

Michelle Hays

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EDUCATION

Postdoctoral Scholar: Stanford University, Genetics Department	2020 - Present
PhD: Molecular and Cellular Biology program, University of Washington (UW), Fred Hutchinson Cancer Research Center	2013 - 2019 Conferred Dec 2019
Bachelor of Science: Microbiology and German Language, Literature and Culture, Colorado State University; Ft. Collins, CO	2001 - 2005
Study Abroad: Keele University, Stoke-on-Trent, UK	2004
University of Hannover, Germany	2003

CURRENT POSITION

Postdoctoral Scholar: Stanford University - Dr. Gavin Sherlock Feb 2020 - Present
I am developing budding yeast and its natural parasites, Totiviruses and selfish plasmids, as a tractable system to study genetic conflict using experimental evolution and lineage tracking. I've been awarded a Postdoctoral Fellowship through the Stanford Center for Computational, Evolutionary and Human Genomics (CEHG) to begin this work, which includes conference travel support and \$13,500 in partial salary funds for use in the first year of my postdoc position. I have been awarded a Postdoctoral position on the NIHGR1 Stanford Genomics Training Program training grant (5 T32 HG000044-24) for 2020 - 2021.

ACADEMIC RESEARCH EXPERIENCE

PhD dissertation research: Fred Hutchinson Cancer Research Center – Dr. Harmit Malik 2014 - Dec 2019
I developed new high throughput, single-cell plasmid loss assay (SCAMPR), and identified natural *Saccharomyces cerevisiae* isolates that are resistant to plasmid parasitism. Using bulk segregant analysis and QTL mapping I identified genomic loci linked to the plasmid restriction phenotype, and one dominant host allele of *MMS21* that contributes to plasmid restriction. My graduate work was funded by a Genome Training Grant Fellowship through the UW, 2014 - 2015 (5 T32 HG000035-20), and a National Science Foundation Graduate Research Fellowship award 2015 - 2020 (DGE-1256082).

University of Washington, Molecular and Cellular Biology PhD program – rotations

Dr. Harmit Malik – Fred Hutchinson Cancer Research Center	2014
Characterizing CG17802: a young, essential gene in <i>Drosophila</i> species	
Dr. Maitreya Dunham – UW Genome Sciences Department	2014
What mutations underlie evolution of flocculation in experimentally evolved yeasts?	
Dr. Trisha Davis – UW Biochemistry Department	2013
Measuring <i>in vivo</i> and <i>in vitro</i> kinetochore tension, utilizing FRET and optical trap	

Research Associate II – Dr. Aimée Dudley 2011 – 2013
Institute for Systems Biology Seattle, WA

- Primarily studied complex colony morphology trait toggling in *S. cerevisiae*; highly structured wild yeast strain utilizes aneuploidy as mechanism to undergo switching between the complex “fluffy” (euploid) state and “smooth” (disomic) colony phenotype common to lab strains.
- Other projects included identification of *S. cerevisiae* enzymes responsible for novel metabolite synthesis, metabolic modeling of colony growth, isolation of wild *S. cerevisiae* strains, automated tetrad dissection method development.

Research Associate II – Dr. Tim Galitski 2009 - 2011
Institute for Systems Biology Seattle, WA
Generated training and test set data for genetic network modeling (developed by Dr. Greg Carter) predicting phenotypic outcomes of complex genotypic interactions based on known partial pleiotropy to inform network interactions.

Research Associate I – Dr. Richard Slayden 2006 - 2007
Colorado State University Fort Collins, CO
Developed and manufactured research materials (such as microarrays and null mutant TB lines) distributed under the TB Vaccine Testing and Research Materials Contract, a NIH NIAID program supporting the Mycobacteria research community.

RISE Summer Research Intern – Dr. Rita Bernhardt, Universität des Saarlandes 2005
Deutscher Akademischer Austausch Dienst Saarbrücken, Germany
Participant in the Research Internships in Science and Engineering program. Creation of a *Schizosaccharomyces pombe* assay to screen small molecules for sensitivity and specificity of cytochrome p450 targeting.

