



Dean's Report

Graduate School of Biomedical Sciences

FALL 2017

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Top Mentors, Top Students, Top Science

It has been a time of outstanding achievement for Mount Sinai faculty, postdoctoral trainees, and graduate students. In 2017, our total National Institutes of Health funding increased to \$318 million—up from \$290 million in 2016. We are also ranked No. 2 in research dollars per investigator among private U.S. medical schools by the Association of American Medical Colleges.

Additionally, the *Nature Index 2017 Innovation* supplement ranked us among the top 10 research institutions in the world based on our contributions to published research that is later cited by other organizations in patent development (see story, page 4). And, in a first-of-its-kind spinoff, Sema4, which is a company owned by the Icahn School of Medicine at Mount Sinai with some 350 employees, began offering high-quality genetic testing to doctors and patients across the country—testing developed through our research enterprise.

At the core of this success is our faculty—extraordinary researchers and mentors who encourage our students



Marta Filizola, PhD, Dean, Graduate School of Biomedical Sciences, and Professor of Pharmacological Sciences, and Neuroscience

and trainees to think boldly, without boundaries, and to take measured risks that spur innovation and advances. Faculty, postdoctoral trainees, and students have the best of both worlds here—we are a comparatively small community of scholars, but with access to the vast resources of the Mount Sinai Health System: seven hospital campuses, renowned centers of excellence and research institutes, 285-plus research laboratories, and unique academic partnerships that offer unparalleled opportunities for research and study.

Our top-notch PhD programs in biomedical sciences, neuroscience, and clinical research, along with expanded Master's programs in biomedical science, public health, biostatistics, clinical research, genetic counseling, and

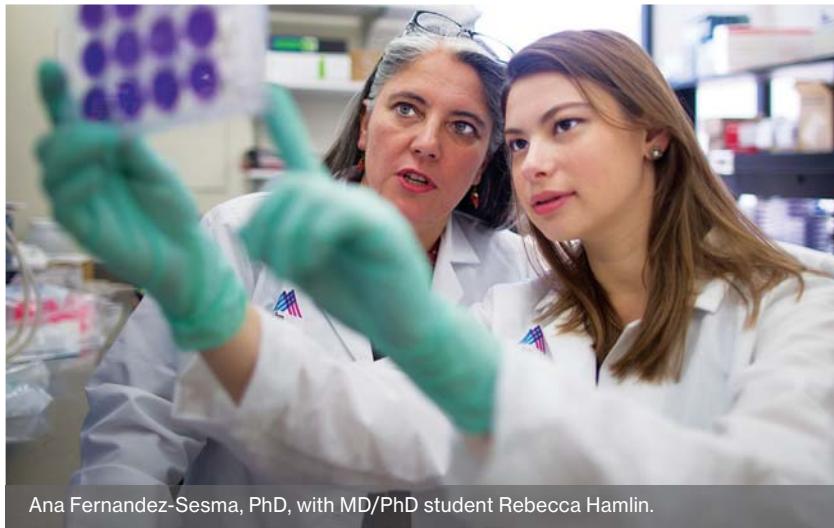
health care delivery leadership, prepare the next generation of leaders and changemakers for a variety of career paths in academia, industry, and health care. Every day, we celebrate the passion and commitment of our faculty and students who continue to be the driving force of excellence that defines Mount Sinai's Graduate School of Biomedical Sciences.

Leading Research and Training Programs in Microbiology

Ana Fernandez-Sesma, PhD, Professor of Microbiology, Icahn School of Medicine at Mount Sinai, and Co-Director of the Microbiology Multidisciplinary Training Area, is one of the nation's top National Institutes of Health (NIH)-funded investigators in microbiology—ranked No. 3 nationally in a department that is ranked No. 4 in NIH funding. The Department includes luminaries Peter Palese, PhD, Chair of Microbiology, and a member of the National Academy of Medicine and National Academy of Sciences; and Adolfo García-Sastre, PhD, pioneers in the study of the molecular basis of influenza viruses, ranked No. 15 and No. 10 respectively, in NIH funding.

