

Biochemistry Laboratory Molecular Techniques 2
BB 494/594 (3 credits)
Winter 2020
OSU Corvallis Campus

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| Laboratory sections | MW 11:00-13:50, 14:00-16:50, TuTh 9:00-11:50, TuTh 13:00-15:50, Location: ALS 0023 |
| Lecture | Tu 16:00-16:50, LINC 200 |
| Instructional Team | |
| Professor | Dr. Rick Cooley, cooleyr@oregonstate.edu |
| Professor | Dr. Andy Karplus andy.karplus@oregonstate.edu |
| Instructor | Dr. Kari van Zee, vanzeek@science.oregonstate.edu |
| GTAs | Aidan Estelle estellea@oregonstate.edu Kayla Jara jarak@oregonstate.edu Kyle Nguyen nguyenky@oregonstate.edu Amber Vogel vogela@oregonstate.edu Phil Zhu zhuph@oregonstate.edu |
| Prerequisites | BB 493/593 Biochemistry Laboratory Molecular Techniques 1, BI 315, BB 315 or Instructor permission. It is expected that students have mastered the simple organic chemistry of functional groups, general chemistry problem solving in stoichiometry, pH and equilibrium calculations and simple algebraic skills such as equation solving and use of logarithms. Students should understand basics of plasmid expression vectors for expression of recombinant proteins in <i>E.coli</i> , antibiotic selection. |
| Required Materials | <i>Chemical Biology and Biochemistry Laboratory using Genetic Code Expansion Manual by Ryan Mehl, Kelsey Kean, and Kari van Zee</i> <i>Posted as pdf on Canvas</i> Primary literature readings will be available through the BB494/594 Canvas course portal. Students are expected to have access to the laboratory manual by either printing a copy or by bringing with them to lab laptops/tablets to access materials during lab. Two computers are available in the teaching lab. |

Students should also bring a lab notebook, USB drive, safety glasses, and lab coat to each session (lab coats and safety glasses are also available to check out for the term from the teaching lab). Laptops will be needed in lab to perform literature searches and analyze molecular structures.

Course Description

This advanced-level laboratory focuses on protein biochemistry. Proteins play vital roles in most biological processes as catalysts for physiological reactions, as regulators for those reactions, or as structural framework around which these processes can occur. Students will work in small interdisciplinary teams to design, execute, evaluate, and communicate guided-research projects focusing on protein structure and function.

Learning Outcomes:

After completing this course students will be able to:

1. Define specialized language of the biochemistry laboratory.
2. Describe concepts fundamental to biochemistry techniques, including concepts relating to protein purification, spectrophotometry, assay design, and characterization of proteins.
3. Operate safely biochemistry laboratory equipment, including micropipets, centrifuges, gel electrophoresis chambers, power supplies, and incubators.
4. Demonstrate quantitative skills by preparing accurately and reproducibly reagents and solutions for experiments.
5. Design experiments, including the proper controls, to express, purify, and characterize recombinant proteins.
6. Collect and analyze experimental data.
7. Evaluate their experimental findings in the context of scientific literature and communicate an understanding of core concepts, experimental details, and calculations used in each experiment in written tests, manuscripts, and oral presentations.

Additional Learning Outcomes for BB 594 graduate students

Graduate students gain additional experience in critical analysis and problems solving skills through a literature-based term proposal project and after completing the course will be able to

1. Evaluate scientific contributions of recent publications in protein biochemistry.
2. Defend their analysis in written and oral communications.
3. Propose next-step approaches to advancing the area of research.

Lectures

Lectures are held at 4:00 pm on Tuesdays in LINC 200. Students registered for the course are expected to attend all lectures and are responsible for mastering the material presented in the lectures and in any assigned reading.

Laboratory

Winter 2020 BB 494 Weekly Schedule will be provided as a separate document.

Attendance in the laboratory sessions is required in order to pass the course.

Students who miss more than three laboratory sessions without special approval in advance of the absence by the instructor(s) will fail the course. Please coordinate absences with Dr. Kari van Zee, Course Coordinator, the Instructor and TA for your session. Lab sessions begin Week 1 of the term.

