Principles of Genetics

Biology 3060 Fall 2017

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Classes: MTWH, 12:30 – 1:20, NR 105

Office Hours: M & H 1:30 – 2:30 and by appointment

Required Materials: Pierce, B. A., *Genetics – A Conceptual Approach*, *6th ed* (2017) W.H. Freeman
An iClicker

Objectives:
Provide content knowledge of major areas of genetics.
Strengthen problem-solving skills.
Develop teamwork skills for tackling scientific problems.
Highlight the link between genetics and society.

Points:

Daily online reading quizzes	16%
In-class clicker questions	3%
Peer and personal evaluations	1%
Group problem sets	30%
Three hourly exams*	11% each
Comprehensive final exam	17%

*There will be four hourly exams, but only the top three scores will count toward your grade.

Overview of the Couse: This course takes a student-centered, team-based approach to learning genetics. The aim is to improve genetics learning by having you work with the material instead of solely listening to lectures. I will help guide your learning, but you will take the lead.

An important part of your learning ownership is daily assigned readings. These readings will provide you with background information that allow class time to focus on difficult concepts and to facilitate work on genetics problems. Quizzes on the readings will be given each day. These will be available on Canvas and need to be completed before class. Full instructions to quizzes will be available at the start of the semester.

Classes will open with a block of lecture on the most important or difficult concepts of the material. Once lecture is finished, you will work in teams on genetics problems while the UTFs and I move from team to team to answer questions and see how you're doing.

One or two clicker questions will be posed during most class periods. These will first be answered individually followed by discussion of the question with classmates. You'll then have a second opportunity to answer the question. Points will be awarded for correct answers to these questions, usually

for the second try only. You must be in class with a working, registered iClicker to receive points for clicker questions. I will not manually add points if you don't have a working iClicker with you.

Problem sets will be due every other week. Each group will submit one problem set, with the same score generally issued to every student in the group. Expect to spend a significant amount of time outside of class on assigned readings and problems sets.

Details of Point-Awarding Activities and Grading:

Reading quizzes: Reading quizzes will be given almost every day. Their purpose is to ensure that you come to class prepared with the background information needed to understand more difficult concepts and to work on genetics problems.

The required reading for each class will be announced on Canvas no later than 5 pm the day before the associated quiz is due. This isn't a lot of lead-time, but it's impossible to post an accurate detailed schedule for the entire semester.

To help you anticipate the readings, the chapter sections that were required for the fall 2016 course are listed on the last pages of this syllabus. The reading assignments for the current course will align well with those of last year's course. Therefore, if you're wondering what's likely to be assigned and want to read ahead, you have a guide. An issue that I'm aware of is that we're using a different, newer edition of the text for this course. However, even with this change, the section numbers listed for the previous readings will proivde a good guide.

Reading quizzes will be completed in Canvas and will be available no later (and generally much earlier) than 7 pm the day before they are due. Reading quizzes close at 12:15 pm. Late submissions will not be possible. Because I have no control over whether the quizzes are completely individually there are no restrictions on how you chose to answer the quiz questions.

The number of questions on each quiz will vary but generally be in the range of 5 – 15 true/false and multiple choice questions. Don't be surprised to occasionally see some longer quizzes, especially in the molecular genetics material. All questions are weighed equally. The reading quiz score constitutes 16% of your overall course score.

Clicker questions: One or two clicker questions will be posed in most classes. You'll have two opportunities to answer each question, first working alone and then after working with classmates. Generally, only correct answers will be awarded points. The good news is that in almost every case, only your answer to the second posing of a question will count. However, I hold open the option of counting initial responses if needed as a way to ensure that an honest effort is made on the individual work. Clicker questions will contribute 3% of your course score.

Problem Sets: You will work in every class in a group of 4 – 6 students to solve genetics problem sets that are due every other week. Each problem set will be submitted through Canvas and be due at 6 pm on the dates posted in the syllabus. There will be a 10% point reduction if the problem set is submitted late ***but within 27*** *hours* after the due date. Beyond this time, submissions will **not be accepted**. New problems may be added to a set up to 32 hours before the due date.

