

Biology 352: GENETICS AND EVOLUTION

Fall 2009

Tuesday, Thursday West Commons 220 11:00-12:15

Class Syllabus

Instructor Contact Information:

Dr. Sandy Bernstein, LS 371, 594-5629, sbernst@sciences.sdsu.edu

Office Hours: 12:30-1:30 pm, Tues. & Thurs. (9/1-9/29)

Dr. Andrew Bohonak, LS 212, 594-0414, bohonak@sciences.sdsu.edu

Office Hours: 12:30-1:30 pm, Tues. & Thurs. (10/6-11/10)

Dr. Tod Reeder, LS 264, 594-7826, treeder@sunstroke.sdsu.edu

Office Hours: 10:00-11:00 am, Mon. & Wed. (11/10 - 12/10), other times by appointment

Organization

Biology 352 is divided into three 5-week sections: transmission genetics, population genetics and evolution. A faculty member with the appropriate expertise will teach each section. Dr. Bernstein will teach the first part, Dr. Bohonak will teach the second part, and Dr. Reeder will teach the third.

Furloughs

The devastating California state budget cuts prohibit faculty and staff at SDSU from working nine days per semester during the 2009/10 academic year. Each instructor for Biology 352 has scheduled one of his faculty furlough days during a class day (see class schedule). While efforts will be made to keep the content of this course consistent with past semesters, no formal lectures or office hours will be held on those days. To minimize or avoid faculty and staff furloughs in future academic years, you may want to contact your State legislators so that they better understand how cutting the state budget for higher education affects your education and your future.

Texts

1) **Pierce, B.A. 2009. Transmission and population genetics. 3rd edition. Freeman.**

OR

Pierce, B.A. 2007. Genetics: a conceptual approach. 3rd edition. Freeman.

Note: “Transmission and population genetics ...” is a custom version of “... a conceptual approach” that W.H. Freeman Publishers have generously prepared for this course, to minimize your textbook expenses. The SDSU bookstore has “Transmission and population genetics ...”, which contains Chapters 1-9 and 22-23 from the full version of the book. Because the customized version contains fewer pages and is softcover, it is less expensive than the full version of the text. You may certainly find and purchase the full version of the “conceptual approach” textbook if you like. If you choose to buy the full hardcover version, or any other edition of the text, please note that the page numbers in the syllabus are for the recommended 2009 softcover version.

There are a few pages in Chapters 10-21 of “... a conceptual approach” that are required, but not included in “Transmission and population genetics”. The publisher has provided PDF files for these sections, which are available on Blackboard for you to download and print.

2) **Freeman, S. and Herron, J. C. 2007. Evolutionary Analysis. 4th edition. Pearson.**

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A limited number of copies of the two textbooks will be on reserve in the library. Search under "Biology 352" (<http://libpac.sdsu.edu/screens/rbr.html>), and check under the names of current and/or previous instructors of the course that are retrieved.

Population genetics (weeks 6-10) is covered only adequately in Pierce. Some students in past semesters have requested additional help and practice problems for this section of the course. The instructors recommend the following supplemental book:

Ayala, F. J. 1982. Population and evolutionary genetics: a primer. Benjamin/Cummings, Menlo Park, CA. This book is now out of print, and because it was published in 1982, it contains almost no information on DNA. Nevertheless, this book most closely parallels the material presented in the second portion of the course. A copy of this book is on reserve in the library, and Dr. Bohonak has a second copy that you may look through during his office hours. You may also be able to find a used copy through Amazon.com or a similar source for less than \$10.

Prerequisites

Biology 201A, 201B and 215 are necessary and required. Another statistics course may be substituted for Bio 215: consult with Dr. Bohonak.

We welcome all students who have fulfilled the three prerequisites to Biology 352. If you are a Biology major (and not enrolled as a "Premajor"), then you should have these. Students that are enrolled for the course but do not have the appropriate prerequisites will be dropped by the instructors. If there is any confusion on these matters, please consult with Dr. Bohonak.