What the Professors Expect of the Students

- Students are expected to attend all laboratory sessions unless they obtain approval in advance from the instructor(s). **Students who miss more than three laboratory sessions without special approval in advance of the absence by the instructor(s) will fail the course.**
- Student will arrive on time and come prepared for lab classes by studying the handouts or posted readings prior to class and planning each session's experimental work in advance with teammates.
- Student will actively keep notes in a hard-copy lab notebook before, during, and after the performance of each experiment. Digital lab notebooks are not accepted.
- Student will follow safety rules of the laboratory and wear appropriate personal protective equipment and clothing in the lab.
- Student will be able to adapt a general protocol to accomplish specific tasks as necessary. The protocols used are similar to those used in research labs.
- Student will read the appropriate experimental materials before lectures and lab and come with questions regarding the experiments.
- If there is difficulty in understanding the concepts or problems, the student is expected to obtain help from the teaching assistants or the professor. Letting problems go until the last minute will not provide for a successful classroom experience.
- Students are expected to work collaboratively in teams and to communicate regularly and effectively with teammates, professors, and teaching assistants.

Grading

Evaluation of Student Performance:

In the OSU online catalog, refer to [AR 18 and AR 19](#) (<https://catalog.oregonstate.edu/regulations/>) regarding assignment of final grades based on the following graded course components.

BB 494

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| Laboratory and Lecture Deliverables | 20% |
| Laboratory Notebooks | 20% |
| Scientific manuscript draft 1 | 10% |
| Scientific manuscript draft 2 | 10% |
| Peer reviews of draft 2 | 10% |
| Final Paper | 20% |
| Group Research Presentation | 10% |

BB 594

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| Laboratory Notebooks | 20% |
| Scientific manuscript draft 1 | 10% |
| Scientific manuscript draft 2 | 10% |
| Peer reviews of draft 2 | 10% |
| Final Paper | 25% |
| Group Research Presentation | 10% |
| Graduate term project | 15% |

All students are expected to meet the lecture, laboratory, and project deliverables assigned on Canvas, described on the 2020 Weekly Schedule and clarified below and adhere to the submission deadlines. Lab and lecture deliverables are worth a total of 20% of the final grade. Project deliverables include drafts of the scientific manuscript, peer review and group research presentation.

Laboratory Deliverables: Weekly lab deliverables are outlined on the 2020 BB 494 Schedule. Each student is expected to upload a lab deliverable handout according to the schedule to receive credit for meeting the deliverable. Deliverables submitted more than 24 hours late will **not** receive credit. In addition, students are expected to be punctual and prepared for class and to conduct their experiments safely, efficiently and with consideration for others on their team and in the lab. Students are expected to plan effectively and complete all experimental work during assigned lab periods. Students are also expected to follow lab rules, demonstrate care in carrying out protocols, keep track of samples, store them appropriately with clear labels, be responsible for the fate of plates, proteins, etc., ensure proper disposal of waste and maintain a clean and tidy workspace.

Lecture Deliverables: Students will complete weekly literature assignments and be expected to participate in discussions. The first four weeks there will be a common paper for all students to read. For the first four lectures you will submit a typed short summary, a single question you would want to ask on this paper and the proper citation of this paper.

We will discuss the paper at the end of weekly lectures. Weeks 5-9 there will be lab group literature cross-fertilization assignments. Each group will select a paper related to their research direction that they find interesting and useful. Each group member will write a summary and question at the end of their notebook with the citation of the paper. In lab, students will discuss the papers. TAs will look for these literature assignments when they grade the notebooks.

Laboratory Notebooks:

Notebooks must be maintained on an ongoing basis throughout the turn and turned in no later than Monday, March 16, 2020, 4:00 pm to Kari's office ALS 2141. Notebooks will be graded by the TAs according to the rubric posted on Canvas. Keeping and maintaining an accurate and complete laboratory notebook is an essential part of experimental science. Electronic notebooks will not be accepted. Notebooks should be written in **permanent ink** in a hardbound or spiral-bound notebook (not a three ring binder) and contain:

- Clear, meaningful headings
- Purpose, prior to lab
- Dated experiments throughout the notebook
- Pre-lab (planning write-up), completed prior to lab
- Procedures as carried out during the lab
- Calculations clearly shown
- Notes and observations made **during** the experiment
- Data (including data collected by teammates)
- Clearly presented and well-labeled results in the form of photos, figures, tables
- Analysis and conclusions clearly stated
- Quality of the results: The professors consider the ability to successfully execute, rather than just understand, experiments a key component of experimental science.

