Bi 320 Molecular Genetics
Spring 2014

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Office hours: Th 11:30-12:30pm in Streisinger Gazebo (3rd floor) & by appt (email me!).

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I will also do my best to answer questions submitted by email.

Logistics:

Lectures:	TuesThurs 10:00-11:20am	Jaqua 101
Discussion:	Fri 9-9:50am	Huestis 111
	Fri 10-10:50am	Huestis 111
	Fri 11-11:50am	Huestis 111
	Fri noon-12:50pm	Huestis 111

Course description

Bi320 is an advanced undergraduate course on how gene expression is regulated in both prokaryotic and eukaryotic organisms. Single-celled organisms selectively activate or repress expression of particular genes in response to changes in their environment. Cells in multicellular organisms selectively activate or repress expression of particular genes depending on the cells' specialized functions within the whole organism. Bi320 will focus on the molecular and genetic approaches that have been used to dissect specific examples of regulated gene expression. We will discuss the fundamental principles that can be derived from such analyses, and students will learn how to apply these approaches to new situations. The course has been designed with the assumption that students enter with a solid grasp of the material presented in Bi214/ Bi282H and with a rudimentary understanding of protein biochemistry.

Learning outcomes

By the end of this course, students will demonstrate:
1. an understanding of the molecular mechanisms that allow cells to regulate the levels of a given protein
2. an understanding of the properties of regulatory pathways, including those that contain positive and negative feedback
3. an understanding of the basic principles that cause cells to adopt distinct fates during development
4. the ability both to design and to interpret biochemical experiments that test necessity and sufficiency, including those that involve northern and western blots, and gel-shift and DNA footprinting assays.
5. the ability both to design and to interpret genetic experiments that test necessity and sufficiency, including cis/trans tests, epistasis analysis, suppressor screens, and the analysis of loss- and gain-of-function mutations.

Course Blackboard site

In the Course Documents section of Blackboard I will post: the syllabus, detailed lecture notes - including all overheads presented and an accompanying text explanation, problem sets (none will be graded), answer keys for the problem sets, practice exams with answer keys, and answer keys and score distributions for the exams.

Lectures

Students are responsible for understanding all material presented in lecture. As stated above, a detailed write-up of each lecture - as well as the accompanying overheads - will be posted on Blackboard shortly after the lecture is given. STUDY THESE LECTURE NOTES! While the assigned readings are also required, they may contain some extra information and be missing some important information. Use them to enhance your understanding of the lecture material.

Assigned readings
Are from *Molecular Biology of the Gene* by Watson et al. 6th edition (page assignments in black font) or 7th edition (page assignments in blue font). Any supplementary readings will be posted on Blackboard.

Discussions
Attendance at your discussion section each week is required (Huestis 111, Fridays at 9am, 10am, 11am, or noon). Attendance will be taken, and is worth 10% of your final grade. Previous students have uniformly commented that these sections are invaluable for learning the material. Sasha Feoktistov (the teaching assistant) will lead the discussion sections and will use them to clarify and expand upon material presented in lecture and to work practice problems. In some cases, Sasha may present supplementary material not covered in lecture!

Problem Sets
Five problem sets will be posted but will NOT be graded. The problem sets will serve to reinforce the material covered in the lectures and reading, will help you explore its ramifications and applications, and will provide **the best preparation for the exams**. WORK THROUGH THESE PROBLEMS - answers will be posted after a suitable delay. The exams will consist of similar or related new problems for you to solve.

Exams
There will be two midterm exams and a final exam. There will be NO make-up exams and NO early or late exams. If you have special needs regarding taking an exam (e.g. a diagnosed learning disability), please let me know early in the term so that appropriate arrangements can be made. All exams will be closed book. **However, you may bring one page of notes (written on both sides) to the midterm exams 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. Again: working the problem sets is the best preparation for the exams. I will grade the exams. 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.

Grading Policy
The final course grade will be calculated as follows:

Discussion attendance 10%
Midterm I 25%
Midterm II 30%
Final Exam 35%

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, etc.) and will not be tolerated. For the definition of cheating and its penalties, consult the University of Oregon Student Conduct Code.