Crashing

We will take crashers if there are available seats. If you are not registered at this time, you may obtain an add code in the following ways:

- 1) A verification form may be obtained from the Biology advising office in LS 135.
 - a) Print out your degree evaluation from the internet, and bring the page that shows your "prep for the major" courses to LS135. (Or, you may bring a transcript from e-portal showing those courses.)
 - b) The advising office will verify that you have the necessary prerequisites and give you a verification form. Bring this form to Dr. Bernstein during office hours.
 - c) We will not accept crashers after the first quiz (likely in week 2 or 3), so talk to Dr. Bernstein as soon as possible.
- 2) You may bring an unofficial copy of your transcripts to Dr. Bernstein during office hours, instead of obtaining a verification form.

Dropping Biology 352

After the first three weeks of the semester (exact date is in the class schedule handbook) it is very difficult to drop any course at SDSU. All requests after that date are reviewed by the University's registrar office or an assistant Dean, not by the instructors of the course. Unless you have a well-documented medical problem or personal problem (e.g., death in the immediate family), your request will probably be denied.

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Cell phones

The use of cell phones in any way (including text messaging) is distracting to other students and the instructor. **TURN OFF CELL PHONES** prior to lecture. The use of all electronic devices except calculators is strictly prohibited during quizzes and exams. This includes cell phones and PDAs. Put a calculator in your backpack and leave it there, so you will have it for quizzes and exams.

Class Blackboard site

All class material will be posted on Blackboard (<https://blackboard.sdsu.edu>). This will include outlines, exam scores and keys to practice problems, quizzes and exams. The lecture outlines will be available prior to each lecture for you to print and bring with you. The Blackboard site is likely to be updated at least weekly.

The lecture material provided on the Blackboard site will be outlines and some figures, rather than a complete set of notes. We emphasize that these outlines do not take the place of lecture notes and they DEFINITELY do not take the place of coming to class. You are expected to attend class and take your own lecture notes.

We expect you to print out materials from Blackboard BEFORE a given lecture, and that you BRING them to class. The pace of the lecture assumes that you have these materials with you in class so that you need not write down information already available from Blackboard.

Grading

The course is divided into three sections. Each section will be concluded with a midterm exam (100 points) over that section's material. The final will not be comprehensive; it will cover the last third of the course only. You can also expect 2 quizzes (20 points each) during each section. Quizzes will be announced in lecture, one lecture before the quiz is to be given. Make-up quizzes and exams will not be given for traffic delays, so plan accordingly.

The total points at the end of the course will be curved. Therefore, grading scales will vary from exam to exam. Without exception, students receiving less than 50% of the total points will be given a grade of F for the semester in all cases.

Exams and quizzes will primarily be multiple-choice. The instructors may present some short answer questions and problems on exams and quizzes.

For quiz #1, you will be expected to bring to class a LARGE red ParSCORE form F-288-ERI-L. (Note that the exact number on these forms may have changed this semester.)

For all other quizzes and exams, you will be expected to bring to class a SMALL red ParSCORE form F-289-PAR-L. (Note that the exact number on these forms may have changed this semester.)

You will not be able to take quizzes or exams without a ParSCORE form and a pencil!

**** The final is already scheduled for Dec. 15 at 10:30 AM. ****

**** Do not schedule personal travel during the final. ****

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Make up quizzes and exams

We will accommodate students who cannot take quizzes or exams, provided there is an unavoidable conflict or illness, and the student has given the instructor prior notice. Decisions for administering a make up exam or quiz will be made on an individual basis, with the following guidelines:

1. Prior notice must be given to the instructor if at all possible.
2. If last-minute severe illness or exceptional personal problems prevent a student from taking a quiz or an exam, the instructor should be notified by email (preferable) or phone as soon as possible, and definitely before class. Documentation may be requested.
3. Make-ups will not be given for traffic delays, work-related conflicts or personal out-of-town travel.
4. Make-up quizzes and exams will be different than those given in lecture. The format of a make-up will be short answer, essay, or some combination of these, rather than multiple choice.
5. Unavoidable conflicts with major sporting events for student-athletes, or academic activities should be kept to a minimum and documented by the appropriate university office. Documentation should be presented to the instructor during the first two weeks of class.
6. Events that require prolonged absence (more than three lectures) should be discussed with the instructor and the Biology undergraduate advisor in LS 134.

Posting grades

All grades will be posted on the Blackboard web site as soon as they are available.

