BI 320, MOLECULAR GENETICS
Spring 2019

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BI 320 is an advanced undergraduate course covering gene expression and gene regulation in both prokaryotic and eukaryotic organisms. The course has been designed with the assumption that students enter with a mastery of the material presented in BI 282H/BI 214 and with a basic understanding of protein biochemistry. We will explore how genetic analysis can be used to understand cellular processes, how different sets of genes are selectively activated in different cell types within multicellular organisms, and the genetic mechanisms that enable organisms to respond to changes in their environment. The course will focus on the experimental approaches that have been used with several model organisms whose properties make them especially well-suited for genetic studies. We will discuss how studies with these model organisms established fundamental principles, and how these principles and approaches apply to more complex creatures.

Course Format:
Canvas Site:
The UO Canvas Site will be used to distribute all information for the class. 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.

Lectures and Discussion Sections: Tuesdays and Thursdays, from 10:00-11:20 in 112 LIL.
Marked up lecture slides will be posted on Canvas **after** each lecture. You are *required* to attend lectures and discussion section each week (130 HUE, Thursdays at 12:00, 1:00, and 2:00). Discussion sessions will be used to take the midterm exam quiz, review material, and to clarify and expand upon material presented in lecture and in videos. *Material presented in Discussions will be represented on exams.*

Videos: Some of the subject material for this class will be presented in mandatory videos. Links to the videos will be posted to canvas. You will be responsible for all the content presented in the videos. Most of this content will be in addition to lectures and discussions, and not just review. Do not wait until just before assessment deadlines to watch these videos; you will not be given an extension on due dates because of technical problems with the videos unless the entire class is affected.
The videos come in two main versions:

Review videos: These videos discuss topics that are central to understanding lecture content, but that should be, for the most part, review from lower division biology courses. Please watch the entire video even if you feel you have a good grasp on the content to avoid missing information key to completing the assignments.

Techniques/methods videos: These videos describe common techniques/methods used in Genetics and Molecular biology. Exam questions can include data generated by these methods, so it is important to understand how to interpret this data and how it was generated. These videos should be particularly relevant to students participating, or planning to participate in biology research, and analysis of primary research articles.

Assigned Reading:
Everyone approaches reading assignments differently; if you are comfortable with the material presented in lecture you might want to do the reading after lecture to deepen your understanding, however if you struggle to keep up in lecture you might find it more useful to do the reading before lecture.

Textbook. *Molecular Biology of the Gene,* 7th edition (Watson et al.) readings are listed at the end of this syllabus. Copies of the textbook will be available in the science library.

Excerpts from other texts. Because the text covers several topics rather superficially, assigned readings from a variety of sources are available as PDF files on Canvas. These are listed in the course outline in italic text.

Grading Policy:
The final course grade will be calculated by the distributions below. Please make note of the due dates, then notify me during the first week of class if you foresee any conflicts. Last minute accommodations for missing class will not be made:

Assignment	% of final grade	Due date (non-transferable)
Participation: Clickers / on time attendance	7%	every lecture & discussion day
Problem Sets (6 @ 3pt each)	18%	see schedule
Importance of Diversity in Science (short paper)	2%	4/4
Group Work Assignment	1%	4/12
Quiz	10%	4/16
Midterm	26%	**5/14**
Quiz over midterm material	extra credit on midterm	5/23
Final Exam	36%	**6/12**

YOU ARE EXPECTED TO KEEP ALL OF YOUR GRADED WORK UNTIL FINAL GRADES ARE POSTED, TO USE AS DOCUMENTATION SHOULD DISAGREEMENTS ARISE.

Participation (7%): Clickers / on time attendance:
This component of the grade is worth 7% and will take into account participation in lecture (via clicker questions) and discussion sections as well punctual attendance in lecture and discussions.