INDUSTRY EXPERIENCE

ZymoGenetics, Inc. – Quality Control Associate II – Contract Seattle, WA	2009
Bayer HealthCare – Quality Control Analyst II – Contract Seattle, WA	2008-2009
GeneCheck – Diagnostics Laboratory Technician Greeley, CO	2008
Insmed Therapeutic Proteins – Quality Control Laboratory Technician Boulder, CO	2006

PEER REVIEWED PUBLICATIONS

*authors contributed equally to this work

1. **Hays M**, Young JM, Levan P, Malik HS. A natural variant of the essential host gene *MMS21* restricts the parasitic 2-micron plasmid in *Saccharomyces cerevisiae*. *eLife* 2020;9:e62337 DOI: 10.7554/eLife.62337
2. Intosalmi J, Scott AC, **Hays M**, Flann N, Yli-Harja O, Lähdesmäki H, Dudley AM, Skupin A. Data-driven multiscale modeling reveals the role of metabolic coupling for the spatio-temporal growth dynamics of yeast colonies. *BMC Mol Cell Biol.* 2019 Dec 19; 1(20)59
3. Cromie GA, Tan Z, **Hays M**, Sirr A, Jeffery EW, Dudley AM. Transcriptional Profiling of Biofilm Regulators Identified by an Overexpression Screen in *Saccharomyces cerevisiae*. *G3 (Bethesda)*. 2017 Aug 7;7(8):2845-2854
4. Cromie GA, Tan Z, **Hays M**, Jeffery EW, Dudley AM. Dissecting Gene Expression Changes Accompanying a Ploidy-Based Phenotypic Switch. *G3 (Bethesda)*. 2017 Jan 5;7(1):233-246.
5. Ludlow CL, Cromie GA, Garmendia-Torres C, Sirr A, **Hays M**, Field C, Jeffery EW, Fay JC, Dudley AM. Independent Origins of Yeast Associated with Coffee and Cacao Fermentation. *Curr Biol.* 2016 Apr 4;26(7):965-71.
6. Cary GA, Yoon SH, Torres CG, Wang K, **Hays M**, Ludlow C, Goodlett DR, Dudley AM. Identification and characterization of a drug-sensitive strain enables puromycin-based translational assays in *Saccharomyces cerevisiae*. *Yeast.* 2014 May;31(5):167-78.
7. Tan Z, **Hays M***, Cromie GA, Jeffery EW, Scott AC, Ah Yong V, Sirr A, Skupin A, Dudley AM. Aneuploidy underlies a multicellular phenotypic switch. *Proc Natl Acad Sci U S A.* 2013 Jul 23;110(30):12367-72.
8. Ludlow CL*, Scott AC*, Cromie GA, Jeffery EW, Sirr A, May P, Lin J, Gilbert TL, **Hays M**, Dudley AM. High-throughput tetrad analysis. *Nat Methods.* 2013 Jul;10(7):671-5.
9. Carter GW, **Hays M**, Sherman A, Galitski T. Use of pleiotropy to model genetic interactions in a population. *PLoS Genet.* 2012;8(10):e1003010.
10. Carter GW, **Hays M**, Li S, Galitski T. Predicting the effects of copy-number variation in double and triple mutant combinations. *Pac Symp Biocomput.* 2012:19-30.

TEACHING AND MENTORING EXPERIENCE

Postdoc Teaching Certificate – Stanford University 2020: Ongoing
Currently pursuing teaching certification through a pedagogy-intensive training program run by the Stanford Office of Postdoctoral Affairs and the Center for Teaching and Learning. Participants complete at least 70 hours of training and workshops on evidence-based practices for building inclusive classrooms and student-centered teaching, then facilitate at least 30 hours of instruction, including mentor feedback and evaluations.

Mentor for Undergraduate Summer Interns – Stanford HB-Rex Summer 2020
I facilitated self-directed research projects for two summer interns as part of a remote summer research experience due to Covid-19. Each student chose their own genetic parasite of interest in budding yeast, and used sequence curation, multiple alignments and evolutionary approaches to look for evidence of rapid evolution in genes thought to interface between parasite and host. This required substantial literature surveying, BLAST and sequencing database usage, multiple alignments by both MAFFT and Clustal, and positive selection analysis by PAML, McDonald-Kreitman

and Datamonkey and HyPhy tool suites. The students presented their summer projects as posters to members of the HB-Rex program and as oral presentations to the lab.

