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2 PAGE BIOGRAPHICAL SKETCH

NAME: Michael Levin

POSITION TITLE: Distinguished Professor, Director of Allen Discovery Center at Tufts University

EDUCATION/TRAINING *(Begin with baccalaureate or other initial professional education, such as nursing, include postdoctoral training and residency training if applicable. Add/delete rows as necessary.)*

INSTITUTION AND LOCATION	DEGREE *(if applicable)*	Completion Date MM/YYYY	FIELD OF STUDY
Tufts University, Medford, MA	dual B.S. degrees	05/1992	Biology and Computer Science
Harvard University, Boston, MA	Ph.D.	05/1996	Genetics
Harvard Medical School, Boston, MA	Post-doctoral research	07/2000	Molecular Embryology

A. Personal Statement + 4 selected publications

My lab specializes in combining molecular biology, developmental biophysics, and neuroscience approaches to understand anatomical and physiological plasticity in regeneration, embryogenesis, and cancer. My long-term mission is to produce 1) computational understanding of how biophysical mechanisms enable cells to cooperate toware an organ-scale collective intelligence that solves problems in physiological, transcriptional, and morphological problem spaces, 2) biomedical interventions that utilize changes in bioelectrical properties of cell networks to enable in situ control of pattern formation in regenerative and neoplastic contexts, and 3) the next-generation of young scientists trained in my lab to us interdisciplinary methods at different scales to address important basic and applied questions at the interface of the life and computational sciences.

My original background was in engineering and computer science (focus in AI), and I was always interested in the mechanisms that enable the self-assembly of bodies and minds. As a graduate student, I was trained in developmental molecular genetics; my Ph.D. work with Cliff Tabin first characterized the molecular pathway regulating invariant left-right asymmetry of the heart and viscera in vertebrate embryos. As a post-doctoral fellow with Mark Mercola, I pursued the laterality pathway upstream, to identify the physiological mechanisms determining sidedness of the first asymmetric gene expressions. That work identified a new embryo-wide signaling system that controlled the patterning of specific organs; this theme of long-range control and pattern coordination has been central throughout my subsequent career. During graduate and post-doctoral training, I carried on independent work in computer modeling of complex morphogenetic systems. The Levin lab was first established in the Harvard system (Forsyth Institute) and is currently the nucleus of the Allen Discovery Center at Tufts University. We seek to understand how cellular swarms produce specific complex anatomical and functional outcomes in evolved and synthetic contexts. Using embryonic, regenerative, neoplastic, and tissue culture systems, we answer questions about the mechanisms and algorithms that regulate growth and form. We use synthetic bioengineering to produce novel proto-organisms and living machines to better understand "life as it could be", and reveal plasticity and basal intelligence that are not apparent from the default outcomes of standard embryogenesis. We investigate how evolution produces genomes that encode a multi-scale competency architecture that can solve new problems in anatomical morphospace and other problem spaces. Our applied goals are to learn to manipulate cellular decision-making towards biomedical therapies that exploit bioelectric and other physical signaling modalities. Our basic science goal is to use morphogenesis as an example of a collective intelligence within which to understand basal cognition and information processing.

In recent years, my group has: created molecular protocols for manipulating ion flows to initiate the regeneration of complex appendages such as limbs and tails, discovered a new role for pre-nervous serotonin as a morphogen downstream of developmental bioelectric signaling, identified membrane voltage and control of serotonergic signaling as a long-range environmental cue mediating neural pathfinding and cancerous transformation in vivo, uncovered voltage-based mechanisms for encoding axial polarity during regeneration, showed that modulation of resting potential in non-neural cells can reprogram tissues into forming entire organs such as eyes and hearts, and demonstrated that the nascent brain provides instructive influence for the patterning of remote body organs during development. We established molecular tools for studying developmental bioelectricity, creating and validating quantitative, multiscale models of the mechanisms by which bioelectric prepatterns in tissue arise and control downstream anatomical outcomes (via regulation of morphogen distributions and canonical transcriptional responses). Our work is beginning to transition to mammalian systems, showing bioelectrical control of stem cell differentiation and limb regeneration in human mesenchymal stem cell models and rodent limbs respectively. Our results on the bioelectrical control of cancer in the frog model is now moving toward preclinical testing, showing effective electroceutical approaches to glioblastoma. We showed how a bioelectric simulation environment can be used to model disruptive effects of drugs and mutations on brain development and identify interventions to repair brain structure, gene expression, and learning ability despite those teratogens. We have produced computational tools, enabling modeling of basal cognition (showing that gene regulatory networks are capable of 6 different kinds of learning without physical rewiring) and a new artificial intelligence platform that discovered the first quantitative model of planarian regeneration and an explanation for stochastic induction of melanoma by bioelectric dysregulation in vivo. Lastly, we produced a self-motile biorobotics platform (the Xenobots) made of frog skin cells which is being used to understand the emergence of novel form and function in a wild-type genome and to produce useful synthetic living machines.

B. Positions

Employment and Appointments

1996-2000	Research Fellow, Department of Cell Biology, Harvard Medical School, Boston
2000-2006	Assistant Professor, Harvard School of Dental Medicine, Boston
2000-2003	Assistant Member of Staff (= Assistant Professor), Forsyth Institute, Boston
2003-2006	Associate Member of Staff (= Associate Professor), Forsyth Institute, Boston
2006-2009	Director, Forsyth Center for Regenerative and Developmental Biology
2007-2008	Senior Member of Staff (equivalent to Full Professor), Forsyth Institute, Boston
2008-2013	Associate Professor of Developmental Biology, Harvard University
2008-2018	Senior Research Investigator, Forsyth Institute, Boston
2008-present	**Professor, Biology Department, Tufts University, Medford,** **Director, Tufts Center of Regenerative and Developmental Biology**
2010-present	**Associate Faculty, Wyss Institute at Harvard University**
2016-present	**Director, Allen Discovery Center, Tufts University**

Awards and Honors

1992-1995	NSF pre-doctoral fellowship for Ph.D. work
1997	Alexander Imich Award, paper on cognitive science and consciousness
1997-2000	Helen Hay Whitney Foundation post-doctoral fellowship
2000	Junior Investigator Award, Society for Physical Regulation in Biology and Medicine
2001	“Best Talk” award, Juan March Foundation conference on Asymmetry in Madrid, Spain
2004	The work on the molecular basis of left-right asymmetry (Cell 1995) was chosen by the journal *Nature* as a “***Milestone in Developmental Biology in the last century***”
2007	**Established Investigator Award** from American Heart Association
2011	Keynote speaker, Gordon Conference Research Symposium
2011	**Vannevar Bush Endowed Chair appointment**
2012	Keynote speaker, IFESS International conference, Canada
2012	**Scientist of Vision Award**, IFESS
2013	Keynote speaker at NIH NCI’s PS-OC National meeting
2013	**Distinguished Scholar Award**, Tufts University
2014	Keynote speaker, Gordon Conference Research Symposium
2020	Featured **TEDtalk** at the 2020 TED event
2020	**Distinguished Professor**, Tufts University
2021	**Cozzarelli Prize** from the **National Academies of Science**
2021	ISAL Outstanding Paper of 2020 Award
2022	Kary Mullis prize