Course Schedule: BI320 Spring 2014

Date	Topic	Concepts include:	Required reading
T 4/1	1. Cells regulate expression of their genes; course overview	Northern blot, Western blot Reporters	Watson 6th ed. 542-3, 740-1, 743-6, 768-9. **or** Watson 7th ed. 610-1, 148-9, 151-3, 176-7,
R 4/3	2. Prokaryotic transcription (TX) initiation	Consensus sequence, Gel shift assay, DNA footprinting, Suppressors	Watson 6th ed. 136-139; 377-91, 563 **or** Watson 7th ed. 200-3, 429-42, 630
F 4/4	Discussion, week 1	northern/western blot problem	problem set 1
T 4/8	3.TX termination; Inducible TX initiation	Dyad symmetry, Allostery	Watson 6th ed. 394-96; 547-52 **or** Watson 7th ed. 445-7, 615-20
R 4/10	4. Inducible TX initiation (cont); Example 1: the *lac* operon	cis/trans tests; Dominant/recessive Combinatorial control	Watson 6th ed. 789-90, 553-62 **or** Watson 7th ed. 802-4, 621-30
F 4/11	Discussion, week 2	cis/trans test problem	problem set 1
T 4/15	5. the *lac* operon (contd)	Gain-of-function, Dominant negative, Redundancy	
R 4/17	6. Example 2: the *ara* operon	Combinatorial control; Negative feedback	Watson 6th ed. 567-68 **or** Watson 7th ed. 634-6
F 4/18	Discussion, week 3	footprinting, gelshift, problems	problem set 2
T 4/22	7. Phage lambda: a genetic switch	Regulatory cascade, Antitermination	Watson 6th ed. 784-788, 568-84 **or** Watson 7th ed. 798-801, 636-51
R 4/24	8. Phage lambda (contd)	Stochasticism, Positive feedback Cooperativity	
F 4/25	Discussion, week 4	Review for midterm 1	problem sets 1 & 2
T 4/29	**Midterm 1 (on lectures 1-8)**		
R 5/1	9. Prokaryotic translation (TL); Trp operon	Coupling of TX & TL, Attenuation	Watson 6th ed. 457-71, 639-40. **or** Watson 7th ed. 509-21, 707-8
F 5/2	Discussion, week 5:	trp northern/western problem	problem set 3
T 5/6	10. Control of TL initiation	RBS, Blocking of RBS	Watson 6th ed. 471-81, 503-8 **or** Watson 7th ed. 521-30, 549-555
R 5/8	11. Eukaryotic genome organization, chromatin structure, TX initiation	Histones, X-inactivation, Eukaryotic activators, Enhancers	Watson 6th ed.135-44, 156-60, 169-74, 182-7, 620-9, 657, 396-403 **or** Watson 7th ed. 199-208, 219-24, 229-36, 241-9, 687-97, 728-9, 448-54
F 5/9	Discussion, week 6		problem set 3

T 5/13	12. Inducible TX initiation	Yeast Gal system, Animal Delta/Notch, Signal transduction, Epistasis analysis Eukaryotic repressors	Watson 6th ed. 589-593, 597-603, 605-7, 610, 613-9 **or** Watson 7th ed. 657-61, 665-73, 675, 678-9, 681-6
R 5/15	13. Multicellular organisms: how study expression in individual cells?	in situ staining, Reporter constructs	
F 5/16	Discussion, week 7	epistasis problems	problem set 4
T 5/20	14. Multicellular organisms: how do different cells come to express different genes?	Asymmetric cell division, Chance, Cell-cell signaling, *C. elegans* embryo	Watson 6th ed. 661-6 **or** Watson 7th ed. 733-8
R 5/22	15. mRNA processing	5' cap polyA tail Splicing	Watson 6th ed. 406-10, 415-25, 430-5 **or** Watson 7th ed. 457-62, 467-75, 480-6
F 5/23	Discussion, week 8	Review for midterm 2	problem sets 3 & 4
T 5/27	**Midterm 2 (on lectures 1- 14)**		
R 5/29	16. Regulation of mRNA processing	Alternative splicing, *Drosophila* sex determ	Watson 6th ed. 439-45 **or** Watson 7th ed. 491-5
F 5/30	Discussion, week 9	alternative splicing problem	problem set 5
T 6/3	17. Eukaryotic TL	Importance of 5' cap	Watson 6th ed. 452-3, 482-7, 508-12 **or** Watson 7th ed. 503-5, 530-5, 556-8
R 6/5	18. Regulatory small RNAs		Watson 6th ed. 641-3 **or** Watson 7th ed. 712-4
F 6/6	Discussion, week 10	Review for final exam	

*****The final exam is scheduled for Wednesday 6/11 at 8AM*****