Stanford



Maria Barna

Associate Professor of Genetics

CONTACT INFORMATION

- **Adminstrative Contact**

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Bio

BIO

Maria Barna is an Associate Professor in the Department of Genetics at Stanford University. Dr. Barna obtained her B.A. in Anthropology from New York University and her Ph.D. from Cornell University, Weill Graduate School of Medicine. She completed her thesis work in the lab of Dr. Lee Niswander in the Developmental Biology Department at Sloan Kettering Institute in 2007. Dr. Barna was subsequently appointed as a UCSF Fellow through the Sandler Fellows program, which enables exceptionally promising young scientists to establish independent research programs immediately following graduate school. Dr. Barna has received a number of distinctions including being named a Pew Scholar, Alfred P. Sloan Research Fellow, and top ’40 under 40’ by the Cell Journal. She has received the Basil O’ Connor Scholar Research Award and the NIH Directors New Innovator Award. In 2016, she was the recipient of the Rosalind Franklin Young Investigator Award, an award given to two female scientist in the world every three years in the field of genetics, the American Society for Cell Biology Emerging Leader Prize, and the RNA Society Early Career Award. She has also received the inaugural Elizabeth Hay award from the Society of Developmental Biology, the H.W. Mossman Award in Developmental Biology and the Tsuneko and Reiji “Okazaki” Award, among others. She was also a NYSCF Robertson Stem Cell Investigator.

ACADEMIC APPOINTMENTS

- Associate Professor, Genetics
- Member, Bio-X
- Member, Maternal & Child Health Research Institute (MCHRI)
- Member, Wu Tsai Neurosciences Institute

ADMINISTRATIVE APPOINTMENTS

- Director of Graduate Studies, Department of Genetics, (2022- present)

HONORS AND AWARDS

- RNA Society Early Career Award, RNA Society (2019)
- Harland Winfield Mossman Award in Developmental Biology, American Association of Anatomists (2017)
- Inaugural Elizabeth Hay Award, Society of Developmental Biology (2017)
- Tsuneko and Reiji 'Okazaki Award', Japan (2017)

- American Society for Cell Biology Emerging Leader Prize, ASCB (2016)
- McCormick and Gabilan Fellow, Stanford University (2016)
- Robertson Stem Cell Investigator, New York Stem Cell Foundation (2016)
- Rosalind Franklin Young Investigator Award, Gruber Foundation and Genetics Society of America (2016)
- Kavli Frontiers of Science Fellow, National Academy of Science (2015)
- Alfred P. Sloan Research Fellow, Alfred P. Sloan Foundation (2014)
- Mallinckrodt Foundation Award, Edward Mallinckrodt Jr. Foundation (2014)
- Pew Scholars Award, Pew Charitable Trusts (2014)
- Top '40 under 40', Cell Press (2014)
- NIH Director’s New Innovator Award, NIH (2011)
- Basil O'Connor Scholar Research Award, March of Dimes (2010)
- National Institutes of Child Health and Development Pediatric LRP, NIH (2009)
- UCSF Faculty Fellows Program, UCSF Program for Breakthrough Biomedical Research, University of California, San Francisco (2007)
- Nominated, Harold M. Weintraub Graduate Student Award, Cornell University (2006)
- Vincent du Vigneaud Award of Excellence for Graduate Research, Cornell University (2004)
- Outstanding Undergraduate Research Award, New York University (1996, 1997)

PROFESSIONAL EDUCATION

- Ph.D., Cornell University, Weill Graduate School of Medicine , Molecular and Cellular Biology (2007)
- B.A., New York University , Anthropology (1998)

LINKS

- Lab Site: http://barnalab.stanford.edu

Research & Scholarship

CURRENT RESEARCH AND SCHOLARLY INTERESTS

How do genomes become living organisms—and how can tissues rebuild themselves after injury? The Barna Lab studies the regulatory systems that control how genetic information is translated into cellular behavior during development, regeneration, and disease. Our work revealed that ribosomes—the molecular machines that translate mRNA into protein—are not uniform entities as long believed. Instead, ribosomes can differ in composition and regulatory capacity, creating specialized translation programs that control developmental gene expression. This discovery established a new paradigm in which the ribosome itself acts as a regulatory hub in gene expression. We combine genomics, quantitative proteomics, mass spectrometry, computational biology, and advanced imaging to uncover how ribosome heterogeneity shapes gene expression across cells and tissues. In parallel, we investigate how cells communicate during organ formation through dynamic networks of actin-based cellular extensions that transmit molecular signals between cells. Finally, using regenerative model organisms such as the axolotl, we study how translational control programs are rewired during tissue regeneration, revealing principles that may ultimately inform strategies for regenerative medicine. Together, these approaches seek to uncover the fundamental molecular mechanisms that allow cells to build, maintain, and regenerate complex biological systems.

