

BIOL 4830 POPULATION GENETICS FALL 2018

Dr. Jennifer Cooper

Office hours: M 12:30-1:30

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Write BIOL 4830 in the subject line!

Check your Stan State email every day!

COURSE PREREQUISITES

Completion of Introductory Genetics BIOL 3350 (or equivalent) with a grade of D or better.

COURSE DESCRIPTION

This course focuses on examining how the forces of evolution contribute to population-level genetic variation, and the current molecular, statistical and bioinformatics approaches toward measuring that variation. The topics to be discussed include: the history of population genetic research, the forces of evolution (natural and sexual selection, genetic drift, inbreeding, gene flow, mutation), F-statistics, coalescence, quantitative traits, comparative genomics and human population genetics. The use of population genetics in conservation, biogeography and ecological studies will also be discussed. Throughout the course, a focus on modern techniques will unite theory with current research in the field.

Familiarity with the concepts of genetics presented in the pre-requisite course is absolutely necessary. There is some mathematical-based theory and statistical problem-solving in this course, therefore a student must possess basic algebra skills and a basic understanding of probability. For a student to be successful a minimum of 12 hours of learning are needed outside of class (this does not include time you spend on homework assignments). **If you are not prepared to dedicate the time and effort needed for this course, you should reconsider your enrollment.**

REQUIRED TEXTS/RESOURCES

- *Molecular Population Genetics*. Hahn, M 2019. Sinauer Associates-Oxford University Press. ISBN: 9780878939657
- A package of 3" x 5" index cards to use for in-class writing and drawing activities.

CENSUS DATE

This course can only be taken for a letter grade. Students can drop the course prior to the census date of September 19. After this date, a student cannot withdraw without an appeals process documenting extraordinary circumstances.

PERSONAL INTEGRITY AND CLASSROOM BEHAVIOR

It is assumed that you have read and understood the university's position on academic integrity and student discipline.

Cheating and plagiarism will be dealt with as severely as university and state regulations allow. This includes receiving an F in the course, and being reported to University Judicial Affairs.

Do not text in my class. It is rude. Use of laptops is forbidden; take notes by hand. You may record the lecture.

GRADING

Grades are determined by the points you earn during the course. I reserve the right to use +/- grades, rather than whole letter grades. Your scores will be archived on **Blackboard**.

Quiz 1	125 points
Quiz 2	125 points
Quiz 3	125 points
Cumulative Final Exam	225 points
Study group activities:	
In-class activities	50 points
Article summaries (2, 50 points each)	100 points
Homework assignments (2, 50 points each)	100 points
Poster (participation 50 pts, presentation 100 pts)	150 points
Total	1000 points

QUIZZES AND EXAMS

The quizzes and exams will be given in a mixed format (multiple choice, true/false, short answer/essay, graph interpretation). Quizzes 2 and 3 will assume that you are familiar with material from earlier quizzes. I do not recycle exam questions. **Do not make the mistake of underestimating the difficulty of exams.**

Students who arrive after the first exam of the day has been turned in will not be allowed to take the exam, and will receive a zero grade for the exam. If you must leave the room for personal reasons, you will not be allowed to finish the in-class exam. Your partially finished exam will be graded as it stands. If you plan to miss an exam for any reason, you must take an alternate exam before the in-class exam is scheduled to take place. If you miss an exam unexpectedly, you must provide documentation of a legitimate reason for doing so; otherwise, you will not be allowed to take the alternate exam, and you will receive a zero grade for the missed exam.

STUDY GROUPS

You will be assigned to a study group of 3 or 4 students at the beginning of the semester. You will work very closely with your study group members in class activities and assignments. Part of your grade is dependent on your teamwork, thus every group member must do their share of the work! To ensure that each group member is contributing, I will be using online submission platforms and co-authorship grading (see the relevant sections below).

IN-CLASS ACTIVITIES

As I progress through a lecture, I will occasionally stop and assess your understanding. You will use a blank index card to answer a question, or explain a concept in your own words, or draw a figure representing a process. You will turn these cards in to me, and I will award points based on the quality of the work. In half of these exercises, you will be allowed to consult with your group members.

