Nathan Crook nccrook@ncsu.edu

Education:

The University of Texas at Austin May 2014
PhD, Chemical Engineering Overall GPA: 4.0/4.0
Thesis: *Novel Approaches for Metabolic Engineering of Yeast at Multiple Scales*
Advisor: Dr. Hal Alper

California Institute of Technology June 2009
BS with Honor, Chemical Engineering Overall GPA: 3.5/4.0
Advisor: Dr. Frances Arnold

Fellowships and Awards:

NIH New Innovator Award	2023
NSF CAREER Award	2023
NIH New Innovator Award (Finalist, Top 18% of applicants)	2020
Dream Chemistry Award (Finalist)	2017
NIH Ruth L. Kirschstein NRSA T32 Postdoctoral Fellowship (5T32DK077653-23)	2015-2017
Lake Arrowhead Microbial Genomics Poster Competition (Second Place)	2016
WashU 12th Annual Postdoc Symposium Poster Competition (Honorable Mention)	2016
Purdue Prospective Faculty Workshop	2015
National Science Foundation Graduate Research Fellowship	2010-2013
Cockrell School of Engineering Thrust Fellowship	2009-2013
Graduated from California Institute of Technology with Honor	2009

Publications: **Total Citations**: 2811 **h-index**: 21

Research Papers *=Equal Contribution, Advisee, Undergraduate advisee

1. Justin M. Vento, Deniz Durmusoglu, Tianyu Li, Constantinos Patinios, Sean Sullivan, Fani Ttofali, John van Schaik, Yanying Yu, Yanyan Wang, Lars Barquist, **Nathan Crook**, and Chase L. Beisel, 2024. A cell-free transcription-translation pipeline for recreating methylation patterns boosts DNA transformation in bacteria. *Molecular Cell*, 84 2785-2796.
2. Deniz Durmusoglu*, Daniel J. Haller*, Ibrahim S. Al'Abri*, Katie Day, Carmen Sands, Andrew Clark, Adriana San-Miguel, Ruben Vazquez-Uribe, Morten O. A. Sommer, and **Nathan Crook**, 2024. Programming Probiotics: Diet-Responsive Gene Expression and Colonization Control in Engineered *S. boulardii*. *ACS Synthetic Biology*, 13(6) 1851-1865.
3. Mariam Sohail, Tahira Pirzada, Richard Guenther, Eduardo Barbieri, Tim Sit, Stefano Menegatti, **Nathan Crook**, Charles H. Opperman, and Saad A. Khan, 2023. Cellulose Acetate-Stabilized Pickering Emulsions: Preparation, Rheology, and Incorporation of Agricultural Active Ingredients. *ACS Sustainable Chemistry & Engineering*, 11(43) 15178–15191.
4. John van Schaik, Zidan Li, John Cheadle, and **Nathan Crook**, 2023. Engineering the Maize Root Microbiome: A Rapid MoClo Toolkit and Identification of Potential Bacterial Chassis for Studying Plant–Microbe Interactions. *ACS Synthetic Biology*, 12(10) 3030–3040.
5. Tianyu Li, Stefano Menegatti, and **Nathan Crook**, 2023. Breakdown of polyethylene therepthalate microplastics under saltwater conditions using engineered *Vibrio natriegens*. *AICHE Journal*, e18228.
6. Sudeep Sarma*, Carly Catella*, Ellyce San Pedro, Xingqing Xiao, Deniz Durmusoglu, Stefano Menegatti, **Nathan Crook**, Scott Magness, and Carol Hall, 2023. Design of 8-mer Peptides that Block *Clostridioides difficile* Toxin A in Intestinal Cells. *Communications Biology,* 6(878).
7. Deniz Durmusoglu, Ibrahim Al'Abri, Taufika Williams, Leonard Collins, Jose Luis Martinez Ruiz, and **Nathan Crook**, 2023. Improving Therapeutic Protein Secretion in the Probiotic Yeast *Saccharomyces boulardii* using a Multifactorial Engineering Approach. *Microbial Cell Factories*, 22(109).

