Daniel Bryan Goodman, PhD

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Scientific Interests and Goals

My work focuses on developing high-throughput approaches to understand and engineer the human immune system. In particular, I am interested in using tools from synthetic biology to both understand and control immune cell differentiation, activation, expansion, and homeostasis for therapeutic applications, with an emphasis on cell therapies for cancer. To this end I use generative computational models to design new receptors, circuits and other genetic elements at scale, and then synthesize, deliver, and measure these DNA sequences in high-throughput pooled single-cell functional assays.

Current position

Post-doctoral Fellow, University of California, San Francisco

Areas of specialization

Synthetic Biology · Cancer Immunotherapy · Immunology · Systems Biology · Genome Engineering · Bioinformatics · Computational Biology · Technology Development for Molecular Biology · Oligonucleotide Libraries · Pooled genetic selections and screens · Comparative Genomics and Evolution · Data Visualization

Education

2017- Postdoctoral Fellowship, University of California at San Francisco
— Advisors: *Kole T. Roybal, Alex Marson, Jeff A. Bluestone*
— Jane Coffin Childs Postdoctoral Fellow

2009-2016 PhD in Bioinformatics and Integrative Genomics,
Massachusetts Institute of Technology
— Thesis: *Understanding Genetic Systems through Multiplexed Design, Synthesis, and Measurement*
— Advisor: *George M. Church*
— NSF Graduate Research Fellow

2008-2009 Whitaker International Bioengineering Fellow, University of Cambridge.
— Project: *Image Recognition and Microfluidics for Bead-based DNA Sequencing*
— Advisor: *Simon Tavaré*

2003-2008 BS in Bioengineering w/ specialization in Bioinformatics,
University of California at San Diego
— Senior Thesis: *Viral Genome Rearrangements in Baculoviridae inform phylogeny and function*
— Advisor: *Pavel A. Pevzner*

Honors & awards

2023 Irving Cancer Immunology Symposium Fellow

2021 Fifty Years: 50 Fifty
50 top early-career scientists at the intersection of Academia and entrepreneurship

2017 Jane Coffin Childs Memorial Postdoctoral Fellowship

2015 Martha Gray Prize for Excellence in Research, Harvard-MIT Division of Health Science and Technology

2012 SynBERC Practices Fellow, Six Parties Synthetic Biology Symposium

2009-2014 National Science Foundation Graduate Research Fellowship

2008-2009 Whitaker International Bioengineering Fellow

2003-2007 Provost Honors, Eleanor Roosevelt College at UCSD

2006 Pacific Rim Undergraduate Experience (PRIME) Award Recipient

2005 Google Summer of Code Award

Consulting and Scientific Advisory Roles

2022-present Retro Bio, Scientific Advisor
T Cell Therapy Program

2021-present Manifold Bio, Scientific Advisor
Immunology and Library Methods Development

2020-present NeXTNet Inc., Scientific Advisor
Bioinformatics, Immuno-oncology, Machine Learning

2019-2020 Arsenal Bio, Scientific Consultant
Inventor on foundational IP, assisted with early implementation of T cell screening technology

2018-2019 HelixNano, Scientific Consultant
Computational Biology and Human Transcriptomics for RNA Therapy

