BI 320, MOLECULAR GENETICS
Fall 2019

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Lectures are Tuesdays and Thursdays, 10:00-11:20 in 221 MCK.
Discussion sections are Fridays at 1:00, 2:00, and 3:00 in 129 HUE

BI 320 is a 4 credit advanced undergraduate course covering gene expression and gene regulation in both prokaryotic and eukaryotic organisms. This course satisfies the area I requirement of the BI major and serves as a prerequisite for many 400 level biology courses. For a full list of BI courses and prereqs please see the Biology, Marine Biology, and General Science Advising center in KLA 65 or the UO online catalog at: http://uocatalog.uoregon.edu/arts_sciences/biology/#courseinventory The course has been designed with the assumption that students enter with a solid grasp of the material presented in its prerequisite, BI 282H/BI 214 and with a rudimentary 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 nature of the genetic mechanisms that enable organisms to respond to changes in their environment.

There is a real likelihood that you will have a job in 10 years that doesn't yet exist. Similarly, our understanding of genetics will certainly be different in 10 years from the content you will learn in this course. Because of this, this class will endeavor to develop not only content knowledge but also transferable skills which will serve you even when the content you apply them to changes. You will be asked to use the course content to answer critical reasoning questions and to model regulatory systems. There is an emphasis on data interpretation and problem solving. You will be expected to work on several projects and problem sets in preassigned groups lasting the duration of the term. Actively reflecting on how your group functions, troubleshooting points of contention, and deliberately striving to maintain a productive group dynamic are an integral part of the course. These skills are vital to most STEM and non-STEM careers and providing the opportunity to practice them is a major learning objective of the course. This course also includes a self-reflective component intended to explore the benefits of a diverse and inclusive scientific community. While this component is not solely related to the field of genetics it is critical to the healthy future of STEM.

Major Learning Objectives:

In this class you will:

- Complete work in preassigned term-long groups, allowing you to practice actively reflecting on how your group functions, troubleshooting points of contention, and deliberately striving to maintain a productive group dynamic.
- Be able to articulate how your personal identity and/or background relates to your interest in science.
- Be able to illustrate prokaryotic and eukaryotic gene architecture and how it relates to regulation of gene expression. Be able to explain the similarities and differences between the gene architecture of proks and euks along with the consequences on expression regulation.
- Be able to explain the differences between coordinate regulation of gene expression in Proks and Euks
- Be able to interpret data from commonly used genetic techniques and recognize the applications and limitations of these techniques.
- Be able to use
    - Your understanding of genetics to propose hypotheses for the mechanisms for gene regulation and…
    - 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.

Miles Kington — '*Knowledge is knowing* that a *tomato is a fruit, wisdom is not putting it in a fruit salad*.'
In this class we will endeavor to gain both knowledge and wisdom regarding genetics

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: Marked up lecture slides, with additional notes, will be posted on Canvas **after** each lecture. You are *required* to attend lectures and discussion section each week. Discussion sessions will be used to present projects, 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. For the most part, this content will be additional to lecture and discussion, and not just review. Do not wait until just before assessment deadlines (i.e. just before canvas question due dates) 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 flavors:

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, there might be something you don't know in there… that said, you can watch them at 1.5 X speed if you want (2 X is hard to understand).
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,* 6th or 7th editions (Watson et al.) readings for both editions 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 below distributions. Please make note of the due dates, if you have a conflict let me know during the first week of class, last minute accommodations for missing class will not be made:

Assignment	**% of final grade**	**Due date (non-transferable)**
Participation: Clickers / on time attendance	6%	every lecture day
Problem Sets (6 @ 2pt each)	12%	see schedule
Week End Canvas Questions (9 @ 1pt each, drop one)	8%	see schedule
Importance of Diversity in Science (short paper)	3%	10/4
Group Work Assignment	1%	10/11
Operon Project	3%	10/25
Paper Project	3%	12/6
Study Journal	2%	12/9
Midterm	26%	**10/31**
Quiz over midterm material	extra credit on midterm	11/8
Final Exam	36%	**12/9**

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

Participation (6%): Clickers / on time attendance:
This component of the grade is worth 6% 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 in this class 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 necessarily 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 (12%): 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.** They will be turned in at the BEGINING of lecture on the day they are due. **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!** *GTF will not provide detailed written feedback so please check the answer key for details about the answers.*

Week End Canvas Questions (8%): Most weeks you will need to complete a set of questions administered through Canvas. These sets will be due on Friday afternoons but you are encouraged to complete them sooner in case you experience technical difficulties or they just take longer then you thought they would. You will not be given an extension on due dates because of technical problems unless the entire class is affected. There will be 9 sets each worth 1% of your course grade, your lowest set grade will be dropped.

