

BI620 Molecular Genetics, Fall 2020

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Office hours: email me for an appointment!

Course description

This course aims to teach you how to use genetic techniques to analyze gene function. We will illustrate the use of model organisms including yeast, *Caenorhabditis elegans* (worms), *Drosophila melanogaster* (flies), *Danio rerio* (zebrafish), and mice. We will cover both forward genetics (function-driven gene discovery) and reverse genetics (gene-driven functional analysis).

Learning outcomes

By the end of this course, students will be able to:

1. design and interpret experiments that distinguish how DNA sequence variations affect proteins and thereby phenotypes
2. design forward genetic screens in yeast, worm, fly, and zebrafish
3. identify the DNA sequence changes responsible for the phenotypes of mutants identified in screens
4. design reverse-engineered gene disruptions
5. use epistasis analysis, suppressors, and enhancers to define genetic pathways

Course Format:

All synchronous class sessions will be held via Zoom

Each week will focus on a single topic/theme:

- Short pre-recorded lectures will introduce each topic/theme
- Synchronous remote class sessions will focus on:
 - 1) putting the topic/theme into practice with actual scientific problem solving activities
 - 2) discussing a research article that utilizes the topic/theme

Class Times

Mondays 10:15-11:45am (optional) – live Discussion Board to answer questions about pre-recorded lectures

Note: Discussion Board will accessible for all to see the questions/answers. I will also answer questions on the board outside of these designated “live” times on Mondays; there just might be a slight delay in my response time.

Wednesdays 12:30-1:30pm (mandatory) – Problem solving activities based on week’s lecture material

Fridays 12:30-1:30pm (mandatory) – Discussion of research article related to week’s theme/topic

Preparing for synchronous class time

Wednesdays 12:30-1:30pm: We will spend much of our synchronous class time working through questions based on the topic/theme presented in the pre-recorded lectures. For a productive class session, you MUST watch the pre-recorded lectures and complete the reading beforehand! Many of the Wednesday readings are from the required textbook (*Genetic Analysis, 3rd edition* by Philip Meneely). Additional readings will be posted on the course site within Canvas (<https://canvas.uoregon.edu/>).

Fridays 12:30-1:30pm: We will spend most Fridays discussing papers (shaded in the table below) that use techniques or approaches discussed earlier in the week. This will be a true discussion - I will not be giving a presentation. Instead, you should expect to answer and ask questions about the assigned paper. You MUST complete the reading beforehand! These readings will be posted on the course site within Canvas (<https://canvas.uoregon.edu/>).

Canvas Site: The UO Canvas Site will be used to distribute all information for the class, including exams and lectures. Please familiarize yourself with the site, download and print the lecture notes and readings, and consult it frequently for announcements and updates. Please make sure that your Canvas settings allow Canvas to email you when new announcements are posted.

Course Communication: Announcements will be made via the Canvas website. For questions regarding the course and lecture material (outside of office hours), please utilize the “Discussion Boards”

on the Canvas site to post questions. If posted outside of Monday's live sessions, I will try to answer your questions as soon as possible.

Final grades

Your final course grade will be calculated by:

- Quizzes: 25%**
- Participation: 10%**
- Student presentation: 20%**
- Midterm: 20%**
- Final exam: 25%**

Quizzes (25%)

Quizzes will be taken on the Canvas website and will be 10 multiple choice questions. They will cover pre-recorded lecture material presented since the previous quiz. Quizzes will be posted at the same time pre-recorded lecture material is posted and must be completed by Wednesday at 12pm. There will be 7 quizzes in total and the lowest quiz score will be dropped. You will have 60 minutes to complete the quizzes. You will also have two opportunities to take each quiz, with the highest score being recorded. You may use your notes and textbook to answer the questions.

Participation (10%)

Participation will be determined based on four factors: attendance, engagement during problem solving activities (Wednesday classes), questions/answers/engagement during journal article discussions (Fridays), and questions asked during the student presentations.

Student presentation (20%)

You will each give a 15 minute oral presentation on a research paper you select that makes extensive use of the genetic approaches we will have learned about in the lectures.

Midterm (20%) and Final Exam (25%)

The midterm and final exams will be take-home exams. You will have 24 hours to complete each exam and they will be turned in on the Canvas site. Exams may not be turned in late. The emphasis of the exams will be on testing your understanding of the concepts, not your ability to memorize facts. Questions will primarily be based off problem solving activities we do in class and applying the concepts from the lectures. The quizzes are NOT indicative of what the exams will be like. You may use your notes and textbook to answer the questions. You may work in groups on the exams, in fact it is encouraged. You may NOT turn in identical responses and must prepare your own individually worded, typed/written responses to the exam questions.

Academic Honesty:

Academic dishonesty includes various forms of "cheating" and will not be tolerated. Academic dishonesty includes but is not limited to:

1. Copying another person's answers to exam and quiz questions.
2. Utilizing materials otherwise not allowed on exam (e.g. textbooks, more than the allocated pages of notes, internet access, etc.).
3. Having someone else take your exams.
4. Altering an exam for a regrade.
5. Copying problem set answers from others.
6. Obtaining/distributing previous exams if those exams are not made available by the instructor to everyone in the class.
7. Submitting clicker questions for other students.
8. Misrepresenting circumstances leading to missed classes, exams, or quizzes.

