BI 320, Molecular Genetics  
Spring 2017

**General Course Information**

**Instructor:**  
Dr. Leslie Coonrod  
115 Huestis  
lvos@uoregon.edu

**Teaching Assistant:**  
Dr. Rachel Rodman  
73 KLA  
rrodman@uoregon.edu

**BTU:**  
Natalie Pellitier  
npellit3@uoregon.edu

**Office hours:**  
Tuesday and Thursday  
2:30 PM in 32 KLA

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<tr>
<th>Office hours:</th>
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<tr>
<td>Tuesday and Thursday</td>
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<td>Tuesday, 5 PM and Friday,</td>
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<tr>
<td>2:30 PM in 32 KLA</td>
<td>1:30 PM in 360 Onyx</td>
<td>11 AM in B009 Sci library</td>
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For email, please use BI 320 in the subject header

**Class meetings:**

**Lecture:**  
T, H  
10:00 – 11:20 AM  
Straub 145

**Discussions:**  
F  
1:00 – 1:50 PM  
Klamath 21

2:00 – 2:50 PM  
Klamath 21

3:00 – 3:50 PM  
Klamath 21

4:00 – 4:50 PM  
Klamath 21

Lecture slides with notes will be posted on Canvas after lecture. You are required to attend lecture and discussion each week. Discussion sections will be used to introduce new material and to clarify and expand upon material presented in lecture. Material presented in Discussions will be represented on exams.

**Course description:** 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 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. 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.

**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 interpret data from these techniques.

- Use your understanding of
  - Genetics to propose hypotheses for the mechanisms for gene regulation
  - Common genetics 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.
Course Organization

Assigned Readings: Assigned readings for this course will come from three sources:
- Textbook: Molecular Biology of the Gene, 6th or 7th editions (Watson et al.)
- Research articles
- Other texts

Because the text covers several topics rather superficially, assigned readings from a variety of sources are available as PDF files on Canvas. We will discuss several original research articles – these papers offer you the opportunity to become acquainted with experimental design and methods used in molecular genetics research.

Problem Sets: Six 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. For each set you will only turn in the first three problems and only one of these will be graded. You are encouraged to discuss the problems with your classmates and instructors. However, you are expected to write up the answers for the problems in your own words. Working through all the problems as independently as possible will provide the best preparation for the exams and quizzes.

Problem set due dates are indicated on the Syllabus. Answers should be concise. They should be uploaded to Canvas. Late problem sets will not be accepted, no exceptions. Be sure to upload your problem set early enough to correct for any technical difficulties that may arise. The answer keys will be posted on Canvas immediately after they are due. The Problem Sets will be graded by the TA; however, due to the large size of the class, the TA will not be able to provide detailed written feedback so please check the answer key for details about the answers.

Quizzes: There are 3 quizzes. Two quizzes cover content primarily presented in discussion; these will be given during discussion and are worth 5% of your grade each. The remaining quiz will cover content from the midterm and will be given during lecture on 5/18; this quiz is worth 10% of your grade. You will not be allowed notes during quizzes.

Projects: You will do two projects in this class: an operon model project and a paper project. Each project is worth 3% of your grade. More information about these projects will be provided in discussion and through Canvas.

iClickers/attendance: iClickers will be used in this class to review lecture topics and encourage participation. Please bring your iClicker to each lecture and have it ready to use. iClickers 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 consider contributions to discussions in lecture and discussion sections as well as participation in clicker questions. To get full credit, you need to arrive to class ON TIME and 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. No partial credit will be given for participation. You MUST HAVE YOUR CLICKER to receive points for the day – no exceptions! The lowest clicker score will be dropped.
Exams: 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. 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.

**Final:** The Final for this class is scheduled for **Monday, June 12**th at 8:00 AM.

**Midterm:** The Midterm will be on **Thursday, May 4**th.

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).

**Grading policy:** The final grade will be calculated by the distribution below. 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.

<table>
<thead>
<tr>
<th>Assignment</th>
<th>% of final grade</th>
<th>Due date (non-transferable)</th>
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<tbody>
<tr>
<td>Clickers/attendance</td>
<td>6%</td>
<td>Every lecture day</td>
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<tr>
<td>Problem sets</td>
<td>6%</td>
<td>See schedule below</td>
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<tr>
<td>2 regular quizzes</td>
<td>10%</td>
<td>4/21 and 5/26</td>
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<td>Quiz over midterm material</td>
<td>10%</td>
<td>5/18</td>
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<td>Operon project</td>
<td>3%</td>
<td>4/28</td>
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<td>Paper project</td>
<td>3%</td>
<td>6/9</td>
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<tr>
<td>Midterm</td>
<td>26%</td>
<td>5/4</td>
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<tr>
<td>Final Exam</td>
<td>36%</td>
<td>6/12</td>
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**YOU ARE EXPECTED TO KEEP ALL YOUR GRADED WORK UNTIL FINAL GRADES ARE POSTED, TO USE AS DOCUMENTATION SHOULD DISAGREEMENTS ARISE.**
Student Resources

LEARNING ENVIRONMENT: The University of Oregon and myself are working to create inclusive learning environments. Please notify Leslie if there are aspects of the instruction or design of this course that result in disability-related barriers to your participation during the first week of class. Please request that a counselor at the Accessible Education Center send a letter verifying the disability. You are also encouraged to contact the Accessible Education Center (formerly Disability Services) in 164 Oregon Hall at 541-346-1155 or uoaec@uoregon.edu.