Funding Awarded

2021 Longevity Impetus Grant
$250,000; applied for, written, and awarded as independent PI

2021 Parker Institute Project Grant
$250,000; written with Kole Roybal

Journal articles

1. Blaeschke, F., Chen, Y. Y., Apathy, R., Daniel, B., Chen, A. Y., Chen, P. A., Sandor, K., Zhang, W., Li, Z., Mowery, C. T., Yamamoto, T. N., Nyberg, W. A., To, A., Yu, R., Bueno, R., Kim, M. C., Schmidt, R., **Goodman**, **D. B.**, Feuchtinger, T., Eyquem, J., Jimmie Ye, C., Carnevale, J., Satpathy, A. T., Shifrut, E., Roth, T. L. & Marson, A. Modular pooled discovery of synthetic knockin sequences to program durable cell therapies. en. **Cell 186,** 4216–4234.e33 (Sept. 2023).
2. Christmas, M. J., Kaplow, I. M., Genereux, D. P., Dong, M. X., Hughes, G. M., Li, X., Sullivan, P. F., Hindle, A. G., Andrews, G., Armstrong, J. C., Bianchi, M., Breit, A. M., Diekhans, M., Fanter, C., Foley, N. M., **Goodman**, **D. B.**, Goodman, L., Keough, K. C., Kirilenko, B., Kowalczyk, A., Lawless, C., Lind, A. L., Meadows, J. R. S., Moreira, L. R., Redlich, R. W., Ryan, L., Swofford, R., Valenzuela, A., Wagner, F., Wallerman, O., Brown, A. R., Damas, J., Fan, K., Gatesy, J., Grimshaw, J., Johnson, J., Kozyrev, S. V., Lawler, A. J., Marinescu, V. D., Morrill, K. M., Osmanski, A., Paulat, N. S., Phan, B. N., Reilly, S. K., Schäffer, D. E., Steiner, C., Supple, M. A., Wilder, A. P., Wirthlin, M. E., Xue, J. R., Zoonomia Consortium§, Birren, B. W., Gazal, S., Hubley, R. M., Koepfli, K.-P., Marques-Bonet, T., Meyer, W. K., Nweeia, M., Sabeti, P. C., Shapiro, B., Smit, A. F. A., Springer, M. S., Teeling, E. C., Weng, Z., Hiller, M., Levesque, D. L., Lewin, H. A., Murphy, W. J., Navarro, A., Paten, B., Pollard, K. S., Ray, D. A., Ruf, I., Ryder, O. A., Pfenning, A. R., Lindblad-Toh, K. & Karlsson, E. K. Evolutionary constraint and innovation across hundreds of placental mammals. **Science 380,** eabn3943 (Apr. 2023).
3. **Goodman**[*], **D. B.**, Azimi[*], C. S., Kearns, K., Talbot, A., Garakani, K., Garcia, J., Patel, N., Hwang, B., Lee, D., Park, E., Vykunta, V. S., Shy, B. R., Ye, C. J., Eyquem, J., Marson, A., Bluestone, J. A. & Roybal, K. T. Pooled screening of CAR T cells identifies diverse immune signaling domains for next-generation immunotherapies. **Science Translational Medicine 14,** eabm1463 (Nov. 2022).
4. Schubert[*], M. G., **Goodman**[*], **D. B.**, Wannier, T. M., Kaur, D., Farzadfard, F., Lu, T. K., Shipman, S. L. & Church, G. M. High-throughput functional variant screens via in vivo production of single-stranded DNA. **Proceedings of the National Academy of Sciences 118,** e2018181118 (2021).
5. Nguyen, D. N., Roth, T. L., Li, P. J., Chen, P. A., Apathy, R., Mamedov, M. R., Vo, L. T., Tobin, V. R., **Goodman**, **D. B.**, Shifrut, E., Bluestone, J. A., Puck, J. M., Szoka, F. C. & Marson, A. Polymer-stabilized Cas9 nanoparticles and modified repair templates increase genome editing efficiency. **Nature Biotechnology 38,** 44–49 (Jan. 2020).
6. Roth, T. L., Li, P. J., Blaeschke, F., Nies, J. F., Apathy, R., Mowery, C., Yu, R., Nguyen, M. L. T., Lee, Y., Truong, A., Hiatt, J., Wu, D., Nguyen, D. N., **Goodman**, **D. B.**, Bluestone, J. A., Ye, C. J., Roybal, K., Shifrut, E. & Marson, A. Pooled Knockin Targeting for Genome Engineering of Cellular Immunotherapies. **Cell 181,** 728–744.e21 (Apr. 2020).
7. Cheung, R., Insigne, K. D., Yao, D., Burghard, C. P., Wang, J., Hsiao, Y.-H. E., Jones, E. M., **Goodman**, **D. B.**, Xiao, X. & Kosuri, S. A multiplexed assay for exon recognition reveals that an unappreciated fraction of rare genetic variants cause large-effect splicing disruptions. **Molecular Cell 73,** 183–194 (2019).
8. Chan, Y., Chan, Y. K., **Goodman**, **D. B.**, Guo, X., Chavez, A., Lim, E. T. & Church, G. M. Enabling multiplexed testing of pooled donor cells through whole-genome sequencing. **Genome Medicine 10,** 1–11 (2018).

9. Der, B. S., Glassey, E., Bartley, B. A., Enghuus, C., **Goodman**, **D. B.**, Gordon, D. B., Voigt, C. A. & Gorochowski, T. E. DNAplotlib: programmable visualization of genetic designs and associated data. **ACS Synthetic Biology 6,** 1115–1119 (2017).

10. **Goodman**[*], **D. B.**, Kuznetsov[*], G., Lajoie, M. J., Ahern, B. W., Napolitano, M. G., Chen, K. Y., Chen, C. & Church, G. M. Millstone: software for multiplex microbial genome analysis and engineering. **Genome Biology 18,** 1–7 (2017).

