BB 315/BI 315 Molecular Biology Laboratory Spring 2020 3 credits

Topics covered: This is an intermediate-level laboratory course designed for students in the Biochemistry and Molecular Biology and other relevant life science majors. By completing guided projects focusing on fundamental molecular biology concepts and essential technologies, participating students will explore the functional relationship between DNA sequence and gene products, and the transmission of genetic information from storage through expression to protein function. Through laboratory projects, lectures, and by reading selected primary research papers, the course will introduce students to the design, expression, and use of recombinant proteins and how they are advance the field of molecular biology and biochemistry. This course is designed to expose students to how research is performed, presented, and analyzed in the academic world. This year, our projects were developed in partnership with Dr. Michael Freitag (professor), Dr. Mareike Moeller (post-doc), Dr. John Ridenour (post-doc), and Allyson Erlendson (PhD candidate), all in the Department of Biochemistry and Biophysics.

Instructors:

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Lecture time: Tuesday 4-4:50 pm **Zoom** (remote delivery)

Lab Sections:		**Instructor/TA**
Monday and Wednesday	1-3:50 pm	Amber/Kendra (section 013)
Monday and Wednesday	1-3:50 pm	Kari/Tanushri (sections 014 and 015)
Tuesday and Thursday	9-11:50 am	Michael/Diego (section 012)
Tuesday and Thursday	1-3:50 pm	Ally/Brooke (section 011)

Office hours during lab session times by Zoom with links provided through Canvas.

COVID-19 Spring 2020: Remote delivery based on social distancing measures and the "Stay Home, Save Lives" order by the Governor

Teaching Philosophy: We understand the need for flexibility during the quickly changing COVID-19 pandemic, and thus the instructional team will do our best providing you with a valuable learning experience that will allow students to meet the course and program learning outcomes while staying on track for graduation. We have instituted a combination of remote and flexible delivery. We also have implemented a detailed teaching succession plan should one of us fall ill, and we will work to accommodate student needs and changing situations. ***Communication is key!***

Method of instruction: During Spring term 2020, OSU will deliver all course content remotely. Faculty and students who are enrolled in BB/BI 315 do not have access to the BB Department Teaching Labs on the Corvallis campus. Of course, these necessary restrictions have changed the format of our content delivery to include:

- Online training videos, including safety training and laboratory techniques
- Lectures (pre-recorded) and introductions to laboratory topics by Zoom (recorded)
- Primary literature readings, discussion groups, and blog assignments
- Analysis of experimental results from members of the Freitag research lab.
- Digital notebooks via "Benchling"; https://benchling.com.
- Discussion groups on Canvas and in Zoom breakout rooms to facilitate collaboration

Lecture times: Lectures will be pre-recorded and available before the lecture time scheduled for Tuesdays from 4-4:50 pm (Pacific Time). Lecture times will be used for discussion and Q&A sessions by Zoom ("flipped classroom" concept). All students are expected to participate in real-time, remotely. We will record these sessions and post them on Canvas for those students who have indicated in the *Remote Learning and Technology Questionnaire* or by email communication to instructors that they need flexibility because of COVID-19. Expect a delay in availability of these postings (it takes some time to move large files from Zoom to Canvas).

Laboratory sessions: In a typical year, we introduce students to the day's topic by a ~20 min meeting in the lab around a white board, followed by ~2 hours of laboratory work. Instead, we will pre-record these introductions and upload them to Canvas. **During the scheduled lab sessions, students will first watch the pre-recorded introductory "lab overviews", then work remotely on group work, participate in discussions, and have opportunities for Q&A with the TAs and instructors. Instructors and TAs will be available during your section's assigned class hours; if you need special arrangements contact the instructor of your lab section by email to make such requests.** Attendance by students via Zoom will be tracked, and the zoom meetings recorded. While students obviously will not have the usual "hands-on" experience, this deficit in terms of program learning outcomes is alleviated because **all** students enrolled in BB 315 have to take the BB 494 lab course to complete their studies at OSU. The subject matter of the two lab courses is different, but general techniques are similar, and students will still gain hands-on laboratory training.

In Fall term, assuming the COVID-19 restrictions are lifted, we will provide optional laboratory technique sessions in the BB teaching laboratories, so students who want hands-on training in molecular biology will receive it. (*Schedule to be announced at a later date.*)

Course content (Spring 2020):

Project 1: Annotation of the *Neurospora crassa* genome
Students will learn how to use sequence analysis tools, specifically **SnapGene**, common biological data bases, and molecular visualization software by annotating ~10-15 kb genome segments of a widely used model organism, the filamentous fungus *Neurospora crassa*.

Project 2: Molecular cloning
Students will learn how to design primers and carry out gene cloning schemes to build plasmids that allow for the deletion or "tagging" of specific genes in the plant pathogenic fungus, *Fusarium graminaerum*.

Project 3: Generating a panel of histone H4 mutants
Histones, as part of nucleosomes, are responsible for DNA packaging in chromosomes. They also affect DNA expression by a variety of post-translational modifications that are especially prevalent on the amino terminus of histones. Co-activator protein complexes "write", "read", or "erase" histone modifications, and in balance determine which sections of DNA are free of histones, and thus can be transcribed or "expressed". The formation of heterochromatin is crucial for cell differentiation, repression of repetitive DNA elements, and protection of chromosome integrity.

Students will investigate the role of histone H4 in transcriptional regulation by systematically mutating amino acids in the amino terminal tail of *Neurospora crassa* histone H4 (*hH4*), and replacing the normal gene with the mutated copies. Students will introduce mutations into plasmids containing a histone H4 cassette by a modified "QuickChange" method, validate mutations by sequencing, and transform mutant variants into *N. crassa* by homologous recombination. Transformants will be screened for proper integration, and strains crossed to reporter strains to yield haploid progeny with mutated *hH4* genes in combination with cytological markers, such as Red Fluorescent Protein (RFP)-tagged centromere proteins or Green Fluorescent Protein (GFP)-tagged proteins involved in gene silencing.

