Department of Biology

Academic year 2014–2015 was exciting and productive for the Department of Biology. The department is considered one of the best biological science departments in the world. Our superb faculty members are leaders in biological research and education. Some of the news regarding our faculty, research, and educational programs is highlighted below.

Faculty Count, Promotions, and Departures

During AY2015, the Department of Biology had 60 faculty members: 44 full professors, nine associate professors, and seven assistant professors. Research homes are distributed among Building 68, the Broad Institute, the Koch Institute for Integrative Cancer Research, the Picower Institute, and the Whitehead Institute.

In addition to 60 primary faculty, there were nine faculty members with secondary appointments in Biology. These joint faculty members provide important connections to other departments, including Brain and Cognitive Sciences, Chemistry, Biological Engineering, and Civil and Environmental Engineering.

Promotions of four faculty members became effective July 1, 2014. Matthew Vander Heiden was promoted to associate professor without tenure, and Laurie Boyer, Iain Cheeseman, and Jeroen Saiej were promoted to associate professor with tenure.

The department is delighted to welcome Assistant Professor Gene-Wei Li joined the department following a postdoctoral fellowship at the University of California at San Francisco. He received his PhD in physics from Harvard University and his bachelor's degree in physics from the National Tsinghua University in Taiwan. The Li lab aims to elucidate the physical and quantitative principles behind the precise control of transcription and translation of DNA.

The department is also delighted to welcome Assistant Professor Omer Yilmaz. Before arriving at MIT, Yilmaz was a postdoctoral fellow at the Whitehead Institute and a resident in anatomic pathology at Massachusetts General Hospital and Harvard Medical School. He received his PhD and MD from University of Michigan Medical School. The Yilmaz lab studies the effect of caloric restriction on intestinal stem cells, linking the benefits of caloric restriction to the regulation of intestinal stem cells by their cellular neighborhood (or niche cells) in the small intestine.

Mary Lou Pardue retired, effective June 30, 2015. Professor Herman Eisen, an emeritus faculty member, and Professor Alexander Rich passed away during the academic year. Their many years of research and teaching greatly contributed both to the Department of Biology and to the world at large.

Faculty Awards

Department of Biology faculty members are widely recognized for their contributions to the field. Among our core faculty are three Nobel Laureates, 25 members of the National

Academy of Sciences, 22 members of the American Academy of Arts and Sciences, 15 fellows of the American Association for the Advancement of Science, and 15 Howard Hughes Medical Institute investigators or early career investigators. Following are some of the many awards and recognitions conferred on Department of Biology faculty members during AY2015.

Angelika Amon received the Genetics Medal from the American Genetics Society.

Tania Baker received the Stanford Medical Center Alumni Association Lifetime Achievement Award.

Sallie (Penny) W. Chisholm was selected as a correspondent member of the Reial Acadèmia de Ciències i Arts de Barcelona and received the Skidmore College Distinguished Alumni Award.

Martha Constantine-Paton was the recipient of a Radcliffe Institute Fellowship.

Catherine Drennan was named a 2015 MacVicar Faculty Fellow.

Gerald Fink has been president of the American Association for the Advancement of Science since February 2014. In 2015 he became chair of the board of the AAAS.

Mary Gehring was named one of Cell's "40 Under 40."

Alan D. Grossman was elected to the National Academy of Sciences.

Lenny P. Guarente received the Irving Wright Award of Distinction from the American Federation for Aging Research.

Richard O. Hynes was elected fellow of the American Academy for Cancer Research (AACR) and chair of the Stand up to Cancer (SU2C) Canada Cancer Stem Cell Subcommittee.

Tyler Jacks was the recipient of MIT's James R. Killian Jr. Faculty Achievement Award.

Rudolf Jaenisch received the Otto Warburg Medal and the March of Dimes Prize in Developmental Biology.

Dennis H. Kim received an NIH Director's Transformative Research Award.

Douglas Lauffenburger received a Cell and Molecular Bioengineering Career Achievement Award from the Biomedical Engineering Society.

Peter W. Reddien was appointed an HHMI Investigator.

David Sabatini was awarded a National Academy of Sciences Award in molecular biology for his discovery of components and regulators of the mTOR kinase pathway and his elucidation of the important roles of this signaling pathway in nutrient sensing, cell physiology, and cancer.

Leona Samson was named a Radcliffe Institute Fellow, Harvard University.