I-clickers: will be used to review lecture topics and to encourage participation. Please bring your I-clicker to each lecture and have it ready for use. I-clickers are available for purchase at the UO Bookstore and should be registered to your Canvas account as soon as possible. To get full credit you need to attempt at least 80% of the clicker questions. Most clicker questions will be graded on participation, not accuracy, but there are some exceptions. You will not be told which questions need to be answered correctly before you attempt them so please try your best on all questions. Submitting I-clicker responses for anyone other than yourself is cheating, will be reported to the dean of students' office, and will result in a failing grade in the class.

Attendance: To get full credit you need to arrive to class and discussion ON TIME, this will be verified through clicker questions (in the case of lecture) and/or through roll call (discussion).

Problem Sets (18%): Your assigned group will turn in 6 problem sets. For each problem set, the group will turn in one set of answers with all contributing group members' names on it. For each set only one question will be graded, but a full key will be available after the sets are turned in. The problem sets serve to reinforce the material covered in the lectures and reading. *Working through ALL of the problems as independently as possible before discussing them with your group will provide the best preparation for the exams and quizzes.* Problem set due dates are indicated on the Syllabus. Answers must be typed (with the exception of illustration, which can be hand drawn), and should be concise. Problem sets must be turned in to the slot box labeled "BI320" next to Rm 13 Klamath. Late problem sets will not be accepted, so if it is your responsibility to turn in your groups set, you need to do it on time! *GE will not provide detailed written feedback so please check the answer key for details about the answers.*

Importance of Diversity in Science (short paper, 250-500 words, typed; 2% of course grade): A self-reflection on how your background influences your scientific interests. Due at the beginning of the first discussion section on 4/4.

Group Work Assignment (1% of course grad): Worksheet that discusses constructive and destructive group behaviors and the stages of team formation. Due with the first problem set on 4/12.

Exams (72%): Exams will be closed book.
For the Midterm, you may bring:

- One page of notes, handwritten on both sides.
- A printed sheet that you will be given in lecture, which can also have hand written notes on it.

For the Final Exam, you many bring:

- Two pages of handwritten notes, handwritten on both sides.

All notes must be turned in with your exam. There will be no notes allowed for the quiz.
The emphasis will be on testing your understanding of the concepts, not your ability to memorize facts. I will grade the exams with the GEs. If you feel that you have been graded unfairly, you must submit your reasoning to me in writing, within one week of the day the exam is returned to you. Attach the original exam to your request. **EARLY EXAMS WILL NOT BE GIVEN UNDER ANY CIRCUMSTANCES!** Schedule travel plans accordingly.

> **Week 3 Quiz (10%): 4/16 in lecture.** If you take your exams through the accessible education center, then you must sign up at least a week in advance. Last minute accommodations will not be made (except under extreme, unforeseeable, circumstances). You will not be allowed notes during the quiz.
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> **Midterm (26%): 5/14 in lecture.** If you take your exams through the accessible education center, then you must sign up at least a week in advance. Last minute accommodations will not be made (except under extreme, unforeseeable, circumstances).
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> **Final Exam (36%): 8:00am on Wednesday, June 12th.** If you take your exams through the accessible education center, then you must sign up at least a week in advance. Last minute accommodations will not be made (except under extreme, unforeseeable, circumstances).

Quiz (extra credit on midterm): This quiz will cover content from the midterm and will be given during discussion week 8. You will not be allowed notes during the quiz.

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. Altering an exam for a regrade.
3. Copying problem set answers from other groups or Canvas Set answers from others.
4. Obtaining/distributing previous exams if those exams are not made available by the instructor to everyone in the class.
5. Submitting clicker questions for other students.
6. 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 uoaec@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. Use your laptop only for class activities. 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.

