# Jonathan Karr

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## Education

**Stanford University**, Stanford CA
Ph.D. in Biophysics – Specialization: Genome-scale computational systems biology
M.S. in Medicine

**Massachusetts Institute of Technology**, Cambridge MA
S.B. in Physics
S.B. in Brain & Cognitive Sciences

## Honors & awards

Genome Web Young Investigator
National Academy of Sciences / Kavli Foundation Frontiers of Science Fellow
Keystone Symposia NSF Scholarship
James S. McDonnell Foundation Postdoctoral Fellowship in Complex Systems
Sage Congress Young Investigator Award
Keystone Symposia Future of Science Fund Scholarship
Stanford School of Medicine Excellence in Teaching Award
National Defense Science and Engineering Graduate Fellowship
National Science Foundation Graduate Fellowship
Department of Homeland Security Graduate Fellowship
Stanford University Graduate Fellowship
Stanford University Translational Medicine Scholarship
MIT Phi Beta Kappa
MIT Sigma Pi Sigma
MIT Brain & Cognitive Sciences Award for Outstanding Academics

## Professional Experience

**Dept of Genetics & Genomic Sciences, Mt Sinai**, New York NY, 2014–present
*Fellow*
Developed comprehensive computational models of health and disease.

**Department of Bioengineering, Stanford University**, Stanford CA, 2007–2014
*Research Assistant to Prof. Markus Covert*
Developed the first comprehensive "whole-cell" computational model. Developed a novel hybrid mathematical framework. Assembled a new molecular biology database. Designed and integrated sub-models of 28 cellular processes. Developed novel algorithms for parameter estimation. Constructed new tools for exploratory data analysis. Conducted a forward genetic screen to validate the model. Investigated the molecular determinants of *M. genitalium* growth and division to discover new biology. Published work in *Cell* and *Bioinformatics*. Mentored several undergraduate and graduate students.

**Department of Brain & Cognitive Sciences, MIT**, Cambridge MA, Spring 2006
*Research Assistant to Prof. Jim DiCarlo*
Developed novel assistive surgical technology to support visual system research in non-human primates. Developed a device that detects the 3-D localization of implanted electrodes and fiducial markers in rhesus monkeys using two pairs of x-ray sources and detectors. Integrated x-ray hardware into an existing surgical systems. Implemented hardware control and image acquisition and processing software.

**Department of Brain & Cognitive Sciences, MIT**, Cambridge MA, Summers 2004–05
*Research Assistant to Prof. Michale Fee*
Developed novel assistive surgical technology to support systems neuroscience research of learning and memory in song birds. Designed and constructed technology that guides the localization of electrode implantation in songbirds. Integrated technology into existing experimental protocols.

**Biotechnology Division, NIST**, Gaithersburg MD, Summer 2003
*Research Assistant to Dr. Adolfas Gaigalas*
Improved fluorescence measurement techniques by modulating excitation to reduce quenching. Integrated modulation hardware into an existing imaging system.

**Neuroscience Division, Walter Reed Institute of Research**, Forest Glen MD, 2001–02
*Research Assistant to Dr. Richard Bauman*
Evaluated the neuroprotective efficacy of pharmaceuticals against trauma. Simulated brain injury in rats by blunt head trauma and hypoxia. Quantitated neuroprotective efficacy using cognitive (Morris water maze) and vestibulomotor (beam-balance and narrow beam-walk) tasks.

## Peer reviewed publications

**Karr JR**, Llorens V, Lluch-Senar M, Serrano L & Covert MW. A whole-cell model of *Mycoplasma pneumoniae* guides biological design. (In preparation).

Cokelaer T, Bansal M, Bare C, Bila E, Bot BM, Neto EC, Eduati F, Gönen M, Hill SM, Hoff B, **Karr JR**, Küffner R, Menden MP, Meyer P, Nore R, Pratap A, Prill RJ, Weirauch MT, Costello JC, Stolovitzky G & Saez-Rodriguez J. DREAMTools: a Python package for scoring collaborative challenges. *F1000Res* 4, 1030 (2015).

Kazakiewicz D*, **Karr JR***,†, Langner KM & Plewczynski D. Combined systems and structural modeling repositions antibiotics for Mycoplasma genitalium. *Comput Biol Chem* pii, S1476-9271(15)30089-X (2015).