11. Kuznetsov[*], G., **Goodman**[*], **D. B.**, Filsinger, G. T., Landon, M., Rohland, N., Aach, J., Lajoie, M. J. & Church, G. M. Optimizing complex phenotypes through model-guided multiplex genome engineering. **Genome Biology 18,** 1–12 (2017).

12. Ostrov, N., Landon, M., Guell, M., Kuznetsov, G., Teramoto, J., Cervantes, N., Zhou, M., Singh, K., Napolitano, M. G., Moosburner, M., Shrock, E., Pruitt, B. W., Conway, N., **Goodman**, **D. B.**, Gardner, C. L., Tyree, G., Gonzales, A., Wanner, B. L., Norville, J. E., Lajoie, M. J. & Church, G. M. Design, synthesis, and testing toward a 57-codon genome. **Science 353,** 819–822 (Aug. 2016).

13. Yang, L., Briggs, A. W., Chew, W. L., Mali, P., Guell, M., Aach, J., **Goodman**, **D. B.**, Cox, D., Kan, Y., Lesha, E., Soundararajan, V., Zhang, F. & Church, G. Engineering and optimising deaminase fusions for genome editing. **Nature Communications 7,** 13330 (Nov. 2016).

14. Gregg, C. J., Lajoie, M. J., Napolitano, M. G., Mosberg, J. A., **Goodman**, **D. B.**, Aach, J., Isaacs, F. J. & Church, G. M. Rational optimization of tolC as a powerful dual selectable marker for genome engineering. **Nucleic Acids Research 42,** 4779–4790 (2014).

15. **Goodman**[*], **D. B.**, Church, G. M. & Kosuri, S. Causes and effects of N-terminal codon bias in bacterial genes. **Science 342,** 475–479 (2013).

16. Kosuri[*], S., **Goodman**[*], **D. B.**, Cambray, G., Mutalik, V. K., Gao, Y., Arkin, A. P., Endy, D. & Church, G. M. Composability of regulatory sequences controlling transcription and translation in Escherichia coli. **Proceedings of the National Academy of Sciences 110,** 14024–14029 (2013).

17. Lajoie[*], M. J., Rovner[*], A. J., **Goodman**, **D. B.**, Aerni, H.-R., Haimovich, A. D., Kuznetsov, G., Mercer, J. A., Wang, H. H., Carr, P. A., Mosberg, J. A., Rohland, N., Schultz, P. G., Jacobson, J. M., Rinehart, J., Church, G. M. & Isaacs, F. J. Genomically recoded organisms expand biological functions. **Science 342,** 357–360 (Oct. 2013).

18. Isaacs, F. J., Carr, P. A., Wang, H. H., Lajoie, M. J., Sterling, B., Kraal, L., Tolonen, A. C., Gianoulis, T. A., **Goodman**, **D. B.**, Reppas, N. B., Emig, C. J., Bang, D., Hwang, S. J., Jewett, M. C., Jacobson, J. M. & Church, G. M. Precise manipulation of chromosomes in vivo enables genome-wide codon replacement. **Science 333,** 348–353 (July 2011).

19. Tiemann-Boege, I., Curtis, C., Shinde, D. N., **Goodman**, **D. B.**, Tavare, S. & Arnheim, N. Product length, dye choice, and detection chemistry in the bead-emulsion amplification of millions of single DNA molecules in parallel. **Analytical Chemistry 81,** 5770–5776 (2009).

20. Gupta, N., Benhamida, J., Bhargava, V., **Goodman**, **D. B.**, Kain, E., Kerman, I., Nguyen, N., Ollikainen, N., Rodriguez, J., Wang, J., Lipton, M. S., Romine, M., Bafna, V., Smith, R. D. & Pevzner, P. A. Comparative proteogenomics: combining mass spectrometry and comparative genomics to analyze multiple genomes. **Genome Research 18,** 1133–1142 (July 2008).

Reviews

21. Bucktrout, S. L., Banovich, N. E., Butterfield, L. H., Cimen-Bozkus, C., Giles, J. R., Good, Z., **Goodman**, **D. B.**, Jonsson, V. D., Lareau, C., Marson, A., Maurer, D. M., Munson, P. V., Stubbington, M., Taylor, S. & Cutchin, A. Advancing T cell-based cancer therapy with single-cell technologies. **Nature Medicine 28,** 1761–1764 (Sept. 2022).

