



PROTEIN ENGINEERING

& Biological Design

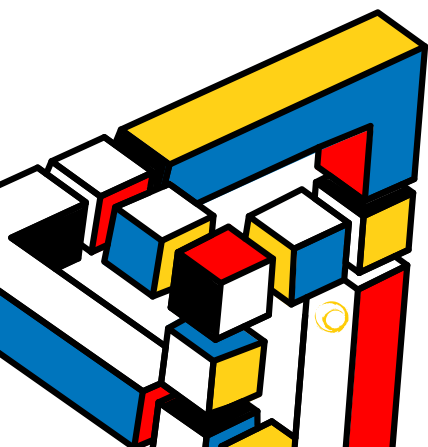
SALTIEL LIFE SCIENCES SYMPOSIUM

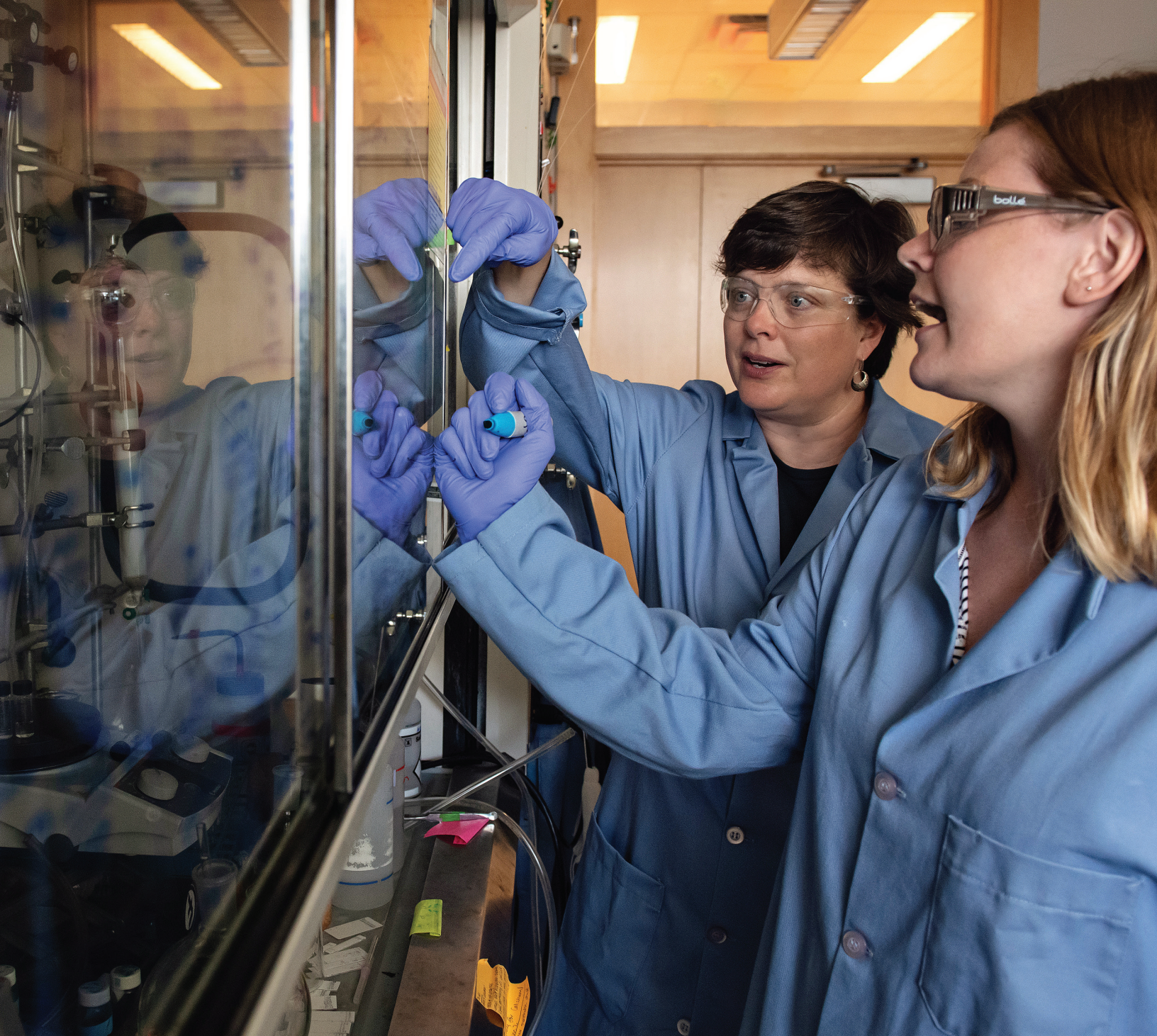
SEPTEMBER 25, 2019

EIGHTEENTH ANNUAL LSI SYMPOSIUM

FORUM HALL, PALMER COMMONS
100 WASHTENAW AVE, ANN ARBOR

#LSIsymposium2019





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SCHEDULE

8:45 A.M.

Welcome

Roger D. Cone, Ph.D.

Vice Provost and Director, U-M Biosciences Initiative; Mary Sue Coleman Director, Life Sciences Institute; Professor of Molecular and Integrative Physiology, Medical School; Professor of Molecular, Cellular, and Developmental Biology, College of Literature, Science, and the Arts

Mark S. Schlissel, M.D., Ph.D.

President of the University of Michigan

8:55 A.M.

Introduction of the Mary Sue and Kenneth Coleman Life Sciences Lecturer

Alan R. Saltiel, Ph.D.

Professor and Director, Institute for Diabetes and Metabolic Health, University of California San Diego School of Medicine; Director, Life Sciences Institute (2002–2015)

9:00 A.M.

Mary Sue and Kenneth Coleman Life Sciences Lecture: Attacking the cell surface proteome in cancer

James A. Wells, Ph.D.

Harry Wm. and Diana V. Hind Distinguished Professor of Pharmaceutical Sciences, Professor of Pharmaceutical Chemistry, University of California San Francisco

9:50 A.M.

Morning break and refreshments

10:10 A.M.

Optogenetic and chemogenetic technologies for mapping molecular and cellular interactions

Alice Y. Ting, Ph.D.

Professor of Genetics, Biology and Chemistry, Stanford University

11:00 A.M.

How do proteins evolve

Dan Tawfik, Ph.D.

Professor, Department of Biomolecular Sciences, Weizmann Institute of Science