Teaching

STANFORD ADVISEES

Doctoral Dissertation Reader (AC)

Jason Yang

Postdoctoral Faculty Sponsor

Kitra Cates, Yuxiang Chen, Mirian Krystel De Siqueira, Mika Nevo

Doctoral Dissertation Advisor (AC)

Sonia Bustos Barocio, Travis Lantz

GRADUATE AND FELLOWSHIP PROGRAM AFFILIATIONS

- Developmental Biology (PhD Program)
- Genetics (PhD Program)

Publications

PUBLICATIONS

- **Optogenetic manipulation of cellular communication using engineered myosin motors.** *Nature cell biology*
  Zhang, Z., Denans, N., Liu, Y., Zhulyn, O., Rosenblatt, H. D., Wernig, M., Barna, M.
  2021
- **Gene- and Species-Specific Hox mRNA Translation by Ribosome Expansion Segments.** *Molecular cell*
  Leppek, K. n., Fujii, K. n., Quade, N. n., Susanto, T. T., Boehringer, D. n., Lenarčič, T. n., Xue, S. n., Genuth, N. R., Ban, N. n., Barna, M. n.
  2020
- **The Discovery of Ribosome Heterogeneity and Its Implications for Gene Regulation and Organismal Life.** *Molecular cell*
  Genuth, N. R., Barna, M.
  2018; 71 (3): 364–74
- **The Mammalian Ribo-interactome Reveals Ribosome Functional Diversity and Heterogeneity.** *Cell*
  Simsek, D., Tiu, G. C., Flynn, R. A., Byeon, G. W., Leppek, K., Xu, A. F., Chang, H. Y., Barna, M.
  2017; 169 (6): 1051-1065 e18
- **Heterogeneous Ribosomes Preferentially Translate Distinct Subpools of mRNAs Genome-wide.** *Molecular cell*
  Shi, Z. n., Fujii, K. n., Kovary, K. M., Genuth, N. R., Röst, H. L., Teruel, M. N., Barna, M. n.
  2017
- **RNA regulons in Hox 5' UTRs confer ribosome specificity to gene regulation.** *Nature*
  Xue, S., Tian, S., Fujii, K., Kladwang, W., Das, R., Barna, M.
  2015; 517 (7532): 33-38
- **Specialized filopodia direct long-range transport of SHH during vertebrate tissue patterning.** *Nature*
  Sanders, T. A., Llagostera, E., Barna, M.
  2013; 497 (7451): 628-632
- **Ribosome-Mediated Specificity in Hox mRNA Translation and Vertebrate Tissue Patterning** *CELL*
  Kondrashov, N., Pusic, A., Stumpf, C. R., Shimizu, K., Hsieh, A. C., Xue, S., Ishijima, J., Shiroishi, T., Barna, M.
  2011; 145 (3): 383-397
- **Suppression of Myc oncogenic activity by ribosomal protein haploinsufficiency** *NATURE*
  Barna, M., Pusic, A., Zollo, O., Costa, M., Kondrashov, N., Rego, E., Rao, P. H., Ruggero, D.
  2008; 456 (7224): 971-U79
- **Evolutionarily divergent mTOR remodels translatome for tissue regeneration.** *Nature*
  Zhulyn, O., Rosenblatt, H. D., Shokat, L., Dai, S., Kuzuoglu-Ozturk, D., Zhang, Z., Ruggero, D., Shokat, K. M., Barna, M.
  2023
- **Subfunctionalized expression drives evolutionary retention of ribosomal protein paralogs Rps27 and Rps27l in vertebrates.** *eLife*
  Xu, A. F., Molinuevo, R., Fazzari, E., Tom, H., Zhang, Z., Menendez, J., Casey, K. M., Ruggero, D., Hinck, L., Pritchard, J. K., Barna, M.
  2023; 12

- **Ribosome specialization in glioblastoma.** *Nature cell biology*
  Genuth, N. R., Barna, M.
  2022

- **A stem cell roadmap of ribosome heterogeneity reveals a function for RPL10A in mesoderm production.** *Nature communications*
  Genuth, N. R., Shi, Z., Kunimoto, K., Hung, V., Xu, A. F., Kerr, C. H., Tiu, G. C., Oses-Prieto, J. A., Salomon-Shulman, R. E., Axelrod, J. D., Burlingame, A. L., Loh, K. M., Barna, et al
  2022; 13 (1): 5491