Major Learning Objectives:

In this class you will:

- Become familiar with prokaryotic and eukaryotic gene architecture and how it relates to regulation of gene expression. Understand the similarities and differences between the gene architecture of prokaryotes and eukaryotes along with the consequences on expression regulation.
- Understand the differences between coordinate regulation of gene expression in prokaryotes and eukaryotes
- Understand the applications and limitations of common genetic techniques and be able to interpret data from these techniques.
- Be able to: 1) use your understanding of genetics to propose hypotheses for the mechanisms for gene regulation and maintenance of genome integrity; and, 2) use your understanding of common genetic techniques to propose a means of testing these hypotheses.
- Understand how chromatin organization and modification in eukaryotes influences gene expression.
- Become familiar with basic RNA processing in eukaryotes and how this processing can be differentially regulated.

Tentative Course Outline: BI 320 Spring 2019
Text: Molecular Biology of the Gene, 7th ed, Watson et al. Abbreviated as "Watson" below.
Other readings are *italicized* below and can be downloaded from Canvas.

Date	Topic (Concepts)	Reading 7th ed	Due dates
4/2	-Overview of Course Themes (video) -Types of mutations	• *Hartwell 221-224* • Watson 807-808	Watch video 1 before class
4/4	-Prokaryotic genome organization (video) -Transcription initiation (cis elements and trans factors).	• *Hartwell 487-493* • Watson 200-204; 429-445	Watch video 2 before class
4/4	Discussion, week 1 (GE: Julia Ngo) -Techniques: PCR, gel mobility shift assays -Meet assigned group members, exchange contact info, schedule out-of-class study time with your group, work on problem set problems		**Importance of Diversity in STEM paper due at beginning of discussion section**
4/9	-Techniques: How to tell if a protein binds to DNA/RNA? PCR, gel mobility shift assays (videos) -A closer look at the promoter and how mutational analysis can be used to identify it -Prokaryotic Termination and palindromic sequences	• Watson 147-149; 158; 182-187 • Watson 615-620 • Watson 445-447	Watch videos 3 & 4 before class
4/11	- Techniques: restriction enzymes, Southern blots (DNA fingerprinting), northern blots, western blots (in video 5) -Positive and negative control of transcription initiation in prokaryotes: *lac* operon. (Dyad symmetry, allostery, cis/trans test)	• Watson 149-153; 176-177 • Watson 620-629	Watch video 5 before class
4/11	Discussion, week 2 (GE: Elizabeth Vargas) -Techniques: Restriction enzymes, Southern blots, northern blots, western blots, cloning, blue/white screening -work on problem set problems		
4/12			• **Problem Set 1 due @ noon** • **Group work assignment due with Problem Set 1**
4/16	**QUIZ***		
4/18	-Review of translation basics (video) -Positive and negative control of transcription initiation in prokaryotes: *lac* operon cont'd (Combinatorial control, dominant negative alleles, redundancy, DNA "looping")	• Watson 510-512; 515-525 (optional) • Watson 147-151; 158-159; 183-185	Watch video 6 before class
4/18	Discussion, week 3 (GE: Julia Ngo) -work on problem set problems		Watch video 7 before class
4/23	-Transcriptional attenuation: Interplay of translation and transcription in the *trp* operon (feedback inhibition of gene expression, RNA structure/function)	•Watson 707-708	
4/25	-Phage Lambda: paradigm for a genetic switch (Regulatory cascade, antitermination)	•*Williams, Science* • Watson 635-648	
4/25	Discussion, week 4 (GE: Elizabeth Vargas) -Trp operon conclusion/review (video) -work on problem set problems		
4/26			**Problem Set 2 due @ noon**
4/30	Phage Lambda continued. (Stochasticism, positive autoregulation, cooperativity)	• Watson 648-652; 528-530; 549-555	