Remember, function trumps form. We are not looking for beautiful notebooks, but will be looking for well-organized notebooks that allow relevant information to be retrieved easily. Neatness naturally helps in this endeavor. Refer to the Lab Notebook Grading Rubric posted on the course portal. Lab notebooks rewritten at the end of the term to improve legibility will not be accepted and will receive a score of 0.

Scientific Manuscript:

One goal for this research project will be for each student to write an individual *Biochemistry* style manuscript discussing the structure of their proteins, what they learned and what they want to tell the scientific community. This manuscript will be built in stages moving toward the final draft. Details for what should be covered in each draft will be provided on the course website/portal.

Each student in the course is expected to write and submit their own drafts and final manuscript. We understand that you are working in teams of 4-5, and that teams will need to divide and conquer to advance the research project. However, each student must understand what is going on in all aspects of the project and must write the manuscript in their own words. Thus, we will allow the sharing of figures/graphs/gel photos among team

members, but the written figure captions, all experimental methods, introduction with hypothesis, and discussion must be written by each student in their own words. If you share information, we recommend sharing bulleted lists of protocols and not written experimental methods sections. If you have questions, please ask your instructor and TA.

Draft one: This will focus primarily on two sections: (1) the introduction of your protein, hypothesis of your study, and what you hope to learn about your protein and (2) the methods containing the bulk of the experimental section. Results may also be included if available. Reference section with complete citations should be included. Due date is listed on the weekly schedule.

Draft two: This will include all the information and corrections from draft one and in addition the results, figures, captions, discussion, and references sections of the manuscript. Due date is listed on the weekly schedule.

Peer Review: Peer review of scientific manuscripts and grant proposals is standard for all scientists. This functions to maintain quality and clarity of all reviewed scientific work. This process also helps the reviewer learn how to present information clearly. Each student will be given manuscripts from two classmates to review and provide feedback. You will be given the manuscripts at the beginning of week 8 and turn them back in at the end of the week. You will be evaluated on how well you review the manuscripts.

Final Draft: Due as **both an upload to Canvas and a hard copy printed in color** on **Monday, March 16, 2020 at 4 pm to Kari's office ALS 2141**. This will be the final polished ACS *Biochemistry* style manuscript including all feedback and scientific results.

Group Research Presentation:

At the end of the term you and your group should be experts on your protein. The last lab periods in Week 10 will be dedicated to group presentations approximately 40 minutes in length. Groups will present their team's work and lead a class discussion about how it compares to the known literature on that protein. Students must attend their schedule lab session both days in order to receive credit for their presentation unless an excused absence has been approved in advance.

Safety: **Protective eye wear, lab coats, and gloves are required at all times when working with chemicals and equipment in the lab.** *The safe handling and proper disposal of toxic chemicals, biological waste, and broken glass in a biochemistry laboratory is required. Professors and TAs will answer questions regarding the location and methods of disposal. Safety or disposal violations will also lead to significant loss of points.*

Absences: If, for some unavoidable reason, you need to be absent for a class period, *it is your responsibility to speak to or email the instructor ahead of time and arrange with your lab partners to make up the work that you miss.* Students who miss more than three laboratory sessions without obtaining prior special permission from the instructors) will fail the class. We understand that graduate school interviews and possible job interviews

are occurring in this time-frame. Please let us know well in advance so we can help you advance your research project. Travel back from winter break is not an excused absence—the term starts January 6th and so does lab.

University Policies

Statement Regarding Students with Disabilities: Accommodations for students with disabilities are determined and approved by Disability Access Services (DAS). If you, as a student, believe you are eligible for accommodations but have not obtained approval please contact DAS immediately at 541-737-4098 or at <http://ds.oregonstate.edu>. DAS notifies students and faculty members of approved academic accommodations and coordinates implementation of those accommodations. While not required, students and faculty members are encouraged to discuss details of the implementation of individual accommodations.

