David F. Savage - Curriculum Vitae

Associate Professor of Biochemistry, Biophysics, and Structural Biology
Investigator, Howard Hughes Medical Institute
University of California, Berkeley
www.savagelab.org
E savage@berkeley.edu T 510.643.7847

Education

2007	Ph.D., Biophysics, University of California, San Francisco
2001	B.A., Chemistry with Minor in Computer Science, Gustavus Adolphus College

Academic Appointments

2022 — present	Investigator, Howard Hughes Medical Institute
2017 — present	Associate Professor of Biochemistry, Biophysics, and Structural Biology Department of Molecular & Cell Biology University of California, Berkeley
2010 — 2017	Assistant Professor of Biochemistry, Biophysics, and Structural Biology Departments of Molecular & Cell Biology and Chemistry University of California, Berkeley
2007— 2011	DOE Physical Biosciences Fellow of the Life Sciences Research Foundation Department of Systems Biology Harvard Medical School

Professional Experience

2016 —	Member, Engineering Biology Research Consortium
2013 —	Member, Graduate Group in Microbiology, UC Berkeley
2011 —	Member, Graduate Group in Chemical Biology, UC Berkeley
2011 —	Member, Graduate Group in Biophysics, UC Berkeley
2011 —	Member, Synthetic Biology Institute, UC Berkeley
2011 —	Principal Investigator, California Institute for Quantitative Biosciences (QB3)
2011 — 2016	Affiliated Investigator, NSF Synthetic Biology Engineering Research Center
2011 — 2016	Principal Investigator, Energy Biosciences Institute
2007 — 2011	Post-doctoral Fellow in Systems Biology, Harvard Medical School *Developed cyanobacteria as a model system for studying the molecular physiology of carbon dioxide assimilation.*
2001 — 2007	Doctoral Student, Biophysics, UCSF *Studied structure and function of aquaporin water channels and developed methods for biophysically characterizing integral membrane proteins.*
2000 — 2001	Undergraduate Researcher, Chemistry, Gustavus Adolphus College *Computational study of allostery in the enzyme glutamate dehydrogenase.*

Honors and Awards

2021	Selected as Investigator, 2020-2021 HHMI Competition
2018	Selected for the “Future of Biochemistry” special issue of ACS-Biochemistry
2015	Agilent Early Career Professor Award, Finalist
2013	NIH Director’s New Innovator Award
2013	Basil O’Connor Starter Scholar Research Award - March of Dimes Foundation

2011	DOE Early Career Program Award
2011	Alfred P. Sloan Research Fellowship
2008 — 2011	DOE Physical Biosciences Fellow of the Life Sciences Research Foundation
2007	Clements Award for outstanding thesis in UCSF Biophysics program
2005 — 2006	ARCS Foundation Scholar
2003 — 2005	Burroughs Wellcome Fellowship in Quantitative Biology
1997 — 2001	Partners in Scholarship Fellowship, Gustavus Adolphus College
1996	Eagle Scout, Boys Scouts of America

Publications

71. Oltrogge LM, Chen AW, Chaijarasphong T, Turnšek JB, Savage DF. 2024. α-Carboxysome Size Is Controlled by the Disordered Scaffold Protein CsoS2. Biochemistry 63: 219–229. http://dx.doi.org/10.1021/acs.biochem.3c00403.

70. Prywes N, Philips NR, Oltrogge LM, de Pins B, Cowan AE, Taylor-Kearney LJ, Chang HA, Hall LN, Bhatt A, Shih PM, et al. 2023. Mapping the biochemical landscape of rubisco. bioRxiv 2023.09.27.559826. https://www.biorxiv.org/content/10.1101/2023.09.27.559826

69. Blikstad C, Dugan EJ, Laughlin TG, Turnšek JB, Liu MD, Shoemaker SR, Vogiatzi N, Remis JP, Savage DF. 2023. Identification of a carbonic anhydrase-Rubisco complex within the alpha-carboxysome. Proc Natl Acad Sci U S A 120: e2308600120. http://dx.doi.org/10.1073/pnas.2308600120.

68. Armbruster EG, Lee J, Hutchings J, VanderWal AR, Enustun E, Adler BA, Aindow A, Deep A, Rodriguez ZK, Morgan CJ, et al. 2023. Sequential membrane- and protein-bound organelles compartmentalize genomes during phage infection. bioRxiv. http://dx.doi.org/10.1101/2023.09.20.558163.

67. Adler BA, Al-Shimary MJ, Patel JR, Armbruster E, Colognori D, Charles EJ, Miller KV, Lahiri A, Trinidad M, Boger R, et al. 2023. Genome-wide Characterization of Diverse Bacteriophages Enabled by RNA-Binding CRISPRi. bioRxiv 2023.09.18.558157. https://www.biorxiv.org/content/biorxiv/early/2023/09/18/2023.09.18.558157

66. Turnšek JB, Oltrogge LM, Savage DF. 2023. Conserved and repetitive motifs in an intrinsically disordered protein drive α-carboxysome assembly. BioRxiv. https://www.biorxiv.org/content/10.1101/2023.07.08.548221.abstract.