ARTICLE SUMMARIES (SUBMITTED VIA TURN-IT-IN ON BB)

I will post PDFs of the articles on the course BlackBoard site (Documents & Content page) days before the assignment is due.

1. Each group member will read the entire article, and think deeply about how the hypotheses are being tested, the analytical approaches, and the emerging conclusions. Each member will take responsibility for writing a summary of one of the sections within the article (Introduction, Materials and Methods, Results, Discussion) **in their own words**, for a total of 1 single-spaced page. **Include all article headers and sub-headers in your summary (these should be identical to the original article, and will not count as plagiarism).**
2. You will post this draft summary on to BlackBoard at least 48 hours before the assignment due date, using the Wiki specific to your assigned study group. Other group members will also post their section summaries to the assignment wiki, placing their text above or below yours to maintain the order found within the original article. Include your name in bold font above your section, so it is easy for me to give you credit for your work. **Once your rough draft is posted, do not modify it in any way.** Incomplete drafts will receive only partial credit.
3. All group members will then use the COMMENT button below to provide **very explicit instructions** on how their partners can improve their draft summary, **focusing on conceptual and analytical aspects (not just editorial aspects)**. You must offer at least 1 substantive conceptual/analytical comment to receive full credit. "Substantive" means you write an explanation which clearly demonstrates to me your deep understanding of an evolutionary concept, or an analytical approach used in the article. It helps if you also write a few sentences which your group member can cut and paste within their own summary, to improve their draft. You must offer a novel comment; do not reiterate suggestions made by another group member. These comments are due 24 hours before the assignment due date.
4. The group member who wrote the Introduction section will then submit the complete, final draft via TurnItIn on BB. This link will appear on the BlackBoard Assignments page 24 hours before the final due date.

You can earn a maximum of 40 points for your summarized section, and 10 points for your commentary. There are 2 article summary assignments, so the total points you can earn sums to 100. Your two summaries must include either an Introduction or a Discussion, and either a Materials/Methods or a Results. Late submissions will have 20% deducted for each day the assignment is overdue.

ONLINE SIMULATION EXERCISES (SUBMITTED VIA TURN-IT-IN ON BB)

We will use an online program (see link on Blackboard) to perform simulations, using parameters which I will provide.

1. Each group member will complete the homework assignment either together or on their own, so that everyone can understand the simulation results. Think deeply about how each simulation result should be explained. Each member will take responsibility for performing and explaining a sub-set of the simulations within the homework assignment **in their own words**, for a minimum of 1/2 single-spaced page. **Analyses must include screenshots of graphs and output.** Authors will focus on describing the concept or process that was being explored in each component of the simulation, and discuss what they learned. Within the summaries, refer directly to specific components of your graph images or results tables, using dots and stars or by circling an area or number. (I.e. "You can see in the graph of allele frequency changes that the frequency of the q allele begins to decline at the 10th generation [star], but the frequency of heterozygotes remains above 40% until the 100th generation [circled].")
2. You will post this draft analysis on to BlackBoard at least 48 hours before the assignment due date, using the Wiki specific to your assigned study group. Other group members will also post their section summaries to the assignment wiki, placing their text above or below yours to maintain the original order within the assignment. Include your name in bold font above your section, so it is easy for me to give you credit for your work. **Once your rough draft is posted, do not modify it in any way.** Incomplete drafts will receive only partial credit.
3. All group members will then use the COMMENT button below to provide **very explicit instructions** on how their partners can improve their draft answer, **focusing on conceptual and analytical aspects (not just editorial aspects).** You must offer at least 1 substantive conceptual/analytical comment to receive full credit. "Substantive" means you write an explanation which clearly demonstrates to me your deep understanding of an evolutionary or population genetic concept or process. It helps if you also write a few sentences which your group member can cut and paste within their own answer, to improve their draft. You must offer a novel comment; do not reiterate suggestions made by another group member. These comments are due 24 hours before the assignment due date.
4. The group member who analyzes the **first** simulation exercise within each homework assignment will then submit the complete, final draft via TurnItIn on BB. This link will appear on the BlackBoard Assignments page 24 hours before the final due date.