8. Suryang Kwak*, **Nathan Crook***, Aki Yoneda, Naomi Ahn, Jie Ning, Jiye Cheng, and Gautam Dantas, 2022. Functional mining of novel terpene synthases from metagenomes. *Biotechnology for Biofuels and Bioproducts* 15:104.
9. Ibrahim Al'Abri, Zidan Li, Daniel Haller, and **Nathan Crook**, 2022. Inducible Directed Evolution of Complex Phenotypes in Bacteria. *Nucleic Acids Research,* gkac094.
10. Emil D. Jensen, Marcus Deichmann, Xin Ma, Rikke U. Vilandt, Giovanni Schiesaro, Marie B. Rojek, Bettina Lengger, Line Eliasson, Justin M. Vento, Deniz Durmusoglu, Sandie P. Hovmand, Ibrahim Al'Abri, Jie Zhang, **Nathan Crook**, and Michael K. Jensen, 2022. Engineered cell differentiation and sexual reproduction in probiotic and mating yeasts. *Nature Communications*, 13:6201.
11. Xingqing Xiao, Sudeep Sarma, Stefano Menegatti, **Nathan Crook**, Scott T. Magness, and Carol K. Hall, 2022. *In Silico* Identification and Experimental Validation of Peptide-Based Inhibitors Targeting *Clostridium difficile* Toxin A. *ACS Chemical Biology*, 17(1) 118-128.
12. Ki Yoon Kwon, Samuel Cheeseman, Alba Frias-DeDiego, Haeleen Hong, Jiayi Yang, Woojin Jung,Hong Yin, Billy J. Murdoch, Frank Scholle, **Nathan Crook**, Elisa Crisci, Michael D. Dickey, Vi Khanh Truong, and Tae-il Kim, 2021. A Liquid Metal Mediated Metallic Coating for Antimicrobial and Antiviral Fabrics. *Advanced Materials,* 33(45) 2104298.
13. Deniz Durmusoglu*, Ibrahim Al'Abri*, Scott P. Collins, Junrui Cheng, Abdulkerim Eroglu, Chase Beisel, and **Nathan Crook**, 2021. *In situ* biomanufacturing of small molecules in the mammalian gut by probiotic *Saccharomyces boulardii*. *ACS Synthetic Biology,* 10(5) 1039-1052.
14. **Nathan Crook***, Aura Ferreiro*, Zevin Condiotte, and Gautam Dantas, 2020. Transcript barcoding illuminates the expression level of synthetic constructs in *E. coli* Nissle residing in the mammalian gut. *ACS Synthetic Biology,* 9(5) 1010-1021.
15. **Nathan Crook***, Aura Ferreiro*, Andrew Gasparrini, Mitchell Pesesky, Molly Gibson, Bin Wang, Xiaoqing Sun, Zevin Condiotte, Stephen Dobrowolski, Daniel Peterson, and Gautam Dantas, 2019. Adaptive strategies of the candidate probiotic *E. coli* Nissle in the mammalian gut. *Cell Host and Microbe* 25(4), 499-512.
16. **Nathan Crook***, Jie Sun*, Joe Abatemarco*, James Wagner, Alexander Schmitz, and Hal Alper, 2016. *in vivo* continuous evolution of genes and pathways in yeast. *Nature Communications*, 7:13051.
17. **Nathan Crook,** Jie Sun, Nicholas Morse, Alexander Schmitz, and Hal Alper, 2016. Identification of gene knockdown targets conferring enhanced isobutanol and 1-butanol tolerance to *Saccharomyces cerevisiae* using a tunable RNAi screening approach. *Applied Microbiology and Biotechnology,* 100(23), 10005-10018.
18. Jinsuk Lee*, **Nathan Crook***, Jie Sun, and Hal Alper, 2016. Improvement of lactic acid production in *Saccharomyces cerevisiae* by a deletion of *ssb1*. *Journal of Industrial Microbiology & Biotechnology* 43(1), 87-96.
19. Kate Curran*, **Nathan Crook***, Ashty Karim, Akash Gupta, and Hal Alper, 2014. Model-based design of synthetic yeast promoters via tuning of nucleosome architecture. *Nature Communications,* 5:4002.
20. **Nathan Crook**, Alexander Schmitz, and Hal Alper, 2014. Optimization of a yeast RNA interference system for controlling gene expression and enabling rapid metabolic engineering. *ACS Synthetic Biology* 3(5), 307–313.
21. Amanda Lanza, John Blazeck, **Nathan Crook**, and Hal Alper, 2012. Linking yeast Gcn5p catalytic function and gene regulation using a quantitative, graded dominant mutant approach. *PLoS ONE* 7(4), e36193.
22. Eric M. Brustad, Victor S. Lelyveld, Christopher D. Snow, **Nathan C. Crook**, Sang Taek Jung, Francisco M. Martinez, Timothy J. Scholl, Alan Jasanoff, Frances H. Arnold, 2012. Structure-Guided Directed Evolution of Highly Selective P450-Based Magnetic Resonance Imaging Sensors for Dopamine and Serotonin. *Journal of Molecular Biology* 422(2), 245-262.
23. **Nathan Crook**, Elizabeth Freeman, and Hal Alper, 2011. Re-Engineering Multicloning Sites for Function and Convenience. *Nucleic Acids Research* 39(14), e92.
24. Rudi Fasan, **Nathan C. Crook**, Matthew W. Peters, Peter Meinhold, Thomas Buelter, Marco Landwehr, Patrick C. Cirino, and Frances H. Arnold, 2011. Improved Product-Per-Glucose Yields in P450-Dependent

Propane Biotransformations Using Engineered *Escherichia coli. Biotechnology and Bioengineering* 108(3), 500-510.

25. Rudi Fasan, Michael M. Chen, **Nathan C. Crook** and Frances H. Arnold, 2007. Engineered Alkane-Hydroxylating Cytochrome $P450_{BM3}$ Exhibiting Native-like Catalytic Properties. *Angewandte Chemie International Edition* 46(44), 8414-8418.