65. Adler BA, Trinidad MI, Bellieny-Rabelo D, Zhang E, Karp HM, Skopintsev P, Thornton BW, Weissman RF, Yoon PH, Chen L, et al. 2023. CasPEDIA Database: a functional classification system for class 2 CRISPR-Cas enzymes. Nucleic Acids Res. http://dx.doi.org/10.1093/nar/gkad890.

64. Prywes N, Phillips NR, Tuck OT, Valentin-Alvarado LE, Savage DF. 2023. Rubisco Function, Evolution, and Engineering. Annu Rev Biochem 92: 385–410. http://dx.doi.org/10.1146/annurev-biochem-040320-101244.

63. Stahl EC, Sabo JK, Kang MH, Allen R, Applegate E, Kim SE, Kwon Y, Seth A, Lemus N, Salinas-Rios V, et al. 2023. Genome editing in the mouse brain with minimally immunogenic Cas9 RNPs. Mol Ther 31: 2422–2438. http://dx.doi.org/10.1016/j.ymthe.2023.06.019.

62 Alvarado LEV, Fakra SC, Probst AJ, Giska JR, Jaffe AL. 2022. Autotrophic biofilms sustained by deeply-sourced groundwater host diverse CPR bacteria implicated in sulfur and hydrogen metabolism. bioRxiv. https://www.biorxiv.org/content/10.1101/2022.11.17.516901.abstract.

61. Lavania AA, Carpenter WB, Oltrogge LM, Perez D, Turnšek JB, Savage DF, Moerner WE. 2022. Exploring Masses and Internal Mass Distributions of Single Carboxysomes in Free Solution Using Fluorescence and Interferometric Scattering in an Anti-Brownian Trap. J Phys Chem B 126: 8747–8759. http://dx.doi.org/10.1021/acs.jpcb.2c05939.

60. Flamholz AI, Dugan E, Panich J, Desmarais JJ, Oltrogge LM, Fischer WW, Singer SW, Savage DF. 2022. Trajectories for the evolution of bacterial CO2-concentrating mechanisms. Proc Natl Acad Sci U S A 119: e2210539119. http://dx.doi.org/10.1073/pnas.2210539119.

59. Wang RZ, Nichols RJ, Liu AK, Flamholz AI, Artier J, Banda DM, Savage DF, Eiler JM, Shih PM, Fischer WW. 2023. Carbon isotope fractionation by an ancestral rubisco suggests that biological proxies for CO2 through geologic time should be reevaluated. Proc Natl Acad Sci U S A 120: e2300466120. http://dx.doi.org/10.1073/pnas.2300466120.

58. Al-Shayeb B, Skopintsev P, Soczek KM, Stahl EC, Li Z, Groover E, Smock D, Eggers AR, Pausch P, Cress BF, et al. 2022. Diverse virus-encoded CRISPR-Cas systems include streamlined genome editors. Cell 185: 4574–4586.e16. http://dx.doi.org/10.1016/j.cell.2022.10.020.

57. Chandrasekaran SS, Agrawal S, Fanton A, Jangid AR, Charrez B, Escajeda AM, Son S, Mcintosh R, Tran H, Bhuiya A, et al. 2022. Rapid detection of SARS-CoV-2 RNA in saliva via Cas13. Nat Biomed Eng 6: 944–956. http://dx.doi.org/10.1038/s41551-022-00917-y.

56. Metskas LA, Ortega D, Oltrogge LM, Blikstad C, Lovejoy DR, Laughlin TG, Savage DF, Jensen GJ. 2022. Rubisco forms a lattice inside alpha-carboxysomes. *Nat Commun* **13**: 4863. http://dx.doi.org/10.1038/s41467-022-32584-7.

55. Carpenter WB, Lavania AA, Borden JS, Oltrogge LM, Perez D, Dahlberg PD, Savage DF, Moerner WE. 2022. Ratiometric Sensing of Redox Environments Inside Individual Carboxysomes Trapped in Solution. J Phys Chem Lett 13: 4455–4462.

54. Perier C, Nasinghe E, Charles I, Ssetaba LJ, Ahyong V, Bangs D, Beatty PR, Czudnochowski N, Diallo A, Dugan E, et al. 2022. Workshop-based learning and networking: a scalable model for research capacity strengthening in low- and middle-income countries. Glob Health Action 15: 2062175.

53. Charles EJ, Kim SE, Knott GJ, Smock D, Doudna J, Savage DF. 2021. Engineering improved Cas13 effectors for targeted post-transcriptional regulation of gene expression. *bioRxiv* 2021.05.26.445687. https://www.biorxiv.org/content/10.1101/2021.05.26.445687v1

52. LaFrance BJ, Cassidy-Amstutz C, Nichols RJ, Oltrogge LM, Nogales E, Savage DF. 2021. The encapsulin from Thermotoga maritima is a flavoprotein with a symmetry matched ferritin-like cargo protein. *Sci Rep* **11**: 22810.

51. Borden JS, Savage DF. New discoveries expand possibilities for carboxysome engineering. *Curr Opin Microbiol* 2021;61:58–66.

50 Liu TY, Knott GJ, Smock DCJ, Desmarais JJ, Son S, Bhuiya A, Jakhanwal S, Prywes N, Agrawal S, Díaz de León Derby M, et al. 2021. Accelerated RNA detection using tandem CRISPR nucleases. *Nat Chem Biol* **17**: 982–988.