Feedback Questions: these questions will ask for feedback on aspects of the course (these questions will not be graded for accuracy, but you do need to answer them or you will lose points on the set.
Graded Questions: these questions will explore content covered in the videos and in lecture and will be graded.

Projects (12%): You will do 5 project assignments in this class. Additional information about these projects will be provided in discussion and through Canvas.

Importance of Diversity in Science (short paper): A self-reflection on how your background influences your scientific interests (due at the beginning of the first discussion) (3% of course grade)
Group Work Assignment: Worksheet that discusses constructive and destructive group behaviors and the stages of team formation. (due at the beginning of the second discussion) (1% of course grade)
Operon Model Project: group project designing models to represent the lac and trp operons (operon show-and-tell will be in discussion during week 4) (3% of course grade)
Paper Project: encourages you to further investigate class content you found interesting (paper project show-and-tell will be during the last discussion section of the term) (3% of course grade).
Study Journal: During the term you should be keeping a journal of your engagement in this class. Document when you study and by doing what (watching video, reading textbook, going over class notes, working on problem set alone, working on set with my group, answering canvas questions). (This journal will be checked for entries at the end of each week in discussion and turned in right before the final exam) (2% of course grade)

Quizzes (extra credit on midterm): The quiz will cover content from the midterm and will be given during discussion week 6. You will not be allowed notes during the quiz.

Exams (62%): Exams will be closed book. **However, you may bring one page of notes (hand written on both sides) + a printed sheet that you will be given in lecture, which can also have hand written notes on it to the midterm exam, and two pages of hand written notes to the final exam.**
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.

Midterm (26%): The midterm will be on 10/31 in lecture. If you take your exams through the accessible education center you must sign up at least a week in advance. Last minute accommodations will not be made (except under extreme, unforeseeable, circumstances).

Final (36%): The Final for this class is scheduled for 8:00 Monday, December 9. If you take your exams through the accessible education center you must sign up at least a week in advance. Last minute accommodations will not be made (except under extreme, unforeseeable, circumstances).

Academic Honesty: (See https://dos.uoregon.edu/academic-misconduct for more information)
The University Student Conduct Code (available at conduct.uoregon.edu) defines academic misconduct. Students are prohibited from committing or attempting to commit any act that constitutes academic misconduct. 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. If there is any question about whether an act constitutes academic misconduct, it is the students' obligation to clarify the question with the instructor before committing or attempting to commit the act. Additional information about a common form of academic misconduct, plagiarism, is available at https://researchguides.uoregon.edu/citing-plagiarism.

Accessible Education - (see https://aec.uoregon.edu/best-practices-faculty for more information)
The University of Oregon is working to create inclusive learning environments. Please notify me if there are aspects of the instruction or design of this course that result in disability-related barriers to your participation. You are also encouraged to contact the Accessible Education Center in 360 Oregon Hall at 541-346-1155 or uoaec@uoregon.edu.

Inclement Weather
It is generally expected that class will meet unless the University is officially closed for inclement weather. If it becomes necessary to cancel class while the University remains open, this will be announced on Canvas and by email. Updates on inclement weather and closure are also communicated in other ways described here: https://hr.uoregon.edu/about-hr/campus-notifications/inclement-weather/inclement-weather-immediate-updates

I am a Student-Directed Employee: For information about my reporting obligations as an employee, please see Employee Reporting Obligations on the Office of Investigations and Civil Rights Compliance (OICRC) website. Students experiencing any form of prohibited discrimination or harassment, including sex or gender-based violence, may seek information and resources at safe.uoregon.edu, respect.uoregon.edu, or investigations.uoregon.edu or contact the non-confidential Title IX office/Office of Civil Rights Compliance (541-346-3123), or Dean of Students offices (541-346-3216), or call the 24-7 hotline 541-346-SAFE for help. I am also a mandatory reporter of child abuse. Please find more information at Mandatory Reporting of Child Abuse and Neglect.

