Bi282H Genetics and Molecular Biology

In this course we will examine the genetic and molecular mechanisms responsible for the inheritance of physical characteristics. We will begin with the key role of DNA as the hereditary material in cells. We will then learn how DNA directs the synthesis of proteins, including how that synthesis is regulated. Finally, we will explore the ways in which DNA is inherited and thereby passes molecular information to subsequent generations.

Learning outcomes

By the end of this course, you will be able to demonstrate an understanding of:
1. how DNA directs the synthesis of proteins, including how protein synthesis is regulated
2. how variations in DNA sequence affect proteins and thereby phenotype
3. how DNA is inherited and thereby specifies the phenotypes of subsequent generations
4. how to design and interpret experiments that test #1-3.

Instructors

Lectures - Chiles Business Center (CHI) 128
Molly Jud
mjud@uoregon.edu
Office Hr: Mon 2-3 pm Kla 21

Labs - in Klamath 21
Laurel Pfeifer-Meister
lpfeife1@uoregon.edu
Office Hr: Thurs 1-2 pm Kla 21

Graduate employees (all office hours in Kla 21)

Acadia DiNardo
acadiad@uoregon.edu
Office Hr: Thurs 12-1 pm

Hope Healey
hhealey@uoregon.edu
Office Hr: Tues 12-1 pm

Undergraduate assistants (all office hours in Kla 21)

Rach Allison	Frances Conable	Anna Kulawiec	Alina Salagean
rallison@uoregon.edu	fconable@uoregon.edu	akulawie@uoregon.edu	asalagea@uoregon.edu
Office Hr: Mon 11am-12pm	Office Hr: Fri 12-1pm	Office Hr: Wed 12-1 pm	Office Hr: Tues 4-5 pm

Course organization

Readings

Annotated slides

Before each lecture, a pdf entitled "annotated slides" will be posted on Canvas. Each such pdf contains an explanation of the topics for that day and will be used during lecture itself. Your focus should be on understanding the material presented in these pdfs and in lecture. Read the corresponding "textbook readings" (see table below) for further clarification.

Textbook readings

Note that the assigned "textbook readings" often include more detail than you need to know. The course textbook, *Molecular Biology of the Gene* (either the *6th or 7th edition* is fine) by Watson et al. (Pearson) was selected because it is also used in Bi320 Molecular Genetics, which many of you will take in the future; two copies are on reserve at the Science Library. For several topics, readings from other sources (indicated by asterisks in the table below) will be posted on Canvas.

Problem-solving

Bi282H focuses on genetics: how do living things reproduce and pass along specific traits? We will learn how key experiments have contributed to our modern understanding of the molecular and cellular mechanisms that underlie this process. Our goal (see Learning Outcomes above) is that by the end of this course, you will be able to demonstrate your understanding of this subject by proposing and interpreting analogous, theoretical experiments. To achieve this, you need **practice**!

In-lecture clicker questions

Bring your clickers to lecture. I will pose several questions during each lecture (except lectures 9 and 29) - you will receive full credit for responding, even if you are incorrect!

Post-lecture questions

Since lecture time is limited, you need to practice solving problems on your own. To facilitate this, a pdf containing short "post-lecture" questions will be posted as pdfs within each lecture module (all except lectures 9 and 29), so that you can immediately test your understanding of the material presented. These questions are designed to make you think - don't panic if you find them difficult. They will NOT be graded: detailed answers will also be posted, so that you can see how you're doing.

Problem sets and past exams

The post-lecture questions are designed as brief tests of concepts from lecture. For more and broader practice, three sets of problems and answers (corresponding to the three exams), as well as examples of past exams and answers, will also be posted on Canvas (and will NOT be graded). **The midterm and final exams will consist of problems such as these**. To solve these problems you may have to integrate concepts from multiple lectures. Try to work through them without looking at the answers first.

Exams

There will be two one-hour midterm exams plus a comprehensive two-hour final exam (past examples will be posted on Canvas). The midterm exams will take place **from 7-9pm in LILLIS 211** (i.e. NOT our regular lecture room or time!). They will be written as one-hour exams, but you will have two hours in which to complete the exams. The exams are not open book - you are allowed only writing implements (no calculators or other devices). The final exam will be in our classroom (**CHI 128**).