49. Shams A, Higgins SA, Fellmann C, Laughlin TG, Oakes BL, Lew R, Kim S, Lukarska M, Arnold M, Staahl BT, et al. 2021. Comprehensive deletion landscape of CRISPR-Cas9 identifies minimal RNA-guided DNA-binding modules. *Nat Commun* **12**: 5664.
*Science Magazine highlight

48. Lien KA, Dinshaw K, Nichols RJ, Cassidy-Amstutz C, Knight M, Singh R, Eltis LD, Savage DF, Stanley SA. 2021. A nanocompartment system contributes to defense against oxidative stress in Mycobacterium tuberculosis. Elife 10. http://dx.doi.org/10.7554/eLife.74358.

47. Nichols RJ, LaFrance B, Phillips NR, Radford DR, Oltrogge LM, Valentin-Alvarado LE, et al. Discovery and characterization of a novel family of prokaryotic nanocompartments involved in sulfur metabolism. Elife 2021;10.: https://doi.org/10.7554/eLife.59288.

46. Flamholz AI, Dugan E, Blikstad C, Gleizer S, Ben-Nissan R, Amram S, et al. Functional reconstitution of a bacterial CO2 concentrating mechanism in Escherichia coli. Elife 2020;9.: https://doi.org/10.7554/eLife.59882.
*Nature research highlight
*Innovative Genomics Institute highlight

45. Laughlin, TG, Savage, DF, Davies, KM, 2020. Recent advances on the structure and function of NDH-1: The complex I of oxygenic photosynthesis. Biochim. Biophys. Acta Bioenerg. 148254. doi:10.1016/j.bbabio.2020.148254.

44. Oltrogge LM, Chaijarasphong T, Chen AW, Bolin ER, Marqusee S, Savage DF. 2020. Multivalent interactions between CsoS2 and Rubisco mediate α-carboxysome formation. Nat Struct Mol Biol 27: 281–287.

43. Lee T-H, Carpenter TS, D'haeseleer P, Savage DF, Yung MC. 2020. Encapsulin carrier proteins for enhanced expression of antimicrobial peptides. Biotechnol Bioeng 117: 603– 613.

42. Desmarais JJ, Flamholz AI, Blikstad C, Dugan EJ, Laughlin TG, Oltrogge LM, Chen AW, Wetmore K, Diamond S, Wang JY, et al. 2019. DABs are inorganic carbon pumps found throughout prokaryotic phyla. Nat Microbiol 4: 2204-2215.
*Nature Microbiology News and Views

41. Flamholz AI, Prywes N, Moran U, Davidi D, Bar-On YM, Oltrogge LM, Alves R, Savage D, Milo R. 2019. Revisiting Trade-offs between Rubisco Kinetic Parameters. Biochemistry. 58: 3365-3376.

40. Huang TP, Zhao KT, Miller SM, Gaudelli NM, Oakes BL, Fellmann C, Savage DF, Liu DR. 2019. Circularly permuted and PAM-modified Cas9 variants broaden the targeting scope of base editors. Nat Biotechnol 37: 626–631.

39. Harper CC, Elliott AG, Oltrogge LM, Savage DF, Williams ER. 2019. Multiplexed Charge Detection Mass Spectrometry for High-Throughput Single Ion Analysis of Large Molecules. Anal Chem 91: 7458 - 7465.

38. Blikstad C, Flamholz AI, Oltrogge LM, Savage DF. 2019. Learning to Build a β-Carboxysome. Biochemistry 58: 2091–2092.

37. Laughlin TG, Bayne AN, Trempe J-F, Savage DF, Davies KM. 2019. Structure of the complex I-like molecule NDH of oxygenic photosynthesis. Nature 566: 411–414.

36. Savage DF. 2019. Cas14: Big Advances from Small CRISPR Proteins. Biochemistry 58: 1024–1025.

35. Oakes BL, Fellmann C, Rishi H, Taylor KL, Ren SM, Nadler DC, Yokoo R, Arkin AP, Doudna JA, Savage DF. 2019. CRISPR-Cas9 Circular Permutants as Programmable Scaffolds for Genome Modification. Cell 176: 254–267.e16.
*GEN highlight

34. Kundert K, Lucas JE, Watters KE, Fellmann C, Ng AH, Heineike BM, Fitzsimmons CM, Oakes BL, Qu J, Prasad N, et al. 2019. Controlling CRISPR-Cas9 with ligand-activated and ligand-deactivated sgRNAs. Nature Communications 1–11.

33. Welkie DG, Rubin BE, Diamond S, Hood RD, Savage DF, Golden SS. 2019. A Hard Day's Night: Cyanobacteria in Diel Cycles. Trends in Microbiology 27: 231–242.

32. Chaijarasphong T, Savage DF. 2018. Sequestered: Design and Construction of Synthetic Organelles. In Synthetic Biology, pp. 279 - 306, Wiley-Blackwell.

31. Higgins SA, Savage DF. 2018. Protein Science by DNA Sequencing: How Advances in Molecular Biology Are Accelerating Biochemistry. *Biochemistry* 57: 38–46.

30. Higgins SA, Ouonkap SVY, Savage DF. 2017. Rapid and Programmable Protein Mutagenesis Using Plasmid Recombineering. ACS Synth Biol 6: 1825–1833.