Reviews

1. Abdulkerim Eroglu, Genan Wang, **Nathan Crook**, and Torsten Bohn, 2024. Carotenoids. *Advances in Nutrition*, *In Revision*.
2. Ethan Gates and **Nathan Crook**, 2024. The Biochemical Mechanisms of Microbe-Mediated Plastic Breakdown. *FEMS Microbiology Reviews*, *In Revision*.
3. Zidan Li and **Nathan Crook**, 2024. Chips, guts, and gas: unraveling volatile microbial mysteries in real time! *Trends in Biotechnology* 42(2), 144-146.
4. Torsten Bohn, Emilio Balbuena, Hande Ulus, Mohammed Iddir, Genan Wang, **Nathan Crook**, and Abdulkerim Eroglu, 2023. Carotenoids in health as studied by omics-related endpoints. *Advances in Nutrition* 14(6), 1538-1578.
5. Rachel S Bang, Michael Bergman, Tianyu Li, Fiona Mukherjee, Abdulelah S Alshehri, Nicholas L Abbott, **Nathan C Crook**, Orlin D Velev, Carol K Hall, and Fengqi You, 2023. An integrated chemical engineering approach to understanding microplastics. *AICHE Journal* 69(4) e18020.
6. Abdulkerim Eroglu, Ibrahim Al'Abri, Rachel E. Kopec, **Nathan Crook**, and Torsten Bohn, 2022. Carotenoids and their health benefits as derived via their interactions with gut microbiota. *Advances in Nutrition* 14(2), 238-255.
7. Ibrahim Al'Abri*, Zidan Li*, Daniel Haller*, and **Nathan Crook**, 2022. A Novel Method of Inducible Directed Evolution to Evolve Complex Phenotypes. *Bio-protocol* 12(20), e4535.
8. Mairead Heavey*, Deniz Durmusoglu*, **Nathan Crook**, and Aaron Anselmo, 2021. Discovery and delivery strategies for engineered live biotherapeutic products. *Trends in Biotechnology* 40(3), 354-369.
9. Deniz Durmusoglu*, Carly Catella*, Ethan Purnell*, Stefano Menegatti, and **Nathan Crook,** 2021. Design and *in situ* biosynthesis of precision therapies against gastrointestinal pathogens. *Current Opinion in Physiology* 23, 100453.
10. Ibrahim Al'Abri, Deniz Durmusoglu, and **Nathan Crook**, 2021. What *E. coli* knows about your 1-year-old infant: Antibiotic use, lifestyle, birth mode, and siblings. *Cell Host and Microbe* 29(6), 854-855.
11. Justin Vento, **Nathan Crook***, and Chase Beisel*, 2019. Barriers to genome editing with CRISPR in bacteria. *Journal of Industrial Microbiology and Biotechnology* 46(9-10), 1327-1341.
12. Aura Ferreiro*, **Nathan Crook***, Drew Gasparrini*, and Gautam Dantas, 2018. Multiscale evolutionary dynamics of host-associated microbiomes. *Cell* 172(6), 1216-1227.
13. Amy Langdon*, **Nathan Crook***, Gautam Dantas, 2016. The effects of antibiotics on the microbiome throughout development and alternative approaches for therapeutic modulation. *Genome Medicine* 8(39).
14. **Nathan Crook** and Hal Alper, 2013. Model-Based Design of Synthetic, Biological Systems. *Chemical Engineering Science* 103, 15 November 2013, 2-11.
15. Amanda Lanza, **Nathan Crook**, and Hal Alper, 2012. Innovation at the Intersection of Synthetic and Systems Biology. *Current Opinion in Biotechnology* 23(5), 712-717.

Book Chapters

1. **Nathan Crook** and Hal Alper, 2013. Classical Strain Improvement. *Engineering Complex Phenotypes in Industrial Strains, First Edition* 1-33. Edited by Ranjan Patnaik. John Wiley & Sons.
2. Kate Curran, **Nathan Crook**, and Hal Alper, 2012. Using Flux Balance Analysis to Guide Microbial Metabolic Engineering. *Methods in Molecular Biology v. 834: Microbial Metabolic Engineering* 197-216.

Intellectual Property:

Patent Applications:

1. **Nathan Crook**, Deniz Durmusoglu, Ibrahim Al'Abri, Daniel Haller. Engineered Microorganisms with Enhanced Protein Expression and Secretion. PCT/US2023/020551, PCT/US2023/074893

2. **Nathan Crook**, Ibrahim Al'Abri. Autonomous inducible directed evolution of complex pathways. PCT/US2020/054100.

