PURDUE UNIVERSITY

DEPARTMENT OF BIOCHEMISTRY

BCHM 322
Analytical Biochemistry II
Fall 2025 Syllabus

Course Information

Meeting Time: Thursdays, 9:20 to 10:20 AM and 1:30 to 4:20 PM
Location: BCHM 112
Modality: Face to face
Credit Hours: 2
CRNs: 12025, 28440
Prerequisite: BCHM 221

Course Instructor

Dr. Ben Carter
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Office Hours: in person by appointment

Teaching Assistant

Beinan Yang
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Office Hours: in person by appointment

Course Description

Modern biochemical techniques for the purification and characterization of proteins. This is a project-oriented course where students begin by purifying a recombinant enzyme by affinity chromatography and then characterize various biochemical properties of the enzyme throughout the semester. Emphasis will be placed on quantitative analyses, including measurements of enzyme activity and inhibition, molecular interactions, and oligomeric state. Students will learn basic principles of designing assays to measure biochemical phenomena. Use of bioinformatics and computational modeling tools for protein structure analysis will be integrated. The course will culminate with preparation of a manuscript-style report describing the enzyme characterization.

Students will engage in a continuous research project throughout the semester. The project assignment will be described in week 1 and will culminate with a final written report describing the project and results obtained in week 15. Most weeks will have an associated lecture that teaches principles and theory of the primary method being used in the lab. There are no in-person lectures. Recorded lectures are available via Brightspace with each week's course module. Students are required to view the lecture on their own time each week before the scheduled Lab Prep period, and to pass a short online quiz based on the lecture content.

Course Objectives

1. Give students practical experience with the process of isolating and characterizing biochemical properties of proteins and enzymes.

2. Expose students to classical and modern methods employed in protein characterization, including computational tools used to augment wet lab experiments. Methods include site-

directed mutagenesis, recombinant protein expression, affinity and size exclusion chromatography, electrophoresis, centrifugation, immunoblotting, spectrophotometry, enzyme activity assays, mass spectrometry, bioinformatics, and protein structural modeling.

3. Introduce students to the early stages of the drug discovery process, including target identification and validation.

4. Provide students opportunities to develop hypotheses based on existing knowledge, and design appropriately controlled experiments to specifically test those hypotheses.

5. Give students practice effectively communicating scientific research results in writing.

Learning Outcomes

1. Students will be able to apply the scientific method to a specific research problem. This will include the design of hypotheses based on finding and evaluating information available in primary literature, design of experiments to test hypotheses, and analysis of experimental data to determine if hypotheses are supported.
Methods of assessment: Weekly lab data submissions, weekly lab question sets, final report

2. Students will demonstrate proficiency in the application of modern biochemical and molecular techniques for the purification and characterization of proteins.
Methods of assessment: Weekly lab instruction quizzes, weekly lab data submissions, weekly lab question sets, mid-term and end-of-semester exams

3. Students will be able to explain the theoretical principles behind modern research methods for protein purification and characterization.
Methods of assessment: Weekly lecture quizzes, mid-term and end-of-semester exams

4. Students will understand the contributions of the course methods to society, especially to the fields of drug discovery and agricultural biotechnology.
Methods of assessment: Weekly lecture quizzes, Final report

5. Students will be able to effectively document and communicate research results and their meaning in writing.
Methods of assessment: Final report (including submissions of individual sections throughout semester)

Textbooks

We do not use a textbook for this course. Reading material from various sources will be provided in electronic format via the Brightspace course page or accessed by computer during the lab periods.

Brightspace

All required files will be posted on the course Brightspace page. This includes the lab instructions for each week, the course syllabus, the lecture videos, and accessory readings. The instructions are needed to conduct the experiments properly.

Lab Computers

Our teaching lab is equipped with PC laptop computers for each student. Students do not need to bring their own computer to lab. Lab computers are exclusively for use on the course project during the lab period. Computers must always remain in the lab room. Downloading or installing any non-course related programs or files or use of the computers for any purpose other than the assigned course project is strictly forbidden.

All software needed for conducting experiments and analyzing data will be pre-installed on the lab laptop computers. We use computational modeling software from Chemical Computing Group called Molecular Operating Environment (MOE). Chemical Computing Group has very generously provided teaching licenses for MOE free of charge for our use in this course. More information about this powerful software can be found at the CCG website:

https://www.chemcomp.com/

Obtaining Extra Help

Beinan and Dr. Carter will be available in class to answer your questions. Further help can be obtained over email: please use “BCHM 322” in the subject line. We will do our best to answer such questions by return e-mail or alternatively in the next class period.

