

# BIEB 156 – Population Genetics

Fall Quarter 2018  
Syllabus

## Basic Course Information

**Course website:** <http://tritoned.ucsd.edu> (BIEB 156 [FA18]) – check in several times a week

**Instructor:** Sergey Kryazhimskiy <[skryazhi@ucsd.edu](mailto:skryazhi@ucsd.edu)>

**Instructional Assistant:** Yuansheng Zhou <[yuz461@ucsd.edu](mailto:yuz461@ucsd.edu)>

**Instructor's Office:** Muir Biology Building, #3258

**Office Hours:** Tuesday 11 AM (at Instructor's office)

### Lectures and Discussion sections:

Lecture	Day	Time	Location
A00	Tuesday Thursday	9:30 AM to 10:50 AM	CSB 005

Discussion sections are an important and required part of the course. You will be graded on your participation in the discussion sections. Sections will be devoted to problem solving and to discussing the lecture topics and papers related to lectures.

Section	Day	Time	Location
A01	Wednesday	6:00 PM to 6:50 PM	CENTER 201
A02	Wednesday	7:00 PM to 7:50 PM	CENTER 201

## Course Description

How do natural selection, mutation, migration and genetic drift drive evolution? You will learn how these forces operate and how to describe them quantitatively with simple mathematical models. We will discuss how to apply this knowledge to understand the spread of drug resistance in pathogens, the evolution of beneficial as well as disease traits in our own species, the evolution of engineered organisms and more.

## Learning Outcomes

In this course, you will learn how and why genetic composition of populations changes over time, and what practical implications these changes can have. By the end of the course, you will be able to:

- Give examples of currently on-going evolutionary changes in various biological systems.
- Explain what genetic variation is, why it is important, how it can be measured, where it comes from and how it changes over time.
- Explain how models are different from reality and why we need models to understand nature.
- Describe models that we use to understand the evolutionary processes in populations, and explain why certain models are used in certain situations.
- List the forces that determine the dynamics of allele frequencies in a population and explain how these forces affect the dynamics.
- Write down a simple mathematical model of an exponentially growing population and analyze it.
- Write down a simple mathematical model of a competition between two genotypes in a population and analyze it.
- List and explain the sources of randomness in evolution. Write down an expression for the probability of fixation an allele in a population, and analyze it.
- Make basic population genetic calculations and estimates. For example, calculate the expected number of mutations that will arise in a population, or estimate the number of generations to the most recent common ancestor of a group of individuals.
- Give examples of the types of information one can extract from genetic data. Design a simple sampling and analysis procedure to obtain some of this information.
- Make basic inferences about population's evolutionary past from simple genealogical trees.

## Course Prerequisites

1. BICD 100 (Genetics)
2. MATH 10A or MATH 20A

Population genetics is a quantitative discipline. To understand the material in this course, in addition to basic knowledge of genetics, you also need to have a working knowledge of calculus. We will review the key topics that will be necessary for this course, but please review this material before the start of the course.

## Required Learning Materials

Short writing activities will be done in class and in discussion sections, so please bring paper, pens and/or pencils. Calculators are sometimes necessary.

## Optional Learning Materials

Richard Halliburton. *“Introduction to population genetics”*, 1<sup>st</sup> edition. Pearson Education Inc (ISBN 0-13-016380-5).

Daniel L. Hartl and Andrew G. Clark. *“Principles of population genetics”*, Sinauer Associates, Inc (ISBN 0-13: 978-0-87893-308-2).

All the required material will be covered in class. However, reading textbooks will likely be very helpful. Halliburton is a basic introductory text, Hartl & Clark is more comprehensive. Textbooks will give you a sometimes different and/or wider perspective on some issues. It also has useful exercises similar to those that will be given on the exams.

## Assessment

Item	Percent
Midterm exam	25%
Final exam	25%
Homework	25%
Group presentation <sup>a</sup>	10%
Participation in class and discussion sections <sup>b</sup>	10%
Quizzes in class <sup>c</sup>	5%
Extra credit <sup>d</sup>	Up to 5%

<sup>a</sup>See [Group Presentation](#)

<sup>b</sup>See [Participation](#)

<sup>c</sup>See [Quizzes](#)

<sup>d</sup>See [Extra credit](#)

## Group Presentation

Two of the most valuable soft skills that you need to master to succeed in any future career are working effectively in a team and presenting your work in a clear compelling way.

To sharpen these skills, everyone will participate in a team project resulting in a presentation. The goal of the project is to read and understand a primary research paper about evolution and present it to the class. Each team will consist of two people. The total score for the presentation for each person will consist of two parts, the Quality Score (QS) and the Contribution Score (CS). The total score is calculated as  $0.8 \times QS + 0.2 \times CS$ . Both members of the team will receive the same QS based on the assessment of the quality of the presentation by the instructor. CS will be determined by each individual's contribution to the team.

## Participation

This class is small. Take advantage of this. You will have a lot opportunities to interact with the instructor. Please use them. The instructor will ask questions during class and you can ask your own questions. Please do not hesitate to ask questions to clarify whatever is unclear to you. If something is unclear to you, chances are it is unclear to other students. Your questions will help not only you but also your fellow students. They

will also help the instructor to teach more effectively. Testing your individual knowledge is NOT the purpose of these interactions. Thus, it is better to say something wrong than to say nothing.