STUDENT LIFE: If you need help and are not sure where to go, check out the Office of Student Life. The student life staff is dedicated to helping students have the most successful experience they can while studying at the University of Oregon. The Office of Student Life staff is available to help you find solutions and resources to most issues and concerns on a drop-in basis Monday-Friday, 8:00 a.m.-noon and 1:00-5:00 p.m. In emergencies after hours and on weekends, contact the Department of Public Safety at 346-5444 and have an on-duty staff member paged. The Office of Student Life is located in room 164 Oregon Hall; phone: 346-3216; e-mail: stl@uoregon.edu.

UNIVERISTY OF OREGON CRISIS CENTER: is a student-funded organization that provides students with confidential telephone crisis intervention 24 hours a day, 7 days a week. The hotline number is 346-4488. “Often students believe that their issues are not “severe” enough for them to call a crisis intervention hotline. Here at the Crisis Center, we truly believe that there is no problem too small for us. At one time or another everyone needs a little help through a difficult personal situation.”

DUTY TO REPORT: UO is committed to providing an environment free of all forms of prohibited discrimination and sexual harassment, including sexual assault, domestic and dating violence and gender-based stalking. Any UO employee who becomes aware that such behavior is occurring has a duty to report that information to their supervisor or the Office of Affirmative Action and Equal Opportunity. The UO Health Center and University Counseling and Testing Center can provide assistance and have a greater ability to work confidentially with students. All UO employees are also required to report to appropriate authorities when they have reasonable cause to believe that any child with whom they come in contact has suffered abuse or any person with whom they come in contact has abused a child.

ACADEMIC INTEGRITY: You are expected to do your own work on homework, proposals, and exams. You are encouraged to discuss ideas with each other and to study together, but don’t copy someone else’s work and don’t allow someone else to copy your work. Academic dishonesty includes all forms of “cheating” (e.g. copying another person's answers to exam questions, altering your exam for a regrade, copying problem set answers from other students etc.) and will not be tolerated. All students are expected to conform to the student conduct code (can be found online at http://uodos.uoregon.edu/StudentConductandCommunity Standards/StudentConductCode/tabid/69/Default.aspx); students not in compliance will be brought to the attention of the university.
**Tentative Course Outline: BI 320 Spring 2015**

Text: Molecular Biology of the Gene, 6th or 7th ed, Watson et al, abbreviated as “Watson” below