If you have any disagreements with the way any of your exams, quizzes, or assignments have been graded, please consult the grading key, if available, and then discuss them with the TA. In the event this does not resolve your concerns, please take them up with the instructor. Requests for re-grades must be submitted no later than the end of the next lab period after the graded exam, quiz or assignment has been returned.

Class Attendance

This course follows the University Academic Regulations regarding class attendance, which state that students are expected to be present for every meeting of the classes in which they are enrolled. This is a laboratory course that focuses on development of practical research skills. Maximizing the educational value of the course therefore requires students to be present in lab, actively engaged in the activities. Lab attendance is mandatory every week. PLEASE NOTE THAT WE USE THE MORNING LAB PREP PERIOD TO START LAB EXPERIMENTS SO THE POLICY APPLIES TO BOTH MORNING AND AFTERNOON PERIODS.

Any unexcused absence from a lab prep or lab period will result in a score of 0 for all of that week’s assessments, including pre-lab quizzes, data submission, and post-lab questions. You may only miss lab for an excused medical or professional reason. You must communicate ahead of time to the instructor and provide documentation if asked. If unable to attend a lab session, students will still be responsible for completing all weekly assignments and quizzes and should communicate with their research group to obtain the data collected in the lab periods so that they can answer the weekly question sets. Students must keep in mind that it is not practical to have make-up lab sessions.

In general, students need to inform the instructor immediately of any anticipated or actual conflicts that will affect the timely submission of an assignment or the ability to take an exam. In cases of excusable absences like bereavement, quarantine, jury or military duty, parental leave, or medical emergencies, the student or the student's representative should contact the Office of the Dean of Students via email or phone at 765-494-1747. Brightspace includes a link to the Dean of Students under 'University Polices and Statements'.

Missing an exam or failure to turn in the final report or lab question sheets on time will result in a grade of 0 being recorded unless documented justification is presented. Any request to be excused from an exam must include official documentation (doctor's note, request from academic advisor, etc) explaining why the exam was, or will be, missed. Makeup tests will be scheduled in consultation with the instructor.

Assessment

Grading for BCHM 322 will be determined from the following assignments and assessments. The relative contribution of each is defined in the table at the end.

Weekly Lecture Quizzes. There will be a brief online quiz associated with the lecture video posted each week. This quiz, which assesses lecture topic comprehension, must be completed each week for students to be eligible to participate in that week's lab.

Weekly Lab Instruction Quizzes. There will be a brief online quiz assessing each week's lab instructions. This is primarily to ensure students have read the instructions ahead of time in preparation for the week's lab activities. Prior preparation is essential to completing the labs on time and to avoid unnecessary mistakes. The quiz must be completed each week for students to be eligible for lab participation.

Weekly Lab Data Submission. At the end of each lab period, students will need to submit their dataset, as directed at the end of the lab instructions. The basis for evaluation of the data will be defined at the end of the instructions as well. All data must be submitted before leaving the lab. Data is submitted as a group and everyone in the group will receive the same grade for the data submission.

Weekly Lab Question Sets. A set of data interpretation questions will be assigned each week. These questions must be answered individually be each student, not as a group, but are based on the group's lab data. Answers to the lab question set are due before the subsequent week's lab prep period begins.

Exams. There will be 2 exams, the first roughly at mid-term, the second the last week of lab. The exams focus primarily on the theory from the lectures and background information from the lab instruction files. However, they also include a data analysis section based on the lab activities. The second exam is not cumulative.

Final Report. Instead of a final exam, you will be required to write a manuscript-style lab report in the format of a biochemistry journal article (Abstract, Introduction, Results, Discussion, Methods) that describes the purification, identification, and characterization of your enzyme, including appropriate figures and tables to present your experimental results

from throughout the semester. Detailed instructions will be provided at the beginning of the semester and opportunities to turn in rough drafts of individual sections for feedback will be provided throughout the semester.