Hazel Sive was named a 2015 MacVicar Faculty Fellow.

JoAnne Stubbe received an Alumnae Award from the University of Pennsylvania.

Matthew Vander Heiden is a recipient of the MIT Eisen and Chang career development chair, and the Gertrude B. Elion Award from the American Association for Cancer Research.

Research Highlights

Our faculty continue to make major research contributions to the life sciences. Research areas include the decoding of genetic information within cells; the structure and function of the cellular machineries involved in normal growth and propagation; how normal cellular processes work and what goes wrong in disease (cancer, neurodegeneration, infection); how cells differentiate to adopt new fates and functions; how microbes function and interact with one another and with larger organisms to promote health or cause disease; how cells process and respond to external and internal signals; how evolution shaped fundamental biological processes; and the factors that control aging and regeneration.

Below are research highlights from Biology Department faculty who successfully completed the promotion process this past year.

Amy Keating's lab continues to study the evolution of dimerization of bZIP transcription factor proteins over the past billion years, showing that many interactions have changed—i.e., have been gained or lost—over time in different species. Collection of a large amount of data made it possible to develop a computational model that predicts dimerization from sequences more accurately than any previous model, and the lab used these improved models to design new proteins with desired interaction patterns.

Aviv Regev's research is focused on experimental and computational approaches to systematically decipher the mechanisms and principles that underlie the rewiring of regulatory networks controlling gene transcription. Her lab studies the rewiring of transcriptional networks at different timescales, asking how gene regulation changes when cells adapt to changing growth conditions, when they differentiate, and when species evolve. These studies provide detailed reconstructions and general principles governing the emergence of novel functions in gene regulation in organisms ranging from yeasts to humans.

Thomas Schwartz's research group has focused on structural and functional analyses of proteins that are critical for the function of the cell nucleus. The group has made important insights toward understanding the nuclear pore complex, a very large assembly of proteins that transport molecules into and out of the nucleus. The Schwartz group solved the structure of a protein involved in remodeling and disassembling nuclear complexes. Cellular defects in this disassembly can result in dystonia, and the group's work shed new light on the molecular mechanisms that underlie this disease.

Education

Using fifth-week enrollment data, 123 undergraduates registered as biology majors, and 13 registered as double majors. Sixty-nine undergraduates registered as majors in computer science and molecular biology.

The bachelor of science degree was awarded to 62 students in biology, 13 students in computer science and molecular biology, and one student who held a double major.

There were 232 graduate students registered in the Department of Biology, and another 24 in the Joint Program in Biological Oceanography with the Woods Hole Oceanographic Institute (WHOI). The department awarded 21 PhD degrees and three SM degrees. Three PhD degrees were awarded in the Joint Program.

We are proud of our long-standing focus on excellence in both undergraduate and graduate education. Our faculty, regardless of rank, are committed to playing an active role in teaching, advising, and mentoring our students. The department encourages and supports continued reviews and development of new and existing courses to keep up with the rapid pace of discovery in life sciences and to adapt to our students' needs and capabilities.

Online Education Initiatives

We have partnered with the Office of Digital Learning to establish an MITx biology team (BIOx) of three PhD biologists who have pedagogical training as well as a specific skill set for creating digital learning materials. The BIOx team continues to enable our faculty to develop innovative massive open online courses (MOOCs) on the edX platform, and residential materials using MITx, an iteration of the edX platform.

The department released the well-received MITx course 7.00x Introduction to Biology—The Secret of Life on edX in September 2013 and June 2014. 7.QBWx Quantitative Biology Workshop, another course developed by the BIOx team, was released in June 2014. The BIOx team is currently developing 7.28x Molecular Biology Part 1 of 3 for edX with Professors Steve Bell and Tania Baker. With each release of a course, 6,000 to 40,000 students have registered, and thousands have actually engaged in the course content.

We made significant progress with integrating MITx sites into nine residential courses (and one outreach) this past year to provide students with additional learning resources. MITx sites are used in a variety of ways in the Introduction to Biology GIRs, and in Molecular Biology, Genetics, and Cell Biology.

An example of how online modalities of instruction have been integrated into our traditional lecture-format courses is in 7.06 Cell Biology, where students can follow short online "Khan Academy-like" presentations to enhance their understanding of fundamental cellular processes such as the secretory pathway. This approach, pioneered by Frank Solomon and Adam Martin this past year, has been remarkably successful.