Presentations:

Invited Presentations

1. **Nathan Crook**, 2024. Engineering Probiotic Yeast for Controlled Synthesis of Drugs and Vitamins in the Gut. *North Carolina Microbiomes Symposium,* Durham, NC.
2. **Nathan Crook**, 2024. Engineering Probiotic Yeast for Controlled Synthesis of Drugs and Vitamins in the Gut. *Department of Chemical and Environmental Engineering, University of California Riverside,* Riverside, CA.
3. **Nathan Crook**, 2024. Engineering Probiotic Yeast for Controlled Synthesis of Drugs and Vitamins in the Gut. *Department of Chemical and Biological Engineering, Northwestern University*, Evanston, IL.
4. **Nathan Crook**, 2024. Engineering Probiotic Yeast for Controlled Synthesis of Drugs and Vitamins in the Gut. *BTEC, North Carolina State University*, Raleigh, NC.
5. **Nathan Crook**, 2024. Engineering Probiotic Yeast for Controlled Synthesis of Drugs and Vitamins in the Gut. *Department of Biomedical Engineering, Duke University*, Durham, NC.
6. **Nathan Crook**, 2024. Combinatorial and Evolutionary Engineering of Probiotic Microbes. *Duke University Precision Microbiome Engineering Seminar Series*, Durham, NC.
7. **Nathan Crook**, 2024. Engineering Probiotic Yeast for Controlled Synthesis of Drugs and Vitamins in the Gut. *UNC Center for Gastrointestinal Biology and Disease Seminar Series*, Chapel Hill, NC.
8. **Nathan Crook**, 2023. Engineering *Vibrio natriegens* for degrading and assimilating Poly(ethylene terephthalate). *American Institute of Chemical Engineers Annual Meeting Futures Talks*, Orlando, FL.
9. **Nathan Crook**, 2023. Metabolic Engineering of Probiotic Yeast for Production of Drugs and Vitamins. *American Institute of Chemical Engineers Annual Meeting*, Orlando, FL.
10. **Nathan Crook**, 2023. Using synthetic biology to engineer agricultural microbiomes. *Agricultural Microbiomes Symposium*, Raleigh, NC.
11. **Nathan Crook**, 2022. Establishing *Saccharomyces boulardii* as an in-gut biomanufacturing platform. *3rd International Biodesign Research Conference,* Virtual.
12. **Nathan Crook**, 2022. Combinatorial and Evolutionary Engineering of Probiotic Microbes. *American Institute of Chemical Engineers Annual Meeting*, Phoenix, AZ.
13. **Nathan Crook**, 2022. Establishing *Saccharomyces boulardii* as an in-gut biomanufacturing platform. *Microbiology Consortium of the Philippines,* Virtual.
14. **Nathan Crook**, 2022. Establishing *Saccharomyces boulardii* as an in-gut biomanufacturing platform. *Department of Biology, Durham Tech*, Durham, NC.
15. **Nathan Crook**, 2022. Combinatorial and Evolutionary Engineering of Probiotic Microbes. *Department of Biology, UNC Greensboro*, Greensboro, NC.
16. **Nathan Crook**, 2022. Establishing *Saccharomyces boulardii* as an in-gut biomanufacturing platform. *SynBYSS Seminar Series*, Virtual.
17. **Nathan Crook**, 2022. Metabolic Generation of Synthetic Microbes. *University-Industry Consortium*, Manhattan, KS.
18. **Nathan Crook**, 2022. Establishing *Saccharomyces boulardii* as an in-gut biomanufacturing platform. *Department of Chemical and Biomolecular Engineering, Georgia Institute of Technology*, Atlanta, GA.
19. **Nathan Crook**, 2022. Establishing *Saccharomyces boulardii* as an in-gut biomanufacturing platform. *BTEC, North Carolina State University*, Raleigh, NC.
20. **Nathan Crook**, 2021. *In situ* biomanufacturing of small molecules and peptides using probiotic *S. boulardii*. *International Conference on Microbiome Engineering*, Virtual.
21. **Nathan Crook**, 2021. Combinatorial and Evolutionary Engineering of Probiotic Microbes. *Biosustain, Denmark Technical University*, Lyngby, Denmark.
22. **Nathan Crook**, 2021. Combinatorial and Evolutionary Engineering of Probiotic Microbes. *Department of Food Science, University of Illinois Urbana Champaign*, Urbana-Champaign, IL.

