirety of the lecture. Problems will be completed in pairs or small groups on the Blackboard website. Groups might be asked to present their thought process and solution to the class. Individuals within a group should all contribute equally to the workload. Points will be given for both participation and correctness. Additionally, students will be asked to submit practice problems from lecture material that appropriately cover learning objectives. Students will submit problems to a Blackboard share page and post correct answers. The instructor will use these questions for up to 10% of the midterm exam content. Each student will be assigned to prepare 2 questions for their assigned lecture and will receive up to 5 points of extra credit, if the questions and answers are well-researched and at an appropriate level of difficulty for the course.

### Grading Breakdown

The course grade will be based upon 1266 possible points:

Assignment	Points	% of Grade
Midterm 1	250	19.75
Midterm 2	250	19.75
Final Exam	250	19.75
At-home quizzes	76	6.0
In-class problem sets	190	15
Laboratory	250	19.75
<b>Total</b>	<b>1266</b>	<b>100</b>

### Course letter grades:

Course final grades will be determined using the following scale:

A 90-100

A- 87-89.9

B+ 82-86.9

B 77-81.9

B- 72-76.9

C+ 67-71.9

C 62-66.9

C- 57-61.9

D+ 52-56.9

D 49-51.9

D- 46-48.9  
F 45 and below

### Assignment Submission Policy

Answers to quiz questions should be submitted prior to the start of class at 12:00 pm. Quizzes for subsequent lectures are typically open 48 hours in advance of the next flipped lecture.

Answers to group work assignments should be submitted before lecture section ends at 12:50 p.m.

If you do not have access to a smart phone, tablet or laptop computer, please see Dr. Bancroft to make accommodations to submit your assignments.

### Grading Timeline

Grades for Midterm Exams will be posted within one calendar week following the exam date.

### Additional Policies

#### COVID-19 health policy:

Students are expected to comply with all aspects of USC's COVID-19 policy. Failure to do so may result in removal from the class and referral to SJACs.

#### Missing Midterm Exam:

In case a midterm exam must be missed for legitimate reasons, discuss the situation with the course instructor prior to the exam, if possible. If an exam is missed for an emergency or for a valid health reason (with written documentation), the scores of the other two exams will be prorated to comprise your total point score. Rules governing exams are given in more detail in your Student Contract, which is also posted on the class website: <https://blackboard.usc.edu>.

#### Regrades:

In the event an error is made in the grading of your exam, written submittal of a description of the error with the exam should be returned to Dr. Bancroft within a week after receiving your graded exam. After this time period, exams will not be regraded.

#### Lecture Absences:

Attendance at all lecture sections is expected. If you must miss class due to illness, valid USC travel or other emergency, please present Dr. Bancroft with evidence of the reason for absence and you will be allowed to make-up in-class work assignments within 1 week of the missed lecture period.

## Course Schedule:

Wk.	Date	Lecture Topic	Reading	Due (in class)
1	Aug. 22	Intro to Biochemistry and the Language of Chemistry	Ch. 1	
	Aug. 24	Chemical Foundations of Life	Ch. 2	Lec 2 quiz & prob. set
	Aug. 26	Energy in Biochemistry	Ch. 3	Lec 3 quiz & prob. set
2	Aug. 29	Nucleic Acids	Ch. 4	Lec 4 quiz & prob. set
	Aug. 31	Nucleic Acids	Ch. 4	Lec 5 quiz & prob. set
	Sept. 2	Amino Acids and Primary Structure	Ch. 5	Lec 6 quiz & prob. set
3	Sept. 5	No lecture, Labor Day		
	Sept. 7	Protein Structure	Ch. 6	Lec 7 quiz & prob. set
	Sept. 9	Protein Structure and Biochemical Methods	Ch. 6	Lec 8 quiz & prob. set
4	Sept. 12	Enzymes	Ch. 8	Lec 9 quiz & prob. set
	Sept. 14	Enzymes	Ch. 8	Lec 10 quiz & prob. set
	Sept. 16	Enzymes	Ch. 8	Lec 11 quiz & prob. set
5	Sept. 19	Enzymes	Ch. 8	Lec 12 quiz & prob. set
	Sept. 21	Current Science in Biochemistry (Discussion)	TBD	Lec 13 quiz & prob. set
	Sept. 23	Midterm 1		
6	Sept. 26	Carbohydrates	Ch. 9	Lec 14 quiz & prob. set
	Sept. 28	Lipids, Membranes and Cellular Transport	Ch. 10	Lec 15 quiz & prob. set
	Sept. 30	Lipids, Membranes and Cellular Transport	Ch. 10	Lec 16 quiz & prob. set
7	Oct. 3	Principles of Metabolism	Ch. 11	Lec 17 quiz & prob. set
	Oct. 5	Carbohydrate Metabolism	Ch. 12	Lec 18 quiz & prob. set
	Oct. 7	Carbohydrate Metabolism	Ch. 12	Lec 19 quiz & prob. set
8	Oct. 10	Carbohydrate Metabolism	Ch. 12	Lec 20 quiz & prob. set
	Oct. 12	Carbohydrate Metabolism	Ch. 12	Lec 21 quiz & prob. set
	Oct. 14	No Lecture, Fall Break		
9	Oct. 17	Carbohydrate Metabolism	Ch. 12	Lec 22 quiz & prob. set
	Oct. 19	Carbohydrate Metabolism	Ch. 12	Lec 23 quiz & prob. set
	Oct. 21	Citric Acid Cycle	Ch. 13	Lec 24 quiz & prob. set
10	Oct. 24	Citric Acid Cycle	Ch. 13	Lec 25 quiz & prob. set
	Oct. 26	Current Science in Biochemistry (Discussion)	TBD	Lec 26 quiz & prob. set
	Oct. 28	Midterm 2		
11	Oct. 31	Electron Transport and Ox. Phosphorylation	Ch. 14	Lec 27 quiz & prob. set
	Nov. 2	Electron Transport and Ox. Phosphorylation	Ch. 14	Lec 28 quiz & prob. set
	Nov. 4	Electron Transport and Ox. Phosphorylation	Ch. 14	Lec 29 quiz & prob. set
12	Nov. 7	Electron Transport and Ox. Phosphorylation	Ch. 14	Lec 30 quiz & prob. set
	Nov. 9	Photosynthesis	Ch. 15	Lec 31 quiz & prob. set
	Nov. 11	Photosynthesis	Ch. 15	Lec 32 quiz & prob. set
13	Nov. 14	Photosynthesis	Ch. 15	Lec 33 quiz & prob. set
	Nov. 16	Calvin Cycle	Ch. 15	Lec 34 quiz & prob. set
	Nov. 18	Calvin Cycle	Ch. 15	Lec 35 quiz & prob. set
14	Nov. 21	Lipid Metabolism	Ch. 16	Lec 36 quiz & prob. set
	Nov. 23	No lecture, Thanksgiving		
	Nov. 25	No lecture, Thanksgiving		
15	Nov. 28	Coordination of Energy Metabolism	Ch. 17	Lec 37 quiz & prob. set
	Nov. 30	Cell Signaling	Ch. 20	Lec 38 quiz & prob. set
	Dec. 2	Current Science in Biochemistry (Discussion)	TBD	Lec 39 quiz & prob. set
	Dec. 9	Final Exam: 11-11:50 a.m.		