As principal investigator for one of the National Institutes of Health/National Institute of Allergy and Infectious Diseases (NIH/NIAID)-funded multicenter

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Ana Fernandez-Sesma, PhD, with MD/PhD student Rebecca Hamlin.

Mentor-Mentee Collaboration Leads to a Novel Study

A groundbreaking study in mice showed that early-life stress during a sensitive period of postnatal development encodes a susceptibility to additional stress and depression-like behavior in adulthood. The study, published June 16, 2017, in *Science*, was led by postdoctoral fellow Catherine Peña, PhD, who worked closely with her mentor and the study's senior author, Eric J. Nestler, MD, PhD, Nash Family Professor of Neuroscience, Director of The Friedman Brain Institute, and Dean for Academic and Scientific Affairs.

The research team found that mice, when stressed during this sensitive period, showed suppressed levels of the transcription factor orthodenticle homeobox 2 (Otx2) in the ventral tegmental area (VTA), a brain reward region. While these Otx2 levels recovered by adulthood, their early suppression had already set in motion gene alterations in the VTA that lasted into adulthood.

Furthermore, the researchers discovered that these early-stressed mice were more likely to succumb to depression-like behavior in adulthood after additional adult stress. Supporting the work was the first-time use of genome-wide transcriptome analysis by RNA-sequencing in research modeling early-life stress.

The study is a pointed example of opportunities that can emerge from well-structured mentor-mentee programs for graduate students and postdocs. Mount Sinai's Department of Neuroscience is ranked No. 2 in the nation in National Institutes of Health (NIH) funding—Dr. Nestler is ranked No. 7 in individual funding.



Catherine Peña, PhD, with mentor Eric J. Nestler, MD, PhD, published a groundbreaking study in *Science*.

"For graduate students and postdocs, our Graduate School offers an incredibly rich array of faculty expertise," says Dr. Nestler, adding that Dr. Peña's work benefited from the knowledge, reagents, and new perspectives from a wide range of labs at Mount Sinai. "The study took advantage of not only the strengths of my lab, but also the unique research strengths brought by Dr. Peña," says Dr. Nestler. "By learning new technology and applying it to my research in a way that had never been done before, I was able to gain valuable insights," adds Dr. Peña. "The result," says Dr. Nestler, "was a very novel paper published in *Science*."

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Human Immunology Project Consortia, Dr. Fernandez-Sesma is leading a high-powered team of investigators to study human immune responses to dengue virus (DENV) infection and vaccination. That group includes Mount Sinai colleagues Dr. García-Sastre; Miriam Merad, MD, PhD; Adeeb Rahman, PhD; Andrew Kasarskis, PhD; and Jun Zhu, PhD; Eva Harris, PhD, UC Berkeley School of Public Health; Steven Wolinsky, MD, Northwestern University Feinberg School of Medicine; Nevan Krogan, PhD, University of California, San Francisco; Anna Durbin, MD, Johns Hopkins Bloomberg School of Public Health; Stephen Whitehead, PhD, NIH/NIAID; and Sumit Chanda, PhD, Sanford Burnham Prebys Medical Discovery Institute.

The Dengue Human Immunology Project Consortia (DHIPC) investigators are studying innate immune responses to DENV in infected

individuals from a Nicaraguan pediatric cohort and DENV-vaccinated individuals, as well as validations in *ex-vivo* systems. The work has generated crucial data on early events in DENV infections that can shape the adaptive immunity directed against these viruses and help scientists to understand the complex immune responses that take place in DENV-infected or vaccinated individuals. The project also includes the study of human immune responses to chikungunya and Zika viruses.



Internationally renowned microbiologists Peter Palese, PhD, left, and Adolfo García-Sastre, PhD, in the lab.