23. **Nathan Crook**, 2021. Combinatorial and Evolutionary Engineering of Probiotic Microbes. *Department of Plant and Microbial Biology, North Carolina State University*, Raleigh, NC.
24. **Nathan Crook**, 2021. Delivery of biomolecules to the mammalian gut using engineered probiotic *Saccharomyces boulardii*. *Controlled Release Society Annual Meeting*, Virtual.
25. **Nathan Crook**, 2021. Delivery of biomolecules to the mammalian gut using engineered probiotic *Saccharomyces boulardii*. *Rising Stars in Drug Delivery and Novel Carriers, University of North Carolina-Chapel Hill*, Chapel Hill, NC.
26. **Nathan Crook**, 2021. Engineering the *in vivo* residence times and biomolecule production capacities of probiotics. *Department of Biomedical Engineering, George Mason University*, Fairfax, VA.
27. **Nathan Crook**, 2021. Combinatorial and Evolutionary Engineering of Probiotic Microbes. *Department of Biochemistry, North Carolina State University*, Raleigh, NC.
28. **Nathan Crook**, 2020. Delivery of biomolecules to the mammalian gut using engineered probiotic *Saccharomyces boulardii*. *6th Annual Microbiome Movement – Drug Development Summit*, Boston, MA.
29. **Nathan Crook**, 2020. Engineering the in vivo residence times and biomolecule production capacities of probiotics. *Osher Lifelong Learning Institute, Duke University*, Durham, NC.
30. **Nathan Crook**, 2020. Engineering the in vivo residence times and biomolecule production capacities of probiotics. *Plants for Human Health Institute*, Kannapolis, NC.
31. **Nathan Crook**, 2019. Querying the *in vivo* evolution of probiotics at high resolution. *NCSU Honors Symposium*, Raleigh, NC.
32. **Nathan Crook**, 2019. Delivery of biomolecules to the mammalian gut using engineered probiotic *Saccharomyces boulardii*. *Triangle Microbial Interactions Meeting*, Durham, NC.
33. **Nathan Crook**, 2018. Adaptive strategies of the candidate probiotic *E. coli* Nissle in the mammalian gut. *Genetics Research Seminar*, Raleigh, NC.
34. **Nathan Crook**, 2018. Genomics-based approaches for engineering probiotics. *Bioinformatics Research Seminar*, Raleigh, NC.
35. **Nathan Crook**, 2018. Querying the evolution of probiotics in the mammalian gut. *First Friday Microbiome Seminar*, Chapel Hill, NC.
36. **Nathan Crook**, 2018. Querying the in vivo transcription, evolution, and engineered metabolism of probiotics at high resolution. *Microbiome Monthly Meetup*, Raleigh, NC.
37. **Nathan Crook**, 2018. Querying the in vivo evolution of probiotics at high resolution. *UNC PharmSci Conference*, Chapel Hill, NC.
38. **Nathan Crook**, 2017. Expanding Human Metabolism by Engineering our Commensal Microbes. *Institute of Organic Chemistry and Biochemistry*, Prague, Czechia.
39. **Nathan Crook**, 2017. Development of tools enabling tunable, *in situ* delivery of therapeutics using probiotics. *LabRoots Microbiology & Immunology Virtual Event*.
40. **Nathan Crook**, 2017. Development of tools enabling tunable, *in situ* delivery of therapeutics using probiotics. *Department of Chemical and Biological Engineering, University of Colorado at Boulder,* Boulder, CO.
41. **Nathan Crook**, 2017. Development of tools enabling tunable, *in situ* delivery of therapeutics using probiotics. *Department of Chemical and Biolomolecular Engineering, Rice University,* Houston, TX
42. **Nathan Crook**, 2017. Development of tools enabling tunable, *in situ* delivery of therapeutics using probiotics. *Department of Chemical Engineering, Massachusetts Institute of Technology,* Boston, MA.
43. **Nathan Crook**, 2017. Development of tools enabling tunable, *in situ* delivery of therapeutics using probiotics. *Department of Chemical and Biomolecular Engineering, North Carolina State University,* Raleigh, NC.
44. **Nathan Crook**, 2017. Development of tools enabling tunable, *in situ* delivery of therapeutics using probiotics. *Artie McFerrin Department of Chemical Engineering, Texas A&M University,* College Station, TX.
45. **Nathan Crook**, 2017. Development of tools enabling tunable, *in situ* delivery of therapeutics using probiotics. *McKetta Department of Chemical Engineering*, *The University of Texas at Austin,* Austin, TX.

46. **Nathan Crook** and Hal Alper, 2014. From Promoters to Global Genetic Networks: Novel Approaches for Metabolic Engineering at Multiple Scales. *McKetta Department of Chemical Engineering Graduate Student Formal Seminar Series, The University of Texas at Austin,* Austin, TX.

Oral Presentations

1. **Nathan Crook**, Zevin Condiotte, and Gautam Dantas, 2017. Developing a gut promoter library for *E. coli* Nissle. *AiChE 2017 National Meeting,* Minneapolis, MN.
2. **Nathan Crook**, Aura Ferreiro, Andrew Gasparrini, Molly Gibson, Mitchell Pesesky, Sherry Sun, Bin Wang, Gautam Dantas, 2016. Improving the Residence Time of Probiotics in the Gut through Functional Metagenomics. *AiChE 2016 National Meeting*, San Francisco, CA.
3. **Nathan Crook**, Jie Sun, Alexander Schmitz, and Hal Alper, 2016. Optimization of a tunable RNAi screening approach for systems engineering of complex phenotypes in yeast. *AiChE 2016 National Meeting*, San Francisco, CA.
4. **Nathan Crook**, Aura Ferriero, Drew Gasparrini, Molly Gibson, Mitchell Pesesky, Sherry Sun, Bin Wang, Gautam Dantas, 2015. Improving the Residence Time of Probiotics in the Gut through Functional Metagenomics. *AiChE 2015 National Meeting*, Salt Lake City, UT.
5. **Nathan Crook**, Joe Abatemarco, Jie Sun, Alexander Schmitz, and Hal Alper, 2014. Rapid evolution of parts and pathways through an *in vivo* Continuous Evolution (ICE) approach in yeast. *ACS 2014 National Meeting*, Dallas, TX.
6. **Nathan Crook**, Joe Abatemarco, Jie Sun, Alexander Schmitz, and Hal Alper, 2013. Rapid evolution of enzymes and regulatory factors through an *in vivo* Continuous Evolution (ICE) approach in yeast. *AiChE 2013 National Meeting*, San Francisco, CA.
7. **Nathan Crook**, Alexander Schmitz, and Hal Alper, 2013. Facile Generation of Knockdown Phenotypes in Yeast through RNA Interference. *AiChE 2013 National Meeting*, San Francisco, CA.
8. **Nathan Crook**, Elizabeth Freeman, and Hal Alper, 2011. Re-Engineering Multicloning Sites for Function and Convenience. *AiChE 2011 National Meeting*, Minneapolis, MN.
9. **Nathan Crook**, Andrea Rentmeister, and Frances Arnold, 2008. Application of a Designed Cytochrome $P450_{BM3}$ Mutant Library Towards Demethylation of Permethylated Nucleosides. *Summer Undergraduate Research Fellowship Seminar Day*, Pasadena, CA.
10. **Nathan Crook**, Rudi Fasan, and Frances H. Arnold, 2007. Use of Engineered *E. coli* Towards Higher Yield of Propanol per Glucose in Whole-Cell Biotransformations Involving Engineered Cytochrome $P450_{BM3}$. *Summer Undergraduate Research Fellowship Seminar Day*, Pasadena, CA.