You can earn a maximum of 40 points for your analyzed simulation components, and 10 points for your commentary. There are 2 homework assignments, so the total points you can earn sums to 100.

PLAGIARISM

Be very careful to avoid plagiarism on article summaries and homework assignments, because the TurnItIn software is very good at detecting even a single plagiarized sentence. You may be tempted to lift phrases directly out of the article, or use wording lifted directly from my slides...resist this temptation, because such phrases are highlighted by the software, and **if there are more than a few phrases (6-8 words in a row) used verbatim within a single summary, I will award every group member 0 points for the assignment (group members will not be penalized if they warned the section author about specific examples of plagiarism in the draft summary).** The TurnItIn archives copies of the work submitted in previous semesters, and will be making comparisons, **so resist the temptation to plagiarize from friends familiar with the course.**

POSTER PRESENTATION

Poster presentations will be created using the Wiki specific to your assigned study group. Each study group will select a topic relevant to population genetics, and perform a small literature review which includes **exactly** 4 recent (no older than 2009) primary literature articles. Each student will focus on reading one of the 4 articles, become intimately familiar with the work, and incorporate the most important aspects of the article within the larger, conceptual poster. The poster will be presented in the Poster Session (during the Final Exam period).

Participation points (50) can only be earned by documenting your contributions on Blackboard.

Each group member's contribution to the poster will be documented using the following structure:

1. Each group member chooses an article to summarize.
2. Each group member creates a new wiki page for their poster contribution, titled like "Poster, Betsy Ross,".
3. Group members will post their article summary on their wiki (see schedule for due date), and other group members will use the "Comments" tab to make suggestions and revisions.
4. More lengthy discussions can be documented on the group's Discussion Board (use the Board only for the poster project, please...don't use it for homework assignments, etc.).
5. To earn full points, a group member must:
 - a. post their own work on their own wiki
 - b. make constructive comments regarding **every other** group member's work on member wikis
 - c. discuss the formatting, organization, and printing of the poster on the Discussion Board

Any contributions which are documented in other ways (texting, Google Docs, etc.) won't be considered for credit.

To find primary literature articles relevant for your topic:

- Go to the CSU Stanislaus library website (link on University homepage).
- Choose "Find Books and Articles", then choose "Databases A-Z", then choose "Biological Abstracts." You will be taken to the Web of Science hub.
- Search on a combination of terms to find articles about the topic your group finds most interesting. Read the abstracts, and choose the article that the entire group feels is interesting and understandable.
- Click the "FIND IT!" link to access the full-text PDF. **Email me the 4 article PDFs for my approval; a single email with your group name in the subject line is desirable.**

Use Microsoft PowerPoint to prepare the poster presentation, by adding components (text boxes, images) to a single slide. You must format the slide as a custom size, with the minimum dimensions of (36" wide X 32" tall). I have posted a couple of **example posters** on Blackboard for you to use as a guideline for formatting and level of scientific rigor.

Currently, the best place to get your poster printed is Staples or Office Max, but you call around and comparison shop. A color print job should cost ~\$40. Talk to the print shop ahead of time to find out how long it will take, and build this into your preparation schedule. **If the print shop makes a mistake, it is their responsibility to print a second perfect copy for free.**

- The main goal of a poster is to relate the main points of your topic with as little effort as possible on the part of the audience to read, interpret, and understand.
- Use a suitable font size (can be read from about four feet away).
- Include a Title, and a list of student presenters. The Literature Cited section can be on a separate sheet of paper, to pin next to your poster.
- Graphics are required (figures, special equations, photos). Graphics should be high resolution, and should convey the most important ideas in the poster. Don't add images just for "pizzazz".
- Clearly explain the ideas with short, concise sentences. **Use bullet points with informative but brief sentence fragments, instead of paragraphs!**
- For each figure, use an explanatory caption. You can outline each figures with a colored box, and outline the relevant paragraph/list in the Results or Discussion with the same color...this will help readers associate figures with text.
- Specific facts, data or images taken from the 4 articles must be cited within the poster text, using APA format.

