Dean, School of Science

This year, Donner Professor of Mathematics Michael Sipser announced he would step down from the position as dean of the MIT School of Science. As dean, Sipser has been MIT's advocate for the importance of basic science and curiosity-driven research. During the past six years, Dean Sipser has overseen the expansion and strengthening of the school's academic and research programs, including the launch of several important Institute-wide initiatives. He introduced the Fundamental Science Investigator Award and championed the Aging Brain Initiative. Dean Sipser will return to the Department of Mathematics faculty and his research in algorithms and complexity theory.

Astrophysicist Nergis Mavalvala, the Curtis (1963) and Kathleen Marble Professor of Astrophysics, is renowned for her pioneering work in gravitational-wave detection, which she conducted as a leading member of the Laser Interferometer Gravitational-Wave Observatory (LIGO). She has received numerous awards and honors for her research and teaching, and since 2015 has been the associate head of the Department of Physics. Mavalvala will be the first woman to serve as dean in the School of Science.

Dean Sipser made his decision in advance of the most disruptive campus event since the confluence of the 1918 flu pandemic and wartime training for World War I. In response to the rising threat of the COVID-19 virus, MIT suspended its on-campus instruction and moved to remote learning in March 2020. Sipser and other academic leaders preserved the academic continuity for MIT students, while similarly ramping up frontline research and coalescing the expertise of our biomedical researchers to address the pandemic. The MIT School of Science has played a pivotal role in research in the basic biology of the virus, in the development of rapid testing, and of potential vaccine treatments, as well as research into the effects of isolation on mental health and global pollution.

These critical research activities require collaborations across departments and schools and are facilitated by affiliations with MIT's numerous laboratories, centers, and institutes, as well as through participation in interdisciplinary initiatives such as the Aging Brain Initiative.

Similarly, our faculty's commitment to teaching and mentorship is not constrained by lines between schools or departments. School of Science faculty teach General Institute Requirement subjects in biology, chemistry, mathematics, and physics that provide the conceptual foundation of every undergraduate student's education at MIT. The school's faculty solidify cross-disciplinary connections through participation in graduate programs established in collaboration with the School of Engineering, such as the programs in biophysics, microbiology, molecular and cellular neuroscience, and statistics. They also forge connections to the new Stephen A. Schwarzman College of Computing. Through our contributions to EdX, our faculty's commitment to excellence in education reaches beyond the walls of MIT's classrooms and laboratories to students around the world—a need more pressing than ever as we seek to adjust to the so-called new normal during the COVID-19 pandemic.

Institute-wide Initiatives and Programs

Aging Brain Initiative

Spearheaded by Li-Huei Tsai, director of the Picower Institute for Learning and Memory and Picower Professor, and Michael Sipser, the Aging Brain Initiative was established to support interdisciplinary research on Alzheimer's disease and other diseases of the aging brain. There is currently no cure for Alzheimer's disease nor an effective means of slowing its progress. Until we know more about what causes brain functions to change with age, we will be no closer to a cure or a disease-modifying therapy. The Aging Brain Initiative seeks to address this gap in knowledge through collaborative efforts by researchers in the areas of neuroscience, bioengineering, biology, computer science, artificial intelligence (AI), medicine, and public health policy.

This year, by developing a lab-engineered model of the human blood–brain barrier, Tsai and neuroscientists at the Picower Institute discovered how the most common Alzheimer's disease risk gene causes amyloid protein plaques to disrupt the brain's vasculature and showed they could prevent the damage with medications already approved for human use. In other Tsai Lab discoveries, research scientist Ping-Chieh Pao and her colleagues have discovered that an enzyme called HDAC1 is critical for repairing age-related DNA damage to genes involved in memory and other cognitive functions. In murine studies, they showed they could reverse damage and improve cognitive function with a drug that activates HDAC1.

MIT Quest for Intelligence

Launched on February 1, 2018, the MIT Quest for Intelligence is a campus-wide initiative to discover the foundations of intelligence and to drive the development of technological tools that can positively influence society. In February 2020, Dan Huttenlocher SM '84, PhD '88 and dean of the Schwarzman College of Computing, announced that The Quest, among other departments and institutes at MIT, would be moved from the School of Science and housed within the new college.