The problem sets allow you to work with peers in improving genetics problem solving and teamwork skills. Some work outside of class almost certainly will be required to complete the problem sets. Only one problem set per group will be submitted. Each team will decide on how to complete and submit problem sets. With two possible exceptions described below, everyone in the group receives

the same score. Late submissions count against all group members, so it is imperative to have a clear understanding of who will submit each problem set.

One possible exception to the same-score-for-all-group-members rule is the case of a disagreement over the group's answer. If you don't agree with your group's answer, you may submit your own dissenting answer as part of the group's answer set.

Another possible exception to everyone receiving the same score is for students who are absent regularly during group work or who fail to fully participate in group work.

Groups will be assigned by the instructor. The expectation is that everyone will participate actively in their group. I will occasionally ask questions about group dynamics. I want groups to first attempt to work out problems on their own. If a solution cannot be found this way, I will attempt to help solve the problem, but only after the group has made a good faith effort at resolving the issue.

Peer and Personal Evaluations: You will evaluate the performance of your teammates and yourself in group work on genetics problems three times during the semester. This will be done with a standard set of questions that focus on each individual's contribution to the team effort. The purpose of these evaluations is to provide assessments of who's pulling their weight and of your own contribution to the team effort. Points will be awarded solely on the basis of a good-faith effort at completing the evaluations, but actions may be taken based on evaluation results.

Exams: There will be four hourly exams and one comprehensive final exam. Only the top three hourly exam scores will count toward your course score. Exam questions will focus primarily on the concepts covered during lectures and in the problem sets. Only rarely will a question come solely from readings. All exams will be taken online through Canvas at the USU Logan Campus Testing Center. Exams will be open over two day testing period. You are responsible for scheduling each of your exams through the Testing Center. Please do so early as all available slots may fill, particularly for the final exam.

Grading: The most stringent possible grading scale is shown at right. Points *may* be added at the instructor's discretion to exams, clicker scores, or the reading quiz score.

Grade	Percentage	Grade	Percentage
A	92-100%	C	72-77%
A-	90-91%	C-	70-71%
B+	88-89%	D+	68-69%
B	82-87%	D	60-67%
B-	80-81%	F	< 60%
C+	78-79%		

Course Policies:

- You must actively participate in your group
- The group stands or falls together – be sure to have a clear line of communication about who is submitting a problem set and the quality of the submission.
- Deadlines for quizzes and problem set submissions are firm.
- You must have a working iClicker in class in order to obtain clicker question points
- Use of another student's iClicker is a USU Academic Honesty and Integrity Policy violation and will result in loss of clicker points.
- Individual extra credit activities are not available.
- Grading of exam questions or problem sets is open for discussion up to 48 hours after scores are returned to the class, but not beyond this time.
- If you contest grading of problem sets, first work with the UTF to see if the issue can be resolved, and see me only if the issue cannot be resolved after working with the UTF.

Everyone knows that problems can occur. I'm reasonable and will be happy to discuss unforeseen events with you and possibly make adjustments, but there must be a well-justified reason for making any exceptions to the course policies.

Canvas: Daily reading lists, lecture recordings, PowerPoints presented in class, answered iClicker questions, and many other important resources will be available on Canvas. You should check this site frequently.

Office Hours and Meeting with the Instructor: Feel free to stop by during regular office hours. I know these times are limited, so if you can't come during regularly scheduled office hours, please send me an e-mail or see me after class to set up an alternative time to meet.

Lecture Schedule: I'll attempt to stay as close as possible to the lecture schedule targets listed below. However, it's almost certain that adjustments will be needed as the semester unfolds.

Access to the eText: (The information that follows is from the publisher.)