COURSE OBJECTIVES

- Understand the molecular basis for population-level diversity
- Understand the processes that result in changes in allele frequencies
- Demonstrate knowledge of the molecular patterns of change that underlie population-level evolution
- Demonstrate knowledge of factors leading to the evolution of and influencing the expression of complex traits

COURSE SCHEDULE

All assignments are due by 5 pm on the date specified.

Week	Lecture topic	Text	Assignment
8/20	Introduction to the course		
8/27	MODELS OF EVOLUTION Basic sequence terminology Models of evolutionary processes Models of molecular evolution	Ch 1 p. 2-3 Ch 1 p. 3-18 Ch 1 p. 18-24	Begin using the Study Recipe
9/3	9/3 Labor Day holiday NO CLASS EXPERIMENTAL DESIGN Population sampling	Ch 2 p. 25	
9/10	DNA sequencing Genotyping	Ch 2 p. 26-40 Ch 2 p. 40	
9/17	9/19 Census date DESCRIBING VARIATION Measures of sequence diversity Additional measures of diversity	Ch 3 p. 43-54 Ch 3 p. 55-58	Quiz 1 Monday
9/24	RECOMBINATION Measuring linkage disequilibrium Estimating recombination Gene conversion	Ch 4 p. 59-67 Ch 4 p. 68-76 Ch 4 p. 77-78	Article 1 due 9/28
10/1	POPULATION STRUCTURE Population differentiation Measuring population differentiation	Ch 5 p. 79-80 Ch 5 p. 81-90	
10/8	10/10 Non-instructional Day NO CLASS Effect of evolutionary processes on differentiation Defining populations	Ch 5 p. 91-103 Ch 5 p. 104-110	Quiz 2 Monday
10/15	THE COALESCENT Simulating samples of DNA sequences Simulating the coalescent	Ch 6 p. 111-113 Ch 6 p. 114-118	Simulation 1 due 10/19
10/22	Understanding the coalescent Extending the coalescent	Ch 6 p. 118-123 Ch 6 p. 124-130	
10/29	DIRECT SELECTION The accumulation of sequence divergence Detecting selection using divergence	Ch 7 p. 131-137 Ch 7 p. 137-145	Quiz 3 Monday
11/5	Detecting selection using polymorphism Detecting selection using polymorphism & divergence	Ch 7 p. 145-149 Ch 7 p. 149-164	Article 2 due 11/16
11/12	11/12 Veteran's Day NO CLASS LINKED SELECTION Detecting selection using the amount of polymorphism	Ch 8 p. 165-174	
11/19	Detecting selection using the allele frequency spectrum Detecting selection using patterns of LD	Ch 8 p. 175-189 Ch 8 p. 189-201	Quiz 4 Wednesday
11/26	DEMOGRAPHIC HISTORY The demographic history of single populations The demographic history of multiple populations Population genetics without polymorphism Caveats to inferences of demographic history	Ch 9 p. 203-222 Ch 9 p. 222-238 Ch 9 p. 239-247 Ch 9 p. 247-248	Simulation 2 due 11/30
12/3	POPULATION GENOMICS Genome-wide scans for selection Methods for genome-wide scans for selection Future approaches	Ch 10 p. 249-257 Ch 10 p. 258-266 Ch 10 p. 268-274	
12/10	FINAL EXAM regular class period		
12/12	POSTER SESSION 11:15 a.m.-1:15 p.m.		

CAMPUS COUNSELING SERVICES

Overwhelmed by the stress of juggling classes and your home life? Our campus offers excellent counseling services to help support you!

Library 185; Phone (209) 667-3381; Web <http://www.csustan.edu/Counseling>

STUDENT HEALTH CENTER

You have already paid for access to health care on campus. Services include: birth control, flu shots, immunizations, pharmacy, check-ups, HIV testing, TB tests, and doctor's notes for when you are sick!

Phone (209) 667-3396; Web <http://healthcenter.csustan.edu>