BI 320, MOLECULAR GENETICS
Summer 2018

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Office hours: this course has a built in hour of problem solving time every day M-F, this time also corresponds to office hours.

BI320 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 solid grasp of the material presented in BI 252/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. The course will focus on the experimental approaches that have been used with several model organisms whose properties make them especially well-suited for genetically-based studies. We will discuss how fundamental principles were established with these model organisms, and how these principles and approaches apply to more complex creatures.

Course Canvas Site

The UO Canvas Site will be used to distribute reading material, lecture notes, problem sets, answer keys, and other information for the class. Please familiarize yourself with the site. You can access Canvas student training videos at: https://canvas.uoregon.edu/courses/26168 . Download and print the lecture figures and readings, and consult it frequently for announcements and updates.

Format and attendance

Lectures are Monday through Friday from 10am to 1pm in **KLA 21**. Marked up lecture slides will be posted on Canvas **after** each lecture. You are *required* to attend every lecture. **If you miss the first lecture you will be dropped from the class.** 5% points will be deducted from your final grade for every lecture you miss (missing at least 20 min of class counts as a missed class) and 2% will be deducted for every lecture to which you are more than 5 min late (or for which you leave early)

Assigned Reading

Assigned readings will come from two sources.

> **(1) Textbook.** *Molecular Biology of the Gene,* 6th or 7th editions (Watson et al.) is the text for the course. It is available for purchase at the UO Bookstore, and two copies have been placed on reserve in the Science Library.
>
> **(2) 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 and are REQUIRED reading.

Grading Policy

The final course grade will be calculated according to the following distribution with the exceptions that 5% points will be deducted from your final grade for every class you miss (missing at least 20 min of class counts as a missed class) and 2% will be deducted for every class to which you are more than 5min late or for which you leave early:

Assignments	% of total grade	Due dates
Clickers	6%	
Video quiz (1% each)	4%	6/26, 6/27, 6/29, 7/13
Problem Sets (2% each)	8%	7/2, 7/9, 7/16, 7/20
Quizzes (5% each)	10%	7/2, 7/16
Operon Project	3%	7/6
Paper project	3%	7/19
Midterm	30%	7/9
Final Exam	36%	7/20

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

Clickers (6%):
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. This component of the grade will require participation on clicker questions. To get full credit for this 8% you need to arrive to class ON TIME and attempt all of the clicker questions. Most clicker questions will be graded on participation, not accuracy, but there may be 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.

Videos and Video quizzes (4%):
You will be asked to watch several pre-class videos (the first one needs to be watched before the first lecture). Some of these videos contain review content from prerequisite courses, and others contain new content. You are responsible for all video content, it will be represented in the homework, on quizzes and on exams. In most cases, the day a video is due, there will be a quiz on the video content at the beginning of class, this quiz is closed book and individual (you cannot work in groups to answer the questions). Each quiz is worth 1% of your final course grade.

Problem Sets (8%):
4 problem sets will be assigned during the term; these can be accessed on Canvas. The problem sets serve to reinforce the material covered in the lectures and reading, and will help you explore its ramifications and applications. Each set will have approximately six problems; You will work on these problems in pre-assigned groups. *Each group will turn in one set.* **Working together to make sure everyone in the group understands the solutions will provide the best preparation for the exams and quizzes.**

The first 3 Problem set will be due on Monday's at the beginning of class. The last problem set will be due right before the Final is given. **Answers must be clearly written and should be concise. Late problem sets will not be accepted**. Answer keys will be posted on Canvas on Mondays. Each group will turn in one problem set. To make sure that grade calculations for the problem set reflect the understanding <u>of the group</u>, problem set grades will be determined as follows: All members of a group will have the exact same problem set grades

- ½ of each grade will reflect the performance on one question (which I will select) from the set turned in by each group.
- The other half will be determined by performance on a single problem set question administered during one of the 4 exams/quizzes. The grade will reflect the second lowest individual score on this question. Because of this, it is in your best interest to make sure everyone in your group understands the problem sets.