Assessment	*Percentage*
Exam 1	20%
Exam 2	20%
Lecture Quizzes	5%
Pre-lab Quizzes	5%
Lab Data	15%
Lab Question Sets	15%
Final Lab Report	20%

Grading Scale

90-100%	A
80-89%	B
70-79%	C
60-69%	D
0-59%	F

Extra Credit

There will be opportunity/no opportunity for extra credit.

Lab Safety

- Safety goggles, lab gloves, dust masks, and a limited number of lab coats will be provided. These must be worn while working in the teaching labs. Students are encouraged to bring their own lab coats and/or goggles if you have them, as we cannot guarantee that the items we have in the lab will fit comfortably. We will only occasionally be working with dangerous chemicals or procedures and these rare cases will be pointed out by the TA or instructor ahead of time.
- Acceptable Lab Attire: Do not wear open-toe shoes (e.g. sandals) or shorts to the lecture and lab sessions. Everyone must wear long pants.
- Food and drinks are not permitted in the teaching labs at any time.
- Bags, coats, umbrellas, etc. must be hung on the provided wall hooks, so they do not take up space on the benches or create safety hazards on the floor.

Protect Purdue

Any student who has substantial reason to believe that another person is threatening the safety of others by not complying with Protect Purdue protocols is encouraged to report the behavior to and discuss the next steps with their instructor. Students also have the option of reporting the behavior to the Office of the Student Rights and Responsibilities. See also Purdue University Bill of Student Rights and the Violent Behavior Policy under University Resources in Brightspace.

Academic Misconduct

Academic misconduct of any kind will not be tolerated in any course offered by the Department of Biochemistry. Information on Purdue's policies with regard to academic misconduct can be found at:

HTTP://WWW.PURDUE.EDU/STUDENTREGULATIONS/STUDENT_CONDUCT/REGULATIONS.HTML

Any incidence of academic misconduct will be reported to the Office of the Dean of Students. Academic misconduct may result in disciplinary sanctions including expulsion, suspension, probated suspension, disciplinary probation, and/or educational sanctions. In addition, such misconduct will result in punitive grading such as:

- receiving a lower or failing grade on the assignment, or
- assessing a lower or failing grade for the course

Punitive grading decisions will be made after consultation with the Office of the Dean of Students. Please note reported incidences of academic misconduct go on record for reference by other instructors. Further, a record of academic misconduct is likely to influence how current/future situations are handled.

To provide you with an unambiguous definition of academic misconduct, the following text has been excerpted from "Academic Integrity: A Guide for Students", written by Stephen Akers, Ph.D., Executive Associate Dean of Students (1995, Revised 1999, 2003), and published by the Office of the Dean of Students in cooperation with Purdue Student Government, Schleman Hall of Student Services, Room 207, 475 Stadium Mall Drive West Lafayette, IN 47907-2050. "Purdue prohibits "dishonesty in connection with any University activity. Cheating, plagiarism, or knowingly furnishing false information to the University are examples of dishonesty." [Part 5, Section III-B-2-a, Student Regulations] Furthermore, the University Senate has stipulated that "the commitment of acts of cheating, lying, and deceit in any of their diverse forms (such as the use of substitutes for taking examinations, the use of illegal cribs, plagiarism, and copying during examinations) is dishonest and must not be tolerated. Moreover, knowingly to aid and abet, directly or indirectly, other parties in committing dishonest acts is in itself dishonest." [University Senate Document 72-18, December 15, 1972]

More specifically, the following are a few examples of academic dishonesty which have been discovered at Purdue University.

- substituting on an exam for another student
- substituting in a course for another student
- paying someone else to write a paper and submitting it as one's own work
- giving or receiving answers by use of signals during an exam
- copying with or without the other person's knowledge during an exam
- doing class assignments for someone else
- plagiarizing published material, class assignments, or lab reports
- turning in a paper that has been purchased from a commercial research firm or obtained from the internet
- padding items of a bibliography
- obtaining an unauthorized copy of a test in advance of its scheduled administration
- using unauthorized notes during an exam

- collaborating with other students on assignments when it is not allowed
- obtaining a test from the exam site, completing and submitting it later
- altering answers on a scored test and submitting it for a regrade
- accessing and altering grade records
- stealing class assignments from other students and submitting them as one's own
- fabricating data
- destroying or stealing the work of other students

Plagiarism is a special kind of academic dishonesty in which one person steals another person's ideas or words and falsely presents them as the plagiarist's own product. This is most likely to occur in the following ways:

- using the exact language of someone else without the use of quotation marks and without giving proper credit to the author
- presenting the sequence of ideas or arranging the material of someone else even though such is expressed in one's own words, without giving appropriate acknowledgment
- submitting a document written by someone else but representing it as one's own”

Academic Integrity

Academic integrity is one of the highest values that Purdue University holds. Individuals are encouraged to alert university officials to potential breaches of this value by either emailing integrity@purdue.edu or by calling 765-494-8778. While information may be submitted anonymously, the more information is submitted the greater the opportunity for the university to investigate the concern. More details are available on our course Brightspace under University Policies and Statements.