Lab work

The total points earned in the lab will account for **34.6%** of your overall Bi282H grade (see point totals below). See the separate Lab Syllabus for details.

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. All work submitted in this course must be your own. Instances of suspected cheating or plagiarism on exams, quizzes, and reports will be referred to the Office of Student Conduct and Community Standards for consideration of sanction.

Your final grade

Your grade for the course will be based upon the combination of your performance on the exams and your work in the labs. Scores will be determined in two ways for each student:

Exam points

Method 1	Midterm #1	150
	Midterm #2	150
	Final exam	300
	Total	600
Method 2	Better midterm x 1.33	200
	Final exam x 1.33	400
	Total	600

Non-exam points

Component	**Number**	**Points each**	**Total points**
In-class clicker Qs	27	2	54
Lab work			346
Total			400

Letter grades will be assigned based on the higher of the two scores (calculated by method 1 or method 2) for each student. Letter grades are determined only after the total course points have been calculated, not for individual hour exams. Since grades are not assigned strictly on the basis of statistical distribution about a numerical mean, the opportunities to earn good grades in this course are not limited, and students are not in competition with each other for those grades.

P/N option: A grade of "P" is given when the calculated grade is "C-" or better; a grade of "N" is given when the calculated grade is "D+" or lower.

Exam re-grades: If you feel that a mistake has been made in the grading of your exam, you must write a logical explanation for why your answer merits a higher score, attach it to the exam, and submit both the explanation and the exam to your lab instructor. Well-thought-out arguments will be considered, but other questions on the exam may be re-graded as well, and requests that we simply "look again" at an answer will not be honored. Please do not abuse this system. The deadline for submission of exams for re-grading is one week following receipt of the graded exam.

Early and make-up exams will not be administered. Please do not ask for exceptions. If you miss an exam for a valid reason (medical or family emergency), you must provide written documentation of the reason to avoid a score of 0. Your grade will then be based on the exams you have taken. A second missed exam will not be excused. Note that Club Sports events do not qualify as excusable absences.

Lecture and Exam schedule BI282H Winter 2019.

	Lectures	Concepts include:	Textbook readings:
	DNA is the genetic material		
M 1/6	1. Course overview; DNA is the genetic material	necessary vs sufficient, fractionation, differential labeling	
W 1/8	2. What is the structure of DNA?	base complementarity, antiparallel 5'-3' strands, Meselson-Stahl	Watson 6th ed. 19-28 **or** Watson 7th ed. 21-30
F 1/10	3. How is DNA replicated?	DNA polymerase, leading & lagging strands, telomeres	Watson 6th 195-9, 207-11, 218, 230, 246-51 **or** Watson 7th 257-62, 265-72, 277, 288, 302-6
	DNA contains separate units of function = genes		
M 1/13	4.DNA sequences can change: mutation	causes of mutations, mutation rates, replica plating, Luria-Delbruck	Griffiths 461-3* Watson 6th 257-60, 265-6 **or** Watson 7th 313-5, 320
W 1/15	5. DNA has separable units of function = genes	auxotroph, genetic screen, complementation test, biosynthetic pathwayk	Griffiths 187-90*
F 1/17	6. Each gene encodes an amino acid sequence	potential genetic codes, frameshift, suppressor	Griffiths 277-82* Crick et al.*
M 1/20	**Martin Luther King, Jr Holiday**	**NO CLASS**	
	How does DNA sequence affect phenotype?		
W 1/22	7. How does DNA sequence encode amino acid sequence?	actual genetic code, mRNA, dominant vs recessive, loss- vs gain-of-function mutations	Watson 6th 28-37 **or** Watson 7th 30-8
F 1/24	8. How do mutations affect protein function and phenotype?	null, hypomorph, hypermorph, antimorph (dominant negative), neomorph	Hartwell et al.*

