Analytical Biochemistry (CHEM/BIOL 535)
Fall 2021
Web course

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Blackboard: https://wku.blackboard.com
Office Hours: By appointment; can meet in person or via Zoom

Prerequisite: CHEM/BIOL 446(G)

Textbook: No textbook required. Russell Drago's *Physical Methods for Chemists* and Kensal van Holde's *Principles of Physical Biochemistry* are two sources that may be useful; they are out-of-print but old versions are still available. Supplemental literature articles will be available via Blackboard.

Content: This course will cover the thermodynamics of macromolecular structure and describe several techniques used to study biological macromolecules including UV-Visible spectroscopy, Circular Dichroism, NMR spectroscopy, and others. The course will also cover antibody-based techniques (ELISA, western blots) and some cellular assays. See Course Outline at the end of the syllabus for more information

Objective: This course will overview the theory and application of several important techniques used to study the structure and function of biological macromolecules, especially proteins.

Specific learning outcomes include but are not limited to:

1) Students will be able to describe how thermodynamics affect macromolecular structure
2) Students will be able to apply advanced NMR techniques to determine structural features of biological macromolecules
3) Students will understand how large mixtures of proteins are separated and identified using electrophoresis or chromatography coupled with mass spectrometry.

Participation: Because this is a web-based course, it is important that students be committed to keeping up with course materials and submitting assignments on time. Generally the necessary content for each week will be available no later than Monday morning of that week and will often be available earlier in case students want to take the opportunity to get ahead. Note that the actual weekly videos may only require 1-2 hours of total time; it is expected that students will use additional time each week to consult supplemental materials as necessary and to keep up with assignments that are upcoming. Waiting until right before the due date to begin assignments is strongly discouraged.

Blackboard: Key materials for the course will be available via Blackboard. The Content section of the Blackboard site will include Videos and PowerPoint presentations along with any supplemental materials of interest. The Assignments section will include the journal articles for the discussions and the tests (available during the weeks of the tests).

Tests: There will three tests during the semester. Each test will be available during the week indicated in the outline; tests will be due by 4:30 PM on the Friday of test week. Students are permitted to use course materials and to access books and/or websites containing relevant information. However, students are not permitted to work together, ask other individuals (aside from Dr. Williams) any questions, or post to message boards or sites such as Chegg in which individuals respond directly to questions posed. Getting assistance from other individuals (even anonymously) to help answer questions is academic misconduct and students will be given an F for the semester and reported to the Office of Student Contact.

Journal articles: There will be a total of 8 assignments of journal articles related to topics during the semester. Students will be expected to read the article, answer a few basic questions about the article (answers submitted via Blackboard in Assignments section), and participate in an online class discussion about the article. The answers will typically be due on Wednesdays (by 4:30 PM) and posts into the discussion board will be due on Fridays (by 4:30 PM). Discussion board posts may include questions (e.g. "Why did the authors use UV-Vis instead of circular dichroism in Figure 2?" or "How did the data in Figure 4 lead to the conclusion that the protein is spherical?"), comments ("I am not convinced their NMR data was sufficient to make the conclusions they made"), or answers to other student questions. However, at least 10 quality posts should be made by each student over the semester (no more than 3 on any given article); brief and generic comments such as "I liked the article" or "I didn't understand Figure 1" will not count as a quality post.

Presentations: Each student will be responsible for creating and uploading a ~15 minute presentation (quality and completeness more important than actual length) on a topic of interest. Students may choose to present a relevant technique that was not covered in class and give an overview of the underlying theory of the technique and/or explain how it is used in the broad area of analytical biochemistry (e.g. Raman spectroscopy). Alternatively, students may choose to show how a technique that was covered in class is applied to a particular topic of interest from the literature (e.g. how NMR spectroscopy was used to determine the folded structure of a particular protein).

Students can use YouTube, Mediasite, Zoom, or other technology to record their presentation but should ensure that it is uploaded in a format that can be readily viewed by other students. Presentations should be uploaded no later than November 23rd at 4:30 PM. Students will then be expected to view all other student presentations and provide a brief synopsis of each submission before the end of the semester.

Grading:

The current tentative grading scale is planned:

Three tests (75 pts each)	225 pts
Journal article assignments (10 pts each)	80 pts
Journal article discussion board (20 pts max)	20 pts
Presentation	60 pts
Critiques of other presentations	15 pts
Total	400 pts

If any adjustments to the grading scale are made, students will be informed in class and via e-mail of a revised syllabus.

90-100%	A
80-89%	B
70-79%	C
60-69%	D
Under 60%	F

No extra credit assignments will be administered at the end of the semester.

Students with disabilities: In compliance with university policy, students with disabilities who require academic and/or auxiliary accommodations for this course must contact the Student Accessibility Resource Center (SARC) on the first floor of DSU, room 1074. The phone number is 270-745-5004. Please DO NOT request accommodations directly from the professor or instructor without a letter of accommodation from SARC.

Course Outline

Week	Dates	Topic	Assignment due
1	Aug 23-27	Introduction, biochemistry review	
2	Aug 30-Sep 3	Thermodynamics, UV-Vis	
3	Sept 7-10	Circular dichroism, fluorescence	
4	Sept 13-17	NMR	Fluorescence answers (due Sept 15) discussion (due Sept 17)
5	Sept 20-24	Test 1	**Test 1** (due Sept 24)
6	Sept 27-Oct 1	Centrifugation	NMR answers (due Sept 29) discussion (due Oct 1)
7	Oct 4-8	Electrophoresis	Centrifugation answers (due Oct 6) discussion (due Oct 8)
8	Oct 11-13 (Fall Break week)	Begin chromatography	
9	Oct 18-22	Chromatography	Electrophoresis answers (due Oct 20), discussion (due Oct 22)
10	Oct 25-29	Mass spectrometry	Chromatography answers (due Oct 27) discussion (due Oct 29)
11	Nov 1-5	Test 2	**Test 2** (Due Nov 5)
12	Nov 8-12	Electron microscopy/X-ray diffraction	Mass spectrometry answers (due Nov 10) discussion (due Nov 12)
13	Nov 15-19	Immunoassays	X-ray answers (due Nov 17), discussion (Due Nov 19)
14	Nov 22-23 (Thanksgiving week)	Upload presentations	Presentations due Nov. 23
15	Nov 29-Dec 3	Cell death assays	Immunoassay answers (due Nov 29), discussion (due Dec 3)
16	FINAL EXAM WEEK	Test 3	**Test 3** (due Dec 10) Analyze presentations (due Dec 10)