**Karr JR**, Williams AH, Zucker JD, Raue A, Steiert B, Timmer J, DREAM8 Parameter Estimation Challenge Consortium, Wilkinson S, Allgood BA, Bot BM, Hoff BR, Kellen MR, Covert MW, Stolovitzky GA & Meyer P. Summary of the DREAM8 parameter estimation challenge: Toward parameter identification for whole-cell models. *PLoS Computational Biology* 11, e1004096 (2015).

**Karr JR**, Guturu H, Chen EY, Blair SL, Irish JM, Kotecha N & Covert MW. NetworkPainter: Dynamic intracellular pathway animation in Cytobank. *BMC Bioinformatics* 16, 172 (2015).

**Karr JR***, Phillips NC* & Covert MW. WholeCellSimDB: a hybrid relational/HDF database for whole-cell model predictions. *Database* 2014, bau095 (2014).

Sanghvi JC, Regot S, Carrasco S, **Karr JR**, Gutschow MW, Bolival B, Covert MW. Accelerated discovery via a whole-cell model. *Nat Methods* **10**, 1192–1195 (2013).

Lee R*, **Karr JR*** & Covert MW. WholeCellViz: data visualization for whole-cell models. *BMC Bioinformatics* **14** (2013).

Purcell O, Jain B, **Karr JR**, Covert MW & Lu T. Towards a whole-cell modeling approach for synthetic biology. *Chaos* **23**, 025112 (2013).

**Karr JR**, Sanghvi JC, Macklin DN, Arora A & Covert MW. WholeCellKB: Pathway/Genome Databases for Comprehensive Whole-Cell Models. *Nucleic Acids Res* **41**, D787?-92 (2013).

**Karr JR***, Sanghvi JC*, Macklin DN, Jacobs JM, Gutschow MV, Assad-Garcia N, Glass JI & Covert MW. A Whole-Cell Computational Model Predicts Phenotype from Genotype. *Cell* **150**, 389–401 (2012).

Covert MW, Xiao N, Chen TJ & **Karr JR**. Integrated Flux Balance Analysis Model of *Escherichia coli*. *Bioinformatics* **24**, 2044–50 (2008).

* These authors contributed equally to this work.
†Corresponding author

## Conference proceedings

Chang R, **Karr JR** & Schadt EE. Causal inference in biology networks with integrated belief propagation. *Pacific Symposium on Biocomputing* (2015).

## Reviews & perspectives

Medley JK, Karr JR & Sauro HM. Towards reproducible dynamical models in systems biology. *IEEE Trans Biomed Eng*. (In submission).

Waltemath D*, **Karr JR*** et al. Combining Standards for tomorrow's models. *IEEE Trans Biomed Eng* (In submission).

**Karr JR**†, Takahasi K & Funahashi A. The principles of whole-cell modeling. *Curr Opin Microbiol*, 27, 18âĂŞ24 (2015).

## Lay articles

**Karr JR**, Chew YH & Goldberg AP. Whole-cell computational models can predict how genes influence behavior. Atlas of Science (2015).

## Invited presentations

Bioinformatics and Systems Biology Conference. Lunteren NL, Apr 2016.
Whole-Cell Modeling Summer School. Barcelona SP, Apr 2016.
Advances in Systems and Synthetic Biology Workshop. Evry FR, Mar 2016.
COMBINE Forum. Salt Lake City UT, Oct 2015.
Whole-Cell Modeling School. Rostock GR, March 2015.
Integrative Cell Models Workshop, Lorentz Center. Leiden NL, Jan 2015.
Systems Biology and Systems Medicine School of Lake Como. Como IT, Sep 2014.
Japan-American Frontiers of Science Symposium. Tokyo JP, Dec 2014.
International Conference on Systems Biology. Copenhagen DK, Aug 2013.

## Contributed presentations

Keystone Symposium – Genome Engineering & Synthetic Biology. Breckenridge CO, Mar 2013.
Biological Computation at Stanford Symposium. Stanford CA, October 2012.
Microbiology Student Symposium. UC Berkeley, Apr 2012.
Bay Area Microbial Pathogenesis Symposium. UCSF, Mar 2012.