- Mentor for undergraduate researcher** – Sherlock lab Autumn 2020
I am mentoring a Stanford undergraduate researcher on a bioinformatics project mining fungal sequencing datasets to identify novel, extrachromosomal selfish elements.
- Instructor of Record** – University of Washington Spring 2018
Current Topics in Molecular and Cellular Biology BIOL410 – Competition and conflict within and between cells
Developed a new course centered on understanding the scientific method and reading primary literature in three different areas of molecular and Cellular biology: adaptive evolution, genetic conflict and chromatin biology.
- Mentor for Rotation Students** – Fred Hutchinson/UW MCB program Winter 2018, Winter 2019
I mentored two rotation students in my time in the Malik lab. One student studied how presence or absence of a parasite in yeast affects which host genes are essential. To do this he built on work done in my thesis project, but also brought new tools, including transposon mutagenesis, into the lab.
Another rotation student explored the mutational robustness of CenH3 in budding yeast (*Cse4*). Using deep mutational scanning, They tested a panel of all possible mutations in a region of the protein that is rapidly evolving across budding yeasts. I was their primary mentor for this project as they learned to work with budding yeast, a system new to them and that no one else in the Malik lab worked in.
- MCB Mentored Teaching Experience** – University of Washington 2017 - 2018
Conceived of and worked with MCB graduate program directors and Biology Department faculty to design and implement a new MCB career development component. This program gives graduate students practical experience with curriculum design, pedagogy and a mentored experience in course instruction. Graduate student instructors gain Instructor of Record experience in a structured setting with mentor feedback. This program continues now as STEP-UP, an NSF funded project: <http://depts.washington.edu/stepuw/home/step-up/>
- Mentor for Undergraduate Researcher** – Fred Hutchinson Cancer Research Center 2015 - 2017
I mentored a young undergraduate student that worked closely with me on a screen to look for *S. cerevisiae* host genes important for 2-micron plasmid maintenance. They rapidly gained independence to increasingly drive the project over time. They learned a number of technical bench techniques, but most impressive to me was their growth in the areas of analytical thinking and her digestion of primary literature. For their work on our project they was awarded the Herschel Roman Scholarship and Mary Gates Undergraduate Research Scholarship, completed research credit hours and wrote her honors thesis on her data. They are currently pursuing an MD.
- Mentor for Postbaccalaureate Researcher** – Fred Hutchinson Cancer Research Center 2019 - 2020
A postbaccalaureate researcher began working closely with me to pursue alternate fine mapping strategies for the 2-micron natural variation project. This project required us working closely together to bring multiple tools and new techniques into the lab. They quickly gained practice and confidence in experimental design and is a fastidious experimentalist. They piloted new methods and refined parameters on a number of assays that were new to us both. As they gained independence I gave her increasing responsibility in building the molecular tools needed for CRISPR-facilitated mitotic recombination, leading to loss of heterozygosity. In parallel they helped build reagents to expand SCAMPR for measuring competitive fitness and plasmid loss in tandem.
- National Academy of Sciences Scientific Teaching Fellow** 2017 - 2018
Summer Institute for Scientific teaching - University of Oregon, Northwest region
Developed a Teachable Tidbit for evolution implementing active learning and inclusive classroom strategies which I subsequently used with undergraduates as an icebreaker for a Molecular Biology: Competition and Conflict course, and further adapted as an activity to teach population genetics to middle school students.
- Girls Excelling in Math and Science (GEMS) project leader** 2017 - 2018
Lead a series of activities to teach middle school girls about DNA and Evolution. Created a new card game activity to model different types of evolution in the classroom population.
- Science Communication Fellow** – Portal to the Public, Pacific Science Center 2014 – present
Created a series of hands-on all-ages activities to talk to the public about evolution and genetic conflict

Science Education Partnership - Fred Hutchinson Cancer Research Center 2015, 2016
Mentored visiting rural high school students in multi-day laboratory workshops learning about molecular biology. We discuss how one can pursue science as a career and what being a scientist is like every day.