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

<table>
<thead>
<tr>
<th>Week</th>
<th>Date</th>
<th>Topic (concepts)</th>
<th>Readings</th>
<th>Due dates</th>
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<tbody>
<tr>
<td>1</td>
<td>4/4</td>
<td>Overview of course themes&lt;br&gt;Types of mutations</td>
<td>• Watson 794 (6th ed)&lt;br&gt;• Watson 807-808 (7th ed)&lt;br&gt;• <em>Hartwell</em> 221-224</td>
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<td></td>
<td>4/6</td>
<td>Prokaryotic genome organization and transcription initiation&lt;br&gt;(cis elements and trans factors)</td>
<td>• Watson 136-140 (6th ed)&lt;br&gt;• Watson 200-204 (7th ed)&lt;br&gt;• <em>Hartwell</em> 487-493</td>
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<td>4/7</td>
<td>Discussion&lt;br&gt;• How to tell if a protein binds to DNA/RNA? PCR, EMSA, DNA footprinting&lt;br&gt;• Form groups of 4 for operon model projects, discuss operon project and paper project</td>
<td>• Watson 739-743, 751-752, 776-776 (6th ed)&lt;br&gt;• Watson 147-151, 158-159, 183-185 (7th ed)</td>
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<td>2</td>
<td>4/11</td>
<td>Prokaryotic genome organization and transcription initiation cont’d&lt;br&gt;(methods)</td>
<td>• Watson 547-556, 563 (6th ed)&lt;br&gt;• Watson 615-623, 630 (7th ed)</td>
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<td>4/13</td>
<td>Positive and negative control of transcription initiation in prokaryotes: <em>lac</em> operon&lt;br&gt;(Dyad symmetry, allosterly, cis/trans test)</td>
<td>• Watson 554-562 (6th ed)&lt;br&gt;• Watson 622-629 (7th ed)</td>
<td>Problem Set 1 due</td>
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<td>4/14</td>
<td>Discussion&lt;br&gt;• More tools: restriction enzymes, Southern blots (DNA fingerprinting), northern blots, western blots, cloning, blue/white screening</td>
<td>• Watson 743-750, 768-769 (6th ed)&lt;br&gt;• Watson 151-157, 176-177 (7th ed)</td>
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<td>4/18</td>
<td>Positive and negative control of transcription initiation in prokaryotes: <em>lac</em> operon cont’d and Arabinose operon&lt;br&gt;(Combinatorial control, dominant negative alleles, redundancy, negative autoregulation, DNA “looping”)</td>
<td>• Watson 567-568 (6th ed)&lt;br&gt;• Watson 634 (7th ed)&lt;br&gt;• <em>Weaver</em> 193-197</td>
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<td>4/21</td>
<td>Discussion&lt;br&gt;• Williams paper discussion&lt;br&gt;• Work on operon models, bring <em>lac</em> and <em>ara</em> models</td>
<td>• <em>Williams, Science</em></td>
<td>Quiz: Williams &amp; Techniques</td>
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<td>4/25</td>
<td>Phage Lambda: paradigm for a genetic switch&lt;br&gt;(Regulatory cascade, antitermination)</td>
<td>• Watson 568-582 (6th ed)&lt;br&gt;• Watson 635-648 (7th ed)</td>
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<td>4/27</td>
<td>Phage Lambda cont’d&lt;br&gt;(Stochasticsim, positive regulation, cooperativity)&lt;br&gt;Translational control in prokaryotes, Riboswitches&lt;br&gt;(translational control, more RNA-mediated feedback regulation)</td>
<td>• Watson 582-584, 479-481, 503-508, 633-637 (6th ed)&lt;br&gt;• Watson 648-652, 528-530, 549-555, 701-706 (7th ed)</td>
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<td>4/28</td>
<td>Discussion&lt;br&gt;• Operon model show and tell&lt;br&gt;• Review for midterm</td>
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| 5    | 5/2  | Finish prokaryotic, start Eukaryotic genome organization and transcription (genome complexity, general transcription factors, RNA polymerase recruitment) | • Watson 140-144, 396-406 (6th ed)  
• Watson 204-208, 448-457 (7th ed) | Problem Set 3 due |
|      | 5/4  | MIDTERM: Prokaryotic genetics | | |
|      | 5/5  | Discussion  
• DNA sequencing, high throughput sequencing | • Watson 753-764 (6th ed)  
• Watson 159-168 (7th ed) | |
| 6    | 5/9  | Transcription in eukaryotes cont’d: Gene regulation in yeast; steroid hormone response in animals (Specific transcription factors, Promoter proximal elements, enhancers, insulators) | • Watson 589-598, 605-610, 618-620 (6th ed)  
• Watson 657-666, 675-679, 686-687 (7th ed)  
• Lodish 392-396 | |
|      | 5/11 | Genome packaging and influence of chromatin structure on transcription (chromatin organization and modification) | • Watson 156-165, 169-173 (6th ed)  
• Watson 219-236 (7th ed) | |
|      | 5/12 | Discussion  
• Midterm review OR paper search time | | |
| 7    | 5/16 | Genome packaging and influence of chromatin structure on transcription (X-chromosome inactivation, DNA and histone modifications, genomic imprinting) | • Watson 174-187, 657, 624-626 (6th ed)  
• Watson 236-249, 728-729, 692-692 (7th ed) | Quiz: Exam 1 
Problem Set 4 due |
|      | 5/18 | Examples, transcription through nucleosomes | | |
|      | 5/19 | Discussion  
• Modular organization of transcription factors: Yeast 2-hybrid assay  
• Establishment of distinct patterns of gene expression in different cells of multicellular organisms | • Watson 594, 661-664 (6th ed)  
• Watson 664, 733-736 (7th ed) | |
| 8    | 5/23 | mRNA processing in eukaryotes (5’ cap, splicing, polyadenylation) | • Watson 406-410, 415-425 (6th ed)  
• Watson 457-462, 467-477 (7th ed) | Quiz: Lodish & Merlo |
• Watson 480-487, 491-496 (7th ed) | |
|      | 5/26 | Discussion  
• Epigenetic silencing of tumor suppressor genes in cancer | • Lodish 1063-1069  
• Merlo et al., Nat. Medicine | |
| 9    | 5/30 | Translation and its control in eukaryotes | • Watson 482-482, 508-512 (6th ed)  
• Watson 530-535, 556-558 (7th ed) | Problem Set 5 due |
|      | 6/1  | Transposable elements | • Watson 334-342, 347-351, 354-357 (6th ed)  
• Watson 393-398, 403-405, 406-410 (7th ed) | |
|      | 6/2  | Discussion  
• Work on paper project | | |
| 10   | 6/6  | Transposable elements and control of gene expression by small RNAs | • Watson 641-655 (6th ed)  
• Watson 711-726 (7th ed) | |
|      | 6/8  | Control of gene expression by small RNAs: RNAI and microRNAs | | |
|      | 6/9  | Discussion  
• Paper project show and tell | | Problem Set 6 due |
| Finals | 6/12 | Monday 8:00 AM FINAL EXAM | | |