11:50 A.M.

Poster session & lunch (Great Lakes Rooms)

1:20 P.M.

Biosystems design via directed evolution

Huimin Zhao, Ph.D.

Steven L. Miller Chair, Department of Chemical and Biomolecular Engineering; Professor of Chemistry, Biochemistry, Biophysics and Bioengineering, University of Illinois at Urbana-Champaign

2:10 P.M.

Navigating the landscapes of protein interaction specificity

Amy E. Keating, Ph.D.

Professor of Biology and Biological Engineering, Massachusetts Institute of Technology

3:00 P.M.

Afternoon break and refreshments

3:20 P.M.

Design, evolution and applications of protein cages

Donald Hilvert, Ph.D.

Professor, Department of Chemistry and Applied Biosciences, ETH Zürich

4:10 P.M.

Closing remarks

Roger D. Cone, Ph.D.

Special thanks to the Saltiel Life Sciences Symposium organizing committee:

David Sherman, Ph.D., Research Professor, U-M Life Sciences Institute; Hans W. Vahlteich Professor of Medicinal Chemistry, College of Pharmacy; Professor of Microbiology and Immunology, Medical School; Professor of Chemistry, College of Literature, Science, and the Arts (committee chair)

Alison Narayan, Ph.D., Research Assistant Professor, U-M Life Sciences Institute; Assistant Professor, Department of Chemistry, College of Literature, Science, and the Arts

Wenjing Wang, Ph.D., Research Assistant Professor, U-M Life Sciences Institute; Assistant Professor, Department of Chemistry, College of Literature, Science, and the Arts

Yang Zhang, Ph.D., Professor, Computational Medicine and Bioinformatics and Biological Chemistry, U-M Medical School

SPEAKER BIOGRAPHIES



Donald Hilvert, Ph.D.

