

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, 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

2021-
present Manifold Bio, Scientific Advisor

2020-
present NeXTNet Inc., Scientific Advisor

2019-2020 Arsenal Bio, Scientific Consultant

2018-2019 HelixNano, Scientific Consultant

Publications & talks

Journal articles

1. 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).
2. **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).
3. 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).
4. 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).

5. 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).
6. 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).
7. 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).
8. Der, B. S., Glassey, E., Bartley, B. A., Enghuus, C., **Goodman, D. B.**, Gordon, D. B., Voigt, C. A. & Gorochoowski, T. E. DNAPlotlib: programmable visualization of genetic designs and associated data. **ACS Synthetic Biology** **6**, 1115–1119 (2017).
9. **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).
10. 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).
11. 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).
12. 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).
13. 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).
14. **Goodman***, **D. B.**, Church, G. M. & Kosuri, S. Causes and effects of N-terminal codon bias in bacterial genes. **Science** **342**, 475–479 (2013).

15. 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).
16. 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).
17. 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).
18. Tiemann-Boege, I., Curtis, C., Shinde, D. N., **Goodman, D. B.**, Tavares, 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).
19. 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

20. 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

21. 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).
22. **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).
23. 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).

24. **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

25. **Goodman, D. B.** *Technologies to clonally track and measure libraries of engineered T cells* Manifold Bio Invited Speaker Series. 2023.
26. **Goodman, D. B.** *Engineering the Immune System in High-Throughput* Retro Bio Salon, 41st Annual J.P. Morgan Healthcare Conference. 2023.
27. **Goodman, D. B.** *Using Multiplexed Synthetic Biology to Meet the Data Demands of AI Models* Lux Capital & 50 Years, AI+Bio Hackathon. 2023.
28. **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.
29. **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.
30. **Goodman, D. B.** *Millstone: A cloud-based genome engineering platform* Synthetic Biology Engineering Research Council 2014 Spring Retreat. UC Berkeley, Berkeley, CA, USA. 2014.
31. **Goodman, D. B.** *Design and Interrogation of Genetic Elements using Megabase-scale DNA Synthesis* Wyss Institute Annual Retreat. Boston, MA, USA. 2013.
32. **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.
33. **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.
34. 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.
35. **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.
36. **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.

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

Preprints

38. Blaeschke, F., Chen, Y. Y., Apathy, R., Li, Z., Mowery, C. T., Nyberg, W. A., To, A., Yu, R., Bueno, R., Kim, M. C., Schmidt, R., **Goodman, D. B.**, Feuchtinger, T., Eyquem, J., Ye, C. J., Shifrut, E., Roth, T. L. & Marson, A. *Modular Pooled Discovery of Synthetic Knockin Sequences to Program Durable Cell Therapies* July 2022.

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. 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>.
44. 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>.
45. 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>.
46. Hamilton, K. *Science Magazine Podcast* September 27. 2013. <http://www.sciencemag.org/content/342/6157/475/suppl/DC2>.
47. Wade, N. *Synthetic Biology at the Megabase Scale* GetSynBio.com. October 22. 2013. <http://www.getsynbio.com/laboratory-george-church-synthetic-biology-megabase-scale/>.

48. 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>.
49. Watts, G. *BBC Radio: Leading Edge* National Radio Program. Broadcast November 8. 2008. http://www.bbc.co.uk/radio4/science/leadingedge_20081106.shtml.

Teaching

- | | |
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| 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. |

Grants Awarded

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| 2021 | Longevity Impetus Grant
\$250,000; applied for and awarded directly as PI |
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Mentoring

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| 2023-present | 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

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Papers, source code, and more information about past research can be found at my website:

<http://www.dbgoodman.com>