Project 4: Visualize important organelles by use of fluorescent proteins
Students will learn about the basics of fluorescence microscopy, and about useful markers to study basic cell biology of eukaryotic cells.

Note: Unlike in a real-life laboratory setting, most of the projects in the online course will be accomplished in succession. This organization likely will help you to understand the processes better but is unlike "life in the lab", where one is expected to juggle many projects at any given time. During the course, we will point out how one efficiently plans a "day in the lab".

Learning Outcomes

Students will:

1. Design experiments including the proper controls to analyze gene expression, construct, express, and characterize recombinant proteins.
2. Compare different types of gene cloning methods, and identify strengths and limitations of each method.
3. Demonstrate quantitative skills by preparing accurately and reproducibly reagents and solutions for experiments.
4. Operate safely molecular biology laboratory equipment including micropipettes, thermocyclers, centrifuges, gel electrophoresis chambers, power supplies, incubators, and autoclaves.
5. Interpret and evaluate scientific papers related to the research project, analyzing both scientific methods as well as writing style.
6. Use databases, computational tools and other online resources to analyze and interpret genomic sequences.
7. Develop an awareness of the major issues at the forefront of the discipline and discuss ethical issues in the molecular life sciences.
8. Recall and relate foundational molecular biology concepts and laboratory techniques to recent advances in basic research, medicine, and industrial applications.

Resources: Experimental protocols, readings, and resources will be posted on Canvas.

We are providing access to **SnapGene software** for the length of the spring term. **Instructions on how to install are provided through Canvas.**

Participation: This is a time-intensive remote instruction lab course aimed to expose students to a variety of techniques in the field of molecular biology. Participation in remote “lab” and lecture activities is required.

NOTE: In-person instruction is suspended for Spring term. All instruction will be delivered remotely. However, this is not an eCampus course! By beginning of Spring term 2020 every student must have installed the Zoom application on their phones and computers. **https://is.oregonstate.edu/zoom/getting-started**

Students are expected to communicate with the instructional team to **arrange for excused absences from regularly scheduled laboratory and lecture meetings** or to notify of illnesses or emergencies preventing lab attendance.

Evaluation of Student Performance:

Lab Safety Training and Participation (15%): Students are expected to participate in lab sessions and discussion groups, complete safety training (*observe safety policies while working in the lab, demonstrate proper care of equipment and reagents*), and be responsible for moving their projects forward. Assignments will include completion of OSU on-line safety training modules, and participation.

Blog Post Assignments (15%): This project gives students the opportunity to write **three** well-crafted blog posts based on reading of the primary scientific literature (**plus one** short introduction post), receiving feedback and comments from classmates, learning from reading each other's posts, and revising their own posts.

Weblogs as a genre are more informal and immediate than most other forms of technical writing. The purpose of this assignment is to use that informality to encourage each student to think reflectively about the topics being discussed in the class, but also to engage more thoroughly with their own disciplines and the role writing will have in their professional lives.

One of our goals with this project is to create a blogging and learning community. With the wide availability of science misinformation on the internet, it is important that we, as scientists and scientist-in-training, do what we can to stop the spread of misinformation. By reading the primary scientific literature and by breaking it down to understandable (or "bite-sized") pieces for the general public we can help them distinguish facts from rumors.

Each time you write a blog post, you will also respond to at least one of your classmates' posts. In this way, we'll ensure that you have an audience for your writing, and we'll create a community of readers and thinkers focused around the issues discussed in the blogs. See the Blog Post assignments for more details.

Pre-lab assignments (20%): Students are required to complete pre-lab assignments and submit them via Canvas by the stated deadlines. These assignments will test students' knowledge of protocol that will be performed, as well as concepts that will be utilized in the lab. Pre-labs are due every Monday by 9 am (*except Week 1*) for all students in all sections.

Notebook (20%): Each student will maintain a digital scientific laboratory notebook recording experimental design notes, procedures, calculations, data, and conclusions. Students are expected to use "Benchling" (see Canvas for instructions). Guidelines for keeping a scientific notebook will be provided in class. Benchling allows for export of pages, and students are expected to upload notebooks to Canvas every two weeks for grading.

Genome Annotation Project Milestones/Deliverables (15%): Assignment and submission instructions will be posted on Canvas.

Deliverable 1: BLASTN, BLASTX and SnapGene map
Deliverable 2: Peer evaluation of one annotated gene with the assigned region
Deliverable 3: Final annotation report and BLASTP analysis for all proteins
(requires use of SnapGene; access via BB 315 provisional license, free of charge)

Final Report on the assigned gene for deletion tagging or cytology (15%): Assignment details will be posted on Canvas.

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."

Reminder of some additional university policies:

The University **rules on student conduct** can be found here: https://studentlife.oregonstate.edu/sites/studentlife.oregonstate.edu/files/code-of-student-conduct-102218.pdf

Diversity: The College of Science strives to create an affirming climate for all students including underrepresented and marginalized individuals and groups. Diversity encompasses differences in age, color, ethnicity, national origin, gender, physical or mental ability, religion, socioeconomic background, veteran status, sexual orientation, and marginalized groups. We believe diversity is the synergy, connection, acceptance, and mutual learning fostered by the interaction of different human characteristics.

Religious Holidays: Oregon State University strives to respect all religious practices. If you have religious holidays that are in conflict with any of the requirements of this class, please see me immediately so that we can make alternative arrangements.

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)

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."

Cellular phones may be used to look up material during class discussions and to find information that corrects potential or actual mistakes by the instructor.