Tentative Course Outline:

Text: Molecular Biology of the Gene, 6th & 7th ed, Watson et al. Abbreviated as "Watson" below.

Other readings are *italicized* below and can be downloaded from Canvas.

Date	**Topic (Concepts)**	Reading 6th ed	Reading 7th ed	Due dates
10/1	-Overview of Course Themes (video) -Types of mutations	• *Hartwell 221-224* • Watson 794	• *Hartwell 221-224* • Watson 807-808	-Watch video 1 before class
10/3	-Prokaryotic genome organization (video) -Transcription initiation (cis elements and trans factors).	• *Hartwell 487-493* • Watson 136-140; 377-394	• *Hartwell 487-493* • Watson 200-204; 429-445	-Watch video 2 before class
10/4	Discussion, week 1 -Discuss papers and meet assigned group members. Exchange contact info, schedule out-of-class study time with your group.			-Importance of Diversity In Stem paper. -Canvas Set 1 due at 6pm
10/8	-Techniques: How to tell if a protein binds to DNA/RNA? PCR, gel mobility shift assays, DNA footprinting, (videos) -A closer look at the promoter and how mutational analysis can be used to identify it -Prokaryotic Termination and palindromic sequences	• Watson 739-741; 751-752; 775-780 • Watson 547-552; 563 • Watson 394-396	• Watson 147-149; 158; 182-187 • Watson 615-620 • Watson 445-447	-Watch videos 3 & 4 before class
10/10	- Techniques: restriction enzymes, Southern blots (DNA fingerprinting), northern blots, western blots (video) -Positive and negative control of transcription initiation in prokaryotes: *lac* operon. (Dyad symmetry, allostery, cis/trans test)	• Watson 742-745; 768-769 • Watson 553-562	• Watson 149-153; 176-177 • Watson 620-629	-Watch video 5 before class
10/11	Discussion, week 2 -discuss operon projects, and work on problems.			-Group work assignment due -Canvas Set 2 due at 6pm
10/15	-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 458-460; 464-466; 469-475 (optional) • Watson 739-743; 751-752; 776-778	• Watson 510-512; 515-525 (optional) • Watson 147-151; 158-159; 183-185	Watch video 6 before class **Problem Set 1 due @ 10am**
10/17	-Transcriptional attenuation: Interplay of translation and transcription in the *trp* operon (feedback inhibition of gene expression, RNA structure/function)	•Watson 638-640	•Watson 707-708	
10/18	Discussion, week 3 -Trp operon conclusion/review (video) - Work on operon models			Watch video 7 before class -Canvas Set 3 due at 6pm
10/22	-Phage Lambda: paradigm for a genetic switch (Regulatory cascade, antitermination)	•*Williams, Science* • Watson 568-582	•*Williams, Science* • Watson 635-648	**Problem Set 2 due @ 10am**
10/24	Phage Lambda continued. (Stochasticism, positive autoregulation, cooperativity) Translational control in prokaryotes, Riboswitches (translational control, more RNA-mediated feedback regulation)	• Watson 582-584; 479-481; 503-508 • Watson 633-637	• Watson 648-652; 528-530; 549-555 • Watson 701-706	
10/25	Discussion, week 4 - Operon Model show and tell			-Canvas Set 4 due at 6pm
10/29	Finish up Prok translational control			**Problem Set 3 due @ 10am**