Poster Presentations

1. **Nathan Crook**, 2022. The Crook Lab: Improving Human and Environmental Health by Engineering Microbial Communities. *China-America Frontiers of Engineering*. Irvine, CA.
2. **Nathan Crook**, 2019. Establishing Probiotic *Saccharomyces boulardii* as a Model Organism for Synthesis and Delivery of Biomolecules to the Gut. *Keystone Conference on the Microbiome: Therapeutic Implications*, Killarney, Ireland
3. **Nathan Crook**, 2017. Advancing STEM Outreach through the Young Scientist Program. *ASEE Summer School 2017*, Raleigh, NC.
4. **Nathan Crook**, 2016. Increasing the Scale and Rate of Metabolic Engineering through Systems Synthetic Biology. *AiChE 2016 National Meeting*, San Francisco, CA.
5. **Nathan C. Crook**, Aura L. Ferriero, Andrew J. Gasparrini, Xiaoqing Sun, Mitchell W. Pesesky, Molly K. Gibson, Bin Wang, Daniel A. Peterson, and Gautam Dantas, 2016. Improving the Residence Time of Probiotics in the Gut through Functional Metagenomics. *Lake Arrowhead Microbial Genomics*, Lake Arrowhead, CA.
6. **Nathan C. Crook**, Aura L. Ferriero, Andrew J. Gasparrini, Xiaoqing Sun, Mitchell W. Pesesky, Molly K. Gibson, Bin Wang, Daniel A. Peterson, and Gautam Dantas, 2016. Improving the Residence Time of Probiotics in the Gut through Functional Metagenomics. *Monsanto Fellows Symposium*, Chesterfield, MO.
7. **Nathan C. Crook**, Aura L. Ferriero, Andrew J. Gasparrini, Xiaoqing Sun, Mitchell W. Pesesky, Molly K. Gibson, Bin Wang, Daniel A. Peterson, and Gautam Dantas, 2016. Improving the Residence Time of

Probiotics in the Gut through Functional Metagenomics. *Washington University 12th Annual Postdoc Symposium*, Saint Louis, MO.

8. **Nathan Crook**, 2015. Systems Synthetic Biology for Engineering in Challenging Biological Contexts. *AiChE 2015 National Meeting*, Salt Lake City, UT.
9. **Nathan Crook***, Joe Abatemarco*, Jie Sun*, James Wagner, Alexander Schmitz, and Hal Alper, 2015. *in vivo* Continuous Evolution of Genes and Pathways in Yeast. *AiChE 2015 National Meeting*, Salt Lake City, UT.
10. **Nathan Crook**, Aki Yoneda, and Gautam Dantas, 2015. Isolation and Characterization of Terpene Synthases from Diverse Metagenomic Libraries. *Synthetic Biology: Engineering, Evolution & Design*. Boston, MA
11. **Nathan Crook**, Jie Sun, Joe Abatemarco, and Hal Alper, 2014. Accelerating Enzyme and Pathway Engineering with *in vivo* Continuous Evolution (ICE). *DARPA Living Foundries Review Meeting*, Denver, CO.
12. **Nathan Crook**, Jie Sun, Joe Abatemarco, and Hal Alper, 2014. Accelerating Enzyme and Pathway Engineering with *in vivo* Continuous Evolution (ICE). *DARPA Living Foundries Midyear Meeting*, La Jolla, CA.
13. **Nathan Crook**, Jie Sun, Joe Abatemarco, and Hal Alper, 2013. Accelerating Enzyme and Pathway Engineering with *in vivo* Continuous Evolution (ICE). *DARPA Living Foundries Midyear Meeting*, San Francisco, CA.
14. **Nathan Crook**, Elizabeth Freeman, and Hal Alper, 2011. Re-Engineering Multicloning Sites for Function and Convenience. *GAIN: Graduate and Industry Networking Conference, 2013.* Austin, TX.