M 1/27	9. Mutations, protein function, and phenotype (cont'd)	importance to understanding human traits	
	How do cells use the DNA code to synthesize proteins?		
W 1/29	10. Step 1: transcription (in prokaryotes)	pulse-chase, transcription, RNA polymerase, consensus, promoter.	Watson 6th 136-9, 377-86, 388 **or** Watson 7th 200-3, 429-38, 440
W 1/29	**MIDTERM EXAM 1**	**lectures 1-9**	**7-9PM in LILLIS 211**
F 1/31	11. Step 1 (cont'd) & Step 2: translation (in prokaryotes)	TX termination, dyad symmetry, stem-loop, translation, operon, ribosome, RBS	Watson 6th 394-6, 457-76, 479-480 **or** Watson 7th 445-7, 509-26, 528
M 2/3	12. Step 2 translation (cont'd)	charged tRNAs, translation cycle	Watson 6th 479-81, 487-8, 492-6 **or** Watson 7th 528-30, 535-7, 541-4
	Cells can turn the expression of some genes on and off		
W 2/5	13. How is gene expression regulated (in prokaryotes)? ex: *lac* operon in *E. coli*	constitutive vs inducible, cis vs trans, repressor, inducer, allostery	Watson 6th 547-50, 553-60 **or** Watson 7th 615-8, 620-7
F 2/7	14. Why is the *lac* operon only TX'd in the presence of lactose?	activator, DNA binding proteins and dyad symmetry	Griffiths 305-315* (has ERROR)
M 2/10	15. Why is the *lac* operon only TX'd in the absence of glucose?	signal integration, "AND" gate, regulatory pathways	Watson 6th 716-7 **or** Watson 7th 776
	Gene expression in eukaryotes		
W 2/12	16. How are genes TX'd and TL'd in eukaryotes (like us)?	chromatin, chromatin regulators, 5' cap, splicing, polyA signal, translation	Watson 6th Figs 7.17, 7.32, 12.15, 402-3, 408-10, 415-7, 482-7 **or** Watson 7th Figs 8-17, 8-32, 13-16, 453-4, 457-60, 467-8, 530-5
F 2/14	17. How is gene expression regulated in eukaryotes? ex: Gal genes in yeast	signal transduction, epistasis	Cox 743-6* (has ERROR)

	How is gene expression regulated in multicellular animals?		
M 2/17	18. Part 1: transcriptional networks. ex: early *Drosophila* (fruitfly) development	asymmetric localization of mRNA or protein, gradient, syncytium	Cox 749-50*, Nusslein-Volhard* Watson 6th 676-8, 682-93 **or** Watson 7th 746, 748-9, 751-762
W 2/19	19. Part 2: cell-cell signaling	regulatory networks, cell-cell signaling, asymmetric cell division	Watson 6th 661-6 **or** Watson 7th 733-8
W 2/19	**MIDTERM EXAM 2**	**lectures 1-17**	**7-9PM in LILLIS 211**
F 2/21	20. example: early *C. elegans* (worm) development	isolating individual cells from embryo to test for signaling	Gilbert 251-7*
	How are DNA sequences transmitted to progeny (in eukaryotes)?		
M 2/24	21. Asexual reproduction: mitosis	cohesin, centromere, MTOC, spindle. sister chromatid, genetic variation	Watson 6th 144-54 **or** Watson 7th 208-17
W 2/26	22. Sexual reproduction: meiosis	homologous chromosomes, crossovers, segregation	Watson 6th 154-6, 303-5 **or** Watson 7th 217-9, 362-3
F 2-28	23. Single Mendelian traits	chromosome theory of inheritance, sex linkage, non-disjunction	Griffiths 28-35, 75-80*
M 3/2	24. Multiple Mendelian traits	independent assortment, linkage	Griffiths 36-40*
W 3/4	25. Linkage	recombination, chi-square test, p value	Griffiths 40-2, 116-124*
F 3/6	26. Special cases of inheritance: maternal, epigenetic, & organelle	maternal vs zygotic effect, genomic imprinting, mitochondria & chloroplasts	Non-Mendelian inheritance 103-6, 109-11, 113-6*
	Analyzing the inheritance of human traits		
M 3/9	27. Pedigree analysis	is a trait genetic or environmental?	Griffiths 42-8, 52-6*
W 3/11	28. Genome sequencing	genome sequencing, DNA polymorphisms, causation	NYTimes*
F 3/13	29. Complications: gene interactions	incomplete penetrance, polygenic inheritance	Lander 2037-9*
Tues 3/17	**FINAL EXAM**	**10:15AM-12:15PM**	**CHI 128**

***reading posted on Canvas (i.e. not from Watson et al. textbook)**