29. Nichols RJ, Cassidy-Amstutz C, Chaijarasphong T, Savage DF. 2017. Encapsulins: molecular biology of the shell. Crit Rev Biochem Mol Biol 52: 583–594.

28. Savage D, Zhang W. 2016. Biofuels: At the crossroads. Current Opinion in Chemical Biology 35: A1–A3.

27. Morgan S-A, Nadler DC, Yokoo R, Savage DF. 2016. Biofuel metabolic engineering with biosensors. Current Opinion in Chemical Biology 35: 150–158.

26. Hood RD, Higgins SA, Flamholz A, Nichols RJ, Savage DF. 2016. The stringent response regulates adaptation to darkness in the cyanobacterium Synechococcus elongatus. Proc Natl Acad Sci USA 113: E4867–76.

25. Mangan* NM, Flamholz* A, Hood RD, Milo R, Savage DF. 2016. pH determines the energetic efficiency of the cyanobacterial CO2 concentrating mechanism. Proc Natl Acad Sci USA 113: E5354–62. *denotes equal authorship

24. Gerhardt KP, Olson EJ, Castillo-Hair SM, Hartsough LA, Landry BP, Ekness F, Yokoo R, Gomez EJ, Ramakrishnan P, Suh J, et al. 2016. An open-hardware platform for optogenetics and photobiology. Sci Rep 6: 35363.

23. Nadler DC, Morgan S-A, Flamholz A, Kortright KE, Savage DF. 2016. Rapid construction of metabolite biosensors using domain-insertion profiling. Nature Communications 7: 12266.

22. Cassidy-Amstutz C, Oltrogge L, Going CC, Lee A, Teng P, Quintanilla D, East-Seletsky A, Williams ER, Savage DF. 2016. Identification of a Minimal Peptide Tag for in Vivo and in Vitro Loading of Encapsulin. Biochemistry 55: 3461–3468.

21. Oakes BL, Nadler DC, Flamholz A, Fellmann C, Staahl BT, Doudna JA, Savage DF. 2016. Profiling of engineering hotspots identifies an allosteric CRISPR-Cas9 switch. Nat Biotechnol 34: 646–651.

20. Chaijarasphong T, Nichols RJ, Kortright KE, Nixon CF, Teng PK, Oltrogge LM, Savage DF. 2016. Programmed Ribosomal Frameshifting Mediates Expression of the α-Carboxysome. J Mol Biol 428: 153–164.

19. Yokoo R, Hood RD, Savage DF. 2015. Live-cell imaging of cyanobacteria. Photosynthesis Research 126: 33–46.

18. Oakes, B.L., Nadler, D.C. & Savage, D.F., 2014. Protein engineering of Cas9 for enhanced function. Methods in enzymology, 546, pp.491–511.

17. Chen AH, Robinson-Mosher A, Savage DF, Silver PA, Polka JK. 2013. The bacterial carbon-fixing organelle is formed by shell envelopment of preassembled cargo. PLoS ONE 8: e76127.

16. Bonacci W, Teng PK, Afonso B, Niederholtmeyer H, Grob P, Silver PA, Savage DF. 2012. Modularity of a carbon-fixing protein organelle. Proc Natl Acad Sci USA 109: 478–483.

15. Chen AH, Afonso B, Silver PA, Savage DF. 2012. Spatial and temporal organization of chromosome duplication and segregation in the cyanobacterium Synechococcus elongatus PCC 7942. PLoS ONE 7: e47837.

14. Savage DF, O'Connell JD, Miercke LJW, Finer-Moore J, Stroud RM. 2010. Structural context shapes the aquaporin selectivity filter. Proc Natl Acad Sci USA 107: 17164–17169.

13. Savage DF, Afonso B, Chen AH, Silver PA. 2010. Spatially ordered dynamics of the bacterial carbon fixation machinery. Science 327: 1258–1261.

12. Niederholtmeyer H, Wolfstadter BT, Savage DF, Silver PA, Way JC. 2010. Engineering Cyanobacteria To Synthesize and Export Hydrophilic Products. Appl Environ Microbiol 76: 3462–3466.

11. Newby ZER, O'Connell JD, Gruswitz F, Hays FA, Harries WEC, Harwood IM, Ho JD, Lee JK, Savage DF, Miercke LJW, et al. 2009. A general protocol for the crystallization of membrane proteins for X-ray structural investigation. Nat Protoc 4: 619–637.

10. Savage DF. 2009. Cell-free protein synthesis: Methods and protocols, edited by Alexander S. Spirin and James R. Swartz. Protein Science 17: 962–963.

9. Savage DF, Way JC, Silver PA. 2008. Defossiling fuel: how synthetic biology can transform biofuel production. ACS Chem Biol 3: 13–16.

8. Savage DF, Stroud RM. 2007. Structural Basis of Aquaporin Inhibition by Mercury. J Mol Biol 368: 607–617.

7. Savage DF, Anderson CL, Robles-Colmenares Y, Newby ZER, Stroud RM. 2007. Cell-free complements in vivo expression of the E. coli membrane proteome. Protein Sci 16: 966–976.