Calculators

Calculators may be permitted on some exams and quizzes, but you must use only your own. Read the following carefully:

1. **Bring your own calculator every time.** You may not borrow a calculator from another student during an exam or quiz.
2. **Only simple non-programmable calculators are acceptable.** Calculations will involve square roots, exponents and scientific notation ... but nothing more difficult than that.
3. If you do not own an appropriate calculator, buy or borrow one before the first quiz.
Programmable calculators, PDAs, cell phones, etc. will not be permitted.

Academic dishonesty

We have a zero-tolerance policy for cheating of any sort. If you are caught cheating on an exam or quiz you will receive a grade of zero on that exercise. The incident will be reported to the campus judicial officer and may lead to your suspension or expulsion from the University.

I need to get a good grade in this class !!!

We want everyone to get a good grade in Genetics and Evolution. But inevitably, not everyone does as well as they should. Those of us who have taught this course for many years know that many students who earn less than a B in Biology 352 have the following comments:

1. I have seen a lot of these concepts in previous courses, so I thought it would be easy. Biology 352 goes far beyond the brief introduction you had to Punnet squares, Hardy Weinberg equilibrium, natural selection and evolution in introductory courses. The topics all *seem* familiar

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and make sense during lecture. So many students do not study as much as they would for a course in which everything is brand new. This is a huge mistake. Some students get 16 or 18 out of 20 on the first quiz, and then stop studying as much. They get 12/20 on the next quiz a few weeks later, and 60/100 on the first major exam. At that point, the course is one-third over and you already have a D. Stay on top of your studying every week, because the course continually gets more difficult.

2. I didn't put enough time into studying for this course. Most students are carrying a full load, with several other upper division courses. Nonetheless, read the text before every lecture and review your notes after every lecture. Do not fall behind! The topics in this course will continue to build on one another, lecture after lecture throughout the semester. Almost every lecture assumes that you remember and understand everything up to that point. If you fall behind after a few weeks, you will have a very difficult time recovering later.
3. I don't understand math. Genetics and Evolution is a course that focuses on the application of quantitative concepts to many kinds of problems. By its very nature, much of the course is focused on quantitative reasoning. There is no way around this. However, there is far less math in this course than in a high school algebra class, and it requires only a few statistical concepts from Bio 215 (Statistics).
4. I study and study but I just don't get it! **You cannot pass Genetics and Evolution by simply memorizing facts.** This is a course that requires quantitative reasoning and problem solving. It requires you to apply principles from lecture to a brand new situation on the exam. You will be tested on your ability to integrate different concepts and decide what the results of a particular experiment would look like – or determine whether natural selection or random drift would be more important in a real life situation. This requires a deeper level of understanding than simple memorization. Study in small groups. For students who have difficulty integrating these concepts, group study seems to help. To explain a difficult concept to one of your peers, you need to *really* understand it yourself.
5. "The tests are tricky." Frankly, we do not like multiple choice tests, but this is what we are stuck with in a course with 150 students and limited support in helping to grade exams. We do our best to make sure that every question has one and only one correct answer, and that the focus of the question is clear.

Every quiz or exam will have a mixture of some simple definitions, some straightforward calculations or breeding experiments, and some more complicated scenarios that require you to apply concepts to brand new situations. The "more complicated scenarios" are often presented as word problems. Several suggestions:

- a. Take advantage of all the practice quizzes and exams provided on Blackboard. This will show you the style of questions we are likely to ask, and the level of understanding that is required. Take the practice exams "cold". Pretend it is a real exam, take it in one sitting, and do not refer to your notes. In our experience, performance on the practice exams is a very good predictor of performance on the actual exam.
- b. If you know the right answer, do not talk yourself out of it! This is a common problem. Some students perform better if they decide what the correct answer is before looking at the answers provided. *Then* search through the list of possible answers for the correct one.
- c. Many students benefit from group study for conceptually challenging topics. Form a study group with a small number of your peers.
- d. Take advantage of office hours with the instructors, and immediately address any unclear

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concepts. The topics for each lecture build upon previous lectures, so any confusion or misconceptions will get compounded as time goes on.

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Course Objectives

By the end of Biology 352 you will have learned much about genetics and evolution. Below is a broad outline of this material. You can think of these as the BIG QUESTIONS that you will be able to answer. We strongly suggest that you keep this list of objectives accessible. On each exam, you will be expected to integrate the detailed lecture material with these broader objectives.

