MCELLBI N184 IGI CRISPR Undergraduate Summer Lecture Series

Course Description: This 3 week course will address topics in genome editing and CRISPR-Cas9 research, including basic and enhanced CRISPR methods, cellular repair mechanisms, regulation of gene expression, bioinformatics, applications to various organisms, and bioethics. Students will learn from a collection of local experts about ongoing campus research, and gain the background knowledge to understand current publications and applications of genome editing.

Class Format: 1 hour of lecture per day. 4 days/wk for 3 weeks; MTuWTh 1-2 pm

Prerequisites: MCELLBI 104, 140, 143 or 110, or equivalent background in genetics and cell biology

Grading Option: P/NP
There is no final exam or paper, but your grade will be determined by daily quizzes (40%) and three weekly tests (60%). To obtain a passing grade for the class, your overall grade should be 70% or above.

The final weekly test (course is only 3 weeks long) will be cumulative, but does not require a separate period of timeslot outside of the 3 week course. Tests will rely on synthesis and critical understanding of materials presented in the course, using short answer questions rather than fact or memorization based assessments.

Units: 1

Co Instructors:

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Lab TAs: TBD
Guest Lecturers: TBD

Week	Day	Date	Topics
Week 1: CRISPR basics	Monday	July 29	Course introduction, overview of topics
	Tuesday	July 30	CRISPR immunity
	Wednesday	July 31	Structure and Function of Cas9
	Thursday	August 1	Genome Editing and DNA repair
Week 2: Genome Editing in practice	Monday	August 5	gRNA Design
	Tuesday	August 6	Reducing Off-Target Effects
	Wednesday	August 7	CRISPR Applications: Plants
	Thursday	August 8	CRISPR Applications: Human Therapeutics
Week 3: Genome Editing Application ctd and Ethics/Policy	Monday	August 12	CRISPR Applications: The CRISPR Toolbox
	Tuesday	August 13	CRISPR Applications: Model Systems
	Wednesday	August 14	CRISPR Ethics
	Thursday	August 15	CRISPR Policy

Resources and Readings:

Wright, A., Nuñez, J. and Doudna, J. (2016). Biology and Applications of CRISPR Systems: Harnessing Nature's Toolbox for Genome Engineering. *Cell*, 164(1-2), pp.29-44.

Barrangou, R., Fremaux, C., Deveau, H., Richards, M., Boyaval, P., Moineau, S., Romero, D. and Horvath, P. (2007). CRISPR Provides Acquired Resistance Against Viruses in Prokaryotes. *Science*, 315(5819), pp.1709-1712.

Amitai, G. and Sorek, R. (2016). CRISPR–Cas adaptation: insights into the mechanism of action. *Nature Reviews Microbiology*, 14(2), pp.67-76.

Hille, F., Richter, H., Wong, S., Bratovič, M., Ressel, S. and Charpentier, E. (2018). The Biology of CRISPR-Cas: Backward and Forward. *Cell*, 172(6), pp.1239-1259.

Abadi, S., Yan, W., Amar, D. and Mayrose, I. (2017). A machine learning approach for predicting CRISPR-Cas9 cleavage efficiencies and patterns underlying its mechanism of action. *PLOS Computational Biology*, 13(10), p.e1005807.

Anders, C., Niewoehner, O., Duerst, A. and Jinek, M. (2014). Structural basis of PAM-dependent target DNA recognition by the Cas9 endonuclease. *Nature*, 513(7519), pp.569-573.

Garcia-Doval, C. and Jinek, M. (2017). Molecular architectures and mechanisms of Class 2 CRISPR-associated nucleases. *Current Opinion in Structural Biology*, 47, pp.157-166.

Jinek, M., Chylinski, K., Fonfara, I., Hauer, M., Doudna, J. and Charpentier, E. (2012). A Programmable Dual-RNA-Guided DNA Endonuclease in Adaptive Bacterial Immunity. *Science*, 337(6096), pp.816-821.

Wang, H., La Russa, M. and Qi, L. (2016). CRISPR/Cas9 in Genome Editing and Beyond. *Annual Review of Biochemistry*, 85(1), pp.227-264.

Aird, E., Lovendahl, K., St. Martin, A., Harris, R. and Gordon, W. (2018). Increasing Cas9-mediated homology-directed repair efficiency through covalent tethering of DNA repair template. *Communications Biology*, 1(1).

Fellmann, C., Gowen, B., Lin, P., Doudna, J. and Corn, J. (2016). Cornerstones of CRISPR–Cas in drug discovery and therapy. *Nature Reviews Drug Discovery*, 16(2), pp.89-100.

Zhang, Y., Long, C., Li, H., McAnally, J., Baskin, K., Shelton, J., Bassel-Duby, R. and Olson, E. (2017). CRISPR-Cpf1 correction of muscular dystrophy mutations in human cardiomyocytes and mice. *Science Advances*, 3(4), p.e1602814.

Xie, K., Minkenberg, B. and Yang, Y. (2015). Boosting CRISPR/Cas9 multiplex editing capability with the endogenous tRNA-processing system. *Proceedings of the National Academy of Sciences*, 112(11), pp.3570-3575.

Schultink, A., Qi, T., Lee, A., Steinbrenner, A. and Staskawicz, B. (2017). Roq1 mediates recognition of the Xanthomonas and Pseudomonas effector proteins XopQ and HopQ1. *The Plant Journal*, 92(5), pp.787-795.

Qi, L., Larson, M., Gilbert, L., Doudna, J., Weissman, J., Arkin, A. and Lim, W. (2013). Repurposing CRISPR as an RNA-Guided Platform for Sequence-Specific Control of Gene Expression. *Cell*, 152(5), pp.1173-1183.

Dominguez, A., Lim, W. and Qi, L. (2015). Beyond editing: repurposing CRISPR–Cas9 for precision genome regulation and interrogation. *Nature Reviews Molecular Cell Biology*, 17(1), pp.5-15.

Absences

If you are ill or have an unplanned absence, please review the slides posted online and speak with a GSI or another student to make sure you understand the material that you missed.

Safe, Supportive, and Inclusive Environment

Whenever a faculty member, staff member, post-doc, or GSI is responsible for the supervision of a student, a personal relationship between them of a romantic or sexual nature, even if consensual, is against university policy. Any such relationship jeopardizes the integrity of the educational process.

Although faculty and staff can act as excellent resources for students, you should be aware that they are required to report any violations of this campus policy. If you wish to have a confidential discussion on matters related to this policy, you may contact the Confidential Care Advocates on campus for support related to counseling or sensitive issues. Appointments can be made by calling (510) 642-1988.

The classroom, lab, and work place should be safe and inclusive environments for everyone. The Office for the Prevention of Harassment and Discrimination (OPHD) is responsible for ensuring the University provides an environment for faculty, staff and students that is free from discrimination and harassment on the basis of categories including race, color, national origin, age, sex, gender, gender identity, and sexual orientation. Questions or concerns? Call (510) 643-7985, email ask_ophd@berkeley.edu, or go to http://survivorsupport.berkeley.edu/.