## Statement on Academic Conduct and Support Systems

### Academic Conduct:

Plagiarism - presenting someone else's ideas as your own, either verbatim or recast in your own words - is a serious academic offense with serious consequences. Please familiarize yourself with the discussion of plagiarism in SCampus in Part B, Section 11, "Behavior Violating University Standards" [policy.usc.edu/scampus-part-b](https://policy.usc.edu/scampus-part-b). Other forms of academic dishonesty are equally unacceptable. See additional information in SCampus and university policies on scientific misconduct, [policy.usc.edu/scientific-misconduct](https://policy.usc.edu/scientific-misconduct).

### Support Systems:

Counseling and Mental Health - (213) 740-9355 - 24/7 on call  
[studenthealth.usc.edu/counseling](https://studenthealth.usc.edu/counseling)

Free and confidential mental health treatment for students, including short-term psychotherapy, group counseling, stress fitness workshops, and crisis intervention.

National Suicide Prevention Lifeline - 1 (800) 273-8255 - 24/7 on call  
[suicidepreventionlifeline.org](https://suicidepreventionlifeline.org)

Free and confidential emotional support to people in suicidal crisis or emotional distress 24 hours a day, 7 days a week.

Relationship and Sexual Violence Prevention Services (RSVP) - (213) 740-9355(WELL), press "0" after hours - 24/7 on call

[studenthealth.usc.edu/sexual-assault](https://studenthealth.usc.edu/sexual-assault)

Free and confidential therapy services, workshops, and training for situations related to gender-based harm.

Office of Equity and Diversity (OED) - (213) 740-5086 | Title IX - (213) 821-8298  
[equity.usc.edu](https://equity.usc.edu), [titleix.usc.edu](https://titleix.usc.edu)

Information about how to get help or help someone affected by harassment or discrimination, rights of protected classes, reporting options, and additional resources for students, faculty, staff, visitors, and applicants.

Reporting Incidents of Bias or Harassment - (213) 740-5086 or (213) 821-8298  
[usc-advocate.symplicity.com/care\\_report](https://usc-advocate.symplicity.com/care_report)

Avenue to report incidents of bias, hate crimes, and microaggressions to the Office of Equity and Diversity | Title IX for appropriate investigation, supportive measures, and response.

The Office of Disability Services and Programs - (213) 740-0776  
[dsp.usc.edu](https://dsp.usc.edu)

Support and accommodations for students with disabilities. Services include assistance in providing readers/notetakers/interpreters, special accommodations for test taking needs, assistance with architectural barriers, assistive technology, and support for individual needs.

USC Campus Support and Intervention - (213) 821-4710  
[campussupport.usc.edu](https://campussupport.usc.edu)

Assists students and families in resolving complex personal, financial, and academic issues adversely affecting their success as a student.

Diversity at USC - (213) 740-2101  
[diversity.usc.edu](https://diversity.usc.edu)

Information on events, programs and training, the Provost's Diversity and Inclusion Council, Diversity Liaisons for each academic school, chronology, participation, and various resources for students.

USC Emergency - UPC: (213) 740-4321, HSC: (323) 442-1000 - 24/7 on call  
[dps.usc.edu](https://dps.usc.edu), [emergency.usc.edu](https://emergency.usc.edu)

Emergency assistance and avenue to report a crime. Latest updates regarding safety, including ways in which instruction will be continued if an officially declared emergency makes travel to campus infeasible.

USC Department of Public Safety - UPC: (213) 740-6000, HSC: (323) 442-120 - 24/7 on call  
[dps.usc.edu](https://dps.usc.edu)

Non-emergency assistance or information.