



Dana and David Dornsife
College of Letters, Arts and Sciences

BISC 312: Molecular Biochemistry

4 units - Summer 2025

Mon - Tues - Wed - Thurs

7:55am - 10:00am (PDT)

Room: ONLINE Zoom classroom

Instructor: Nancy Castro, PhD

Office: Online Zoom classroom

Office Hours: by appointment

Contact Info:

Email: ncastro@usc.edu

Subject line should state: "BISC 312".

Course Topic Description

The student will learn the structure and function of biological macromolecules: DNA, RNA, proteins, lipids and carbohydrates. We will study cellular metabolism and energy production pathways, including glycolysis, the Citric Acid cycle, oxidative phosphorylation, gluconeogenesis, and the pentose phosphate pathway. Students will gain an understanding of how these systems are all controlled via hormone regulation. We will also learn how DNA, RNA and proteins act to copy, express and accurately transmit genetic information, specifically the mechanisms of: DNA replication, transcription, translation, DNA repair, recombination and gene regulation. Techniques used to study molecular biology and biochemistry will be presented in the context of these major biological mechanisms.

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, 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. Compare major cellular signaling pathways (Tyrosine kinase receptors, G-protein coupled receptors and steroid receptors).
 11. Interpret biochemical data tables.
 12. Describe the important enzymatic steps involved in DNA synthesis, RNA transcription, and Protein synthesis in both prokaryotes and eukaryotes.
 13. Compare how gene regulation systems in prokaryotic and eukaryotic organisms control protein concentration in a cell.

Recommended Preparation: BISC 220/221

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 attending lecture that day. It is also recommended to read the corresponding section of the textbook in preparation for class problem sets. There will be quiz questions associated with the at-home portion of the lecture on Blackboard prior to coming to lecture. The remainder of the lecture slides will be presented in class.

It is important to attend or watch video recordings of 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, 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 lecture 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 that 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 as a package in the bookstore in hardback or loose-leaf. Alternatively, you may buy e-text access online.

Description and Assessment of Assignments

Midterms will include multiple choice problems that can be done without a calculator. Quizzes will be on material from the at-home portion of flipped lecture material and should be answered individually prior to coming to class. Points will be given both for participation and correctness. In-class problem sets from flipped lectures will be on material from the entirety of the lecture. Problems will be completed in pairs or small groups in breakout rooms and submitted on the class Blackboard website.

Grading Breakdown

The course grade will be based upon **493 possible points**:

Assignment	Points	% of Grade
Midterm 1	120	24
Midterm 2	120	24
Midterm 3	120	24
At-home Quizzes	38 (19 x 2 points each)	8
In-class problem sets	95 (19 x 5 points each)	20
Total	493	100

Grading Scale

Course final grades will be determined using the following scale:

A	92.1 - 100
A-	88.7 - 92
B+	85.3 - 88.6
B	82 - 85.2
B-	78.7 - 81.9
C+	75.3 - 78.6
C	72 - 75.2
C-	68.7 - 71.9
D+	64.3 - 68.6
D	61 - 64.2
D-	56.7 - 60.9
F	≤56.6

Assignment Submission Policy

Answers to quiz questions for flipped lectures should be submitted prior to the start of class at 7:55am (PDT). Quizzes for a subsequent flipped lecture 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. PDT on the day of the lecture**. Any technical difficulties or other issues that result in your not being able to submit on time should be brought up to the professor as soon as possible and within one week at the latest, see below for missed classwork protocols.

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

Lecture Absences and Missed classwork:

Attendance at all lecture sections is encouraged. If you must miss class due to illness or valid USC travel, please present the current instructor with evidence of the reason for missing the assignment and you will be allowed to make-up classwork assignments within **3 days** of the missed lecture period. **No makeups will be allowed after 3 days post-due date of the assignment.**

Grading Timeline

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

Additional Policies

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 (relevant to the class average) to comprise your total point score.

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. Castro **within 3 days** after receiving your graded exam. After this time period, exams will not be regraded.