Professor, Department of Chemistry and Applied Biosciences, ETH Zürich

Donald Hilvert obtained his Ph.D. in chemistry from Columbia University. Following postdoctoral work at Rockefeller University, he joined the faculty of the Scripps Research Institute in La Jolla, California in 1986 as an assistant professor. He was subsequently promoted to associate professor in 1989 and full professor in 1994. In 1995, he was named the Janet and W. Keith Kellogg II Professor of Chemistry and an affiliate of the Skaggs Institute for Chemical Biology at Scripps. Since October 1997, he has been a professor in the Laboratory of Organic Chemistry at the ETH Zürich, Switzerland.

Hilvert's research program focuses on understanding how enzymes work and evolve and on mimicking the properties of these remarkable catalysts in the laboratory. These efforts have been recognized by numerous awards, including the Arthur C. Cope Scholar Award from the American Chemical Society, the Pfizer Award in Enzyme Chemistry and the Protein Society Emil Thomas Kaiser Award. He received an honorary doctorate from Uppsala University and is an elected member of the American Academy of Arts and Sciences.



Amy E. Keating, Ph.D.

Professor of Biology and Biological Engineering, Massachusetts Institute of Technology

Amy E. Keating joined the Massachusetts Institute of Technology faculty in 2002. She is now a professor of biology and biological engineering at MIT and a member of the Koch Institute for Integrative Cancer Research. As an undergraduate, Keating studied physics at Harvard before pursuing graduate studies at the University of California Los Angeles. She earned her Ph.D. in organic chemistry, studying carbene reactions with Ken Houk, Ph.D., and Miguel Garcia-Garibay, Ph.D.

Keating was introduced to protein biochemistry as a postdoctoral fellow with Peter Kim, Ph.D., of the Whitehead Institute and Bruce Tidor, Ph.D., of MIT — and she has been working to understand how protein sequences and structures encode interaction specificity ever since. Her lab uses computational and experimental methods to measure protein interactions in high throughput, to develop models that predict binding and to design new proteins and peptides with novel interaction properties. Her trainees have gone on to careers in academia and at pharmaceutical and biotech companies.

In addition to her research program, Keating teaches in the graduate curriculum, is director of the MIT graduate program in biology and serves as the president of the Protein Society. She is the busy mother of two teens and enjoys family travel, particularly road trips in the American west.



Dan Tawfik, Ph.D.

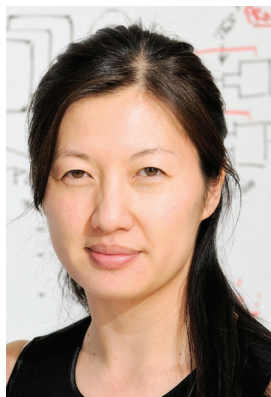
Professor, Department of Biomolecular Sciences, Weizmann Institute of Science

After earning his B.S. in chemistry and biochemistry, and his M.S. in biotechnology, Dan Tawfik completed his Ph.D. at the Weizmann Institute of Science and his postdoctoral research at Cambridge University and the MRC Centre for Protein Engineering. He then served as a senior research fellow at Sidney Sussex College and at the MRC Centre for Protein Engineering, where he was appointed group leader in chemical biology. He returned to the Weizmann Institute as a faculty member in 2001 and holds the Nella and Leon Benozio Professional Chair.

Tawfik's research seeks to answer the following questions: Although we largely lack the "fossils" of the protein world, can we trace back the way today's proteins have evolved? Can this research help us create "designer" proteins for a variety of applications? In work that lies at the interface of chemistry and biology, Tawfik has developed a range of experimental systems that can reproduce protein evolution in the laboratory and in real time. In addition to shedding light on evolutionary processes, including how the very first proteins emerged approximately 3.7 billion years ago, his research is leading to new, tailor-made enzymes with important potential uses, such as degrading toxic chemicals, and to new synthetic metabolic pathways.