Go to www.saplinglearning.com/login to log in or create an account. The following link includes detailed instructions on how to register for your course: https://community.macmillan.com/docs/DOC-5972-sapling-learning-registering-for-courses.

If you have any issues during sign up or throughout the term, the publisher will provide technical support. Go to https://community.macmillan.com/docs/DOC-6915-students-still-need-help for detailed information.

Critical Deadlines: Deadlines for adding and dropping the course with various notations on your transcript and for changing to P/D$^+$/D/F are all given in the Spring Registration Calendar at: http://catalog.usu.edu/content.php?catoid=12&navoid=7345 If you find yourself wondering about any of these options, please check the posted dates carefully.

Academic Honesty and Integrity Policy: Policies described in the USU Academic Integrity/Honesty document (http://catalog.usu.edu/content.php?catoid=12&navoid=3140&hl=Academic+Honesty%2FIntegrity&returnto=search) will be followed for this course.

ADA compliance: Students with physical, sensory, emotional or medical impairments may be eligible for reasonable accommodations in accordance with the Americans with Disabilities Act and Section 504 of the Rehabilitation Act of 1973. All accommodations are coordinated through the Disability Resource Center (DRC) in Room 101 of the University Inn, 797-2444 voice, 797-0740 TTY, or toll free at 1-800-259-2966. Please contact the DRC as early in the semester as possible. Alternate format materials (Braille, large print or digital) are available with advance notice.

Advice: Realize that you're going to need to spend a lot of time on this course and that you must keep up with readings and problem sets. Be careful to avoid the trap of having your teammates do the problem solving for you. You can easily get a great score on the problem sets, but things won't go well in exams if you lean on others to do your work.

Principles of Genetics (Biol 3060) Fall 2017
Target[1] Lecture Schedule

Meeting			Topic	Chapter[2]	Exams[3]
1	M	8/28	Introduction to Course; Introduction to Genetics	1	
2	T	8/29	Chromosomes & Cellular Reproduction	2	
3	W	8/30	Chromosomes & Cellular Reproduction	2	
4	H	8/31	Basic Principles of Heredity	3	
	M	9/4	***Labor Day Holiday!***		
5	T	9/5	Basic Principles of Heredity	3	
6	W	9/6	Basic Principles of Heredity	3	
7	H	9/7	Sex Determination & Sex-Linked Characteristics ***Problem Set 1 Due at 6 pm***	4	
8	M	9/11	Sex Determination & Sex-Linked Characteristics	4	
9	T	9/12	Sex Determination & Sex-Linked Characteristics	4	
10	W	9/13	Extensions & Modifications of Basic Principles	5	
11	H	9/14	Extensions & Modifications of Basic Principles	5	
12	M	9/18	Extensions & Modifications of Basic Principles	5	
13	T	9/19	Extensions & Modifications of Basic Principles	5	***Exam 1***
14	W	9/20	Extensions & Modifications of Basic Principles	5	***Exam 1***
15	H	9/21	Pedigree Analysis, Applications, & Genetic Testing ***Problem Set 2 Due at 6 pm***	6	
16	M	9/25	Linkage, Recombination, & Eukaryotic Gene Mapping	7	***Eval.1***
17	T	9/26	Linkage, Recombination, & Eukaryotic Gene Mapping	7	
18	W	9/27	Linkage, Recombination, & Eukaryotic Gene Mapping	7	
19	H	9/28	Linkage, Recombination, & Eukaryotic Gene Mapping	7	
20	M	10/2	Linkage, Recombination, & Eukaryotic Gene Mapping	7	
21	T	10/3	Chromosome Variation	8	
22	W	10/4	Chromosome Variation	8	
23	H	10/5	Chromosome Variation ***Problem Set 3 Due at 6 pm***	8	
24	M	10/9	Chromosome Variation	8	
25	T	10/10	Quantitative Genetics	24	***Exam 2***
26	W	10/11	Quantitative Genetics	24	***Exam 2***
27	H	10/12	Quantitative Genetics	24	
28	M	10/16	Population Genetics	25	
29	T	10/17	Population Genetics	25	
30	W	10/18	Population Genetics ***Problem Set 4 Due at 6 pm***	25	
	H	10/19	***No Class (Friday Schedule)***		
31	M	10/23	Population Genetics	25	
32	T	10/24	DNA: The Chemical Nature of the Gene	10	
33	W	10/25	Chromosome Structure & Organelle DNA	11	
34	H	10/26	Chromosome Structure & Organelle DNA	11	
35	M	10/30	Chromosome Structure & Organelle DNA	11	***Eval. 2***
36	T	10/31	DNA Replication & Recombination	12	***Exam 3***
37	W	11/1	DNA Replication & Recombination	12	***Exam 3***
38	H	11/2	DNA Replication & Recombination ***Problem Set 5 Due at 6 pm***	12	
39	M	11/6	Transcription	13	

