BISC 330L: Biochemistry
4 units
Fall 2025
Monday, Wednesday and Friday—12-12:50 p.m.
Room: ZHS 252

Instructor: Christa Bancroft, Ph.D.
Office: ZHS 470
Office Hours:
Wednesday: 2-3 p.m (Zoom) and by Appointment
Contact Info:
Email: cbancrof@usc.edu
I will typically reply to emails within 24 hours during the workweek and 48 hours over the weekend.

Instructor: Grayson Jaggers, Ph.D.
Office: ZHS 256
Office Hours:
TBD
Contact Info:
Email: jaggers@usc.edu

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 O2 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.
6. 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):
    a. Carbohydrates
    b. Lipids
7. 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.
8. Identify important characteristics of lipid membrane structure and compare mechanisms of molecular transport across membranes.
9. Evaluate how organismal energy state and hormonal signals modify activation and inhibition of different biochemical pathways.
10. Interpret biochemical data tables

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

Course Notes

Lectures: The lecture slides posted on the course Brightspace learning management system site. Lectures 2-19 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 Brightspace 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 Brightspace 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. RuveneCo 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, and 10
Midterm 2 will cover material for Learning Objectives 4, 5, 6, 7, 8, 9 and 10
Midterm 3 will cover material for Learning Objectives 6, 7, 9, and 10
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 Brightspace website. Groups might be asked at 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 Brightspace 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 1126 possible points:

Assignment	Points	% of Grade
Midterm 1	250	22.2
Midterm 2	250	22.2
Final Exam	250	22.2
At-home quizzes	36	3.2
In-class problem sets	90	8.0
Laboratory	250	22.2
Total	1126	100

Course letter grades:

The following is an average of previous years' grade distributions. It is not meant to be definitive, but rather to set a general expectation. The final grade distribution for the 2023 spring semester will reflect both overall class performance, and the academic standards of the instructors.

A-range: 90.9 ±1.5%
B-range: 74.1 ±1.4%
C-range: 57.1 ±1.4%

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 11:59 p.m. on days with a lecture section.
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 email communication), 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://Brightspace.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. 25 (CB)	Intro to Biochemistry and the Language of Chemistry	Ch. 1	
	Aug. 27	Chemical Foundations of Life	Ch. 2	Lec 2 quiz & prob. set
	Aug. 29	Energy in Biochemistry	Ch. 3	Lec 3 quiz & prob. set
2	Sept. 1	No lecture, Labor Day		
	Sept. 3	Nucleic Acids	Ch. 4	Lec 4 quiz & prob. set
	Sept. 5	Nucleic Acids	Ch. 4	Lec 5 quiz & prob. set
3	Sept. 8	Amino Acids and Primary Structure	Ch. 5	Lec 6 quiz & prob. set
	Sept. 10	Protein Structure	Ch. 6	Lec 7 quiz & prob. set
	Sept. 12	Protein Structure and Biochemical Methods	Ch. 6	Lec 8 quiz & prob. set
4	Sept. 15	Protein Sequencing	Ch. 6	Lec 9 quiz & prob. set
	Sept. 17	Predicting and determining protein structure	Ch. 6	Lec 10 quiz & prob. set
	Sept. 19	Enzymes	Ch. 8	Lec 11 quiz & prob. set
5	Sept. 22	Enzymes	Ch. 8	Lec 12 quiz & prob. set
	Sept. 24	Enzymes	Ch. 8	Lec 13 quiz & prob. set
	Sept. 26	**Midterm 1 (Lectures 1-12) (CB)**		
6	Sept. 29	Enzymes	Ch. 8	Lec 14 quiz & prob. set
	Oct. 1	Current Science in Biochemistry (Discussion)	TBD	Lec 15 quiz & prob. set
	Oct. 3	Carbohydrates	Ch. 9	Lec 16 quiz & prob. set
7	Oct. 6	Lipids, Membranes and Cellular Transport	Ch. 10	Lec 17 quiz & prob. set
	Oct. 8	Lipids, Membranes and Cellular Transport	Ch. 10	Lec 18 quiz & prob. set
	Oct. 10	No Lecture, Fall Break		
8	Oct. 13	Cell Signaling	Ch. 20	Lec 19 quiz & prob. set
	Oct. 15 (GJ)	Intro to Metabolism	Ch. 11	
	Oct. 17	Intro to Metabolism	Ch. 11	
9	Oct. 20	Glycolysis	Ch. 12	
	Oct. 22	Glycolysis	Ch. 12	
	Oct. 24	Gluconeogenesis and Glycolysis Review	Ch. 12	
10	Oct. 27	The Citric Acid Cycle	Ch. 13	
	Oct. 29	The Citric Acid Cycle	Ch. 13	
	Oct. 31	**Midterm 2 (Lectures 13-25)**		
11	Nov. 3	Oxidative Phosphorylation	Ch. 14	
	Nov. 5	Oxidative Phosphorylation	Ch. 14	
	Nov. 7	Oxidative Phosphorylation	Ch. 14	
12	Nov. 10	Oxidative Phosphorylation	Ch. 14	
	Nov. 12	Photosynthesis	Ch. 15	
	Nov. 14	Photosynthesis	Ch. 15	
13	Nov. 17	Photosynthesis	Ch. 15	
	Nov. 19	The Calvin Cycle	Ch. 15	
	Nov. 21	The Calvin Cycle	Ch. 15	
14	Nov. 24	The Pentose Phosphate Pathway	Ch. 12	
	Nov. 26	No lecture, Thanksgiving		
	Nov. 28	No lecture, Thanksgiving		
15	Dec. 1	Glycogen	Ch. 12	
	Dec. 3	Fatty Acid Metabolism	Ch. 16	
	Dec. 5	Final Exam Review		
	Fri. Dec. 12	**Final Exam: 11 am-12 pm (Lectures 26-38)**		