His awards and fellowships include the Sir Charles Clore Prize, the Alon Fellowship, the Wolgin Prize for Scientific Excellence, the Weizmann Prize from the Tel Aviv municipality, the Teva Award for Excellence in Memory of Eli Hurvitz and the ECI Enzyme Engineering Award.

SPEAKER BIOGRAPHIES



Alice Y. Ting, Ph.D.

Professor of Genetics, Biology and Chemistry, Stanford University

Before joining Stanford University as a professor of genetics, biology and chemistry, Alice Y. Ting was a faculty member in the Massachusetts Institute of Technology for 14 years. She completed her undergraduate education at Harvard, earned her Ph.D. from the University of California Berkeley and conducted her postdoctoral research at the University of California San Diego with Roger Tsien, Ph.D.

Ting's lab develops molecular technologies for studying proteins and signaling pathways in living cells and organisms, and applies those technologies to neuroscience and mitochondrial biology. Her tools include APEX and TurboID proximity labeling, fluorophore ligases, monovalent streptavidin and the FLARE neuronal activity integrator. Her work has been recognized by the NIH Pioneer Award, the McKnight Technological Innovations in Neuroscience Award and the ACS Arthur C. Cope Scholar Award, among other prizes. She is an investigator of the Chan Zuckerberg Biohub.

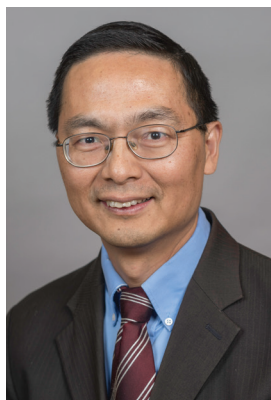


James A. Wells, Ph.D.

*Harry Wm. and Diana V. Hind Distinguished Professor of Pharmaceutical Sciences,
Professor of Pharmaceutical Chemistry, University of California San Francisco*

James Wells pioneered the engineering of proteins, antibodies and small molecules that target catalytic, allosteric and protein-protein interaction sites. He has developed technologies including protein phage display, alanine-scanning, engineered proteases for improved hydrolysis, bioconjugations, N-terminomics, disulfide "tethering" and an industrialized recombinant antibody production pipeline for the proteome and protein-Seq. These have led to new insights into protease mechanisms, growth factor signaling, hot-spots in protein-protein interfaces, the role of caspases in biology and how cell surfaces change in health and disease. He has published over 200 peer-reviewed papers and is the inventor on more than 60 patents.

Wells received a B.A. in biochemistry from the University of California Berkeley and a Ph.D. in biochemistry from Washington State University with Ralph Yount, Ph.D. After completing postdoctoral studies at Stanford University Medical School with George Stark, Ph.D., he joined Genentech in 1982 as a founding member of the Protein Engineering Department and then founded Sunesis Pharmaceuticals. Wells joined the University of California San Francisco faculty in 2005 and now serves as a professor and former chair of pharmaceutical chemistry. He is an elected member of the National Academy of Sciences, the American Association of Arts and Sciences and the National Academy of Inventors.



Huimin Zhao, Ph.D.

*Steven L. Miller Chair, Department of Chemical and Biomolecular Engineering; Professor of
Chemistry, Biochemistry, Biophysics and Bioengineering, University of Illinois at Urbana-Champaign*

Huimin Zhao received his B.S. in biology from the University of Science and Technology of China and his Ph.D. in chemistry from the California Institute of Technology under the guidance of Frances Arnold, Ph.D. Prior to joining the University of Illinois at Urbana-Champaign, he was a project leader at the Industrial Biotechnology Laboratory of the Dow Chemical Company. He was promoted to full professor at the University of Illinois at Urbana-Champaign in 2008 and now serves as the Steven L. Miller Chair of Chemical and Biomolecular Engineering and a professor of chemistry, biochemistry, biophysics and bioengineering.