Keystone Symposium – Complex Traits. Breckenridge CO, Feb 2012.
Biophysics Graduate Program Conference. Stanford CA, Jan 2012.
Biological Computation at Stanford Symposium. Stanford CA, Nov 2011.
Biophysical Society Annual Meeting. Baltimore MD, Mar 2011.
Biological Computation at Stanford Symposium. Stanford CA, Nov 2010 – *3$^{rd}$ place presentation.*

## Seminars

Children's Hospital of Pennsylvania/University of Pennsylvania. Philadelphia PA, Feb 2016.
Mt Sinai School of Medicine, Dept of Genetics & Genomic Sciences. New York NY, Jun 2015.
National Institute for Agricultural Research (INRA). Bordeaux FR, Mar 2015.
National Research Council Institute of Systems Informatics Analysis. Rome IT, Sep 2014.
IBM Center for Computational Biology. Yorktown Heights, NY, Feb 2014.
Center for Regulatory Genomics. Barcelona, Sep 2013.
Massachusetts Institute of Technology Synthetic Biology Center. Cambridge MA, Apr 2013.
Northeastern University Center for Complex Network Research. Boston MA, Apr 2013.
Stanford University Department of Pediatrics. Stanford CA, Apr 2013.
Massachusetts General Hospital Center of Systems Biology. Boston MA, Apr 2013.
Mt Sinai School of Medicine, Dept of Genetics & Genomic Sciences. New York NY, Apr 2013.
Columbia University Computational Biology & Bioinformatics Center. New York NY, Apr 2013.
University of California San Diego, Department of Medicine. La Jolla CA, Apr 2013.
Seminar Series in BioMathematical Methodology. Stanford CA, Jul 2012.
Molecular Biophysics Seminar. Stanford CA, Nov 2011.
Bioengineering Department Colloquium. Stanford CA, Oct 2007.

## Professional service

Member, Scientific Committee, Pacific Symposium on Biocomputing, 2016
Co-organizer, Whole-Cell Modeling Summer School, 2016
Reviewer, National Science Foundation, 2016
Ad hoc reviewer, National Institutes of Health BUILD Initiative, 2015
Ad hoc reviewer, National Science Foundation, 2014
Organizer, Graduate fellowships information session, Mount Sinai, 2014–present
Reviewer, NSF Graduate Research Fellowship Program, 2013–present
Organizer, Whole-cell parameter estimation DREAM challenge, 2013
Member, International Scientific Committee, ICSB, 2013
Member, Stanford Biophysics Graduate Program Student Committee, 2006–2013
Member, Stanford Biosciences Graduate Student Advisory Committee, 2012–2013
Co-organizer, Fellowships info session, Adv of Chicanos & Native Americans in Science Conf, 2011
Co-organizer, Biological Computation at Stanford Symposium, 2009
Webmaster, International Conference on Systems Biology, 2009
Ad-hoc reviewer, various journals, 2008–present

## Ad-hoc reviewer

*Bioinformatics*
*BMC Systems Biology*
*Cell*
*Computation*

*Computational Biology and Chemistry*
*Molecular Systems Biology*
*Nature*
*Pacific Symposium on Biocomputing*
*PLoS Computational Biology*
*PLoS One*
*Science*

*See review record at Publons.

## Teaching

Co-organizer, **Whole-Cell Modeling School**, Barcelona SP, Apr 2016

Organizer, **Whole-Cell Modeling Seminar**, Paris FR, Mar 2016

Instructor, **Whole-Cell Modeling School**, Rostock GR, Mar 2015

Lecturer, **Systems Biology and Medicine School**, Lake Como School, Como IT, Sep 2014

Program assistant, **Stanford Summer Research Program**, 2012

Teaching Assistant, **MCP 256: How cells work, Stanford**, Stanford CA, Spring 2008

Tutor, **8.01X: Electricity & Magnetism, MIT**, Cambridge MA, Spring 2003

Developer, **MasteringPhysics CyberTutor Project, MIT**, Cambridge MA, Spring 2003

## Mentoring

Anne Marie Barrette (Rotation student, Mt Sinai; 2016)

Graeme Gossel (Postdoctoral advisor, MT Sinai; 2016–present)

Yin Hoon Chew (Postdoctoral advisor, MT Sinai; 2015–present)

Roger Rodgriguez (Visiting student, IBM; 2015–present)

Theodore Pak (PhD thesis committee, MT Sinai; 2015–present)

Samuel Miravet (MS thesis committee, CRG; 2015–present)

Nolan Phillips (Thesis mentor, 2013–2014)
*Undergraduate student, Computer Science, University of Prince Edward Island*
*Currently: Research assistant, University of Prince Edward Island*