40	T	11/7	Transcription	13	
41	W	11/8	RNA Molecules & RNA Processing	14	
42	H	11/9	RNA Molecules & RNA Processing	14	
43	M	11/13	RNA Molecules & RNA Processing	14	
44	T	11/14	The Genetic Code & Translation	15	
45	W	11/15	The Genetic Code & Translation	15	
46	H	11/16	The Genetic Code & Translation ***Problem Set 6 Due at 6 pm***	15	
47	M	11/20	The Genetic Code & Translation	15	
48	T	11/21	Control of Gene Expression in Bacteria	16	
			Thanksgiving Break!		
49	M	11/27	Control of Gene Expression in Bacteria	16	
50	T	11/28	Control of Gene Expression in Bacteria	16	***Exam 4***
51	W	11/29	Control of Gene Expression in Eukaryotes	17	***Exam 4***
52	H	11/30	Gene Mutations & DNA Repair ***Problem Set 7 Due at 6 pm***	18	
53	M	12/4	Gene Mutations & DNA Repair	18	***Eval. 3***
54	T	12/5	Gene Mutations & DNA Repair	18	
55	W	12/6	Gene Mutations & DNA Repair	18	
56	H	12/7	Gene Mutations & DNA Repair	18	
	M	12/11			***Final***
	T	12/12			***Final***

1. Don't be surprised if adjustments are needed during the semester. The only things that are locked in place are exam dates and the holidays

2. This is an overview reading list. Details of each reading will be posted on Canvas no later than 5 pm the day before each reading quiz is due. A reading list from the fall 2016 class is provided below. What was done then will be a close match to this semester's reading assignments. Therefore, if you want or need to read ahead, the previous reading list as a guide.

3. All exams will be administered through Canvas and taken at the USU Logan Testing Center. Be sure to schedule each exam well ahead of the exam dates. Early scheduling is especially important for the final. "***Eval***" refers to the due dates for the teammate and self evaluations.