Student Conduct Expectations

The Department of Biochemistry/Biophysics follow the university policies on student conduct. These can be found at

https://studentlife.oregonstate.edu/sites/studentlife.oregonstate.edu/files/code_of_student_conduct_final.pdf

Cheating or plagiarism by students is subject to the disciplinary process outlined in the Student Conduct Regulations. Students are expected to be honest and ethical in their academic work. Academic dishonesty is defined as an intentional act of deception in one of the following areas:

- * cheating- use or attempted use of unauthorized materials, information or study aids
- * fabrication- falsification or invention of any information
- * assisting- helping another commit an act of academic dishonesty
- * tampering- altering or interfering with evaluation instruments and documents
- * plagiarism- representing the words or ideas of another person as one's own

Behaviors disruptive to the learning environment will not be tolerated and will be referred to the Office of Student Conduct for disciplinary action.

“The goal of Oregon State University is to provide students with the knowledge, skill and wisdom they need to contribute to society. Our rules are formulated to guarantee each student's freedom to learn and to protect the fundamental rights of others. People must treat each other with dignity and respect in order for scholarship to thrive. Behaviors that are disruptive to teaching and learning will not be tolerated, and will be referred to the Student Conduct Program for disciplinary action. Behaviors that create a hostile, offensive or intimidating environment based on gender, race, ethnicity, color, religion, age, disability, marital status or sexual orientation will be referred to the Affirmative Action Office.

Reach Out for Success:

University students encounter setbacks from time to time. If you encounter difficulties and need assistance, it's important to reach out. Consider discussing the situation with an instructor or academic advisor. Learn about resources that assist with wellness and academic

success at oregonstate.edu/ReachOut. If you are in immediate crisis, please contact the Crisis Text Line by texting OREGON to 741-741 or call the National Suicide Prevention Lifeline at 1-800-273-TALK (8255)

BB 594 Term Project

Description: This project will be a mini research proposal. The idea is to extend what we have been doing with our literature summaries into what would be the next generation work. Below I have provided you with a scientific paper and you will repeat the summary process on it as you have done before (writing a single paragraph to answer the three key points).

Scientific Paper to be announced at the beginning of the term.

In addition to this paragraph you will add the next research step surrounding this area of your interest. This next generation work can take the area in whatever direction you are excited about or think is easiest. It can be a structural biology direction, a signaling direction, enzymology, drug design, application in medicine or material science, or simply an extension of protein characterization to clarify the proposed model or interactions. You are welcome to explore other options as well; just discuss them with us first. Your research proposal should be broken into three defined sections: Problem Significance, Approach, Expected Outcomes.

- (1) **Problem Significance:** What is the gap in knowledge and why is it significant (or important to fill)?
- (2) **Approach:** What are the steps, tools, methods, or approach you would use to fill this gap and type of information would they provide?
- (3) **Expected Outcomes:** What are your expected outcomes or new knowledge? If you have trouble with expected outcomes it helps to include potential problems one expects to encounter.

We have seen many methods to solve problems in the papers we have read. You can draw from these approaches and are welcome to read as much additional literature you would like to craft your proposal. To assist you, additional papers are included in the folder as resources to put the protein in the context of the field and a unique method or tool that we have not seen before. Neither of these papers need including in your report but are meant to help provide a broader scope. You are welcome to brainstorm with each other and with me as much as you would like.

Grading Rubric: The project will be worth 100 points and will be 15% of your total course grade.

The standard summaries will be graded out of a total of **25 points**.

4 points: following the technical instructions completely.

21 points: For an effective first paragraph summarizing the paper. This should touch on the gap of knowledge in the field that is being filled with this publication, any unique approaches needed for the advance, major contributions and their meaning.

The remaining 75 points will be distributed equally for each of the three section of your proposal. Attention should be paid to the logic and clarity of your ideas, arguments and

proposed solutions. Meaning a proposal that is really novel and a significant advance only has merit if the problem, approach and outcomes are logical.

Deadlines and Details:

1. Your individually written report must be in your own words.
2. The written summary **must** be single-spaced and typed in 12 point Times, Times New Roman, or in 11 point Arial font.
3. The summary **must** be no longer than 2 page in length including figure and captions if needed. The references can be on a third page. It must contain your name and date in the header.
4. You are expected to use clear and coherent writing with correct use of grammar, punctuation etc.
5. The written report is due by *Friday* of Week 10 by 4:30 pm. Late papers will lose one letter grade per day.
6. Both a paper copy and an electronic copy must be submitted. Electronic copies must be submitted to Ryan Mehl (ryan.mehl@oregonstate.edu). Paper copies may be submitted to the BB receptionist, in the BB office.