	Translational control in prokaryotes, Riboswitches (translational control, more RNA-mediated feedback regulation)	• Watson 701-706	
5/2	Finish up Prokaryotic translational control		
5/2	Discussion, week 5 (GE: Julia Ngo) -work on problem set problems		
5/3			**Problem Set 3 due @ noon**
5/7	-Eukaryotic genome architecture (video) -Transcription in eukaryotes: general transcription factors, RNA polymerase recruitment	• Watson 204-208; • Watson 448-457	Watch video 8 before class
5/9	-Transcription in eukaryotes: Gal regulon in yeast; steroid hormone response in animals (Specific transcription factors, Promoter proximal elements, enhancers, insulators)	• Watson 159-168 • Watson 657-666; 675-679; 686-687. • *Lodish 392-396*	Watch video 9 before class
5/9	Discussion, week 6 (GE: Elizabeth Vargas) -Techniques: DNA sequencing, High throughput sequencing (video) -Midterm Review		
5/14	**MIDTERM***		
5/16	-Genome packaging and Influence of chromatin structure on transcription (chromatin organization and modification)	• Watson p. 664; 733-736 • Watson 219-236;	Watch video 10 before class
5/16	Discussion, week 7 (GE: Julia Ngo) -Techniques: enhancer traps; yeast 2-hybrid -Work on problems (enhancer trap problem from video)		
5/21	-Genome packaging and Influence of chromatin structure on transcription (X-chromosome inactivation, DNA and histone modifications, Genomic imprinting)	• Watson 236-249; 728-729; 692-693	**Problem Set 4 due @ noon**
5/23	-mRNA processing in eukaryotes (5' cap, splicing, polyadenylation) (video), - Regulation of mRNA processing in eukaryotes Intro to sex determination in *Drosophila*	• Watson 457-462; 467-478; 480-482 • Watson 483-487; 491-496	Watch video 11 before class
5/23	Discussion, week 8 (GE: Elizabeth Vargas) **Quiz on Midterm (extra credit)**		**Quiz on Midterm** during discussion section
5/28	alternative splicing, *Drosophila* sex determination continued		
5/30	Translation and its control in eukaryotes	• Watson 530-535; 556-558	
5/30	Discussion, week 9 (GE: Julia Ngo) -Techniques: ChIP and ChIP-sequencing -Work on problems		
5/31			**Problem Set 5 due @ noon**
6/4	Transposable Elements	• Watson 393-398; 403-405; 406-410	
6/6	Control of gene expression by small RNAs: RNAi and microRNAs	• Watson 711-726	
6/6	Discussion, week 10 (GE: Elizabeth Vargas) - Work on problems - Final exam review		
6/7			**Problem Set 6 due @ noon**
6/12	**8:00 Wednesday, FINAL EXAM (cumulative…ish)***		

***Early exams will not be given under any circumstances**, schedule travel plans for **after** all of your finals.

Due dates BI 320, S19: all assigned work is due at the beginning of the lecture or discussion unless otherwise stated.

April

Monday	Tuesday	Wednesday	Thursday	Friday
1	2 Introduction Video 1	3	4 Video 2 Diversity in STEM paper (2%)	5
8	9 Videos 3 and 4	10	11 Video 5	12 Group Work Sheet (1%) and **Problem Set 1 (3%) due at noon**
15	16 **Quiz* (10%)**	17	18 Videos 6 and 7	19
22	23	24	25	26 **Problem Set 2 (3%) due at noon**
29	30	1	2	3 Problem Set 3 (3%) due at noon

May

Monday	Tuesday	Wednesday	Thursday	Friday
29	30	1	2	3 **Problem Set 3 (3%) due at noon**
6	7 Video 8	8	9 Video 9	10
13	14 **Midterm* (26%)**	15	16 Video 10	17
20	21 **Problem Set 4 (3%) due at noon**	22	23 Video 11 **Quiz on Midterm (extra credit)**	24
27	28	29	30	31 **Problem Set 5 (3%) due at noon**

June

Monday	Tuesday	Wednesday	Thursday	Friday
3	4	5	6	7 **Problem Set 6 (3%) due at noon**
10	11	12 **Final* at 8:00am (36%)**	13	14

***Early exams will not be given under any circumstances**, schedule travel plans for **after** all of your finals.