Conference papers

22. Ferreira, L., Muller, Y. D., Kaul, A. M., Shaikh, H., Guerrero-Moreno, R., Yao, L. E., **Goodman**, **D. B.**, Bluestone, J. A. & Tang, Q. Chimeric antigen receptor signaling confers antitumor activity to human regulatory T cells. **AAI 2020 204,** 238–1 (2020).

23. **Goodman***, **D. B.**, Enghuus*, C. & Church, G. M. *Design and Characterization of Genetic Circuits using Multiplex DNA Synthesis* in *7th International Workshop on Bio-Design Automation* (2015).

24. Kuznetsov*, G., **Goodman***, **D. B.**, Lajoie*, M. J. & Church, G. M. *Millstone: Software for iterative genome engineering* in *7th International Workshop on Bio-Design Automation* (2015).

25. **Goodman***, **D. B.**, Ollikainen, N. & Sholley, C. *Baculovirus phylogeny based on genome rearrangements* in *Comparative Genomics: RECOMB 2007 International Workshop, RECOMB-CG 2007, San Diego, CA, USA, September 16-18, 2007. Proceedings 5* (2007), 69–82.

Invited Talks

26. **Goodman**, **D. B.** *Technologies to clonally track and measure libraries of engineered T cells* Manifold Bio Invited Speaker Series. 2023.

27. **Goodman**, **D. B.** *Engineering the Immune System in High-Throughput* Retro Bio Salon, 41st Annual J.P. Morgan Healthcare Conference. 2023.

28. **Goodman**, **D. B.** *Using Multiplexed Synthetic Biology to Meet the Data Demands of AI Models* Lux Capital & 50 Years, AI+Bio Hackathon. 2023.

29. **Goodman**, **D. B.** *Pooled screening of CAR T cells identifies diverse immune signaling domains for next-generation immunotherapies* International Mammalian Synthetic Biology Workshop (mSBW). 2021.

30. **Goodman**, **D. B.** & Azimi, C. A. *Pooled screening of CAR T cells identifies diverse immune signaling domains for next-generation immunotherapies* Keystone Symposium: Emerging Cellular Therapies, Cancer and Beyond. 2020.

31. **Goodman**, **D. B.** *Millstone: A cloud-based genome engineering platform* Synthetic Biology Engineering Research Council 2014 Spring Retreat. UC Berkeley, Berkeley, CA, USA. 2014.

32. **Goodman**, **D. B.** *Design and Interrogation of Genetic Elements using Megabase-scale DNA Synthesis* Wyss Institute Annual Retreat. Boston, MA, USA. 2013.

33. **Goodman**, **D. B.**, Kosuri, S., Cambray, G., Mutalik, V. K., Gao, Y., Arkin, A. P., Endy, D. & Church, G. M. *Composability of regulatory sequences controlling transcription and translation in E. coli.* Synthetic Biology 6.0 Conference, University College London, London, UK. 2013.

34. **Goodman**, **D. B.** *Multiplex Synthesis and Characterization of Transcriptional and Translational Regulatory Elements in E. coli* Synthetic Biology Engineering Research Council 2012 Spring Retreat. UC Berkeley, Berkeley, CA, USA. 2012.

35. Boettger, L., **Goodman**, **D.**, O'Neill, E. & Yan, X. *Cambridge iBrain: Foundations for an Artificial Nervous System using Organizing Electrical Patterning* iGEM Jamboree 2008. Cambridge, MA, USA. 2008.

36. **Goodman**, **D.**, Xie, L., Wang, J., Chung, J., Ollikainen, N. & Bourne, P. E. *Genome Wide Identification of Off-site Protein Targets for Major Pharmaceuticals using Functional Site Similarity and Protein-Ligand Docking.* Intelligent Systems for Molecular Biology 2007. Vienna, Austria. 2007.

37. **Goodman**, **D.** & Levesque, M. *High-Throughput Virtual Screening of a Novel Kinase on the Grid: Homology Modeling and Template-based techniques.* Supercomputing 2006. Tampa Bay, FL, USA. 2006.

38. **Goodman**, **D.**, Ollikainen, N. & Sholley., C. *Genome Rearrangements In Baculovirus Genomes.* Algorithmic Biology 2006. La Jolla, CA, USA. 2006.

Patents

39. **Goodman**, **D. B.**, Azimi, C. S., Roybal, K. T., Bluestone, J. A. & Marson, A. *Method for making CAR-T libraries* Aug. 2022.

40. Kuznetsov, G., Lajoie, M. J., Landon, M. M., Napolitano, M. G., **Goodman**, **D. B.**, Gregg, C. J., Church, G. M. & Ostrov, N. *Methods for rule-based genome design* US Patent 11,361,845. June 2022.