Responsible Use of AI in Completing Coursework

Advancements in Artificial Intelligence (AI) provide students with unparalleled access to information and problem-solving capabilities. However, with these advantages come the responsibilities of ethical use and academic integrity. This statement outlines the expectations and guidelines for the responsible use of AI in our course.

Objectives:

By adhering to these guidelines, students aim to:

1. Uphold academic honesty and personal integrity.
2. Ensure equitable access and opportunities for all students.
3. Develop skills for critical thinking and independent reasoning.
4. Understand the strengths and limitations of AI tools.

Guidelines for Responsible Use:

1. Original Work: Students should ensure that assignments submitted are original and based on their understanding. While AI can assist in research or provide general guidance, it should not produce work on behalf of the student.
2. Citation: Any content, ideas, or assistance obtained through AI tools must be appropriately cited, similar to any other reference or source. You will need to find the relevant citations from the primary literature (journal articles)!

3. Collaboration: If a student collaborates with AI tools, (and you are encouraged to do so in this course!) they must specify the nature and extent of this collaboration in their submission. This includes providing details of the prompts used to generate the AI responses.
4. Prohibited Uses: AI should not be used to complete quizzes, exams, or any other assessments unless explicitly permitted by the instructor.
5. Accessibility: All students must have equal access to AI tools. If a particular tool is used in a course, it should be free of cost for all users.
6. Data Privacy: Students must be cautious when sharing personal or sensitive information with AI platforms and should be familiar with the terms of service of any third-party AI tools.

Consequences for Misuse:
Misuse of AI tools in coursework, which includes but is not limited to producing unoriginal work, uncited use of AI-generated content, or unauthorized assistance on assessments, will be considered a breach of academic integrity. Consequences will follow the Purdue's policies on academic dishonesty as detailed in this syllabus, which may include grade penalties, course failure, or more severe disciplinary actions.

Reflection & Discussion:
Students are encouraged to reflect on their experiences using AI tools and to discuss openly any ethical or academic concerns. Periodic class discussions or forums might be held to address advancements in AI and their implications in academia. The promise of AI in enhancing learning and research is vast, but it must be used judiciously. Responsible use not only ensures academic honesty but also maximizes genuine learning and skill development. Students are urged to approach AI as a supplementary tool, not a replacement for their unique intellectual capacities and insights.

Notice of Copyright Protection of Course Materials

See the University Policies and Statements section of Brightspace for guidance on Use of Copyrighted Materials. Effective learning environments provide opportunities for students to reflect, explore new ideas, post opinions openly, and have the freedom to change those opinions over time. Students and instructors are the authors of the works they create in the learning environment. As authors, they own the copyright in their works subject only to the university's right to use those works for educational purposes Students may not copy, reproduce, or post to any other outlet (e.g., YouTube, Facebook, or other open media sources or websites) any work in which they are not the sole or joint author or have not obtained the permission of the author(s).

Emergency Preparedness

In the event of a major campus emergency, course requirements, deadlines and grading percentages are subject to changes that may be necessitated by a revised semester calendar or other circumstances beyond the instructor's control. Relevant changes to this course will be posted onto the course website or can be obtained by contacting the instructors or TAs via email or phone. You are expected to read your @purdue.edu email on a frequent basis.

A link to Purdue's Information on Emergency Preparation and Planning is located on our Brightspace under "University Policies and Statements." This website covers topics such as

Severe Weather Guidance, Emergency Plans, and a place to sign up for the Emergency Warning Notification System. I encourage you to download and review the Emergency Preparedness for Classrooms document (PDF) or (Word).

The first day of class, I will review the Emergency Preparedness plan for our specific classroom, following Purdue's required Emergency Preparedness Briefing. Please make note of items like:

- The location to where we will proceed after evacuating the building if we hear a fire alarm.
- The location of our Shelter in Place in the event of a tornado warning.
- The location of our Shelter in Place in the event of an active threat such as a shooting.