6. Stroud RM, Harries WEC, Lee JK, Khademi S, Savage DF. 2006. Aquaporins: Integral Membrane Channel Proteins. In Structural Biology of Membrane Proteins (eds. R. Grisshamer and S.K. Buchanan), Royal Society of Chemistry, London.

5. Lee JK, Khademi S, Harries W, Savage D, Miercke L, Stroud RM. 2004. Water and glycerol permeation through the glycerol channel GlpF and the aquaporin family. J Synchrotron Radiat 11: 86–88.

4. Egea PF, Shan S-O, Napetschnig J, Savage DF, Walter P, Stroud RM. 2004. Substrate twinning activates the signal recognition particle and its receptor. Nature 427: 215–221.

3. Savage DF, Egea PF, Robles-Colmenares Y, O'Connell JD, Stroud RM. 2003. Architecture and selectivity in aquaporins: 2.5 Å X-ray structure of aquaporin Z. PLoS Biol 1: E72.

2. Stroud RM, Savage D, Miercke LJW, Lee JK, Khademi S, Harries W. 2003. Selectivity and conductance among the glycerol and water conducting aquaporin family of channels. FEBS Letters 555: 79–84.

1. Keatinge-Clay AT, Shelat AA, Savage DF, Tsai SC, Miercke LJW, O'Connell JD, Khosla C, Stroud RM. 2003. Catalysis, specificity, and ACP docking site of Streptomyces coelicolor malonyl-CoA:ACP transacylase. Structure 11: 147–154.

Invited Presentations

2024 Biophysical Society Annual Meeting, Plenary Speaker
2023 Mexican Congress of Physicochemical, Structure, and Protein Design, Plenary Speaker
2023 UCSF / UC Berkeley Biophysics Joint Retreat, Invited Speaker
2023 North African Gene Editing Workshop, Speaker
2023 Gordon Research Conference: CO2 Assimilation, Speaker
2023 Vanderbilt Center for Structural Biology, Speaker
2023 ASBMB Meeting, Invited Speaker
2022 Johns Hopkins University, Department of Chemistry, Seminar Speaker
2022 EBI-Shell Net Zero Emission Materials Workshop
2022 University of Texas Southwestern, Department of Biochemistry Seminar Speaker
2022 Gordon Research Conference: Bioorganic Chemistry, Invited speaker
2022 Protein Society webinar on Green Energy, Invited speaker and panelist
2021 31st International Conference on Arabidopsis Research, Plenary Speaker
2020 UCSF PSPG Series, Seminar Speaker
2020 David Liu Laboratory Annual Retreat, Broad Institute, Keynote Speaker
2019 Frontiers in Genome Engineering, Kobe, Japan, Invited Speaker
2019 University of Wisconsin Madison, Department of Bacteriology, Seminar Speaker
2019 Northwestern University, Department of Molecular Biosciences, Seminar Speaker
2019 3rd International Conference on Plant Synthetic Biology, Cambridge, UK, Selected Speaker
2019 Synthetic Biology Meetup, Rice University, Keynote Speaker
2019 University of Pittsburgh, Biological Chemistry Division, Seminar Speaker
2019 University of Colorado Boulder, Department of Biochemistry, Seminar Speaker
2019 10th International Symposium on Innovative Bio Production, Kobe University, Invited Speaker
2018 DOE-BES Physical Biosciences Research Meeting, Speaker
2018 Society for Experimental Biology, Annual Meeting, Selected Speaker
2018 UCSF, CRISPR Developers Seminar Series, Invited Speaker
2018 ICCMB5, Nanyang Technological University of Singapore, Invited Speaker