In addition, a major departmental effort over the past few years has been the development of freely available educational software (StarBiochem, StarGenetics, StarCellBio) that allows for simulated experimental experiences and assessments. We envision these programs continuing to be integrated into our residential core course offerings.

Undergraduate Awards

Class of 2015

Elliot Akama-Garren, Rhodes Scholar and January Scholar in France for excellence in French studies.

James Anderson, Everett Longstreth Jazz Award in recognition of distinguished service and musical contributions to the MIT Festival Jazz Ensemble.

Kevin Erazo, Service Award for outstanding contributions in the area of service to the Department of Chemistry.

Chrysonthia Horne, Service to Student Life Award honoring students who have made a sustained and outstanding contribution to the MIT community.

Andrea Kriz, first prize, Prize for Writing Science Fiction, awarded by MIT Department of Comparative Media Studies/Writing.

Muneeza Patel, Advanced Certificate of Engineering Leadership recognizing the successful completion of the requirements of the Bernard M. Gordon—MIT Engineering Leadership Program.

Divya Pillai, Emerson Music Scholarship in Voice.

Rebecca Shi, Hans Lukas Teuber Award for Outstanding Academics and the Walle J.H. Nauta Award for Outstanding Research in Brain and Cognitive Sciences.

Ava Soleimany, SuperUROP Outstanding Research Project Award from the Department of Electrical Engineering and Computer Science.

Rebecca Taylor, Chemistry Research Award; Merck Index Award for outstanding scholarship; Association of MIT Alumnae Senior Academic Award nominee.

Adelaide Tovar, first prize, S. Klein Prize for Technical Writing.

Angela Zhang, Znaty-Merck Prize for Research in Biological Engineering.

Daniel Zhang, David Epstein Award in recognition of distinguished service and musical contribution to the MIT Symphony Orchestra; Emerson Music Scholarship in Strings; Chemistry Department Research Award; Service Award for outstanding contributions to the Department of Chemistry.

Phi Beta Kappa: Elliot Akama-Garren, Andrew Chen, Amita Gupta, Pooja Jethani, Luke Koblan, Andrea Kriz, Vivian Liu, Quynh Nguyen, Sarah Oberhelman, Rebecca Shi, Rebecca Taylor, and Angela Zhang.

Class of 2016

Grace Assaye, first prize, essay, Robert A. Bolt Writing Prize.

Kristen Finney, summer 2014 Davis Peach Fellowship.

Amna Magzoub, summer 2015 Paul and Priscilla Gray Internship from the Public Service Center; winner of 2015 IDEAS Global.

Tobi Rudoltz, Department Service Award for outstanding service to the Department of Mechanical Engineering.

Marsha Wibowo, Kelly-Douglas Summer Travel Fellow to support projects that enrich understanding of one or more fields comprising the Humanities, Arts, and Social Sciences at MIT; second prize, S. Klein Prize for Technical Writing.

Class of 2017

Melanie Abrams, third prize, Prize for Writing Science Fiction, awarded by MIT Department of Comparative Media Studies/Writing; first prize, Vera List Prize for Visual Arts; honorable mention, Bolt Manuscript Prize in Fiction.

Dina Levy-Lambert, third prize, Isabelle de Courtivron Prize for excellent student writing on topics related to immigrant diaspora, bicultural, bilingual, and/or mixed-race experiences.

Anita Liu, summer 2014 Paul and Priscilla Gray Internship from the Public Service Center.

Biology Department Awards

Lakshmi Subbarah, John L. Asinari Award for outstanding research in the field of life sciences.

Amy Fan and Jennifer Halford, Gene Brown Prize for academic scholarship and demonstrated excellence as a teaching assistant.

Alice Lu, Susan Hockfield Prize in Life Sciences for a third-year MIT undergraduate student in any area of the life sciences who has demonstrated both exceptional performance and promise for graduate study and research.

Elliot Akama-Garren, Ned Holt Prize for demonstrated excellence in scholarship and service to the MIT community.

Quynh Nguyen, Salvador E. Luria Prize for scholarship and research of publication quality.

Anastassia Bobokalonova, Merck Prize for outstanding research and academic performance in biophysical or bioinformatics sciences.

Vivian Liu, Whitehead Prize for outstanding promise for a career in biological research through academic scholarship as well as contributions to research and the MIT community.