Quizzes (10%):
There will be 2 quizzes. These are different from the video quizzes in that they cover all class material (including material from the videos) and they are worth 5% points each. You will not be allowed notes during quizzes, unless otherwise instructed. The first will be on the second Monday of class and the second will be on the Monday of the last week of class.

Projects (6%):
You will do two projects in this class, an operon model project, and a paper project each of these will be worth 3% of your grade. More information about these projects will be posted on the course Canvas site.

Exams (66%):
There will be one midterm exam (30%) and a final exam (36%). All exams will be closed book. **However, you may bring one page of notes (hand written on both sides) to the midterm exam and two such pages to the final exam.** The emphasis will be on testing your understanding of the concepts, not your ability to memorize facts.

The Final for this class is scheduled for Friday, 7/20. Schedule travel plans accordingly. **EARLY EXAMS WILL NOT BE GIVEN UNDER ANY CIRCUMSTANCES!**

If you feel that you have been graded unfairly, you should 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.

Academic Honesty

Academic dishonesty includes various forms of "cheating" (e.g. copying another person's answers to exam questions, altering your exam for a regrade, adding your name to a problem set to which you contributed no work or copying problem set answers from other students or from previous years keys etc.) and will not be tolerated. For the definition of cheating and its penalties, consult the University of Oregon 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

Course Topic Outline: BI 320 Summer
Because of the condensed format of the class we might need to make adjustments to when content is presented.
Text: Molecular Biology of the Gene, 6th or 7th ed, Watson et al. Abbreviated as "Watson".
Other readings are *italicized* below and can be downloaded from Canvas.

Topic (Concepts)	Reading: Watson 6th ed	Reading: Watson 7th ed
Week 1		
Before Monday's class: Video 1: Overview of Course Themes, protein structure/function	• Watson 136-140 • *Hartwell 487-493*	• Watson 200-204 • *Hartwell 487-493*
Monday: Types of mutations, Bacterial RNA polymerase Transcription initiation promoter recognition	• Watson 377-383 • *Hartwell 221-224* • Watson 383-396; 563	• Watson 429-434 • *Hartwell 221-224* • Watson 434-447; 630
Before Tuesday's class: Video 2: Prokaryotic genome organization. DNA Footprinting Video	• Watson 794	• Watson 807-808
Tuesday: The bacterial promoter, techniques: PCR, gel mobility shift assays, DNA footprinting, consensus sequences, mutational analysis (Second-site suppressors, genetic screens and selections)	• Watson 751-752; 739-743; 776-778	• Watson 158-159; 147-151; 183-185
Before Wednesday's class: Video 3: Dyad symmetry, intrinsic terminators, transcriptional termination	• Watson 394-396	• Watson 445-447
Wednesday: - techniques: restriction enzymes, cloning, .Southern blots (DNA fingerprinting), northern blots, western blots Positive and negative control of transcription initiation in prokaryotes: *lac* operon. (Dyad symmetry, allostery, cis/trans test, Combinatorial control, dominant negative alleles, redundancy)	• Watson 739-750; 768-769 • Watson 547-562	• Watson 147-157; 176-177 • Watson 615-629
Thursday: Positive and negative control of transcription initiation in prokaryotes: Arabinose operon (Negative autoregulation, DNA "looping")	• Watson 567-568 • *Weaver 193-197*	• Watson 634 • *Weaver 193-197*
Before Friday's class: Video 4: translation in Bacteria	• Watson 458-460; 464-466; 469-475 (optional review of translation)	• Watson 510-512; 515-525 (optional review of translation)
Friday: Transcriptional attenuation: Interplay of translation and transcription in the *trp* operon (feedback inhibition of gene expression, RNA structure/function) Review video: trp operon attenuation	•Watson 638-640	•Watson 707-708
Week 2		
Monday: Phage Lambda: paradigm for a genetic switch (Regulatory cascade, antitermination, stochasticism, positive autoregulation, cooperativity)	•*Williams, Science* • Watson 568-582	•*Williams, Science* • Watson 635-648
Tuesday: Phage Lambda continued. Translational control in prokaryotes (RNA-mediated feedback regulation)	• Watson 582-584 • Watson 479-481; 503-508	• Watson 648-652 • Watson 528-530; 549-555