Course Schedule:

Wk.	Date	Lecture Topic	Lec. #	Reading	Assignment
1	W, May 21	(Intro to Biochemistry) Chemical bonds and Acids & Bases	1	Ch. 1-4	Lec.1 quiz & prob. set
	Th, May 22	Amino Acid and Analysis	2	Ch. 5	Lec.2 quiz & prob. set
2	M, May 26	No lecture, Memorial Day	3	Ch. 6	Lec.3 quiz & prob. set
	Tu, May 27	Protein Structures	4	Ch. 6/8	Lec.4 quiz & prob. set
	W, May 28	Biochemical Methods	5	Ch. 8	Lec.5 quiz & prob. set
	Th, May 29	Enzymes	6	Ch. 10	Lec.6 quiz & prob. set
3	M, June 2	Lipids, Membranes and Cellular Transport			
	Tu, June 3	Carbohydrate Metabolism	7	Ch.12	Lec.7 quiz & prob. set
	W, June 4	Citric Acid Cycle	8	Ch. 13	Lec.8 quiz & prob. set
	Th, June 5	Midterm 1 (lectures 1-7) 9:00am - 10am PDT			
4	M, June 9	Electron Transport and Oxidative Phosphorylation	9	Ch. 14	Lec.9 quiz & prob. set
	Tu, June 10	Electron Transport and Oxidative Phosphorylation	10	Ch. 14	Lec.10 quiz & prob. set
	W, June 11	Lipid Metabolism	11	Ch. 16	Lec.11 quiz & prob. set
	Th, June 12	Coordination of Energy	12	Ch. 17	Lec.12 quiz & prob. set
5	M, June 16	Signal Transduction	13	Ch. 20	Lec.13 quiz & prob. set
	Tu, June 17	The Genome	14	Ch. 21	Lec.14 quiz & prob. set
	W, June 18	Midterm 2 (lectures 8-13) 9:00am - 10am PDT			
	Th, June 19	No lecture, Juneteenth	15	Ch. 22	Lec.15 quiz & prob. set
6	M, June 23	DNA Synthesis	16	Ch. 23	Lec.16 quiz & prob. set
	Tu, June 24	DNA: Repair and Recombination	17	Ch. 24	Lec.17 quiz & prob. set
	W, June 25	Gene transcription			
	Thu, June 26	Translation: Protein Synthesis	18	Ch. 25	Lec.18 quiz & prob. set
7	M, June 30	Regulation of Gene Expression	19	Ch. 26	Lec.19 quiz & prob. set
	Tu, July 1	Midterm 3 (lectures 14-19): 9:00am - 10am PDT			

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”

<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, <http://policy.usc.edu/scientific-misconduct>.

Support Systems:

Student Counseling Services (SCS) - (213) 740-7711 – 24/7 on call

Free and confidential mental health treatment for students, including short-term psychotherapy, group counseling, stress fitness workshops, and crisis intervention. <https://engemannshc.usc.edu/counseling/>

National Suicide Prevention Lifeline - 1-800-273-8255

Provides free and confidential emotional support to people in suicidal crisis or emotional distress 24 hours a day, 7 days a week. <http://www.suicidepreventionlifeline.org>

Relationship and Sexual Violence Prevention Services (RSVP) - (213) 740-4900 - 24/7 on call free and confidential therapy services, workshops, and training for situations related to gender-based harm.

<https://engemannshc.usc.edu/rsvp/>

Sexual Assault Resource Center

For more information about how to get help or help a survivor, rights, reporting options, and additional resources, visit the website: <http://sarc.usc.edu/>

Office of Equity and Diversity (OED)/Title IX Compliance – (213) 740-5086

Works with faculty, staff, visitors, applicants, and students around issues of protected class.

<https://equity.usc.edu/>

Bias Assessment Response and Support

Incidents of bias, hate crimes and microaggressions need to be reported allowing for appropriate investigation and response. <https://studentaffairs.usc.edu/bias-assessment-response-support/>

The Office of Disability Services and Programs

Provides certification for students with disabilities and helps arrange relevant accommodations.

<http://dsp.usc.edu>

Student Support and Advocacy – (213) 821-4710

Assists students and families in resolving complex issues adversely affecting their success as a student EX: personal, financial, and academic. <https://studentaffairs.usc.edu/ssa/>

Diversity at USC

Information on events, programs and training, the Diversity Task Force (including representatives for each school), chronology, participation, and various resources for students. <https://diversity.usc.edu/>

USC Emergency Information

Provides safety and other updates, including ways in which instruction will be continued if an officially declared emergency makes travel to campus infeasible, <http://emergency.usc.edu>

USC Department of Public Safety – 213-740-4321 (UPC) and 323-442-1000 (HSC) for 24-hour emergency assistance or to report a crime.

Provides overall safety to USC community. <http://dps.usc.edu>