TRANSMISSION GENETICS

- I. Students should have a mechanistic understanding of segregation, independent assortment, linkage and crossing over and how these influence patterns of inheritance.
- II. Students should have an understanding of the nature of the basic structural elements of genetics (chromosomes, genes, and alleles) and how these elements are related to one another.
- III. Students should have an understanding of the basic modes of Mendelian inheritance: dominance/recessiveness, incomplete dominance, sex-linkage, and epistasis. They should be able to discern these modes from distributions of phenotypes resulting from crosses and from pedigrees.

POPULATION GENETICS

- I. Students should understand Hardy-Weinberg equilibrium, the null model that provides a basis for population genetics. This includes knowing the assumptions of the H-W model, and being able to determine departures from H-W equilibrium statistically.
- II. Students should qualitatively and quantitatively understand the sources of genetic variation: gene flow and mutation.
- III. Students should qualitatively and quantitatively understand modes of sorting in population genetics. These include drift, assortative mating, inbreeding, and natural selection.
- IV. Students should understand how quantitative (continuously distributed, metric) characters are treated in population genetics. This includes the concept of heritability, and the relationship between single-locus, multi-locus and quantitative traits.

EVOLUTIONARY BIOLOGY

- I. Students should know the basic principles and ideas underlying evolutionary theory and its history.
- II. Students should understand how one determines phylogenetic relationships using morphological and molecular data.
- III. Students should have a general understanding of modes of sorting for biological variation (e.g., natural selection, sexual selection, group selection, kin selection, random drift, neutral theory).
- IV. Students should know broadly what species are and how they form.
- V. Students should know how evolutionary changes are related to developmental processes
- VI. Students should know the broad outline of major evolutionary events in the history of life and how they have shaped the biota.

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Date	Topic	Readings: Pierce 2009	Freeman and Herron 2007
Sept 1	Introduction to genetics, DNA structure	Review Chapters 1 & 2. <u>Also read pp. 275-280, 412-414 in "Pierce extra" PDF on Blackboard</u>	143-145
Sept 3	Mutations: the source of variation	237-257, 267-279	145-148, 152-159
Sept 8	Mendel, monohybrid cross, probability theory	43-54	
Sept 10	Incomplete dominance, independent assortment, dihybrid cross, sex determination	55-60, 73-80	
Sept 15	Sex linked genes	81-91	
Sept 17	Modifications to Mendelian patterns	99-117	
Sept 22	<u>Furlough day</u> - No class	Assignment TBA	
Sept 24	Pedigree analysis	134-142	
Sept 29	Linkage and recombination in eukaryotes. Wrap-up	160-170, 173-179	
Oct 1	EXAM I		449 (Box 12.1)
Oct 6	Quantifying genetic variation	333-337, 361-367	160-166
Oct 8	Random mating and the Hardy-Weinberg principle	337-341	170-182
Oct 13	Assortative mating and inbreeding	341-343	264-273
Oct 15	Mutation and migration	344-346	210-212, 223-227
Oct 20	Random genetic drift	346-349	232-249
Oct 22	Introduction to natural selection	349-352	182-188
Oct 27	<u>Furlough day</u> - No class		
Oct 29	Models of natural selection	352-355	195-205, 212-219
Nov 3	Quantitative genetics. Wrap-up	299-305, Fig.11.15, 312-319	319-324, 333-338
Nov 5	EXAM II		
Nov 10	Evolution overview		Ch. 1, Ch. 2, Ch. 14: 556-560
Nov 12	Ideas about evolution		Ch. 2, Ch. 3: 73-95
Nov 17	Evolution since Darwin		Ch. 3: 96-107
Nov 19	Importance and use of phylogenies		Ch. 4
Nov 24	Speciation and species concepts		Ch. 16
	FALL BREAK		
Dec 1	Sexual and kin selection		Ch. 11, Ch. 12
Dec 3	Evolution and development		Ch. 19
Dec 8	<u>Furlough day</u> - No class		Assignment TBA
Dec 10	Biological radiations and extinctions: History of life. Wrap-up.		Ch. 18
Dec 15	FINAL EXAM 10:30-12:30		