Researchers in the School of Science have played active roles in leading The Quest through their longstanding commitment to understanding the science and engineering of intelligence. James DiCarlo, Peter de Florez Professor of Neuroscience, head of the Department of Brain and Cognitive Sciences, and investigator at the McGovern Institute for Brain Research, is co-director and the science lead for the initiative.

Tomaso Poggio, Eugene McDermott Professor in the Brain Sciences, director of the Center for Brains, Minds and Machines (CBMM), as well as a member of MIT's Computer Science and Artificial Intelligence Laboratory (CSAIL), and investigator at the McGovern Institute, is a founding scientific advisor. CBMM remains independent of the college but has ties to its research and faculty. Other scientific directors include Josh Tenenbaum, professor of computational cognitive science in the Department of Brain and Cognitive Sciences, a research thrust leader at CBMM, and a member of CSAIL. This year, Tenenbaum and other researchers within CBMM have produced a computer model that captures the human visual system's ability to quickly generate a detailed scene description from an image and offers some insight into how the brain achieves this.

Transiting Exoplanet Survey Satellite

The Transiting Exoplanet Survey Satellite (TESS) will monitor more than 200,000 stars in search of exoplanets capable of supporting life. Faculty members in the Departments of Aeronautics and Astronautics, Physics, and Earth, Atmospheric and Planetary Sciences (EAPS) participate in the first MIT-led NASA (National Aeronautics and Space Administration) mission, with support from staff in the Lincoln Laboratory. Managed by NASA's Goddard Space Flight Center, the TESS mission is led by George Ricker, a senior research scientist at the MIT Kavli Institute for Astrophysics and Space Research (MKI). Leading the TESS science team are Harvard-Smithsonian astronomer David Latham '61; Sara Seager, MIT's Class of 1941 Professor of Planetary Science, professor of physics, and faculty member in the Department of Aeronautics and Astronautics; and Ronald Vanderspek, MKI principal research scientist.

TESS uses an array of wide-field cameras—designed and fabricated at Lincoln Laboratory—to survey the entire sky, looking for the transient dimming of stars that indicates that planets may be passing in front of them. Since TESS began scientific operations in July 2018, TESS has reported more than 2,000 objects of interest with more than 60 confirmed exoplanet discoveries, including the detection of its first Earth-sized world in the habitable zone this past January, as well as the most recent discovery in July of a massive Neptune-sized planet with a density that is comparable to Earth. Further statistical analysis is needed to confirm all of the candidate exoplanets, which are shared publicly in real time to facilitate efforts by telescopes and other instruments around the world to validate the data.

While all recent exoplanets' sizes, orbits, and masses are known, further study with other telescopes will be needed to determine if they have atmospheres and, if so, which gases are present. For example, a new study this year by MIT researchers found that microbes can survive and thrive in atmospheres that are dominated by hydrogen—an environment that is vastly different from Earth's nitrogen- and oxygen-rich atmosphere. Seager says this finding opens up the types of exoplanets that could be explored as candidates for life on other planets using NASA's upcoming James Webb Space Telescope.

Additional partners include Northrop Grumman, based in Falls Church, VA; NASA's Ames Research Center in California's Silicon Valley; the Harvard-Smithsonian Center for Astrophysics in Cambridge, MA; MIT's Lincoln Laboratory; and the Space Telescope Science Institute in Baltimore, MD. More than a dozen universities, research institutes, and observatories worldwide are participants in the mission.

Education

Undergraduate Education

MIT is exceptional among major research institutions for its dedication to undergraduate education. Unlike most leading schools of science, MIT puts great emphasis on hiring and promoting young faculty members and using undergraduate teaching as an important criterion for promotion and tenure. It is not uncommon for Nobel Prize winners and others among our best researchers to teach first-year subjects. Committed to providing undergraduates with a strong science base for studies in their majors, the

School and its departments participate in and support a variety of programs designed to create more active, student-centered learning environments inside the classroom.

Starting in fall 2019, the Departments of Biology and Brain and Cognitive Sciences launched Course 6-9, Computation and Cognition. The new major provides students with an outstanding preparation for research and development in the science and engineering of intelligent systems. The problem of intelligence—how the brain produces intelligent behavior and how it can be replicated in machines—is one of the greatest engineering and scientific challenges of our time. The fields of neuroscience and computer science are complementary and interacting. Transformative advances in machine intelligence will require an understanding of the mechanisms of the human mind and brain in engineering terms.