All such activities will be reported to the Dean of Students office and will result in a failing grade in the class if academic dishonesty is confirmed. For further definitions of cheating and its penalties, consult the University of Oregon Student Conduct Code <https://policies.uoregon.edu/vol-3-administration-student-affairs/ch-1-conduct/student-conduct-code>.

Learning Environment:

The University of Oregon and I are working to create inclusive learning environments. Please notify me if there are aspects of the instruction or design of this course that result in barriers to your participation. You

may also wish to contact the UO Accessible Education Center in 164 Oregon Hall at 346-1155 or uoac@uoregon.edu

Reporting:

The instructor of this class is a Student-Directed Employee. As such, if you disclose to me, I will respond to you with respect and kindness. I will listen to you, and will be sensitive to your needs and desires. I will not judge you. I will support you. As part of that support, I will direct students who disclose sexual harassment or sexual violence to resources that can help. I will only report the information shared to the university administration when you as the student requests that the information be reported (unless someone is in imminent risk of serious harm or is a minor). Please note the difference between ‘privacy’ and ‘confidentiality.’ As a Student-Directed Employee I can offer privacy because I am not required to report certain information to the university. However, I cannot be bound by confidentiality in the same way that a counselor or attorney is. Confidential resources such as these means that information shared is protected by federal and state laws. Any information that I as a student-directed employee receive may still be accessed by university or court proceedings. This means, for example, that I could still be called as a witness or required to turn over any related documents or notes that I keep.

Please note also that I am required to report all other forms of prohibited discrimination or harassment to the university administration. Specific details about confidentiality of information and reporting obligations of employees can be found at titleix.uoregon.edu.

Class Courtesy

Please arrive in class on time. Late arrivals distract the instructor and the other students. Please turn off cell phones during the class meeting times. Do not leave class early unless you have cleared it with the instructor in advance. Ask questions if you did not hear or understand something.

Class rosters are provided to the instructor with the student's legal name. I will gladly honor your request to address you by an alternate name or gender pronoun. Please advise me of this preference early in the quarter (or before) so that I may address you properly.

Open inquiry, freedom of expression, and respect for difference are fundamental to a comprehensive and dynamic education. We are committed to upholding these ideals by encouraging the exploration, engagement, and expression of divergent perspectives and diverse identities. Classroom courtesy and sensitivity are especially important with respect to individuals and topics dealing with differences of race, culture, religion, politics, sexual orientation, gender, gender variance, and nationalities. Our classroom is a learning environment, and as such should be a safe, inclusive and respectful place. Being respectful also includes using preferred pronouns for your classmates. Disrespecting fellow students as well as combative approaches, tones and/or actions are not acceptable. Please make me aware if there are classroom dynamics that impede your (or someone else's) full engagement.

Course outline: BI620 Fall 2020

Note: before each Wednesday session, you MUST watch the pre-recorded lectures

Date	Synchronous Class Session	<u>Before</u> class, read:
Week 1: What is modern genetics? Readings: Bill & Doug; Meneely Chapter 1 (if you need a brush-up)		
W 9/30	Introductions What is modern genetics?	Bill & Doug
F 10/2	Mendelian Genetics Problem Solving Activities	
Week 2: Mutations – sources and functional consequences Readings: Griffiths 452-456, 461-463; Meneely, section 4.6, and p132-133		
W 10/7	Problem Solving Activities	
F 10/9	Discussion: Lou Gehrig's disease	Wong <i>et al.</i> (1995)

Week 3: Forward Genetic Screens: Yeast and Worms		
Readings: Meneely, sections 4.1-4.3, 4.5, and Chapter 9; Forsburg review (2001); Giaever & Nislow review (2014); Jorgensen & Mango review (2002)		
W 10/14	Problems Solving Activities	
F 10/16	Discussion: a yeast screen to identify genes that regulate aging	Kaeberlein <i>et al.</i> (2005)
Week 4: Forward Genetic Screens: Flies, Mice, Zebrafish		
Readings: St Johnston review (2002); Patton and Zon review (2001); Kile and Hilton review (2005)		
W 10/21	Guest Lecturer: John Postlethwait Zebrafish Forward Genetic Screens	
F 10/23	Discussion: zebrafish screen paper	See Canvas site
Week 5: Identifying the Causative Mutation		
Readings: Meneely, section 4.4 and chapter 5		
W 10/28	Problem Solving Activities	
F 10/30	Discussion: worm screen paper	Bohnert and Kenyon (2017)
Week 6: Midterm week!		
W 11/4	Review for Midterm	your questions & problem set questions
F 11/6	MIDTERM EXAM!	MUST submit on Canvas by 5:00pm!
Week 7: Reverse Genetics (and CRISPR)		
Readings: Meneely, Chapter 6, sections 8.1, 8.4, 8.5; Hsu <i>et al.</i> (2014)		
W 11/11	Problem Solving Activities	
F 11/13	STUDENT PRESENTATIONS	
Week 8: Epistasis Analysis		
Readings: Meneely, Chapter 11		
W 11/18	Problem Solving Activities	
F 11/20	STUDENT PRESENTATIONS	
Week 9: Suppressors and enhancers		
Readings: Meneely, sections 10.1-10.4; O'Neil <i>et al.</i> (2017)		
W 11/25	STUDENT PRESENTATIONS	
F 11/27	THANKSGIVING HOLIDAY	No class
Week 10: Final Exam Week!		
W 12/2	STUDENT PRESENTATIONS	
F 12/4	FINAL EXAM!	MUST submit on Canvas by 5:00pm!