Statement on University Academic and Support Systems

Students and Disability Accommodations:

USC welcomes students with disabilities into all of the University's educational programs. The Office of Student Accessibility Services (OSAS) is responsible for the determination of appropriate accommodations for students who encounter disability-related barriers. Once a student has completed the OSAS process (registration, initial appointment, and submitted documentation) and accommodations are determined to be reasonable and appropriate, a Letter of Accommodation (LOA) will be available to generate for each course. The LOA must be given to each course instructor by the student and followed up with a discussion. This should be done as early in the semester as possible as accommodations are not retroactive. More information can be found at osas.usc.edu. You may contact OSAS at (213) 740-0776 or via email at osasfrontdesk@usc.edu.

Student Financial Aid and Satisfactory Academic Progress:

To be eligible for certain kinds of financial aid, students are required to maintain Satisfactory Academic Progress (SAP) toward their degree objectives. Visit the Financial Aid Office webpage for undergraduate- and graduate-level SAP eligibility requirements and the appeals process.

Support Systems:

Counseling and Mental Health - (213) 740-9355 – 24/7 on call

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

988 Suicide and Crisis Lifeline - 988 for both calls and text messages – 24/7 on call

The 988 Suicide and Crisis Lifeline (formerly known as the National Suicide Prevention Lifeline) provides free and confidential emotional support to people in suicidal crisis or emotional distress 24 hours a day, 7 days a week, across the United States. The Lifeline consists of a national network of over 200 local crisis centers, combining custom local care and resources with national standards and best practices. The new, shorter phone number makes it easier for people to remember and access mental health crisis services (though the previous 1 (800) 273-8255 number will continue to function indefinitely) and represents a continued commitment to those in crisis.

Relationship and Sexual Violence Prevention Services (RSVP) - (213) 740-9355(WELL) – 24/7 on call
Free and confidential therapy services, workshops, and training for situations related to gender- and power-based harm (including sexual assault, intimate partner violence, and stalking).

Office for Equity, Equal Opportunity, and Title IX (EEO-TIX) - (213) 740-5086
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) 740-2500
Avenue to report incidents of bias, hate crimes, and microaggressions to the Office for Equity, Equal Opportunity, and Title for appropriate investigation, supportive measures, and response.

The Office of Student Accessibility Services (OSAS) - (213) 740-0776
OSAS ensures equal access for students with disabilities through providing academic accommodations and auxiliary aids in accordance with federal laws and university policy.

USC Campus Support and Intervention - (213) 740-0411
Assists students and families in resolving complex personal, financial, and academic issues adversely affecting their success as a student.

Diversity, Equity and Inclusion - (213) 740-2101
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
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) 442-1200 – 24/7 on call
Non-emergency assistance or information.

Office of the Ombuds - (213) 821-9556 (UPC) / (323-442-0382 (HSC)

A safe and confidential place to share your USC-related issues with a University Ombuds who will work with you to explore options or paths to manage your concern.

Occupational Therapy Faculty Practice - (323) 442-2850 or otfp@med.usc.edu
Confidential Lifestyle Redesign services for USC students to support health promoting habits and routines that enhance quality of life and academic performance.