BI620 Molecular Genetics, Fall 2022

Instructor: **Kryn Stankunas, Ph.D.**
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Office hours: Fridays, 3:30-4:30pm or by 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, mouse, 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
6. consider use of genetic approaches to answer biological questions

Textbook. *Genetic Analysis, 3rd edition* by Philip Meneely. The readings are listed at the end of this syllabus. The textbook is available for purchase at the UO DuckStore. You can "make-do" with older editions, although some content is not present in the older textbooks. Past students and labs likely have copies available.

In-Class time
MW 12:00-1:20pm Science Library B042
F 12:00-12:50pm Science Library B042
Attendance on all three days is mandatory

Preparing for in-class time (Science Library B042)

Mondays and Wednesdays 12:00-1:20pm: We will spend much of our in-class time working through questions based on the reading that was assigned for that day. Complete the reading beforehand to support productive class sessions. Many of the Monday/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 12:00-12:50pm: We will spend most Fridays discussing papers that use techniques or approaches introduced 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 Canvas course site (https://canvas.uoregon.edu/).

Practice problems
You will learn best by working through problems. In addition to in-class time, you should spend time on your own working through the problems posted on Canvas. These will not be graded. However, answer keys will be posted.

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.

Final grades
Your final course grade will be calculated by:

Midterm: 25%
Student presentation: 25%
Attendance: 5%
Engagement: 10%
Final exam: 35%

Engagement (10%)
Engagement will be determined based on four factors: contributing to problem-solving activities (Monday and Wednesday classes), questions/answers/engagement during journal article discussions (Fridays), and questions asked during the student presentations. Everyone should receive full credit by embracing the value of the activities towards achieving the learning outcomes.

Student presentation (25%)
Presentations are in groups of two due to the large class size. You will provide a 20-minute oral presentation on a select research paper that extensively uses genetic approaches covered in the lectures. The presentation should relate the "scientific narrative" motivating the study – how does the genetics-based experimental approach tackle an important biological question?

Midterm (25%)
The midterm will be a take-home exam. You will have 48 hours to complete the exam and it will be turned in on the Canvas site. Exams may not be turned in late. The emphasis of the midterm will be on testing your understanding of the concepts, not your ability to memorize facts. Questions primarily will be based off problem solving activities we do in class and applying the concepts from the lectures. You may use your notes and textbook to answer the questions. You are encouraged to consult with each other while completing the exams. However, you must prepare your own individually worded, typed/written responses to the exam questions.

Final Exam (35%)
The final will be a take-home exam. You will have 4 days to complete the final exam and it will be turned in on the Canvas site. The final exam may not be turned in late. The final exam will be composed of two parts: 1) testing your understanding of the concepts based on problem solving activities from class (not your ability to memorize facts; 2) reading and answering questions on a research paper that primarily utilizes genetic techniques. You may use your notes and textbook to answer the questions. You are encouraged to work collectively on the exams. However, you must prepare your own individually worded, typed/written responses to the exam questions.

Academic Honesty:
Scientific progress depends on rigor, honesty, and inclusivity. Inclusivity requires fairness and equity. You are expected to apply the same principles and ethics to this course, including when completing the assignments and exams.

Learning Environment:
I strive to provide an inclusive learning environment. 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 uoaec@uoregon.edu.

COVID-19
UO continues to update its COVID-19 Safety Resources (https://coronavirus.uoregon.edu). Please familiarize yourself with this page, which reminds us that COVID-19 vaccinations are required for all students and employees, masks are welcome on campus (and required in some locations), *we should not come to campus if sick*, and free COVID-19 testing remains available.

Reporting:
I am 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. Please turn off cell phones during the class meeting times. Do not leave class early unless you have cleared it with me 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 unacceptable. Please make me aware if there are classroom dynamics that impede your (or someone else's) full engagement.

Course outline: BI620 Fall 2022

Date	Topic	Before class, read:
Week 1: What is modern genetics?		
W 9/28	Introductions What is modern genetics?	Bill and Doug
F 9/30	Mendelian Genetics Problem Solving Activities	Meneely Chapter 1 (if you need a brush-up)
Week 2: Mutations – sources and functional consequences		
M 10/3	Sources of Mutations and Mutant Classification	Readings: Griffiths 452-456, 461-463; Meneely, section 4.6, and p132-133
W 10/5	Forward Genetics Screen Intro	Meneely, sections 4.1-4.3, 4.5, and Chapter 9
F 10/7	Discussion: Lou Gehrig's disease	Wong *et al. Neuron* (1995)
Week 3: Forward Genetic Screens: Yeast and Worms		
M 10/10	Designing Screens: Yeast	Forsburg review (2001); Giaever & Nislow review (2014)

W 10/12	Designing Screens: Worms	Jorgensen & Mango review (2002)
F 10/14	Discussion: a yeast screen to identify genes that regulate aging	Kaeberlein *et al. Nature* (2005)
Week 4: Forward Genetic Screens: Flies, Mice, Zebrafish		
M 10/17	Designing Screens: Flies and Mice	St Johnston review (2002); Kile and Hilton review (2005)
W 10/19	Designing Screens: Zebrafish	Patton and Zon review (2001)
F 10/21	Discussion: Drosophila screen paper	Lake *et al., eLife* (2015)
Week 5: Identifying the Causative Mutation		
M 10/24	Identifying the Causative Mutation Part I	Meneely, section 4.4 and chapter 5
W 10/26	Identifying the Causative Mutation Part 2	Meneely, section 4.4 and chapter 5
F 10/28	Discussion: mapping a selfish genetic element in worms	Ben-David *et al., Science* (2017)
Week 6: Reverse Genetics (and CRISPR) and Midterm week!		
M 10/31	Reverse Genetics and CRISPR	Meneely, Chapter 6, sections 8.1, 8.4, 8.5; Hsu *et al.* (2014)
W 11/2	Review for Midterm	your questions & problem set questions Midterm posted at 5pm
F 11/4	**MIDTERM EXAM DUE!**	MUST submit on Canvas by 5:00pm!
Week 7: Epistasis Analysis		
M 11/7	Epistasis Analysis	Meneely, Chapter 11
W 11/9	Problem Solving Activities	
F 11/11	**STUDENT PRESENTATIONS (3)**	
Week 8: Suppressors and Enhancers		
M 11/14	Suppressors	Meneely, sections 10.1-10.3
W 11/16	Enhancers	Meneely, sections 10.4; O'Neil *et al.* (2017)
F 11/18	**STUDENT PRESENTATIONS (3)**	
Week 9: Student Presentations		
M 11/21	**STUDENT PRESENTATIONS (3)**	
W 11/23	**STUDENT PRESENTATIONS (4)**	
F 11/25	THANKSGIVING HOLIDAY	No class
Week 10: Final Exam Week!		
M 11/28	Review for Final Exam	Your questions and problem set questions Final Exam posted at 5pm
W 11/30	No Class	
F 12/2	**FINAL EXAM DUE!**	MUST submit on Canvas by 5:00pm!