

CRISPR, Genome Editing, and the Future of Medicine

FRS 50Z

Harvard University, Fall, 2019

Thursdays 3-5:15, Broad Institute of Harvard and MIT, 75 Ames Street, Room 3013

(Pre-paid Charlie Cards will be provided to ride the T from Harvard to Kendall and back)

Overview

The life sciences are undergoing a revolution stimulated by breakthrough advances in genome editing technologies. These technologies, including CRISPR, enable researchers and physicians to modify target DNA sequences in the genomes of living cells, including human cells and human embryos. The goal of this Seminar is to equip participants with an understanding of the genome editing revolution that will inform their lives inside or outside of science. During the early part of the semester, students will learn how these remarkable agents were discovered and how they work. We will also discuss their current limitations, their potential to shape medicine, and some social and ethical implications of their use. Students will analyze recent reports from both the scientific literature and from popular media, and will present their analyses and reasoned opinions during the semester. Participants will also visit a state-of-the-art genome editing laboratory during the semester, and will develop and propose “think pieces” on an aspect of genome editing to the class at the end of the semester.

Instructors

David Liu is the Richard Merkin Professor and Vice-Chair of the Faculty at the Broad Institute, Thomas Dudley Cabot Professor of the Natural Sciences and Professor of Chemistry and Chemical Biology at Harvard, and a Howard Hughes Medical Institute Investigator. He graduated from Harvard College in 1994 and earned his Ph.D. at U. C. Berkeley in 1999 before starting as an Assistant Professor at Harvard the same year. He has previously taught chemical biology (Chem 170), Molecules of Life (SLS 11), organic chemistry (Chem 27), and an integrated introduction to the life sciences (Life Sciences 1a). He has been awarded three university-wide teaching distinctions at Harvard: the Roslyn Abramson Award in 2003, the Joseph R. Levenson Memorial Teaching Prize in 2007, and a Harvard College Professorship in 2007. David’s research group integrates chemistry and evolution to illuminate biology and enable new therapeutics, including the development of several widely used genome editing technologies.

David R. Liu

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Aditya Raguram (teaching fellow) is a second-year Ph.D. student in the Chemical Biology program. He graduated from Harvard College in 2018 with an A.B. in Chemistry & Physics. He has previously served as a teaching fellow for calculus (Math 1b), organic chemistry (Chem E-2a), and laboratory electronics (Physics 123). As an undergraduate, his research spanned antibody engineering and evolution, ribozyme biochemistry, and viral capsid structural biology. As an NSF Graduate Research Fellow in the Liu laboratory, Aditya works at the intersection of directed evolution, protein engineering, and genome editing.

Aditya Raguram

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Prerequisites

High school chemistry and biology knowledge.

Readings

In addition to the lectures and discussions, articles from the scientific literature and from the popular media will form the course material.

Academic Integrity Policy

You are expected to attend all Seminar meetings, participate in discussions, and refrain from distracting behavior in class or section. If you have professional conflicts (job interviews, medical school visits, etc.) discuss them with the instructor and we will develop a plan to resolve the conflict. Please review Harvard's Plagiarism Policy (available online), which describes the university's rules on coursework and collaboration.

Seminar Schedule (subject to change)

Meeting	Date	Topic	Assignments
1	9/5/19	Introduction and information flow in living systems	Pre-read #1
2	9/12/19	Genome editing in the pre-CRISPR era	Pre-read #2
3	9/19/19	Discovery of CRISPR and its development as a genome editing agent	Pre-read #3
4	9/26/19	Next-generation genome editing agents	Pre-read #4
5	10/3/19	Visit to a genome editing laboratory	
6	10/10/19	Case study: genome editing in agriculture	Pre-read #5
7	10/17/19	Case study: genome editing in medicine	Pre-read #6
8	10/24/19	Genome editing challenges and limitations	Pre-read #7
9	10/31/19	Case study: genome editing in the popular media	
10	11/7/19	Genome editing commercialization, ethics, and other societal issues	Pre-read #8
11	11/14/19	Student "think piece" planning	
12	11/21/19	Presentation of student think pieces	