Pacific Science Center Events Volunteer 2010 – 2019
Facilitated a wide range of hands-on activities for all ages: Life Sciences Research Weekend, PAWS on Science, Meet a Scientist

Academic Teaching Assistantships
University of Washington – Laboratory techniques in Molecular and Cellular Biology (Biol302) 2015
Prof. Linda Martin-Morris
North Seattle College – Organic Chemistry I & II 2011 – 2012
Profs. Randall Engel and Guy Ting

Guest Lecturer
North Seattle College – Organic Chemistry I & II 2012, 2013

Tutor
Organic Chemistry – North Seattle College 2010 - 2013
Academic Advancement Center, Colorado State University 2002 - 2006

ORAL PRESENTATIONS

November 2020 - Invited speaker, Eastern Michigan University seminar series

September 2020 - Natural variation of the essential host gene *MMS21* restricts the parasitic 2-micron plasmid in *Saccharomyces cerevisiae*, EMBO Molecular Mechanisms in Evolution and Ecology

June 2019 - Gordon Research Seminar on Molecular Mechanisms in Evolution, Chair. Building inclusive lab communities: peer CIMER workshop, with Dr. Devon Fitzgerald.

2015 - 2018 - Does the 2-micron plasmid drive evolution in budding yeast? American Indian Science and Engineering Society (AISES) National Conference (2015-2018)

- Awarded Excellence in Biology for graduate oral presentation, 2017
- Best Graduate Student Oral Presentation: Biology Track 2016
- Honorable Mention for graduate student oral presentation award 2015

June 2017 - Do selfish plasmids drive evolution in budding yeast? Gordon Research Seminar on Molecular Mechanisms in Evolution. Travel award and conference registration Award for selected abstract for oral presentation

November 2016 - Does the 2-micron plasmid drive evolution in budding yeast? Friday Night Seminar series, Fred Hutchinson Cancer Research Center (FHCRC)

October 2016 - Does the 2-micron plasmid drive evolution of budding yeast? EMBO Experimental Approaches to Ecology and Evolution Using Yeast and Other Model Systems. One of only two graduate students to present platform talk at this conference

November 2016 - Does the 2-micron plasmid drive evolution in budding yeast? University of Washington, University of Tokyo Joint Symposium, University of Tokyo Graduate Program for Leaders in Life Innovation

March 2014 - Evolution of flocculation in the budding yeast *Saccharomyces cerevisiae*, University of Washington MCB rotation talks

December 2013 - Monitoring tension in vivo in the outer kinetochore of budding yeast, University of Washington MCB rotation talks

POSTER PRESENTATIONS

2020 - Michelle Hays, Gavin Sherlock; Contrasting biotic and abiotic drivers of adaptive evolution in a host-pathogen conflict. Stanford Genetics Retreat

2020 - Michelle Hays, Janet Young and Harmit Malik; Natural variation in an essential host gene underlies resistance to a parasitic plasmid in budding yeast. TAGC 2020 online

2019 - Michelle Hays, Janet Young and Harmit Malik; How yeast battle a genetic parasite. Gordon Research Conference on Molecular Mechanisms in Evolution. Joint Chair for affiliated GRS meeting.

2018 - Michelle Hays, Janet Young and Harmit Malik; How yeast battle a genetic parasite. EMBO Experimental approaches to evolution and ecology using yeast and other model systems - Best poster award

2018 - Michelle Hays, Janet Young and Harmit Malik; How yeast battle a genetic parasite. SMBE meeting, Yokohama Japan (2018) – abstract selected for a registration award

2015 - 2018 - Michelle Hays and Harmit S. Malik; How yeast battle a genetic parasite. FHCRC Basic Sciences retreat – Best poster award: 2015, 2018

2017 - Michelle Hays and Harmit Malik; Do selfish plasmids drive evolution in budding yeast? Fred Hutchinson Cancer Research Center Scientific Advisory Board poster session

