

## BIOL 5112/3112: Fundamentals of Evolutionary Genomic Medicine

---

**Dr. Sudhir Kumar**

Office: 602A SERC

Email: s.kumar@temple.edu

Room: SERC 110B

Time: Wednesdays: 5:30-8:00 PM

Office hours: By appointment (e-mail me)

BIOL 3112 (For undergraduate students)

BIOL 5112 (For graduate students)

Prerequisite: Biology 2112 with a grade of C or better.

NOTE. Graduates and undergraduate attend the lectures together at the same time in the same room. All students are encouraged to read and participate in the discussion of the weekly reading assignments. But, only graduate students will be required to make short presentations on reading assignments. Each graduate student will make two short 5-slide presentations during the semester and will answer questions from fellow students.

### Course Description

Modern evolutionary theory offers a conceptual framework for understanding human health and disease. In this course we will examine human disease in evolutionary contexts with a focus on genome variation. We ask: What can evolution teach us about human populations? How can we understand disease from molecular evolutionary perspectives? What are the relative roles of negative and positive selection in disease? How do we apply evolutionary principles to diagnose diseases and develop better treatments? This course focuses on discovery-based learning and case studies in genome medicine.

### Course Learning Objectives

1. Learn key concepts and principles of molecular evolution in a discovery-based classroom
2. Learn to apply evolutionary concepts and principles to genetic diseases and adaptations
3. Critically evaluate how phylogeny informs medicine (phylomedicine)
4. Critically evaluate if past adaptations were precursors of contemporary human diseases
5. Develop familiarity with state-of-the-art genome medicine through reading assignments

### Textbook

Required: Principles of Evolutionary Medicine (Gluckman et al.; Oxford, 2016)

Reference: Molecular Evolution and Phylogenetics (Nei & Kumar; Oxford, 2000)

### Course Segments

#### Key evolutionary concepts and methodologies

1. Chromosomal change and diseases
2. Interpreting DNA and protein sequence differences
3. Fate of new mutations
4. Inferring evolutionary histories and dynamics
5. Discovering negative selection and adaptive evolution

#### Case studies in Genetic and genome medicine

6. Human adaptations via genetic innovations
7. Phylomedicine of Mendelian diseases
8. Phylomedicine of Complex diseases
9. Phylomedicine in Oncology
10. Phylomedicine of pathogens
11. Role of microbiome in our health and disease

## Grading

Separate grading curves will be used for graduate students (GS) and undergraduate students (UG). All graduate students will be given reading assignments each week. They will be required to submit short summaries and discuss it in the class (see grading component #4 below).

1. **Classroom attendance**: 200 points (GS & UG)

This will be a highly interactive classroom, where students will learn concepts through personal observations in the classroom. Therefore, attendance is required, and students are strongly advised to avoid scheduling conflicting events with the class time. Exceptions will be made in only rare cases (e.g., severe medical or family emergencies), and the penalty for missing a class period is 50 points unless the absence is preapproved in writing. Note that missing one week is equal to missing three lectures in course, which is impossible to make up.

2. **Mid-term exam**: 400 points (GS & UG) (**March 8<sup>th</sup>**)

There will be one mid-term exam that will test key evolutionary concepts and methodologies taught in the class. It will be administered in the classroom and will be in two parts:

(A) Multiple-choice questions (5:45 – 6:45 pm)

(B) Essay-type questions (7:00 – 7:45 pm)

**Sorry, NO make-ups.**

3. **Final exam**: 400 points (GS & UG) (**May 10<sup>th</sup>**)

This will be an in-class 2-hour exam. You will be given case-studies to critically evaluate and answer related questions in multiple-choice and short-essay formats.

4. **Reading assignments**: 500 points (**GS only**)

a. *Weekly reading assignment summary* (250 points): All graduate students will be required to come to class prepared to discuss each of the reading assignments.

b. *Class presentation* (250 points): Each week, two graduate students will be selected to make a 5-slide presentation of the reading assignment to the class. Each student will summarize the key findings and answer questions from fellow students.

### Class days:

January			18	25	
February	1	8	15	22	
March	1	(Exam) 8	15	22	29
April	5	12	19	26	
May		(Final) 10			

**Civility & Temple's Code of Conduct (CoC):** Violations of the CoC include, but are not limited to: academic dishonesty and impropriety, including plagiarism and academic cheating; interfering or attempting to interfere with or disrupting the conduct of classes or any other normal or regular activities of the University (see: [http://policies.temple.edu/getdoc.asp?policy\\_no=03.70.12](http://policies.temple.edu/getdoc.asp?policy_no=03.70.12)).

**Disability Disclosure:** Any student who has need for accommodation based on the impact of a disability should contact the instructor privately to discuss the specific situation as soon as possible. In addition, Disability Resources should be contacted at 215-204-1280.

**Student/Faculty Academic Rights and Responsibilities:** The University's policy can be accessed through the following link:

[http://policies.temple.edu/getdoc.asp?policy\\_no=03.70.02](http://policies.temple.edu/getdoc.asp?policy_no=03.70.02)