Also this fall, Jeremiah Johnson, associate professor of chemistry, developed a new minor in polymers and soft matter (MPSM) in response to the increasing need for knowledge of chemistry in materials-related fields. Polymers and soft matter are critical components of existing and next-generation materials. Although MPSM is new to undergraduate students, the interdisciplinary graduate program in polymers and soft matter (PPSM), which involves the Departments of Materials Science and Engineering, Mechanical Engineering, Chemical Engineering, Biological Engineering, and Chemistry, has existed at MIT since 1986.

Interdisciplinary Graduate Programs

The School of Science has worked to expand educational and training opportunities for graduate students, collaborating with other schools and centers within the Institute to create innovative graduate programs in fields in which MIT shows great strength. These programs exemplify the Institute-wide goal of reducing boundaries between disciplines, allowing MIT to attract the most talented students in their respective fields. The programs—biophysics, computational and systems biology, microbiology, molecular and cellular neuroscience, and statistics and data science—integrate educational resources across participating departments, build connections among faculty with shared interests, and create an educational and research community for training students.

Following in the footsteps of the computational and system biology program, several other departments are launching efforts to increase computational opportunities within their field. In fall 2019, PhD students in the Department of Brain and Cognitive Sciences had the opportunity to pursue an interdisciplinary statistics program, with courses such as 6.804/9.66 Computational Cognitive Science; 9.19/9.190 Computational Psycholinguistics; and 9.583/HST.583Functional Magnetic Resonance Imaging: Data Acquisition and Analysis.

EdX

Krishna Rajagopal, the William A. M. Burden Professor of Physics, is the dean for Digital Learning, giving him oversight of Residential Education, MITx, OpenCourseWare (OCW), and the Digital Learning Lab. During the spring term, Rajagopal oversaw a massive undertaking to ensure that all spring courses were moved online for remote learning in the last two weeks of March. This work has laid the foundation for remote instruction in fall 2020.

In order to support MIT's goals to establish leadership in online education through our involvement with EdX and our own MITx initiative, School of Science departments continue to add to MITx curricula on EdX, massive open online courses, and OCW.

A brand-new OCW course for undergraduates, 7.341 DNA's Sister Does All the Work: The Central Roles of RNA in Gene Expression, was offered in spring 2019 by Ana Fiszbein and Marvin Jens. Teaching students to look at all the details in existing research literature, lest a major discovery reveal itself from those overlooked aspects, the course largely focuses on RNA studies.

Three new mathematics courses were added to OCW in fall 2019. 18.217 Graph Theory and Additive Combinatorics, instructed by Yufei Zhao, Class of 1956 Career Development Assistant Professor, focused on the intersection of graph theory and additive combinatorics for graduate students; 18.785 Number Theory I, a graduate-level online class, taught by Principal Research Scientist Andrew Sutherland, introduced students to algebraic and analytic number theory with applications in topology, algebraic geometry, and other mathematics fields; 18.600 Probability and Random Variables, taught by Leighton Family Professor of Mathematics Scott Sheffield, included topics on distribution functions, probability and various relevant theorem and laws (this course is an updated version of 18.440 Probability and Random Variables, from spring 2014).

Jeremy Kepner, Lincoln Laboratory Supercomputing Center director who is also a research affiliate in the Department of Mathematics, and Vijay Gadepally, senior staff member at Lincoln Lab, offered RES.LL-005 Mathematics of Big Data and Machine Learning. The supplemental course provided some history and basics on big data, such as signal processing and software, as well as delving into the various uses of big data, including social media, advertising, mapping, tracking, drug discovery, and informatics.

MathWorks Professor Gilbert Strang continues to teach 18.06 Linear Algebra, which has surpassed 10 million views on OCW and is always in the top 10 most-viewed courses since OCW's launch. His lectures for this course, posted on YouTube, have more than three million views. Strang offers several variations on this course, including the newest offered in spring 2020 as a supplemental course for undergraduates, RES.18-010 A 2020 Vision of Linear Algebra.