Online Course Evaluations

During the last two weeks of the semester, you will be provided with an opportunity to evaluate this course and your instructor(s). To this end, Purdue has transitioned to online course evaluations. On Monday of the fifteenth week of classes, you will receive an official email from evaluation administrators with a link to the online evaluation site. You will have two weeks to complete this evaluation. Your participation in this evaluation is an integral part of this course. Your feedback is vital to improving education at Purdue University. I strongly urge you to participate in the evaluation system.

Non-discrimination Policy

Purdue University is committed to maintaining a community that recognizes and values the inherent worth and dignity of every person; fosters tolerance, sensitivity, understanding, and mutual respect among its members; and encourages each individual to strive to reach his or her potential. In pursuit of its goal of academic excellence, the University seeks to develop and nurture diversity. The University believes that diversity among its many members strengthens the institution, stimulates creativity, promotes the exchange of ideas, and enriches campus life. A hyperlink to Purdue's full Nondiscrimination Policy Statement is included in our course Brightspace under University Policies and Statements.

Mental Health

If you find yourself beginning to feel some stress, anxiety and/or feeling slightly overwhelmed, try WellTrack. Sign in and find information and tools at your fingertips, available to you at any time. If you need support and information about options and resources, please contact or see the Office of the Dean of Students. Call 765-494-1747. Hours of operation are M-F, 8 a.m.- 5 p.m.

If you find yourself struggling to find a healthy balance between academics, social life, stress, etc., sign up for free one-on-one virtual or in-person sessions with a Purdue Wellness Coach at RecWell. Sign up is free and can be done on BoilerConnect. Students in Indianapolis will find support services curated on the Vice Provost for Student Life website.

If you're struggling and need mental health services: Purdue University is committed to advancing the mental health and well-being of its students. If you or someone you know is feeling overwhelmed, depressed, and/or in need of mental health support, services are available. For help, such individuals should contact Counseling and Psychological Services (CAPS) at 765-

494-6995 during and after hours, on weekends and holidays, or by going to the CAPS offices in West Lafayette or Indianapolis.

Basic Needs Security

Any student who faces challenges securing their food or housing and believes this may affect their performance in the course is urged to contact the Dean of Students for support. There is no appointment needed, and Student Support Services is available to serve students 8 a.m.-5 p.m. Monday through Friday.

Accessibility and Accommodations

Purdue University strives to make learning experiences as accessible as possible. If you anticipate or experience physical or academic barriers based on disability, you are welcome to let me know so that we can discuss options. You are also encouraged to contact the Disability Resource Center at: drc@purdue.edu or by phone: 765-494-1247.

Disclaimer

This syllabus is subject to change.

Lecture and Lab Topic Schedule

Date	Lecture Topic	Lab Exercises
Aug. 28	Course overview; Bioinformatics, evolutionary relationships between proteins	Using bioinformatics tools (homology searching, sequence alignments, etc.)
Sep. 4	Studying enzyme structure and function	Site-directed mutagenesis
Sep. 11	Recombinant protein expression	Recombinant protein expression
Sep. 18	Chromatography, protein purification	Affinity purification of proteins
Sep. 25	Electrophoresis and other protein separation methods	Protein analysis by SDS-PAGE, measuring protein concentration
Oct. 2	Use of antibodies in biochemical research	Quantitative Western blotting
Oct. 9	Analysis of proteins by mass spectrometry	Protein ID using mass spectrometry; Homology-based structural modeling
Oct. 16	Spectroscopic methods for protein analysis	**Exam 1**
Oct. 23	Intro to enzyme catalysis and regulation	Enzyme assays
Oct. 30	Studying protein hydrodynamic properties	Determining protein oligomeric state by measuring hydrodynamic properties
Nov. 6	Enzyme kinetics and inhibition	Michaelis-Menten enzyme kinetics
Nov. 13	Molecular recognition/substrate specificity	Substrate specificity
Nov. 20	Methods for studying protein structure	Enzyme inhibition
Nov. 27	**No Class (Thanksgiving)**	
Dec. 4	Computational modeling tools for proteins	Ligand docking and optimization for drug discovery
Dec. 11	No Lecture	**Exam 2**