Class Date	Assigned Readings Fall 2016
8/31	Chapter 1: Section 1.3; Chapter 2: Eukaryotic Chromosomes through Meiosis in Animals (p. 21- 36. Most of this should be review but its foundational material that you absolutely need to know.
9/1	Section 3.1 and 3.2 through The Molecular Nature of Alleles (stop at Prediction the Outcome of Genetic Crosses) [The trickiest point in this section is distinguishing between segregation and independent assortment.]
9/6	Section 3.2 starting from Predicting the Outcome of Genetic Crosses to the section end (stop at section 3.3). You can skip the section on the binomial expansion, but you need to know the formula $((n!/s!t!)p^s q^t)$ for calculating the probability of any combination of two events.
9/7	Section 3.3 (we won't cover section 3.4)
9/8	(We won't cover the assigned reading material in Thursday's class that will be devoted to finishing off Problem Set 1, but I'm thinking that it's better to maintain a steady pace on the readings.) Section 4.1. There's a lot of detail in this section. Focus on the fact that there are many sex determination systems and know their outlines, but don't worry about details. Pay the most attention to the XY, XO, and ZW systems, and sex determination in *Drosophila*. DON'T worry about memorizing the names of specific human sex chromosome abnormalities, but do realize that there are lot of them. Carefully read *The Role of Sex Chromosomes* and *The Male Determining Gene in Humans*. Don't worry about details of *Androgen-Insensitivity Syndrome*.
9/12	Section 4.2 (with the exception of *Nondisjunction and the Chromosome Theory*). Read *Y-Linked Characteristics* in overview, but don't get bogged down in the details. Section 4.3: Here I want you to know about dosage compensation, the Lyon hypothesis, X-chromosome inactivation and the underlying mechanism of inactivation, but don't get bogged down in details.
9/14	Section 5.1. All the concepts here are important, so take time to get to know them. What's not important are the details in the examples used to illustrate these concepts. For example, you need to know about multiple alleles, but you don't need to know the details of the mallard feather pattern alleles and their interactions.
9/15	Section 5.2 up to, but not including, *Complementation*. In the material on epistasis, what's important is seeing how epistasis is a special form of gene interaction and being able to work problems involving epistasis (worked problems, however, won't be on the reading quiz). It's easy to get bogged down in the names of all the different forms of epistasis. Don't worry about the names, but do focus on the big ideas.
9/20	Section 5.2 beginning at complementation (you can skip *The Complex Genetics of Coat Color in Dogs*); Section 5.3, up to, but not including *Cytoplasmic Inheritance*).
9/21	Section 5.3 beginning with *Genomic Imprinting*; Section 5.5 (we'll skip section 5.4 because the same material will be covered later in the course but in a more satisfying way).
9/27	Chapter 6, Sections 6.1 and 6.2.
9/28	Chapter 7, Sections 7.1 and 7.2 up to, but not including, *Evidence for the Physical Basis of Recombination*.
9/29	Chapter 7, Begin with the subsection *Predicting the Outcomes of Crosses with Linked Genes*. This is within Section 7.2. Skip Testing for Independent Assortment, then resume reading at *Gene Mapping with Recombination Frequencies* and continue through the end of Section 7.2
10/3	Chapter 7, Section 7.3, beginning with the subsection *Effect of Multiple Crossovers* (skip all material of Section 7.3 up to this point). Skip *Mapping Human Genes*, then resume reading at *Mapping with Molecular Markers* and continue through *Genes Can Be Located with Genomewide Association Studies*. Finish off with *Physical Chromosome Mapping Through Molecular Analysis* (in Section 7.4) then reading the final short section 7.5 (*Recombination Rates Exhibit Extensive Variation*).
10/4	Chapter 8, Sections 1 and 2. In Section 8.2, don't worry about every detail of chromosome inversions.
10/5	Section 8.3
10/6	Section 8.4
10/11	Chapter 10, Sections 10.1, 10.3, and 10.4.
10/12	Chapter 11, Section 11.1 – 11.3.
10/13	Chapter 11, Section 11.4. There's a ton of extraneous detail in this section. I'd like you to focus on the ideas of the endosymbiotic theory, uniparental inheritance, replicative segregation, homo- and heteroplasmy, a very high-level look at what's in mitochondrial and chloroplast genomes, and the movement of genes between organelle genomes and the nuclear genome. Don't get bogged down in details of organelle structure, various organelle-encoded traits, or lists of genes found in organelle DNA.
10/18	Chapter 12, Section 12.1; 12.2 starting from Modes of Replication; Section 12.3.