In the Discussion sections, you will work with the instructor or the IA on problem sets. The instructor or IA will ask each of you to come to the board and solve problems. Again, these exercises are not intended for testing your knowledge, but to help you learn.

Here is how the participation point (PP) system works:

1. Each PP is worth 1% of your final grade
2. You can earn up to 3 PPs per week
3. You can earn a maximum of 10 PPs during the entire course
4. Since there are 30 opportunities to earn PPs, the expectation is that each of you earns all 10 points
5. What earns you a PP is inherently somewhat informal, but here is a rough guide for you. The following activities will generally earn you PPs:
  - a. Answer instructor's questions during lectures or discussion sections. However, not all questions will have the same value. For example, if you attempt to answer a difficult question, you might get one PP right off the bat. But you might need to answer multiple smaller questions to earn one PP. Your answer does not have to be correct, but it needs to make sense. Nonsensical answers will not be accepted.
  - b. Work on the blackboard during class or discussion section. Whether you succeed in solving the problem at hand does not affect your PP.
  - c. Participate in team exercises during lectures or discussion sections.
  - d. Ask substantive and or insightful questions on the topic of the lecture. This is something that may occasionally happen, but you should not count on it as a default mechanism of earning PPs.
6. Activities that generally will NOT earn you PPs (but you should still do them):
  - a. Being present at lectures
  - b. Being present at discussion sections
  - c. Coming to office hours and working on the board in the instructor's office
  - d. Asking clarifying or tangential questions during lecture
  - e. Asking questions about homeworks
  - f. Any interaction with the instructor at times other than lectures or discussion sections

## Quizzes

On Tuesday each week, we will have a 5-minute quiz in class. Bring a pen/pencil and a calculator. Quizzes are designed for the instructor to gauge how you absorb the material, NOT to test your knowledge. Quizzes should be easy. If you feel that you do not know how to solve the problem on the quiz, talk to the instructor or the IA. Midterm and the final will most certainly have problems that are analogous to those in quizzes.

Each quiz will be between 5 and 7 points worth, of which 1 point will be given for merely writing your name on the piece of paper.

### **Extra credit**

A number of extra credit (bonus) assignments will be given throughout the course. Bonus problems/assignments will be more difficult than usual. However, each bonus point will be equal to 1% of your final grade.

## **Course Policies**

### **Homeworks**

Homeworks are an essential element of the course. Homeworks will primarily consist of problem sets, but there will also be other assignments. Problems in the exams will be similar to those in the homeworks, but easier. So, if you do well on your homeworks, you will do really well on the exams. You will do well on the homeworks if you attend discussion sections and ask questions. If you have difficulties with some homework problems, please talk to the instructor or IA.

Homeworks will be due in class as specified in the Lecture Plan (see below), unless instructed otherwise.

### **Late Turn-ins**

Late turn-ins will generally not be accepted.

### **Grade Dissemination and Answer Keys**

You can access your scores using the Grade Center in TritonEd.

The instructor will do their best to return all graded quizzes, in-class writing materials, and midterm exams as soon as possible. Your final exam will not be returned and no answer key will be provided. If you need to see your final exam, you will be able to do so by setting up a special appointment with the instructor.

### **Make-ups and Regrades**

There will be no make-ups for quizzes and presentations.

Make-ups for missed exams will be given only with a valid excuse. A valid excuse is a serious medical or family emergency. Appropriate documentation (for example, letter from doctor) is required. Extraordinary circumstances will be considered on a case by case basis. If you have such an emergency, inform the instructor as soon as possible. No midterm make-ups will be possible after the graded exams and answer keys have been returned.

Regrades can be requested only if there are errors in either the addition of points or the reading of your answers. If a regrade request is made, we may regrade the entire exam. If the score changes after the regrade, the new score will be recorded. **WARNING:** All

exams will be photocopied before being returned to students. Do not modify your exam after it has been graded when asking for a regrade. Regrade exams found to be modified will be sent to the UCSD's Office of Academic Integrity.

Requests for regrading of exams must be made in writing (email is okay) within 2 days after the exam is returned and/or answer key is posted. Please explain concisely what errors you believe were made. All additional communications on regrade between the instructor and student will be conducted by email.

## **Teamwork Policy**

You are encouraged to work together with other students on homeworks and take-home exams, or you can consult with the IAs or the instructor, if you have questions.

However, you must write the final answers by yourself based on your own understanding, without consulting with other students. Thus, no two handed-in homeworks/exams should ever be exactly identical.

## **Academic Conduct Policy**

Academic conduct and integrity is an essential part of teaching and learning. Visit the [Office of Academic Integrity](#) (OAI) for more information.

## **Lecture plan**

Please find a link to the current lecture plan on TritonEd. This plan will be updated as the course goes on.

## **Instructor Goals**

At a minimum, I hope to pursue the following goals and solicit your open and timely feedback on how well we are meeting these goals:

- Communicate effectively and frequently;
- Be an enthusiastic, active and involved;
- Demonstrate a mastery of the discipline;
- Relate material to current practices;
- Clearly explain complex concepts and ideas;
- Provide a framework for lifelong learning;
- Strive to involve participant in class activities;
- Be available to assist participants in or out of class; and
- Have respect and concern for all participants.

To provide your feedback, you can either talk to the instructor in person during office hours, or relay your feedback through your IA (anonymously, if you wish).