- **The promises and pitfalls of specialized ribosomes.** *Molecular cell*
  Barna, M., Karbstein, K., Tollervey, D., Ruggero, D., Brar, G., Greer, E. L., Dinman, J. D.
  2022; 82 (12): 2179-2184

- **The Mettl3 epitranscriptomic writer amplifies p53 stress responses.** *Molecular cell*
  Raj, N., Wang, M., Seoane, J. A., Zhao, R. L., Kaiser, A. M., Moonie, N. A., Demeter, J., Boutelle, A. M., Kerr, C. H., Mulligan, A. S., Moffatt, C., Zeng, S. X., Lu, et al
  2022

- **Combinatorial optimization of mRNA structure, stability, and translation for RNA-based therapeutics.** *Nature communications*
  Leppek, K., Byeon, G. W., Kladwang, W., Wayment-Steele, H. K., Kerr, C. H., Xu, A. F., Kim, D. S., Topkar, V. V., Choe, C., Rothschild, D., Tiu, G. C., Wellington-Oguri, R., Fujii, et al
  2022; 13 (1): 1536

- **Functional and structural basis of extreme conservation in vertebrate 5' untranslated regions.** *Nature genetics*
  Byeon, G. W., Cenik, E. S., Jiang, L., Tang, H., Das, R., Barna, M.
  2021

- **VELCRO-IP RNA-seq reveals ribosome expansion segment function in translation genome-wide.** *Cell reports*
  Leppek, K. n., Byeon, G. W., Fujii, K. n., Barna, M. n.
  2021; 34 (3): 108629

- **Controlling tissue patterning by translational regulation of signaling transcripts through the core translation factor eIF3c.** *Developmental cell*
  Fujii, K., Zhulyn, O., Byeon, G. W., Genuth, N. R., Kerr, C. H., Walsh, E. M., Barna, M.
  2021; 56 (21): 2928-2937.e9

- **An rRNA variant to deal with stress.** *Nature microbiology*
  Leppek, K., Barna, M.
  2019; 4 (3): 382–83

- **Translation control of the immune checkpoint in cancer and its therapeutic targeting.** *Nature medicine*
  Xu, Y., Poggio, M., Jin, H. Y., Shi, Z., Forester, C. M., Wang, Y., Stumpf, C. R., Xue, L., Devericks, E., So, L., Nguyen, H. G., Griselin, A., Gordan, et al
  2019

- **RPS25 is required for efficient RAN translation of C9orf72 and other neurodegenerative disease-associated nucleotide repeats.** *Nature neuroscience*
  Yamada, S. B., Gendron, T. F., Niccoli, T. n., Genuth, N. R., Grosely, R. n., Shi, Y. n., Glaria, I. n., Kramer, N. J., Nakayama, L. n., Fang, S. n., Dinger, T. J., Thoeng, A. n., Rocha, et al
  2019

- **Decoding the Function of Expansion Segments in Ribosomes.** *Molecular cell*
  Fujii, K., Susanto, T. T., Saurabh, S., Barna, M.
  2018; 72 (6): 1013

- **Heterogeneity and specialized functions of translation machinery: from genes to organisms.** *Nature reviews. Genetics*
  Genuth, N. R., Barna, M.
  2018

- **An emerging role for the ribosome as a nexus for post-translational modifications.** *Current opinion in cell biology*
  Simsek, D., Barna, M.