2018 Lawrence Livermore National Laboratory, Biosciences and Biotechnology Division, Invited Speaker
2017 Agilent - Synthetic Biology Institute Workshop, Speaker
2017 Dupont Pioneer, Invited Speaker
2017 EBRC Fall Retreat, Georgia Tech University, Speaker
2017 Cold Spring Harbor Laboratory, Genome Engineering Meeting, Speaker
2017 Gordon Research Conference: Photosynthesis, Discussion Leader
2017 Hong Kong University, Engineering Complex Genetic Systems Symposium, Speaker
2017 Texas A&M, F.A. Cotton Medal Symposium, Speaker
2017 UCSF Spring Mutations Symposium on DNA Sequencing, Speaker
2017 University of Washington, Dept. of Genome Sciences, Seminar Speaker
2016 Max Plank Institute for Molecular Plant Physiology, Golm, Seminar Speaker
2016 ETH Zurich, Institute of Microbiology, Seminar Speaker
2016 17th International Congress on Photosynthesis Research, Speaker
2016 Synthetic Biology - Engineering, Evolution & Design 2016 Meeting, Chicago, IL, Speaker
2016 UCSF, Bioinformatics, Biophysics, Chemistry and Chemical Biology, Seminar Speaker
2016 251st American Chemical Society National Meeting, San Diego, CA, Speaker
2016 Weizmann Institute, Plant Stress Symposium, Speaker
2016 Harvard Medical School, Wyss Institute of Biological Engineering, Seminar Speaker
2016 UCLA, Department of Chemistry and Biochemistry, Seminar Speaker
2015 University of Chicago, Institute for Biophysics Dynamics, Seminar Speaker
2015 Washington University, St. Louis, Center for Biological Systems Engineering, Seminar Speaker
2015 Cold Spring Harbor Laboratory Course in Synthetic Biology, Speaker
2015 Gordon Research Conference: Photosynthesis, Discussion Leader
2015 Gordon Research Conference: Proteins, Speaker
2015 University of Illinois, Institute for Genome Biology, Seminar Speaker
2015 Genomics Institute of the Novartis Research Foundation, Seminar Speaker
2015 Rice University, Center for Theoretical Biological Physics, Seminar Speaker
2015 University of Texas-Austin, Department of Molecular Biosciences Seminar, Seminar Speaker
2015 Keystone Symposium: Precision Genome Engineering and Synthetic Biology, Speaker
2014 UC Berkeley, Structural and Quantitative Biology Seminar, Seminar Speaker
2014 Amyris Biotechnologies, Emeryville, Seminar Speaker
2014 Biophysical Society, Molecular Self-assembly Symposium, San Francisco, Speaker
2013 American Institute of Chemical Engineers, Annual Meeting San Francisco, Speaker
2013 Danforth Plant Science Center, Seminar Speaker
2013 Texas A&M, Dept. of Biochemistry and Biophysics, Seminar Speaker
2012 Carnegie Institute and Stanford University, Dept. of Plant Biology, Seminar Speaker
2012 Synthetic Biology Engineering Research Center, Annual Retreat, Berkeley, CA Speaker
2012 UC Berkeley, Dept. of Nutritional Science and Toxicology, Seminar Speaker
2012 Agilent - Synthetic Biology Institute Workshop, Speaker
2011 Synthetic Biology LabLinks Symposium, UCSF and Cell Press, Speaker
2011 CSHL Asia, Design and Synthesis of Biological Systems, Suzhou, China, Speaker
2010 ASCB 50th Annual Meeting, Cell Biology of Metabolic Pathways Subgroup, Speaker
2010 DOE-BES Physical Biosciences Research Meeting, Speaker
2010 Caltech Bioengineering Bootcamp, Speaker
2010 Gordon Research Conference: Molecular basis of microbial one-carbon metabolism, Speaker
2010 Boston Bacterial Meeting, Speaker
2010 Harvard Medical School, Department of Systems Biology, Invited Seminar
2010 UC Berkeley, Departments of MCB and Chemistry, Invited Seminar
2010 Weizmann Institute of Science, Department of Plant Biology, Seminar Speaker
2009 Evolution and Design of Biomolecular Systems Workshop, Mallorca, Spain, Speaker
2009 Wyss Institute of Harvard University, Seminar Speaker
2009 MIT Microbial Systems, Seminar Speaker

2008 UCSF Clements Biophysics, Outstanding Thesis Award Seminar
2006 UCSF Biophysics/Chemical Biology/ Bioinformatics Yearly Retreat, Speaker
2003 Burroughs Wellcome Fund - Interfaces in Science Program, San Diego, CA, Speaker
2003 Gordon Research Conference: Mechanisms Of Membrane Transport, Speaker

Patents Applications

12. Savage et al. Compositions and methods of a nuclease chain reaction for nucleic acid detection. (Provisional filed)
11. Hsu et al. Compositions and Methods of Isothermal Amplification and Detection. (Provisional filed)
10. Ott et al. Rapid Field-Deployable Detection of SARS-CoV-2 Virus. (Published 2021)
9. Doudna et al. Activators of Type III Cas Proteins. (Provisional filed)
8. Doudna, J., Savage, D., Higgins, S., Oakes, B., Rna-guided effector proteins and methods of use thereof. WO2020005980A1. (Published 2021)
7. Savage, D., Doudna, J., Oakes, B., Yokoo, R. Variant rna-guided polypeptides and methods of use. US20190233847A1. (**Issued 2021**)
6. Oakes, B., Savage D., Nadler, D., Flamholz, A., Doudna, J. Variant Cas9 peptides comprising internal insertions. US11008555B2. (**Issued 2021**)
5. Yung et al. Engineered microcompartment protein and related methods and systems of engineering bacterial systems for non-native protein expression and purification. US10738090B2. (**Issued 2020**)
4. JC Way, H Niederholtmeyer, B Wolfstaedter, D Savage. Production of Secreted Bioproducts from Photosynthetic Microbes. WO2011029013A3. (Published 2012, Abandoned)
3. Silver, P., Savage, D., Agapakis, C., Systems of Hydrogen Production in Bacteria. US20120021479A1. (Published 2012, Abandoned)
2. Savage, D., Silver, P. Photoautotrophic adipogenesis technology. WO2010033921A3. (Published 2011, Abandoned)
1. Silver, P., Waks, Z., Kennedy, C., and Savage D. Systems of hydrogen and formic acid production in yeast. WO2008063650A3. (Published 2007)

Selected Poster Presentations

2022 2022 DOE-BES Physical Biosciences Research Meeting
2016 2016 DOE-BES Physical Biosciences Research Meeting
2014 2014 DOE-BES Physical Biosciences Research Meeting
2012 2012 DOE-BES Physical Biosciences Research Meeting
2009 SynBERC retreat, poster award winner
2008 Synthetic Biology 4.0
2007 8th International Hydrogenase Conference
2005 UCSF/Chile Exchange Program Research Symposium, poster award winner
2005 49th Biophysical Society Meeting.
2001 American Society for Biochemistry and Molecular Biology Meeting