Mount Sinai Researchers Advance Study of DENV Infection

Dr. Fernandez-Sesma's lab broke additional ground by identifying host factors that initiate the human immune response to DENV infection, while describing how the virus counteracts this mechanism and evades immune detection—findings published this spring in *Nature Microbiology*.

Mount Sinai contributors to that article

included: Research Assistant Professors (and former postdocs): S. Aguirre, PhD (first author), P. Luthra, PhD, and S. Tripathi, PhD; current postdoctoral fellows: M.T. Sanchez-Aparicio, PhD, and Solovyov A. Maestre, PhD; PhD students T. Zhu, L.G. Webb, and J. Patel; MS in Biomedical Science student A.C. Fredericks; and J. Pintado-Silva, a student in the Graduate School's Post-Baccalaureate Research Education Program who is currently a PhD student.

MSTP Celebrates 40 Years of Continuous Funding

The Icahn School of Medicine at Mount Sinai was awarded its first T32 training grant from the National Institutes of Health (NIH) in 1977 to establish its Medical Scientist Training Program (MSTP). Mount Sinai's MSTP has much to celebrate in 2017, the fortieth year of continuous NIH funding. This rigorous physician-scientist training program has produced 221 graduates and continues to attract outstanding MD/PhD students who achieve at an extraordinary level, as measured

by publications in high-impact journals, receipt of independent fellowship support, and matching in top residency programs. World-class Mount Sinai faculty and facilities—and the innovative, individualized curriculum—enable graduates to pursue highly successful careers in academic medicine, biotechnology, the pharmaceutical industry, and government.

Driven by a commitment to provide the best education possible to the next generation,

the MSTP recently introduced an integrated Medical/Graduate School curriculum with courses that facilitate smooth transitions from preclinical training to PhD, and from PhD to clinical training. Additional features that distinguish Mount Sinai's MSTP include enhanced flexibility in the pathway through the program, early admission through Mount Sinai's unique FlexMed—and the new FlexGrad—programs, and exposure to the innovation and entrepreneurial foundations of Mount Sinai.

Students Harness Big Data to Help Solve Medical Challenges

For good reason, Avi Ma'ayan, PhD, is known as the "big data guru" at the Icahn School of Medicine at Mount Sinai, where he is Director of the Center for Bioinformatics and Professor in the Department of Pharmacological Sciences. He also heads the multi-institute National Institutes of Health (NIH)-funded BD2K-LINCS data coordination and integration center (DCIC), which is not only developing methods to better harness and manage big data in biomedicine at the national level, but also teaching students how to process, analyze, and visualize complex biomedical datasets to someday solve medicine's greatest challenges.

Big Data to Knowledge (BD2K) was launched in 2014 by the NIH to bridge the gap between the amount of big data that is collected and the data that can be exploited for knowledge discovery. Icahn School of Medicine was named as one of 12 national BD2K Centers of Excellence. The center also serves as the data coordination and integration center for the Library of Integrated Network-Based Cellular Signatures (LINCS) NIH Common Fund program. The center analyzes and integrates data from six LINCS data generation centers from around the country. By collecting big data from many types of human cells after treatment with many drugs and genetic stressors, LINCS aims to give scientists a better understanding of



Avi Ma'ayan, PhD, right, led a Summer Research Training Program in Biomedical Big Data Science for graduate and undergraduate students.

the pathways that control cell behavior. The data coordination and integration center is funded through a six-year, \$20 million NIH grant. In 2016, Mount Sinai was ranked No. 3 nationally in NIH funding for Pharmacology; Dr. Ma'ayan was ranked No. 3 in individual NIH funding.

The BD2K-LINCS DCIC run by Dr. Ma'ayan has also become a powerful platform for graduate level education in the fields of systems biology and genomics. The center hosts a Summer Research Training Program

in Biomedical Big Data Science for graduate and undergraduate students, which attracts some of the country's brightest young talent.