Zhao's primary research interests are in the development and applications of synthetic biology tools to address society's most daunting challenges in health, energy and sustainability, and in the fundamental aspects of enzyme catalysis, cell metabolism, gene regulation and cell differentiation. He has authored and co-authored more than 300 research articles and more than 25 issued and pending patent applications, with several being licensed by industry. In addition, he has given over 360 plenary, keynote and invited lectures and has received numerous research and teaching awards and honors.

POSTER SESSION

"A shared substrate specificity in the small multidrug resistance family provides a route to evolutionary novelty"

Christian B. Macdonald, Ali A. Kermani, Jesse Mangat, Randy B. Stockbridge

"Activity-based discovery and optimization of agonist antibodies"

John Schardt, Hark Jhaji, Ryen O'Meara, Peter Tessier

"Bacterial biosynthesis of dimeric diketopiperazine alkaloids"

Vikram V. Shende, Yogan Khatri, Sean Newmister, Jacob Sanders, Petra Lindovska, Fengan Yu, Tyler J. Doyon, Justin Kim, Ken N. Houk, Mohammad Movassaghi, David H. Sherman

"Biocatalysis and complex molecule synthesis"

Summer Baker Dockrey, Tyler Doyon, Joshua Pyser, Attabey Rodríguez Benítez, Jessica Yazarians, Kevin Skinner, Jonathan Perkins, Lara Zetzsche, Evan Romero, Janet Smith, Alison Narayan

"Characterizing plasminogen activator inhibitor-1 as a scaffold for designer SERPIN development"

Laura M. Haynes, Zachary M. Huttinger, David Ginsburg

"Comparison between YfeX and myoglobin as catalyst for carbene insertion reactions"

Victor Sosa, Nicolai Lehnert

"Designing protein nanocages using a generalizable symmetry-based approach"

Ajitha S. Cristie-David, Neil Marsh

"Correcting gene ontology misannotations by taxon-specific rate ratio analysis"

Xiaoqiong Wei, Chengxin Zhang, Peter L. Freddolino, Yang Zhang

"Development of a pH-dependent NMR chemical shift predictor"

Efrosini Artakis, Charles L. Brooks III

"Development of targeted cancer therapeutics through de novo protein design"

Robin Pearce, Xiaoqiang Huang, Yang Zhang

"Directed evolution using stabilized peptide display on E. coli"

Tejas Navaratna, Lydia Atangcho, Mukesh Mahajan, Vivekanandan Subramanian, Greg M. Thurber

"Elucidation of biosynthetic pathways"

April Lukowski, Stephanie Chun, Sarah Ackenhuisen, Jianxin Liu, Sherwood Hall, Jennifer Bridwell-Rabb, Alison Narayan

"Engineering microtubule-based transport of viral-like particles"

Somaye Badieyan, Sharon Garrott, Tobias W. Giessen, Michael Cianfrocco

"Improved library design and selection methods for identifying antibodies with high specificity and affinity"

Alec Desai, Matt Smith, Edward Ionescu, Peter Tessier

"Investigating substrate scope of a biocatalyst for late-stage halogenation"

Samantha P. Kelly, Amy E. Fraley, Artiorn Cernijenko, Hasnain Malik, David H. Sherman

"isoTarget for interrogating isoform-specific function, localization, and signaling at subcellular compartments of neurons in vivo"

Hao Liu, Sarah Pizzano, Ruonan Li, Wenquan Zhao, Macy Veling, Limin Yang, Bing Ye

"Iterative late-stage diversification of tirandamycin antibiotics via selective enzymatic C-H functionalization and substrate engineering strategies to expand substrate scope"

Rosa Vasquez, Kersti Haatveit, Yogan Khatri, Sean Newmister, Jessica Stachowski, Ken Houk, John Montgomery, David H. Sherman

"Molecular tools for imaging cell-signaling in the brain"

Kayla Kroning, Ruby M. Miller, Wenjing Wang

"pH dependence on binding and release of folate by folic acid receptor α "

Thomas J. Paul, Hedieh Torabifard, Jonah Z. Vilseck, Ryan L. Hayes, Charles L. Brooks III