10/19	Chapter 12, Section 12.4
10/24	Chapter 12, Section 12.5
10/25	Chapter 13, Sections 13.1 and 13.2
10/26	Chapter 13, Sections 13.3 – 13.5
10/31	Chapter 14, Sections 14.1 and 14.2.
11/2	Chapter 14, Sections 14.3 - 14.6. Don't worry about the details of tRNA and rRNA processing (sections 14.3 and 14.4), simply know that there's processing involved and that tRNAs have many unusual bases that are created by modifying normal bases after transcription. Spend most of your time with Sections 14.5 (a challenging but important section) and 14.6
11/3	Chapter 15 Section 15.1 (The Structure and Function of Proteins subsection only); Section 15.2
11/7	Chapter 15, Section 15.3 and 15.4. In section 15.4, read the Messenger RNA Surveillance section for an overview, but you won't be responsible for knowing the details of the various mechanisms.
11/9	Chapter 16, Section 16.1 and Section 16.2 through *The lac Operon of E. coli* (stop at *lac Mutations*).
11/14	Chapter 16, Section 16.2, beginning with *lac Mutations* and through *Positive Control and Catabolite Repression*. Skip *The trp operon of E. coli*, and then read the short section *Bacterial Enhancers*. Skip section 16.3, but read Section 16.4
11/15	Chapter 17, Sections 17.1 and 17.2. In section 17.2, read all parts but don't worry about memorizing details of flowering control in the plant Arabidopsis (view this as an interesting example), and don't focus on the details of chromatin immunoprecipitation (but do know the basic idea of the technique).
11/6	Chapter 17, Sections 17.3 & 17.4. In both sections, don't worry about details of specific examples, but try to use the examples to get a sense of the broader picture of how transcription and RNA processing work in regulating gene expression.
11/17	Chapter 17, Sections 17.5 & 17.6. As for the previous sections, don't worry about details of specific examples, but try to use the examples to get a sense of the broad picture.
11/21	Chapter 21, **The Introduction** (How Your Grandfather's Diet Could Affect Your Health), Section 21.1 and select portions of Sections 21.2 and 21.3. Section 21.2 repeats a lot of what we just finished in Chapter 17. Read over most of 21.2 with an eye for **things you haven't already learned**, and read the interesting story of **DNA methylation in the making of a queen bee,** and the subsections **Maintenance of Histone Modifications** and **Epigenetic Effects by RNA Molecules**. Section 21.3 provides a lot of examples of epigenetic effects. They're all interesting, but here focus on **Paramutation/Paramutation in Corn**, **Epigenetic Effects of Early Stress in Humans, Epigenetic Effects of Environmental Chemicals, Transgenerational Epigenetic Effects on Metabolism, Epigenetic Changes Associated with Cell Differentiation,** and **Genomic Imprinting**. I know this is a lot of reading, but the intent is to give you an idea of the importance of epigenetics, not to memorize every detail about every aspect of epigenetics.
11/22	Chapter 18, Section 18.1
11/28	Chapter 18, Section 18.2. There are a lot of details in this section and you can ignore most them. Simply get a feeling for the many ways DNA sequences can be changed. For example, I'd like you to know what a base analog is, but you don't need to know the details of exactly how 5-bromouracil works as a base analog.
11/29	Chapter 18, Sections 18.3 and 18.5 (we'll circle back to 18.4 later). Read Section 18.3 for an overview, but you don't need to know the details of the Ames test or details of the mutagenic effects of the atomic bomb blasts in Japan.
11/30	Chapter 18, Section 18.4. In this section, try to get a picture of what transposable elements are, what they can do, and the fact that they make up a large part of many genomes. You don't need to memorize the names of individual transposable elements or know details of how these particular elements move.
12/1	Chapter 25, Sections 25.1 and 25.2.
12/5	Chapter 25, Section 12.3.
12/6	Chapter 25, Section 12.4 through Genetic Drift. This material is math-intensive. What I want you to be able to do with the equations is modest: Understand their significance, but you don't need to be able to derive the equations or memorize them. What you should take away is a sense of how mutation, migration, and genetic drift change allele frequencies.
12/7	Chapter 25, Section 12.4, Natural Selection. The same things that were said for the earlier material of the section hold here: Get a good sense of how selection works, but don't worry about memorizing equations.