2017; 45: 92-101

- **The p53 family members have distinct roles during mammalian embryonic development.** *Cell death and differentiation*
  Van Nostrand, J. L., Bowen, M. E., Vogel, H., Barna, M., Attardi, L. D.
  2017
- **Pervasive translational regulation of the cell signalling circuitry underlies mammalian development** *NATURE COMMUNICATIONS*
  Fujii, K., Shi, Z., Zhulyn, O., Denans, N., Barna, M.
  2017; 8
- **Functional 5' UTR mRNA structures in eukaryotic translation regulation and how to find them.** *Nature reviews. Molecular cell biology*
  Leppek, K. n., Das, R. n., Barna, M. n.
  2017
- **Translating the Genome in Time and Space: Specialized Ribosomes, RNA Regulons, and RNA-Binding Proteins.** *Annual review of cell and developmental biology*
  Shi, Z., Barna, M.
  2015; 31: 31-54
- **Cis-regulatory RNA elements that regulate specialized ribosome activity.** *RNA biology*
  Xue, S., Barna, M.
  2015: 0
- **Differential Requirements for eIF4E Dose in Normal Development and Cancer** *CELL*
  Truitt, M. L., Conn, C. S., Shi, Z., Pang, X., Tokuyasu, T., Coady, A. M., Seo, Y., Barna, M., Ruggero, D.
  2015; 162 (1): 59-71
- **The ribosome prophecy.** *Nature reviews. Molecular cell biology*
  Barna, M.
  2015; 16 (5): 268
- **Specialized filopodia: at the 'tip' of morphogen transport and vertebrate tissue patterning.** *Current opinion in genetics & development*
  Fairchild, C. L., Barna, M.
  2014; 27C: 67-73
- **Tailor Made Protein Synthesis for HSCs.** *Cell stem cell*
  Barna, M., Ruggero, D.
  2014; 14 (4): 423-4
- **When the going gets tough: scientists' personal challenges.** *Cell*
  Lengerke, C. n., Fernandez-Capetillo, O. n., Tolic-Norrelykke, I. n., Barna, M. n., Coleman, T. n., Zamboni, D. n.
  2014; 159 (2): 225–26
- **Ribosomes take control** *PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES OF THE UNITED STATES OF AMERICA*
  Barna, M.
  2013; 110 (1): 9-10
- **Specialized ribosomes: a new frontier in gene regulation and organismal biology** *NATURE REVIEWS MOLECULAR CELL BIOLOGY*
  Xue, S., Barna, M.
  2012; 13 (6): 355-369
- **Visualization of cartilage formation: Insight into cellular properties of skeletal progenitors and chondrodysplasia syndromes** *DEVELOPMENTAL CELL*
  Barna, M., Niswander, L.
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- **Gli3 and Plzf cooperate in proximal limb patterning at early stages of limb development** *NATURE*
  Barna, M., Pandolfi, P. P., Niswander, L.
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- **Essential role of Plzf in maintenance of spermatogonial stem cells** *NATURE GENETICS*

Costoya, J. A., Hobbs, R. M., Barna, M., Cattoretti, G., Manova, K., Sukhwani, M., Orwig, K. E., Wolgemuth, D. J., Pandolfi, P. P.
2004; 36 (6): 653-659

- **Plzf mediates transcriptional repression of HoxD gene expression through chromatin remodeling** *DEVELOPMENTAL CELL*
  Barna, M., Merghoub, T., Costoya, J. A., Ruggero, D., Branford, M., Bergia, A., Samori, B., Pandolfi, P. P.
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- **Plzf regulates limb and axial skeletal patterning** *NATURE GENETICS*
  Barna, M., Hawe, N., Niswander, L., Pandolfi, P. P.
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- **Interleukin-12 promotes recovery from viral encephalitis** *VIRAL IMMUNOLOGY*
  Komatsu, T., Barna, M., Reiss, C. S.
  1997; 10 (1): 35-47
- **Activation of type III nitric oxide synthase in astrocytes following a neurotropic viral infection** *VIROLOGY*
  Barna, M., Komatsu, T., Reiss, C. S.
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- **Sex differences in susceptibility to viral infection of the central nervous system** *JOURNAL OF NEUROIMMUNOLOGY*
  Barna, M., Komatsu, T., Bi, Z. B., Reiss, C. S.
  1996; 67 (1): 31-39
- **Interleukin-12: Promotes enhanced recovery from viral infection of neurons in the central nervous system** *Conference on Interleukin-12 - Cellular and Molecular Immunology of an Important Regulatory Cytokine*
  Reiss, C. S., Komatsu, T., Barna, M., Bi, Z. B.
  NEW YORK ACAD SCIENCES.1996: 257–265
- **Host immune response to vesicular stomatitis virus infection of the central nervous system in C57BL/6 mice** *VIRAL IMMUNOLOGY*
  CHRISTIAN, A. Y., Barna, M., Bi, Z. B., Reiss, C. S.
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- **IL-12 PROMOTES ENHANCED RECOVERY FROM VESICULAR STOMATITIS-VIRUS INFECTION OF THE CENTRAL-NERVOUS-SYSTEM** *JOURNAL OF IMMUNOLOGY*
  Bi, Z. B., QUANDT, P., Komatsu, T., Barna, M., Reiss, C. S.
  1995; 155 (12): 5684-5689
- **VESICULAR STOMATITIS-VIRUS INFECTION OF THE CENTRAL-NERVOUS-SYSTEM ACTIVATES BOTH INNATE AND ACQUIRED-IMMUNITY** *JOURNAL OF VIROLOGY*
  Bi, Z. B., Barna, M., Komatsu, T., Reiss, C. S.
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