Co-sponsored by MIT Open Learning and the Office of the Vice Chancellor, the Teaching with Digital Technology Awards are student-nominated awards for faculty and instructors who have improved teaching and learning at MIT with digital technology. This year's awardees include Wolfgang Ketterle, the John D. MacArthur Professor of Physics; Phiala Shanahan, the Class of 1957 Career Development Professor in Physics; Amanda Bosh, senior lecturer in EAPS; Jonathan Kelner, professor of mathematics; Semyon Dyatlov, associate professor of mathematics; Pei-Ken Hung, CLE Moore instructor of mathematics; and Clair Travis, graduate student in the laboratory of Ronald Raines, the Roger and Georges Firmenich Professor of Natural Products Chemistry.

Education Awards

In order to reward individual faculty members for supporting the Institute's mission to foster excellence in teaching, the School awards student-nominated professors with the School of Science Prizes in Undergraduate and Graduate Teaching.

Mehrdad Jazayeri, an associate professor in the Department of Brain and Cognitive Sciences and investigator at the McGovern Institute, was awarded the prize for graduate education for 9.014 Quantitative Methods and Computational Models in Neurosciences. Earlier this year, he was recognized for excellence in graduate teaching by his department.

Hazel Sive, now a professor emeritus in the Department of Biology, member of the Whitehead Institute for Biomedical Research, and associate member of the Broad Institute of MIT and Harvard, was awarded the prize for undergraduate education. A MacVicar Faculty Fellow, she has been recognized with MIT's highest undergraduate teaching award in the past, as well as the 2003 School of Science Teaching Prize for Graduate Education. In June 2020, Sive left MIT to become dean of Northeastern University's College of Science.

Research

School of Science researchers seek to answer fundamental questions about nature, ranging from the microscopic, where a neuroscientist might isolate the electrical activity of a single neuron, to the telescopic, where an astrophysicist might scan hundreds of thousands of stars to find Earth-like planets in their orbits. The following is a sampling of the School's many research programs and topics.

COVID-19

Beginning in March 2020, COVID-19 research dominated the news coming out of MIT. A team of MIT chemists, led by Brad Pentelute, an associate professor of chemistry, designed a drug candidate that may block coronavirus' ability to enter human cells. His colleague Alex Shalek, the Pfizer-Laubach Career Development Associate Professor of Chemistry, is working with collaborators to profile tissue models that incorporate cells identified as targets of the coronavirus. Such models could be used to test existing antiviral drugs and predict how they might affect infection. Satrajit Ghosh, a principal research scientist at the McGovern Institute, is modifying his VoiceUp app to integrate new data from MIT Lincoln Laboratory researchers who found evidence of vocal biomarkers or measurable indicators of people infected with COVID-19 but not yet showing symptoms. Multiple researchers in Picower Institute labs pursued research to determine whether and how COVID-19 affects the brain, either directly or via the body's heightened immune response as well as how the brain is affected by isolation. Michael Yaffe, David H. Koch Professor of Science at MIT, member of the Koch Institute for Integrative Cancer Research, and an intensive care physician at Boston's Beth Israel Deaconess Medical Center/Harvard Medical School, led investigations into repurposing a drug commonly given to heart attack and stroke victims to help address COVID-19 patients who have a profound disorder of blood clotting that contributes to respiratory failure.

In May 2020, the Massachusetts Consortium on Pathogen Readiness based at Harvard Medical School announced more than $16.5 million in funding to support 62 research projects, including six projects at MIT, three of which are led by Science-affiliated researchers. Jianzhu Chen, a professor in the Department of Biology and also a member of the Koch Institute, was selected for a project focusing on enhancing mRNA-based coronavirus vaccines. Bruce Walker, professor of the practice at the Institute for Medical Engineering and Science and the Department of Biology and founding director of the Ragon Institute of Massachusetts General Hospital, MIT, and Harvard, received funding for research on an exosome-based SARS-CoV-2 vaccine. Feng Zhang's laboratory also developed a one-step diagnostic test based on CRISPR technologies that provides sensitive COVID-19 detection results within one hour. Zhang is the James and Patricia Poitras Professor of Neuroscience and a professor of brain and cognitive sciences and biological engineering at MIT, a Howard Hughes Medical Institute (HHMI) investigator, an investigator at the McGovern Institute, and a core member of the Broad Institute.

In other collaborative efforts, MIT, Harvard University, and Stanford University organized the COVID-19 Technology Access Framework to establish and commit to a set of technology licensing principles that will incentivize and allow for the most broad and equitable access to university innovations during the pandemic.