Current Research Trainees:

Lab Manager: Tyasia Fiffie

Postdoc: Genan Wang, Alexandra Imre, Zidan Li

Graduate: Tianyu Li, Will Parker, Aryan Razdan, John Cheadle, Qiaochu Li, Amanda Taylor, Jose Escarce

Undergraduate: Brian Yoo, Benjamin Li, Hannah Carels, Revy Godehn

Past Research Trainees:

Research Scientist: Fani Ttofali

Postdoc: Ibrahim Al'Abri, Deniz Durmusoglu, Scott Collins, Kathryn Polkoff, Thuan Nguyen-Vo, John van Schaik

Graduate: Justin Vento, Ethan Purnell, Carly Catella

Undergraduate: Akansha Pandey, Iustina Banerji, Katie Day, Allison Williams, Anuj Jayaram, Daniel Bun, Daniel Haller, Sean Sullivan, Laura Merkel, Aarati Bothe. Caroline Moody, Tyler Jordan, Ali Alkhater, Shuang Wu, Nicholas Dasburg, Caroline Moody, Tyler Jordan, Ali Alkhater, Elizabeth Freeman, Heming Bai, Alexander Schmitz, Zevin Condiotte, Naomi Ahn, Andrea Zuzack

High School: Divya Ramamoorthy, Fatima Al-Hanoosh, Anuva Nuzhat

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Research Experience:

Washington University in St Louis September 2014-December 2017

Postdoctoral Research Associate Supervisor: Gautam Dantas

- Led teams which conceived and authored four major grant proposals: NIH R01 (5 grads/1 Postdoc), two Gates Foundation Grand Challenges Explorations (1 grad/2 Postdoc), and I-CARES (2 PIs/1 grad).
- Authored major sections of five multi-PI grant proposals: NIH R21, NIH R21/R33 (x2), NIH R01 (x3), Kavli Ideas Challenge, ARPA-E OPEN, DoD PRMRP, and DOE Biosystems Design.
- Assisted in reviewing articles for *Science* and *Nature Microbiology*.
- Led the setup and operation of the Dantas Lab's first gnotobiotic mouse facility, *H. polygyrus* infection cycle, and Pah^{enu2} (phenylketonuria model) mouse colony.
- Led a team of two graduate students and one technician in the usage of functional metagenomics to discover pathways conferring increased gut persistence of *E. coli* Nissle in multiple human-relevant dietary contexts and to apply improved strains toward the treatment of parasitic helminth infections and phenylketonuria.

- Led a team of one high school student, one undergraduate, and one graduate student in the development and optimization of screening strains, conditions, and computational tools in order to adapt a functional metagenomics approach to discover novel terpene synthases.
- Developed and optimized a high-throughput approach for characterizing the strength of transcriptional regulators in probiotic *E. coli* Nissle during growth in the gastrointestinal tract.

The University of Texas at Austin August 2009-July 2014
Graduate Researcher Supervisor: Hal Alper
- Conceived and drafted grant proposals for the development of new yeast engineering techniques, resulting in 2 funded grants (DARPA Living Foundries and Samsung Global Research Outreach).
- Designed, built, and managed the Alper Lab research webpage.
- Led a team of one undergraduate student, two graduate students, and one postdoctoral scholar in the conception and development of a technique for *in vivo* continuous evolution in yeast which accelerates directed evolution by an order of magnitude over the previous state-of-the-art.
- Conceived and developed and optimized a technique for rapid prototyping of gene knockdowns in yeast through RNA interference.
- Developed experimentally validated computational approaches to generate variants of native yeast promoters with increased strength and also functional, fully synthetic yeast promoters to significantly expedite the design-build-test cycle of these biological parts.
- Computationally designed and experimentally validated a set of multicloning sites enabling significantly improved yeast genetic engineering outcomes versus previous state-of-the-art.

California Institute of Technology August 2006-July 2009
Undergraduate Researcher Supervisor: Frances Arnold
- Developed P450-based MRI sensors for neurotransmitters exhibiting high contrast and selectivity.
- Developed a propane monooxygenase through directed evolution and optimized the productivity of a propanol bioreactor utilizing engineered *E. coli* expressing the evolved enzyme.

Teaching Experience:

Assistant Professor of Chemical Engineering January 2018-present
- Mentored four graduate students in the areas of synthetic biology, metabolic engineering, and genomics research. Mentored one undergraduate student as a research assistant from introduction to research to independent researcher level.

Instructor – CHE 452/552: Biomolecular Engineering Spring 2021, Spring 2022, Spring 2023, Spring 2024
- Taught fundamental concepts in DNA, RNA, protein, and microbial community engineering to advanced undergraduate and graduate students. Designed lecture content, exams, and homework sets, led office hours, and graded assignments.

Instructor – CHE 395: Professional Development Spring 2021, Spring 2022, Spring 2023, Fall 2023
- Taught undergraduate chemical engineers technical writing, engineering ethics, and professionalism. Designed lecture content, assignments, and assessed both written and oral presentations.