Undergraduate Research Symposium

Fifteen students spoke in the Undergraduate Research Symposium in January at the invitation of their research faculty mentors: Max Baas-Thomas, Jeff Chen, Sung Won Cho, Alycia Gardner, Jenny Halford, Choah Kim, Sharon Kim, Julie Ko, Kyle Lathem, Luke Koblan, Lakshmi Subbaraj, Preeti Singhal, Meghan Torrence, Adelaide Tovar, and Joanne Zhou.

Diversity Initiatives

A strategic objective of the Department of Biology is to increase the pipeline of underrepresented minority (URM) students pursuing research careers. A primary, but not the sole, focus of our efforts is to increase URM enrollment in our own graduate

programs. To this end, we engage in a variety of outreach activities, including participation in national conferences for minority scientists and undergraduate students; visits to colleges and universities with large URM populations to establish regular and direct contact with students, faculty, and program directors at these institutions; MIT campus visits with URM and underprivileged students interested in graduate school in the biological sciences; and opportunities for faculty from primarily URM-serving institutions to perform sabbatical research, visit, and present their research at MIT.

We continue to participate actively in the MIT Summer Research program (MSRP), designed to encourage URM and underprivileged students to pursue careers in the sciences. Students spend 10 weeks conducting full-time supervised research and participate in classes and other activities designed to prepare them for graduate studies in biomedical sciences. Summer 2015 was highly competitive—16 students were selected from a pool of over 206 applications, and another five were accepted through our cost sharing with Howard Hughes Medical Institute (HHMI).

During January 2015 we offered another session of the Quantitative Biology Workshop, a one-week program for students and faculty from historically black colleges and universities (HBCUs) and minority-serving institutions. The intensive, fast-paced workshop exposes participants to the quantitative and computational tools required for analyzing large biological datasets and modeling biological phenomena. Participants also meet faculty, learn about the process for applying to graduate schools, and experience a small slice of our community.

The department also organizes high school outreach programs. Over a two-day period in March, we hosted class field trips for more than 200 high school students from five Boston-area high schools. These students attended lectures, toured facilities, and participated in hands-on activities and computer labs led by graduate students. In the summer, we hosted the annual summer workshop for Massachusetts high school biology teachers, a five-day workshop in which teachers participate in hands-on lab activities. This year, the workshop focused on neuroscience.
Our programs and emphasis on personal contact and long-term regular interactions with faculty who mentor URMs has been an effective recruitment strategy. From FY2005 to FY2015, the percentage of URM graduate students in the department has increased steadily, from ~5% to 15%.

Development

In response to the urging of the 2013 Visiting Committee, and in recognition of the key role that graduate students play in our research efforts, our ability to attract superb faculty, and our contributions to the nation's science and technology enterprise, we initiated the Graduate Training Initiative. With the help of alumni and friends, we have centered our efforts on enhancing the graduate student experience, in the form of both direct student support (tuition and stipend) and indirect support (programmatic activities such as seed funds for student-directed projects, shared computing facilities, forums related to post-graduation employment, and special activities). Initial efforts are proving successful: in the past year we have secured commitments for more than $15M.

In September 2014, Dr. Susan Stokes, Associate Director of R&D Portfolio Operations at Vertex Pharmaceuticals, visited the department. Shortly after this meeting, Vertex Pharmaceuticals renewed its longstanding support for the Vertex Scholars Program, with a grant of $85,000 for one PhD student. This support is for one year and subject to reevaluation by Vertex.

Named Lectures

The department welcomed the following named speakers during AY2015:

Salvador E. Luria Lecture: Richard O. Hynes, MIT

Malvin and Eleanor Mayer Lecture in the Life Sciences: Eric Olson, University of Texas Southwest Medical Center

Chipperfield Lecture: Jeremy Nathans, Johns Hopkins Medical School

Alexander Rich Lecture: Martin Karplus, Harvard University

Charles "Ned" E. Holt Memorial Lecture: Michael Nussenzweig, Rockefeller University

Paul F. Glenn Distinguished Lecture: Gary Ruvkun, Massachusetts General Hospital

Sackler Lecture: Kari Alitalo, Translational Cancer Biology and Wihuri Research Institute, Helsinki

Francis O. Schmitt Memorial Lecture: Marc Tessier-Lavigne, Rockefeller University

Alan D. Grossman
Praecis Professor and Head
Department of Biology