Research Advising

Savage Laboratory Graduate students (24 total, 11 currently).
Dana Nadler, CBE, 2011-2015 (PhD, Thesis title “Transposon-Based Tools for Enhancing Protein Function”).
Thawatchai Chaijarasphong, Chemistry, 2011 - 2016 (PhD, Thesis title: “Towards an In Vitro Reconstitution of the α-Carboxysome”).
Rachel Hood, MCB, 2012 - 2017 (NSF Graduate Fellowship; PhD, Thesis title “Regulation of cyanobacterial physiology by the stringent response”).
Caleb Cassidy-Amstutz, MCB, 2012 - 2017 (PhD, Thesis title “Shellular biology – exploring the biochemistry and physiology of a protein nanocompartment”).

Benjamin Oakes, MCB / Chemical Biology, 2014 - 2017 (joint with Jennifer Doudna) (PhD, Thesis title “Engineering CRISPR-Cas systems to expand functionality”).
Sean Higgins, MCB / Chemical Biology, 2014 - 2018 (PhD, Thesis title “Towards Comprehensive and Programmable Protein Mutagenesis”).
Avi Flamholz, MCB, 2014 - 2019 (NSF Graduate Fellowship; PhD, Thesis title: “Analysis and Reconstitution of a Bacterial CO2-Concentrating Mechanism”).
Robert Nichols, MCB, 2015 - 2020 (PhD, Thesis title: “Molecular and shell biology – examining the biochemistry and physiology of prokaryotic nanocompartments”)
Thomas Laughlin, MCB, 2016 - 2020 (joint with Karen Davies) (NSF Graduate Fellowship; PhD, Thesis title: “Structure-Function Studies in Prokaryotic Photosynthesis and CO2-Concentrating Mechanisms”).
Emeric Charles, MCB 2017 - present (joint with Jennifer Doudna). (PhD, Thesis title “Mechanisms and applications of Cas13-mediated RNA targeting”).
Jack Desmarais, MCB, 2017 - 2022 (PhD, Thesis title: “Mapping the relationship between genotype and phenotype at the gene and genome scale”).
Arik Shams, MCB 2018 - 2022 (NSF GRFP; PhD, Thesis title: “Minimization of Cas9 and Perspectives on Genetically Engineered Microorganisms and Their Regulation”).
Julia Borden, MCB 2018 - 2023 (PhD, Thesis title: “Molecular Design Principles of Bacterial Carbon Fixation: Investigations into Carboxysome Assembly and Permeability”).
Evan Groover, PMB, 2019 - present (joint with Brian Staskawicz).
Naiya Phillips, MCB, 2019 - present.
Andrew Plebanek, MCB, 2019 - present.
Luis Valentin-Alvarado, GGM, 2019 - present (joint with Jill Banfield).
Julia Tartaglia, MCB, 2020 - present (joint with Jennifer Doudna).
Brittney Thornton, MCB, 2020 (NSF Graduate Fellowship, joint with Jennifer Doudna).
Muntathar Al-Shimary, MCB 2021 - present (NSF Graduate Fellowship, joint with Jennifer Doudna).
Jorge Rodríguez, MCB 2022 - present.
Flora Wang, PMB, 2022 - present (joint with Kris Niyogi).
Rachel Weissman, 2022 - present. (NSF Graduate Fellowship).
Cynthia Terrace, 2023 - present.

Savage Laboratory Postdoctoral fellows (10 total, 3 currently).
Poh Teng, 2011 - 2015 (Patent Agent, Patent Agent, McNeill Baur PLLC).
Stacy Morgan. 2011 - 2017 (Scientist, Zymergen).
Rayka Yokoo. 2012 - 2017 (Life Sciences Research Foundation Fellow of the Simons Foundation).
Dana Nadler, 2015 - 2017 (Scientist, Amyris).
Luke Oltrogge, 2015 - 2022 (Research Specialist, Savage Lab)
Cecilia Blikstad, 2017 - 2021. (PI, Upsala University)
Noam Prywes, 2018 - present.
Avi Flamholz, 2019 - 2020 (postdoctoral fellow in Newman Lab, Caltech).
Maria Lukarska, 2020 - present.
David Ding, 2022 - present

Savage Laboratory Staff (6 total, 2 currently).
Katie Kortright, SRA, 2013 - 2015 (PhD student, Yale University).
Eli Dugan, SRA, 2017 - 2021. (PhD student, UCSF).
Shin Kim, SRA, 2018 - 2022. (MD student, UCLA).
Allen Chen, SRA, 2020 - 2021. (PhD student, Caltech).
Christian Nixon, SRA, 2022 - current.
Joe Rivera, SRA, 2022 - current.

Undergraduate Research Advising (29 total).
Teddy Fagin, 2011 - 2012.

