

Course Syllabus – GNET 760

Advanced Topics in CRISPR-Based Genome Engineering; Origins, Applications, and Ethical Considerations

Short Title: CRISPR Course

Effective Term: Spring 2020 (March 19-April 23)

Dates: Tuesday/Thursday 3:30pm-4:45pm (5 weeks)

Location: TBD

Course units/hours: 1 Credit Hour

Grading Basis: (GRAD – H, P, L, F)

Course Director: Hector L. Franco Ph.D., Assistant Professor, Department of Genetics

Email Address: hfranco@med.unc.edu

Office Hours: By appointment

Prerequisite: This course is targeted to graduate students in the biomedical sciences, and previous advanced coursework in genetics or molecular biology is expected. Others may audit, or participate informally with prior permission from the course director.

Course Description: Precise genome engineering of living cells has been revolutionized by the introduction of the highly specific and easily programmable properties of the CRISPR-Cas technology. This has greatly accelerated research into human health, has facilitated the discovery of novel therapeutics, and has also been used as a clinical tool for gene therapy. However, the ability to alter the human genome in a permanent and inheritable way can lead to unintended (or sometimes intended) consequences that can profoundly change society. This graduate-level course is designed to teach students about the origins of CRISPR-Cas genome engineering technology, its applications to research and human health, and the ethical/societal considerations surrounding this powerful technology. Emphasis will be made on recent literature, new applications, discoveries and bioethics. As a prerequisite, students interested in taking this class must have taken an advanced Genetics or Molecular Biology course. Students that are unsure if they meet the requirements to take this course can email the course director Dr. Hector L. Franco (hfranco@med.unc.edu) with their inquiries. Registration will be limited to 15 students.

Course Objectives (Learning Outcomes): This course is designed to provide graduate students in biomedical research programs familiarity with biological principles and modern approaches for the use of CRISPR-Cas genome engineering technologies. Students will learn about the discovery of CRISPR and how it is applied to mammalian cells, with emphasis on the molecular mechanisms of how CRISPR-based genome engineering works. In addition, this course will provide students with a base of knowledge on the various and often evolving applications of this technology for research, gene-therapy and the discovery of novel therapeutics. Students will become familiar with experimental design and potential pitfalls to consider when applying this technology to their own research. Finally, students will critically evaluate recent literature and debate about the future of CRISPR, the ramifications on humans and society, and whether or not its application in certain contexts should be limited. Lectures will be based on scientific literature, recent news, and case studies.

Evaluation Criteria: Student evaluation and individual grades will be determined from their journal club paper presentations, classroom debates, active participation in class, and attendance. Each student (or pair of students) will be assigned a paper or case study to present to the rest of the class in a 'journal club' style format. Paper assignments and presentation dates will be established at the end of lecture #1.

Instructors

Hector L. Franco, PhD – hfranco@med.unc.edu – Assistant Professor, Department of Genetics

Adriana Beltran, PhD - adriana_beltran@med.unc.edu - Director, Human Pluripotent Stem Cell Core Facility

Dale Cowley, PhD - dale_cowley@med.unc.edu - Director, Animal Models Core Facility

Nate Hathaway, PhD - natehat@email.unc.edu - Assistant Professor, Eshelman School of Pharmacy

Jesse Raab, PhD - jesse_raab@med.unc.edu - Assistant Professor, Department of Genetics

Mark Zylka, PhD - mark_zylka@med.unc.edu - Director, UNC Neuroscience Center

Eric Juengst, PhD - ejuengst@email.unc.edu - Director, UNC Center for Bioethics

Course Schedule

3:30pm – 4:45pm

Location - TBD

Date	Topic	Lecturer	Student Presenters
March 19	Origins of CRISPR (Discovery, Implementation, Zhang vs Doudna Debate)	Dr. Franco	N/A
March 24	CRISPR Knockout Basics (Experimental Design, Guide RNA design, Delivery into Cells, Genotyping, Validation)	Dr. Franco	TBD
March 26	CRISPR Knockout Basics (Experimental Design, Guide RNA design, Delivery into Cells, Genotyping, Validation)	Dr. Franco	TBD
March 31	CRISPR Knockin (Inserting or Mutating DNA Sequences in the Genome)	Dr. Beltran	TBD
April 2	CRISPR Editing in Animal Models (Knockout and Knockin Strategies in Mice)	Dr. Cowley	TBD
April 7	<i>No Class</i>		
April 9	CRISPR Screens (High throughput applications of CRISPR)	Dr. Raab	TBD
April 14	CRISPR Interference (dCas9 Fusions Inhibition or Activation)	Dr. Hathaway	TBD
April 16	CRISPR to target RNA and Other Cas Proteins	Dr. Franco	TBD
April 21	CRISPR-Based Gene Therapy for Brain Diseases (Gene editing, Clinical Applications)	Dr. Zylka	TBD
April 23	The Future of CRISPR and Ethical Considerations (CRISPR in the Clinic, CRISPR Babies, Case-Studies)	Dr. Juengst	TBD