10/31	**MIDTERM: Prokaryotic genetics***			
11/1	Discussion, week 5 -Review midterms with your group, and other groups			-Canvas Set 5 due at 6pm
11/5	-Eukaryotic genome architecture (video) -Transcription in eukaryotes: general transcription factors, RNA polymerase recruitment	• Watson 140-144; • Watson 396-406	• Watson 204-208; • Watson 448-457	Watch video 8 <u>before class</u>
11/7	-Techniques: DNA sequencing, High throughput sequencing (video) -Transcription in eukaryotes: Gal regulon in yeast; steroid hormone response in animals (Specific transcription factors, Promoter proximal elements, enhancers, insulators)	• Watson 753-764 • Watson 589-598; 605-610; 618-620 • *Lodish 392-396*	• Watson 159-168 • Watson 657-666; 675-679; 686-687. • *Lodish 392-396*	Watch video 9 <u>before class</u>
11/8	Discussion, week 6 **Quiz on Exam**			**Quiz on Exam** -Canvas Set 6 due at 6pm
11/12	-Techniques: Establishment of distinct patterns of gene expression in different cells of multicellular organisms: Enhancer traps (video) Techniques: Modular organization of transcription factors: Yeast 2-hybrid assay (video) -Genome packaging and Influence of chromatin structure on transcription (chromatin organization and modification)	• Watson p. 594; 661-664 • Watson 156-165; 169-173;	• Watson p. 664; 733-736 • Watson 219-236;	Watch video 10 <u>before class</u>
11/14	-Genome packaging and Influence of chromatin structure on transcription (X-chromosome inactivation, DNA and histone modifications, Genomic imprinting)	• Watson 174-187; 657; 624-626	• Watson 236-249; 728-729; 692-693	
11/15	Discussion, week 7 Work problems (enhancer trap problem from video)			-Canvas Set 7 due at 6pm
11/19	-mRNA processing in eukaryotes (5' cap, splicing, polyadenylation) (video), - Regulation of mRNA processing in eukaryotes Intro to sex determination in *Drosophila*	• Watson 406-411; 415-425; 430-431 • Watson 432-435; 439-445	• Watson 457-462; 467-478; 480-482 • Watson 483-487; 491-496	**Prob Set 4 due @ 10am** Watch video 11 <u>before class</u>
11/21	alternative splicing, *Drosophila* sex determination continued			
11/22	Discussion, week 8 Work on problems			-Canvas Set 8 due at 6pm
11/26	Translation and its control in eukaryotes	• Watson 482-487; 508-512	• Watson 530-535; 556-558	**Prob Set 5 due @ 10am**
11/28 **11/29**	Thanksgiving break			
12/3	Transposable Elements	• Watson 334-342; 347-351; 354-357	• Watson 393-398; 403-405; 406-410	
12/5	Control of gene expression by small RNAs: RNAi and microRNAs	• Watson 641-655	• Watson 711-726	
12/6	Discussion, week 10 - Paper project show and tell			**Prob Set 6 due in discussion** -Canvas Set 9 due at 6pm
12/9	**8:00 Monday, FINAL EXAM (cumulative…ish)***			

*__Early exams will not be given under any circumstances__, schedule travel plans for __after__ all your finals.

Due dates BI 320, F19: all assigned work is due at the beginning of the lecture or discussion unless otherwise stated.

October (10)

Monday	Tuesday	Wednesday	Thursday	Friday
30	1 Introduction Video 1	2	3 Video 2	4 Bring schedule & first paper (3%) Canvas Set (CS) 1 due at 6pm (1%)
7	8 Videos 3 and 4	9	10 Video 5	11 Group Work (1%) CS 2 at 6pm (1%)
14	15 Video 6 PS 1 @ 10am (2%)	16	17	18 Video 7 CS 3 at 6pm (1%)
21	22 PS 2 @ 10am (2%)	23	24	25 Operon (3%) CS 4 at 6pm (1%)
28	29 Video crisper PS 3 @ 10am (2%)	30	31 Midterm (26%)*	1 CS 5 at 6pm (1%)

November (11)

Monday	Tuesday	Wednesday	Thursday	Friday
4	5 Video 8	6	7 Video 9	8 Midterm Quiz (extra credit) CS 6 at 6pm (1%)
11	12 Video 10	13	14	15 CS 7 at 6pm (1%)
18	19 Video 11 PS 4 @ 10am (2%)	20	21	22 CS 8 at 6pm (1%)
25	26 PS 5 @ 10am (2%)	27	28 Thanksgiving	29 Thanksgiving

December (12)

Monday	Tuesday	Wednesday	Thursday	Friday
2	3	4	5	6 Paper (3%) PS 6 in discussion (2%) CS 9 at 6pm (1%)
9 Final @ 8:00 (36%)* Study Journal (2%)	10	11	12	13