BI 320, MOLECULAR GENETICS
Summer 2016

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Office hours: this course has a build in hour of problem solving time every day M-R, 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

Lectures are on Monday and Thursdays from 10:00 to 12:50 and on Tuesdays and Wednesday, from 10:00 to 1:50 in **KLA 21**. Marked up lecture slides will be posted on Canvas **after** each lecture. You are *required* to attend every lecture. 3% 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 1% will be deducted for every lecture to which you are more than 5 min late (or for which you leave early)

The final exam will be on Friday July 15th from 10 to 12:50, see below for details.

I-Clickers

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.

Assigned Reading

Assigned readings will come from three 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.

(3) Research articles. We will discuss several original research articles, which can be downloaded from the course Canvas site. An important goal of this course is to help you appreciate the process and excitement of genetic research rather than simply memorizing the current state of knowledge. These papers offer you the opportunity to become acquainted with experimental design and methods used in molecular genetics research. On exams and problem sets you will sometimes be asked to use what you have learned to develop your own hypotheses and experimental strategies for testing them.

Problem Sets

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.

Exams and Quizzes

There will be one midterm exam and a final exam. All exams and quizes 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.** You will not be allowed notes during quizzes, unless otherwise instructed. 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.

The emphasis will be on testing your understanding of the concepts, not your ability to memorize facts. If you feel that you have been graded unfairly, you should submit your reasoning to me <u>in writing,</u> 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.

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

Grading Policy

The final course grade will be calculated according to the following distribution with the exceptions that 3% 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 1% 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	8%	
Problem Sets (2% each)	8%	6/27, 7/5, 7/11, 7/15
Quizzes (4% each)	8%	6/27, 7/11
Operon Project	3%	6/30
Paper project	3%	7/14
Midterm	30%	7/5
Final Exam	40%	7/15

Final: The Final for this class is scheduled for Friday, 7/15. Schedule travel plans accordingly. **EARLY EXAMS WILL NOT BE GIVEN UNDER ANY CIRCUMSTANCES!**

Midterm: The Midterm will be on Monday 7/5. 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).

Quizzes: There will be 2 quizzes. The first will be on the second Monday of class and the second will be on the Monday of the last week of class.

Clickers: 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. You may be asked to watch pre-class videos (like before the first day of class), if you do not watch these when they are assigned points will be deducted from your i-clicker score.

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 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 U16

Because of the condensed format of the class, content is not split up into individual days, please use class content to inform you on which reading is appropriate.

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
Overview of Course Themes Types of mutations Prokaryotic genome organization and transcription. (Second-site suppressors, protein structure/function)	• *Hartwell 487-493* • *Hartwell 221-224* • Watson 136-140 • Watson 377-383 • Watson 794	• *Hartwell 487-493* • *Hartwell 221-224* • Watson 200-204 • Watson 429-434 • Watson 807-808
Positive and negative control of transcription initiation in prokaryotes: *lac* operon. (Dyad symmetry, allostery, cis/trans test, Combinatorial control, dominant negative alleles, redundancy)	• Watson 383-396; 563 • Watson 547-526	• Watson 434-447; 630 • Watson 615-629
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*
- techniques: PCR, restriction enzymes, gel mobility shift assays, DNA footprinting	• Watson 739-743; 751-752; 776-778	• Watson 147-151; 158-159; 183-185
- More tools: Southern blots (DNA fingerprinting), northern blots, western blots, cloning, blue white screening	• Watson 743-750; 768-769	• Watson 151-157; 176-177
Transcriptional attenuation: Interplay of translation and transcription in the *trp* operon (feedback inhibition of gene expression, RNA structure/function)	• Watson 458-460; 464-466; 469-475 (optional review of translation) •Watson 638-640	• Watson 510-512; 515-525 (optional review of translation) •Watson 707-708
- Williams paper discussion	•*Williams, Science*	•*Williams, Science*
Phage Lambda: paradigm for a genetic switch (Regulatory cascade, antitermination)	• Watson 568-582	• Watson 635-648
Phage Lambda continued. (Stochasticism, positive autoregulation, cooperativity)	• Watson 582-584	• Watson 648-652
Translational control in prokaryotes Riboswitches (translational control, more RNA-mediated feedback regulation)	• Watson 479-481; 503-508 • Watson 633-637	• Watson 528-530; 549-555 • Watson 701-706
Eukaryotic genome organization and packaging (genome complexity, chromatin organization)	• Watson 140-144; 156-165; 169-173	• Watson 204-208; 219-236
-DNA sequencing, High throughput sequencing	• Watson 753-764	• Watson 159-168
Transcription in eukaryotes (general vs specific transcription factors, RNA polymerase recruitment, enhancers)	• Watson 396-406	• Watson 448-457
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*
Influence of chromatin structure on transcription (X-chromosome inactivation, DNA and histone modifications)	• Watson 174-187; 657; 624-626	• Watson 236-249; 728-729; 692-693
mRNA processing in eukaryotes (5' cap, splicing, polyadenylation)	• Watson 406-410; 415-425	• Watson 457-462; 467-477
-Modular organization of transcription factors: Yeast 2-hybrid assay - Establishment of distinct patterns of gene expression in different cells of multicellular organisms	• Watson p. 594; 661-664	• Watson p. 664; 733-736
Regulation of mRNA processing in eukaryotes (alternative splicing, Drosophila sex determination)	• Watson 430-435; 439-445	• Watson 480-487; 491-496
Translation and its control in eukaryotes	• Watson 482-487; 508-512	• Watson 530-535; 556-558
-Epigenetic silencing of tumor suppressor genes in cancer	• *Lodish 1063-1069* • *Merlo et al, Nat. Medicine*	• *Lodish 1063-1069* • *Merlo et al, Nat. Medicine*
Transposable Elements	• Watson 334-342; 347-351; 354-357	• Watson 393-398; 403-405; 406-410
Control of gene expression by small RNAs: RNAi and microRNAs	• Watson 641-655	• Watson 711-726

Due dates BI 320, U16:

June (6)

Monday	Tuesday	Wednesday	Thursday	Friday
		1	2	3
6	7	8	9	10
13	14	15	16	17
20 Class starts	21	22	23	24
27 Quiz 1 (4%) PS 1 (2%)	28	29	30 Operon (3%)	

July (7)

Monday	Tuesday	Wednesday	Thursday	Friday
				1
4	5 Midterm (30%) PS 2 (2%)	6	7	8
11 Quiz 2 (4%) PS 3 (2%)	12	13	14 Paper (3%)	15 Final (40%) PS 4 (2%)
18	19	20	21	22