Peter Chou, 2012 - 2014. PhD student, Stanford
Robert Nichols, 2013. PhD student, UC Berkeley
Ziyou Ren, 2013 - 2015. PhD student, Northwestern
Casey Roos, 2014-2015. PhD student, Princeton.
David Quintanilla, 2014 - 2015.
Matthew Kim, 2014-2016. PhD student UCSF.
Matthew Romer, 2015 (visiting summer student). Senior Guidance Engineer, Lockheed Martin
Jay Stanley, 2015 (Amgen Scholar). PhD student, Yale University.
Sumedha Ravishankar, 2015 - 2016. PhD student, UCSD.
Sorel Ouonkap, 2015 - 2016 (PhD student, Brown U.).
Tyler Davis, 2015 - 2016. (PhD student, UCLA)
Brandon Kim, 2016 - 2017.
Kelsey Wong, 2016-2017.
Eli Dugan, 2015 - 2017, PhD student, UCSF
Kian Taylor, 2016 - 2017, MD/PhD student, Emory University
Katherine Baney, 2016 - 2019. Research Specialist, Scribe Therapeutics
Hannah Spinner, 2016 - 2019, PhD student, Harvard Medical School
Allen Chen, 2016 - 2020. PhD student, Caltech
Raul Alvarez, 2017 - 2020. Associate Scientist, Lucira Health
Antonio Rodriguez, 2019 - 2020. Clinical Research Coordinator, UCSF
Abhishek Bhatt, 2019 - 2021. Applying to medical school
Ryan Allen, 2021 - 2022. SRA. Doudna Lab, UC Berkeley
Hannah Shadmany, 2021 - 2022. UC Berkeley undergraduate
Aakarsh Kankaria, 2021 - 2022. UC Berkeley undergraduate
Maggie Khoury, 2022 - 2023. UC Berkeley undergraduate
Ryan Tran, 2022 - present. UC Berkeley undergraduate
Carolina Guerrero, 2022 (Amgen Scholar). Dartmouth College undergraduate
Lia Zhu, 2022 - present. UC Berkeley undergraduate
Hana Chang, 2022 - present. UC Berkeley undergraduate

Departmental Service

2017 - 2024	Graduate Affairs Committee (BBS Representative) for MCB
2023 - 2024	MCB Graduate Admission Committee
2022 - 2023	PMB Faculty Search (outside member)
2021 - 2022	2nd Year Graduate Advisor
2021 - 2022	Graduate Group in Microbiology Admissions Committee
2019 - 2020	Graduate Admissions Chair
2018 - 2019	Graduate Admissions Co-Chair
2016 - 2018	Chemical Biology Graduate Program Faculty Advisor (Department of Molecular & Cell Biology)
2013 - 2017	Chemical Biology Graduate Program Faculty Advisor (Chemistry Department)
2013 - 2014	Biophysics Graduate Admission Committee
2012 - 2016	Co-chair Structural and Quantitative Biology Seminar Series
2011 - 2018	Chemical Biology Undergraduate Faculty Advisor
2011 - 2014	MCB Graduate Admission Committee

University Service

2020 - 2023	IGI Building Committee
2018	Amgen Scholarship reviewer
2017 - 2018	Bioengineering Faculty Search Committee, Outside Member

Ad hoc reviewer: Cal Energy Corp, Energy Biosciences Institute, France Berkeley Fund, Peder Sather Center for Advanced Study.

Miscellaneous seminars: Transfer to Excellence REU program (2014). MCB198: MCB for Transfer Students (2012), PhD Colloquium: Dual-Track Couples (2012), AUA Symposium: Biotechnology, the Environment and Human Ecology (2012).

Professional Service

2018 - 2019	Technical lead on Environmental Biotechnology, EBRC Roadmap for Synthetic Biology
2016 - 2018	Scientific Advisory Board, UCLA-DOE Institute
2016 - current	Member, Engineering Biology Research Consortium (EBRC)
2016 - 2021	Editor mSystems
2016	Co-Editor of Current Opinion in Chemical Biology special issue on Bioenergy

Grant Review Panels

3/2022	US Department of Energy, Grant Review Panel
7/2020	US Department of Energy, Ad hoc grant review
6/2019	Hong Kong Innovation and Technology Commission, Ad hoc grant review
4/2019	National Science Foundation, Ad hoc grant review
3/2019	US Department of Energy, Grant Review Panel
6/2017	UK Biotechnology and Biological Sciences Research Council, Grant Reviewer
3/2017	US Department of Energy, Grant Review Panel
12/2015	UK Biotechnology and Biological Sciences Research Council, Grant Reviewer
2/2015	National Science Foundation, Grant Review Panel
2/2014	National Science Foundation, Grant Review Panel
3/2014	US Department of Energy, Early Career Review Panel
2/2013	UK Royal Society, Grant Review
5/2012	US Department of Energy, Biosystems Design Review Panel
3/2012	US Department of Energy, Early Career Review Panel
9/2010	W.M. Keck Foundation, Grant Review

Ad hoc publication reviewer

ACS Chemical Biology, ACS Synthetic Biology, Biochemistry, Cell, eLife, Journal of Biological Engineering, Microbial Cell Factories, Molecular Biology of the Cell, Nature, Nature Communications, Nature Biotechnology, Nature Methods, Nature Microbiology, PNAS, Protein Science, Science.

Entrepreneurial Efforts

2017 - current	Co-founder and Scientific Advisory Board Member, Scribe Therapeutics
2017 - 2020	Scientific Advisory Board Member, Mammoth Biosciences