During the 10-week course, students conduct full-time faculty-mentored research projects at laboratories affiliated with the center, solving data-intensive biomedical problems, while attending weekly lectures. In addition, the BD2K-LINCS DCIC has created an active community around its cutting-edge work through online video lectures on Coursera that have been viewed by tens of thousands of students from around the world. The center's training program also includes webinars available on YouTube, workshops, and a yearly symposium.

Clinical Research PhD Graduate Takes Top Start-Up Award

Technology for identifying at-risk atrial fibrillation patients developed by Ya-El Mandel-Portnoy, PhD, through her start-up company, Cardea Sciences, won the inaugural Alexandria LaunchLabs Scholarship Award at the 2017 NYC Life Science Innovation Showcase. Dr. Mandel-Portnoy created her technology during her doctoral program in Clinical Research at the Graduate School of Biomedical Sciences—under the mentorship of Lynne D. Richardson, MD, Professor and Vice Chair of Emergency Medicine, Professor of Population Health Science and Policy, and a member of the National Academy of Medicine—and launched her company by working with Mount Sinai Innovation Partners, the commercialization arm of the Icahn School of Medicine at Mount Sinai. The award includes laboratory and office space at the Alexandria LaunchLabs®NYC, a full-service life-science start-up platform. "Ya-El's work is a perfect example of how validating new technology through clinical research is helping to improve medical care and patient outcomes," says Janice Gabrilove, MD, The James F. Holland Professor of Medicine, and Director, Clinical Research Education Program.

By the Numbers

Top 10 World Ranking



Nature Publication Names Mount Sinai Among Most Innovative in Research

The Icahn School of Medicine at Mount Sinai is among the top 10 research institutions in the world based on its contributions to published research that is later cited by other organizations in patent development. The rankings, created by the *Nature Index 2017 Innovation* supplement and published in August, used a unique set of metrics to shed light on the impact academic research is having on innovation and determine key academic players whose ideas may shape tomorrow's inventions. According to the *Nature Index*, the top rankings reflect institutions with global reputations for high-quality research and others whose published work is having a disproportionately high impact relative to their size. The Scripps Research Institute in San Diego (No. 1), Rockefeller University in New York City (No. 2), and Massachusetts Institute of Technology (No. 3) led the list, which also included, among others, "U.S. research heavyweights—the National Institutes of Health (No. 7), University of California, San Francisco (No. 8), and Stanford University (No. 9)," a press release issued by the publication wrote, adding, "Icahn School of Medicine at Mount Sinai is notably placed tenth."

\$318M
in total NIH funding
(fiscal year 2017)

No. 2
in research dollars per
principal investigator
among private U.S.
medical schools
*Association of
American Medical
Colleges*

The Graduate School of Biomedical Sciences

Fully integrated with the Icahn School of Medicine at Mount Sinai and the Mount Sinai Health System, with seven hospital campuses, centers of excellence, research institutes and laboratories, strategic partnerships, faculty, and affiliated practices.



Our students are
successful,
bright, and
diverse

4.4

Average number of publications per PhD student at graduation; 5.6 publications for MD/PhD students

3.7

Average undergraduate GPA (MD/PhD and PhD matriculants, past 5 years)

67

Countries, including the United States, represented by our postdoctoral fellows and graduate students

285+
Research Laboratories

»»»
National Cancer
Institute-Designated
Cancer Center (The
Tisch Cancer Institute)

Scientific Research Priorities

MOLECULAR BRAIN
HIV INFLUENZA
DEVELOPMENT DRUG AUTISM SIGNALING
CANCER FUNCTION
VIRUS INFLAMMATION
MECHANISMS TREATMENT
DISEASE

Top NIH-funded
Basic Science
Departments

No. 2
Neuroscience

No. 3
Pharmacology

No. 4
Genetics

No. 4
Microbiology