"pH-mediated processes in the integral membrane influenza A proton channel (AM2) studied by constant pH molecular dynamics"

Hedieh Torabifard, Afra Panahi, Charles L. Brooks III

"Physicochemical determinants of drug-like monoclonal antibodies"

Yulei Zhang, Lina Wu, Manali Sawant, Emily Makowski, Peter Tessier

"Relative free energies of dimerization of non-natural amino acid insulin variants"

Luis F. Cervantes, Jonah Vilseck, Charles L. Brooks III

"Rieske non-heme oxygenases in paralytic shellfish toxin biosynthesis"

Jianxin Liu, April Lukowski, Alison Narayan, Jennifer Bridwell-Rabb

"Shape driven liquid-liquid phase separation and crystallization of proteins"

Jens Glaser, Sharon C. Glotzer

"SSiPe: A server for binding affinity change prediction"

Xiaoqiang Huang, Wei Zheng, Robin Pearce, Yang Zhang

"Substrate recognition of small multi drug resistance (SMR) proteins"

Olive Burata, Chris Macdonald, Ali Kermani, Randy Stockbridge

"Supercharging enables organized assembly of synthetic biomolecules"

Anna J. Simon, Yi Zhou, Vyas Ramasubramani, Jens Glaser, Arti Pothukuchy, Jimmy Gollihar, Jillian C. Gerberich, Janelle C. Leggere, Barrett R. Morrow, Cheulhee Jung, Sharon C. Glotzer, David W. Taylor, Andrew D. Ellington

"The lipid kinase Vps34 is a driver of selected membrane trafficking pathways"

Noah Steinfeld, Vikramjit Lahiri, Anna Morrison, Daniel J. Klionsky, Lois Weisman



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SALTIEL LIFE SCIENCES SYMPOSIUM

SEPTEMBER 30, 2020

ABOUT THE LIFE SCIENCES INSTITUTE

The Life Sciences Institute is a hub for collaborative bioscience discovery at the University of Michigan. Our faculty, who hold joint appointments in schools and colleges across the campus, work to advance the understanding of fundamental biology in important areas of human health and disease. In addition to faculty labs, the LSI houses a world-class cryo-electron microscopy facility, a high-throughput screening center with extensive chemical libraries, a unique library of natural products and a comprehensive protein production and X-ray crystallography facility. The LSI is also the administrative home for the U-M Program in Chemical Biology, Michigan Drug Discovery and the Michigan Life Sciences Fellows program.

ABOUT THE ANNUAL SYMPOSIUM

In 2002, while construction of the institute was still underway, the LSI held its first symposium. The event continues to represent the LSI's most important values: excellence in science, investment in high-impact research and especially the synergy that happens when top scientists from a range of fields meet and share their work around a common theme.

In 2016, the annual LSI symposium was named the Saltiel Life Sciences Symposium thanks to an endowment made possible by the generous support of the LSI's faculty, Leadership Council, Scientific Advisory Board and friends. The name recognizes the leadership and scientific contributions made by former LSI Director Alan R. Saltiel during his 13-year tenure.

PAST SYMPOSIA

2018	The Power of One: Frontiers in Single Cell Biology	2010	Macromolecular Complexes in Cell Biology
2017	Game Changers: Technologies that Are Rewriting the Future of the Life Sciences	2009	Evolutionary Biology
2016	Chemical Biology: Rise of the Cellular Machine	2008	Focus on Chemical Biology
2015	Defense Mechanisms in Life: From Bacteria to the Human Body	2007	Frontiers in Stem Cell Biology
2014	Victors for Discovery: Biomedicine at Michigan	2006	Molecular Insights into Metabolic Disease
2013	Exploring Epigenetics and RNA	2005	Cancer Insights: Molecules to Medicine
2012	Development and Diseases of the Nervous System	2004	Exploring the Complexity of Life
2011	Autophagy	2003	Genetic Insights into Biology and Disease
		2002	Structural Biology of Cell Signaling

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