John Mason (Rotation mentor, 2013)
*1st year PhD student, Bioengineering, Stanford University*
*Currently: 3rd year PhD student, Bioengineering, Stanford University*

Ruby Lee (Thesis mentor, 2012–2013)
*Undergraduate student, Computer Science and Bioengineering, Stanford University*
*Currently: Associate project manager, Google*

Weizhuang Zhou (Stanford Bioscience Student Association mentor, 2012–2013)
*1st year Phd student, Bioengineering, Stanford University*
*Currently: 3rd year Phd student, Bioengineering, Stanford University*

Patricia Nano (Stanford Summer Research Program assistant, Summer 2012)
*Undergraduate student, Biochemistry and Cell Biology, Rice University*
*Currently: 2nd year PhD student, Chemical and Systems Biology, Stanford University*
*Awards: National Science Foundation Graduate Fellowship Honorable Mention*

Clayton Brown (Stanford Summer Research Program assistant, Summer 2012)

*Undergraduate student, Biochemistry, Indiana University*
*Currently: 2nd year PhD student, Biochemistry, Stanford University*
*Awards: National Science Foundation Graduate Fellowship*

William Leon (Stanford Summer Research Program assistant, Summer 2012)
*Undergraduate student, Biochemistry, University of California at Riverside*
*Currently: 1st year medical student, University of California at Riverside*

Vibha Rao (Stanford Summer Research Program assistant, Summer 2012)
*Undergraduate student, Biology, University of Maryland, Baltimore Campus*

Abhishek Arora (Research mentor, 2012)
*Masters student, Electrical Engineering, Stanford University*
*Currently: Software engineer, Altiscale*

Derek Macklin (Research mentor, 2011)
*1st year PhD student, Bioengineering, Stanford University*
*Currently: 5th year PhD student, Bioengineering, Stanford University*
*Awards: Department of Energy CSGF and SCGF graduate fellowships*

Raymond (Stanford Medical Youth Science Program mentor, Summer 2010)
*High school student*

Harendra Guturu (Rotation mentor, 2009)
*1st year PhD student, Electrical Engineering, Stanford University*
*Currently: Engineering research associate, Stanford University*
*Awards: National Science Foundation Graduate Fellowship*

Edward Chen (Research mentor, 2009)
*Masters student, Bioengineering, Stanford University*
*Currently: Software engineer, Spotify*

Donald (Stanford Medical Youth Science Program mentor, Summer 2008)
*High school student*
*Currently: Undergraduate student, Columbia University*

Fernando Rios (Stanford Medical Youth Science Program mentor, Summer 2007)
*High school student*
*Currently: 2nd year medical student, University of California at Merced*
*Awards: Questbridge National Match Scholarship*

## Community service

Mentor, Stanford Bioscience Student Association Mentoring Program, 2012–2013
Volunteer, Humanimal Connection, San Mateo CA, 2010–2013
Educational Counselor, MIT, Cambridge MA, 2008–2012
Mentor, Stanford Medical Youth Science Program, Stanford CA, 2007–2011
Mentor, Stanford University Pre-Grad/Pre-Med Mentoring Program, Stanford CA, 2007–2008
Mentor, Stanford University Minority Medical Alliance Mentorship Program, Stanford CA, 2007
Volunteer, Recording for the Blind & Dyslexic, Cambridge MA, 2005

## Funding

NSF, 2016 Whole-celll modeling summer school, $10,000, 2016
NSF/ERASynBio 2nd Joint Call, MiniCell project $741,999, 2015–2018
James S. McDonnell Foundation Postdoctoral Fellowship in Complex Systems, $200,000, 2014–15

National Defense Science and Engineering Graduate Fellowship, $180,000, 2008–2011
National Science Foundation Graduate Fellowship, $120,000, 2008–2013
Department of Homeland Security Graduate Fellowship, $90,000, 2006 (declined)
Stanford University Graduate Fellowship, $180,000, 2006–2012
Stanford University Translational Medicine Scholarship, $60,000, 2006–2008
Keystone Symposia Scholarship, $1200, 2013
Stanford University Office of Graduate Education Biosciences Travel Grant, $750, 2013
Stanford University Bio-X Travel Subsidy, $1500, 2011–2013
Keystone Symposia Future of Science Fund Scholarship, $1200, 2012
Stanford University Vice Provost for Student Affairs SACNAS Workshop Grant, $315, 2010
Stanford Bioscience Student Association Conference Grant, $100, 2010