A group of researchers, including Professor Laura Schulz in the Department of Brain and Cognitive Sciences, launched a website called Children Helping Science—a massive project connecting families to hundreds of online studies of developmental psychology and cognition that they and their children can do from home.

Astrophysics

Physicists from MIT and colleagues have studied the ringing of gravitational waves from the merger of two black holes and found that the pattern of this ringing does, in fact, predict the combined black hole's mass and spin. Using data from the first gravitational waves observed with LIGO, Maximiliano Isi, a NASA Einstein Fellow at MIT's Kavli Institute, determined the new black hole's mass, spin, and charge—and once again confirmed Einstein's theory of general relativity.

In recent research that reverses her original finding, Tracy Slatyer, the Jerrold R. Zacharias Career Development Professor of Physics, and physics postdoctoral researcher Rebecca Leane, found that the model they developed to understand the concentration of gamma rays at the center of the Milky Way could, in fact, be tricked to produce the wrong result. The model failed to pick up an injected, or fake, signal of dark matter; and even as they turned the signal up, the model continued to assume pulsars were the cause of gamma rays at our galaxy's center. This new finding reopens the door to further study of dark matter.

MIT graduate students Maggie Tse and Haocun Yu, and Lisa Barsotti, a principal research scientist at the MIT Kavli Institute, along with others in the LIGO Scientific Collaboration, have created a "squeezing" device to eliminate quantum noise in the LIGO instruments, extending the detectors' range by 15%. Combined with an increase in LIGO's laser power, this means the detectors can pick out a gravitational wave generated by a source more than 400 million light years away.

Climate Change

Brent Minchew, the Cecil and Ida Green Career Development Professor in MIT's Department of Earth, Atmospheric and Planetary Sciences, and colleagues have developed a model that pins down the conditions in the sediment underlying glaciers that trigger them to surge, causing avalanches or flooding waterways. The model may also help scientists better understand the behavior of larger masses of moving ice.

MIT researchers have found that much of the current emission of chlorofluorocarbons gases CFC-11 and CFC-13, known for ozone depletion and global warming potential, likely stems from large CFC banks—old equipment, such as building insulation foam, refrigerators and cooling systems, and foam insulation that were manufactured before the global phase out of CFCs. Susan Solomon, the Lee and Geraldine Martin Professor of Environmental Studies at MIT, and EAPS graduate student Megan Lickley, lead author of the research, predicted that if all such CFC banks were destroyed today, the equivalent of nine billion metric tons of carbon dioxide would be eliminated from the atmosphere.

New Technologies and Discoveries

MIT scientists, including Adam Martin, an associate professor of biology, discovered a key mechanism that helps explain reproducibility of tissue folding in embryonic development. A network of proteins connected like a fishing net creates alternative pathways that tissues can use to fold the right way. To uncover this feature, Martin worked with Jörn Dunkel, an associate professor of physical applied mathematics in the Department of Mathematics, to apply an algorithm that is normally used by astronomers to study the structure of galaxies.

Researchers at MIT and elsewhere have combined the power of a super collider with techniques of laser spectroscopy to precisely measure radium monofluoride—a short-lived radioactive molecule—for the first time. The results pave the way to high-precision studies of short-lived radioactive molecules, which could offer a new and unique laboratory for research in fundamental physics and other fields, according to Ronald Fernando Garcia Ruiz, the lead researcher and an assistant professor of physics.

Pablo Jarillo-Herrero, the Cecil and Ida Green Professor of Physics, continued his research on magic angle graphene, a two-dimensional layer of carbon atoms with a honeycomb-like lattice that, when layered and twisted by 1.1 degrees, can behave at two electrical extremes: as an insulator in which electrons are completely blocked from flowing, and as a superconductor in which electrical current can stream through without resistance. They found that structures with a narrower range of angle variations from 1.1 degrees had more pronounced exotic properties, such as insulation and superconductivity, than structures with a wider range of twist angles. The team also observed that a four-layer, magic-angle structure is more sensitive to certain electric and magnetic fields when compared to its two-layer predecessor.