2017 - Michelle Hays and Harmit Malik; Do selfish plasmids drive evolution in budding yeast? University of Washington Molecular and Cellular Biology program recruitment faculty poster session

2017 - Michelle Hays and Harmit Malik; Do selfish plasmids drive evolution in budding yeast? Gordon Research Conference in Molecular Mechanisms of Evolution

2014 - Michelle Hays and Harmit S. Malik; Domestication of plasmid genes may facilitate genetic innovation in budding yeasts; FHCRC Basic Sciences retreat

2014 - Michelle Hays and Harmit S. Malik; Evolution and function of a young, essential gene in *Drosophila melanogaster*; University of Washington MCB spring poster session

2012 - Zhihao Tan*, Michelle Hays*, Eric W. Jeffery, Gareth Cromie, Amy Sirr, Aimée M. Dudley; Aneuploidy provides a mechanism for a multicellular phenotypic switch; Genetics Society of America's Yeast Genetics and Molecular Biology Meeting at Princeton University

*Authors contributed equally to this work. Poster awarded best GSA Student Poster Award in Chromosome Dynamics category

LEADERSHIP ACTIVITIES, ACHIEVEMENTS AND AWARDS

LEADERSHIP ACTIVITIES

2017, 2019 - Elected joint Chair for Gordon Research Seminar in Molecular Mechanisms in Evolution, 2019 meeting

2018 - FHCRC Invited speaker student committee member - selected and invited speakers for the ongoing Fred Hutch Current Biology Seminar series

2017-2018 - Creation of STEP-UP: an MCB Mentored Teaching Experience program – worked with MCB directors to create and participate in first ever curriculum development and mentored teaching experience for UW MCB program. This program continues on as an NSF funded program through UW.

2016 – 2019 - MCB program Student Area Director for Genetics, Genomics and Evolution: helped incoming graduate students select courses and rotation labs in area of interest, shaped MCB core curriculum offerings for subfield

2017 - Weintraub Award Selection Committee

2015 - Co-organizer for Seattle Genetic Instability and Cancer Symposium

2014-2019 Union Bay Rowing Club Leadership: 2015 Secretary, 2016 – 2019 Co-captain, 2014-2019 Learn to Row course instructor, 2018-2019 Safety officer and part-time Coach

PRESENTATION AWARDS

2018 - EMBO Experimental Approaches to Ecology and Evolution using Yeast and Other Model Systems best poster,
2017 - American Indian Science and Engineering Society (AISES) awarded excellence in biology,
2016 - AISES best graduate oral presentation biology track
2015 - AISES honorable mention, graduate student oral presentation
2015, 2018 - Best poster, Fred Hutchinson Basic Sciences Division retreat

FELLOWSHIPS, GRANTS and AWARDS

2020 - 2021 - Stanford Center for Computational, Evolutionary and Human Genomics (CEHG) Postdoctoral Fellow
2020 - 2021 NIH NHGRI Stanford Genomics Training Program (SGTP) Training Grant (5 T32 HG 000044-24)
2015 – 2020 National Science Foundation Graduate Research Fellow (NSF GRFP Grant No. DGE-1256082)
2019 - MCB Departmental Nominee for UW Graduate Medal
2018 - Finalist, UW Excellence in Teaching Award
2018, 2019 - Finalist FHCRC Nancy Hutchison Mentoring award
2014 - 2015 - NIH NHGRI Genome Training Grant, UW 2014- 2015 (5 T32 HG000035-20)
2014 – 2019 - Portal to the Public Science Communication Fellow, Pacific Science Center
2017 - 2018 - Summer Institute for Scientific Teaching; National Academy of Sciences Scientific Teaching Fellow
2017 - Hutch United Travel Award for Gordon Research Conference on Molecular Mechanisms in Evolution
2018 - SMBE Registration Award, Annual Conference in Tokyo
2018 - FHCRC Student-Postdoc Advisory Committee Travel Award for EMBO Yeast Eco-Evo meeting
2016, 2018 - Work featured in GSA meeting reports for both 2016 and 2018 EMBO Experimental Approaches to Ecology and Evolution Using Yeast and Other Model Systems conferences