Wednesday: 4th of July holiday, no class		
Thursday: Riboswitches, Crisper Cas9, other interesting things	• Watson 633-640 • *Mali et al: CRISPR cas9 2013*	• Watson 701-711 • *Mali et al: CRISPR cas9 2013*
Friday: Eukaryotic genome organization and packaging (genome complexity, chromatin organization) Transcription in eukaryotes: cis elements: core promoter elements; trans factors: RNA polymerase holoenzyme, General transcription factors	• Watson 140-144; 156-165; 169-173 • Watson 396-406	• Watson 204-208; 219-236 • Watson 448-457
Week 3		
Monday: midterm exam		
Tuesday: Transcription in eukaryotes continued: cis elements: PPE, enhancers, insulators; trans factors: specific transcription factors, mediator complex. Control of transcription in eukaryotes: Gal regulon in yeast; steroid hormone response in animals	• Watson 589-598; 605-610; 618-620. • *Lodish 392-396*	• Watson 657-666; 675-679; 686-687. • *Lodish 392-396*
Wednesday: techniques: - Establishment of distinct patterns of gene expression in different cells of multicellular organisms: Enhancer traps - Modular organization of transcription factors: Yeast 2-hybrid assay -co-immunoprecipitation DNA packaging in Eukaryotes	• Watson p. 594; 661-664	• Watson p. 664; 733-736
Thursday: Influence of chromatin structure on transcription (X-chromosome inactivation, DNA and histone modifications, Gal regulon, retinoblastoma regulation, genomic imprinting)	• Watson 174-187; 657; 624-626	• Watson 236-249; 728-729; 692-693
Before Friday's class: Video 5: mRNA processing in eukaryotes (5' cap, splicing, polyadenylation)	• Watson 406-410; 415-425	• Watson 457-462; 467-477
Friday: Regulation of mRNA processing in eukaryotes (alternative splicing, Drosophila sex determination)	• Watson 430-435; 439-445	• Watson 480-487; 491-496
Week 4		
Monday: Alternative processing continued, Translation and its control in eukaryotes	• Watson 482-487; 508-512	• Watson 530-535; 556-558
Tuesday: Transposable Elements Start control of gene expression by small RNAs	• Watson 334-342; 347-351; 354-357	• Watson 393-398; 403-405; 406-410
Wednesday: Control of gene expression by small RNAs: RNAi and microRNAs - techniques: DNA sequencing, High throughput sequencing	• Watson 641-655 • Watson 753-764	• Watson 711-726 • Watson 159-168
Thursday: paper project and review and/or catch up		
Friday: final exam		

Due dates BI 320, U18:

June (6)

Monday	**Tuesday**	**Wednesday**	**Thursday**	**Friday**
25 Class starts **Watch video 1 before the start of class**	26 Video 2 quiz **Watch video 2 and DNA Footprinting Video before the start of class**	27 Video 3 quiz **Watch video 3 before the start of class**	28	29 Video 4 quiz **Watch video 4 before the start of class**

July (7)

Monday	**Tuesday**	**Wednesday**	**Thursday**	**Friday**
2 Quiz 1 (4%) PS 1 (2%)	3	4 Holiday, no class	5	6 Operon (3%)
9 Midterm (30%) PS 2 (2%)	10	11	12	13 Video 5 quiz **Watch video 5 before the start of class**
16 Quiz 2 (4%) PS 3 (2%)	17	18	19 Paper (3%)	20 Final (40%) PS 4 (2%)
23	24	25	26	27