41. Marson, A., Roth, T. L., **Goodman**, **D.**, Nguyen, D.-H. N. & Szoka, F. C. *Compositions and methods for modifying a target nucleic acid* US Patent App. 17/312,191. Jan. 2022.

42. Roybal, K. T., **Goodman**, **D. B.**, Azimi, C., Marson, A. & Bluestone, J. A. *Chimeric receptors with diverse co-regulatory sequences* Mar. 2022.

Press

43. AACR. *What we're reading: Article Recommendations from Our Deputy and Senior Editors* Jan. 2023. https://cancerimmunolres.aacrjournals.org/content/canimmarch/11/1/1.full-text.pdf.

44. Cheng, N., Dainow, S., **Goodman**, **D. B.** & Kajderowicz, K. *SynBio for Human Health: Synergizing Synthetic Biology and Longevity* Panel at SynbioBeta & TranslatingAging Podcast. 2023. https://twitter.com/BioAgePodcast/status/1663946045469110272?s=20.

45. Chavez, M., Teng, A. & **Goodman**, **D.** *Cell Therapies of the Future with Dan Goodman* Translation Podcast - Fifty Years. 2022. https://translation.simplecast.com/episodes/cell-therapies-of-the-future-with-dan-goodman-qb51esV4.

46. Peltan, E., Elkington, J. & **Goodman**, **D.** *Breakthroughs in Cell Therapies, CRISPR, and Synbio* DNA Tie Club Podcast. 2021. https://www.clubhouse.com/join/dnatie/S0AhDdZu/xoNRjlK5.

47. Hamilton, K. *Science Magazine Podcast* September 27. 2013. http://www.sciencemag.org/content/342/6157/475/suppl/DC2.

48. Wade, N. *Synthetic Biology at the Megabase Scale* GetSynBio.com. October 22. 2013. http://www.getsynbio.com/laboratory-george-church-synthetic-biology-megabase-scale/.

49. Wade, N. *Genetic Code of E. Coli Is Hijacked by Biologists* New York Times. July 14. 2011. http://www.nytimes.com/2011/07/15/health/15genome.html.

50. Watts, G. *BBC Radio: Leading Edge* National Radio Program. Broadcast November 8. 2008. http://www.bbc.co.uk/radio4/science/leadingedge_20081106.shtml.

Teaching

2018-2019 Guest Lecturer, Cellular Design 1 Course, Bristol University

2017 Guest Lecturer, SynBio CDT Course, Oxford University

2016 Judge, International Genetically Engineered Machines (iGEM), World Finals, Boston, MA

2015 Lecturer, ENG-SCI 222: Advanced Cellular Engineering, School of Engineering and Applied Sciences, Harvard University

2011 Head Teaching Fellow, International Genetically Engineered Machines (iGEM) Team, Harvard University

2007-2008 Salk Mobile Science Laboratory

2007 Biology Teaching Assistant, University of California at San Diego.

Mentoring

2023 Mentored MD/PhD Student Ankit Salhotra, UCSF

2023 Mentored PhD Student Kamyar Yazdani , UCSF

2022-present Mentored technician Clarity Chua, UCSF

2022-present Mentored technician Majo Duran, UCSF

2018-2022 Mentored PhD student Camillia Azimi, UCSF
Currently postdoc, Mount Sinai, NYC

2017-2020 Mentored technician Emily Park, UCSF
Currently PhD Student, Fred Hutchinson Cancer Center

2018-2020 Mentored technician Kendall Kearns, UCSF
Currently PhD Student, UCSD

2013-2020 Mentored PhD student Max Schubert, Harvard University
Currently postdoc at Harvard / Wyss Institute

2013-2015 Mentored MS student Casper Enghuus, Harvard University
Currently Partner at BCG

2012-2014 Mentored PhD Student Gleb Kuznetsov, Harvard University
Currently CEO, Manifold Bio

References

Dr. Jeffrey A. Bluestone, PhD
CEO & President, Sonoma Bio

Prof. Kole Roybal, PhD
Associate Professor, Dept. of Microbiology and Immunology, UCSF

Prof. Alexander Marson, MD, PhD
Director of the Gladstone-UCSF Institute of Genomic Immunology

Dr. Sriram Kosuri, PhD
CEO, Octant Bio

Prof. George Church, PhD
Robert Winthrop Professor of Genetics, Harvard Medical School

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Papers, source code, and more information about past research can be found at my website:
http://www.dbgoodman.com