Instructor – CHE 596: Microbial Community Engineering Fall 2020, Fall 2024
- Taught fundamental concepts in microbial community engineering, biology, and measurement to advanced undergraduate and graduate students. Designed lecture content, exams, and homework sets, led office hours, and graded assignments.

Instructor – CHE 225: Chemical Engineering Analysis Spring 2020, Fall 2021, Fall 2022, Fall 2023
- Taught computational approaches to solving steady state and transient mass and energy balance problems to 2nd year undergraduates. Designed lecture content, exams, and homework sets, led office hours, and graded exams.

Instructor – CHE 205: Chemical Process Principles Spring 2018, Spring 2019, Fall 2019

- Taught fundamental concepts in mass and energy balances to 2nd year undergraduates. Designed lecture content, exams, and homework sets, led office hours, and graded exams.

Washington University in St. Louis STEM Pedagogies Program (Associate Level) 2014-2017

- Completed series of workshops offering practical advice for incorporating emerging pedagogical research into STEM courses, including active learning, process-oriented guided inquiry learning (POGIL), and metacognition.

TA Certification: UT Austin Cockrell School of Engineering 2013

Postdoctoral Researcher May 2014-December 2017

- Mentored two undergraduates and one high school student as research assistants from introduction to research to independent researcher level.

Graduate Researcher August 2009-May 2014

- Mentored four graduate students, four undergraduates and one high school student as research assistants from introduction to research to independent researcher level.

Teaching Assistant – CHE 317: Introduction to Chemical Engineering Analysis Fall 2013

- Taught fundamental concepts in mass and energy balances to 2nd year undergraduates. Designed course material, led recitation sections and office hours, and graded materials.

Teaching Assistant – CHE 379: Biochemical and Cellular Metabolic Engineering Fall 2012

- Taught advanced topics in enzyme kinetics, metabolic modeling, and bioreactor design to senior level undergraduates and graduate students. Led review sessions, office hours and graded exams.

Teaching Assistant – CHE 253M: Measurement, Control and Data Analysis Lab Spring 2010

- Introduced 3rd year chemical engineering undergraduates to fundamental laboratory techniques and technical writing. Facilitated laboratory modules and graded lab reports.

Outreach:

- Biobuilder Educational Foundation (Team Mentor) 2024
- Research presentation and lab activity with Omni Montessori High School. 2021
- NCSU TRIO Upward Bound (Research Mentor) 2018-present
  - Mentored a first-generation college student in summer research, and provided advice leading toward acceptance in a chemical engineering PhD program.
  - Led two half-day workshops in the Crook Lab where 20 high school students learned the basics of bacterial culture and DNA manipulation techniques.
- Hot Topics in Synthetic Biology Workshop (Keynote Speaker) 2016
  - Presented and discussed emerging applications and ethical considerations in synthetic biology to high school science teachers from around the St. Louis Metro area.
- Young Scientist Program (Research Mentor) 2016
  - Introduced an at-risk high school student to cutting-edge synthetic biology research and provided mentorship during a summer research project involving the discovery of novel terpene synthases using functional metagenomics.
- Missouri Regional Science Bowl (Moderator) 2016
- AP Biology Outreach 2015-2016
  - Demonstrated new DNA sequencing technologies and cloning techniques to Saint Louis University High School students
- ChE Undergraduate Research Poster Competition (Judge) 2010-2011, 2013
- Austin Energy Regional Science Fest (Poster Judge, grades 1-3) 2011
- Chandler Oaks Elementary Science Fair (Poster Judge) 2011

- 9th Annual Engineer's Day at Austin Children's Museum 2010
  - Taught hands-on engineering design via construction of towers using spaghetti and marshmallows to elementary students.

Service:

- Faculty Advisor, *NCSU BioTech Syndicate* (Undergraduate Club) 2024-present
- Co-Chair, *CBE Graduate Admissions and Recruiting Committee* 2024-present
- Organizing Committee, *International Conference on Microbiome Engineering* 2024
- Session Chair, National Academy of Engineering's US Frontiers of Engineering Conference 2024
- Theme Editor, *Advanced Drug Delivery Reviews* 2023-present
- Organizer, *NCSU Biolunch Seminar Series* 2023-present
- Organizer, *NCSU Future Leaders in Chemical Engineering Symposium* 2023-present
- Co-Organizer, *Schoenborn Graduate Research Symposium* 2023
- Committee Member, *CBE Graduate Admissions and Recruiting Committee* 2019-present
- Session Chair, American Chemical Society National Meeting 2019
- Session Chair, American Institute of Chemical Engineers National Meeting 2017-present
- Grad Student/Postdoc ChE Faculty Candidate Interview Committee 2013-2014
  - One of 11 students selected to provide feedback to department chair on faculty candidates
- UT Austin Graduate Student Assembly (GSA) (Departmental Representative) 2011-2013
  - Solicited feedback from ChE grad students on upcoming university and state policy decisions
  - Represented opinions of ChE grads to the wider graduate student body on GSA legislation.
- American Institute of Chemical Engineers (Member) 2011-present