Using cryo-electron microscopy, JoAnne Stubbe, a professor emerita of chemistry and biology; Catherine Drennan, a professor of chemistry and biology and an HHMI investigator and professor; and their labs were able to freeze and study the detail of the enzymatic activity of ribonucleotide reductase (RNR), which is responsible for converting

RNA building blocks into DNA building blocks. Because RNR is a target for anticancer therapies, as well as drugs that treat viral diseases, such as HIV/AIDS, knowing its active-state structure could help researchers devise more effective treatments.

For the first time, scientists have observed that developing embryos generate waves similar to the waves generated in other seemingly unrelated systems, such as the vortices in quantum fluids and the circulations in the atmosphere and oceans. Nikta Fakhri, an associate professor of physics and Jörn Dunkel, have shown that this is a universal pattern in nature.

MIT neuroscientists found that mice lacking a protein called Shank3, which has previously been linked with autism, were more sensitive to a touch on their whiskers than unaltered mice. These Shank3-deficient mice also had overactive excitatory neurons in the somatosensory cortex, which the researchers believe accounts for their over-reactivity. Researchers, including Guoping Feng, the James W. (1963) and Patricia T. Poitras Professor of Neuroscience and a member of the McGovern Institute, believe that uncovering the cellular basis of this sensitivity may help scientists to develop potential treatments.

A team of MIT chemists led by Mei Hong, a professor of chemistry, has discovered the structure of a key influenza protein known as BM2, a proton channel that controls acidity within the virus, helping it to release its genetic material inside infected cells. The finding could help researchers design drugs that block the protein and prevent the flu virus from spreading.

Myriam Heiman, the Latham Family Career Development Associate Professor of Neuroscience in the Department of Brain and Cognitive Sciences, investigator in the Picower Institute, and core member of the Broad Institute, and other neuroscientists have identified hundreds of genes that are necessary for neuron survival, as well as genes that protect against the toxic effects of a mutant protein that causes Huntington's disease. These efforts yielded at least one promising drug target: a family of genes that may normally help cells to break down the mutated protein before it can aggregate and form the clumps seen in the brains of Huntington's patients.

Research from Sebastian Lourido, the Latham Family Career Development Assistant Professor of Biology and member of the Whitehead Institute, and graduate student Benjamin Waldman has identified a single gene the protein product of which is the master regulator of the trigger that causes a parasite, *Toxoplasma gondii*, to transition to its chronic stage, causing toxoplasmosis, a dangerous, and even deadly, disease for those who are immunocompromised and for developing fetuses. Their findings may prove valuable for eliminating toxoplasmosis, as preventing the parasites from transitioning keeps them susceptible to both treatment and removal by the body's immune system.

MIT geoscience researchers have determined that properties of plate tectonics and mantle plumes set the lifespan of volcanic islands, such as the Hawaiian and the Galápagos Islands. Researchers, including Kimberly Huppert, a graduate student; Taylor Perron, professor and associate head of the Department of Earth, Atmospheric and Planetary Sciences; and Leigh Royden, Cecil and Ida Green Professor of Geology and

Geophysics, found that the interplay between tectonic speed and plume size explains why the Hawaiian Islands persist above sea level for millions of years longer than the oldest Galápagos Islands, which also sit on plates that travel at a similar speed but over a much smaller plume.

Researchers found that in some cases of infection, an immune molecule called IL-17a is released and suppresses a small region of the mouse brain's cortex previously linked to social behavioral deficits in mice. Gloria Choi, an associate professor of brain and cognitive sciences, and member of the Picower Institute, says the findings may help to guide the development of strategies that could help to reduce some behavioral symptoms of autism or neurological disorders.

Barbara Imperiali, Class of 1922 Professor of Biology and Chemistry, and other scientists from MIT devised a rapid and generalizable way to extract, purify, and label membrane proteins for imaging without impacting the structure of function of the cell membrane. By combining well-established chemical and biochemical techniques in a new way, researchers efficiently isolated and then imaged membrane proteins from the foodborne pathogen *Campylobacter jejuni*.

Researchers from MIT, Harvard University, and the US Army have built a device the size of a shoebox that works at room temperature to produce a terahertz laser by spinning up the energy of molecules in nitrous oxide, or as it's more commonly known, laughing gas. Steven Johnson, professor of mathematics at MIT, says that "T-ray vision" can produce higher resolution images than microwaves and more safely than X-rays. Terahertz waves can be used as a form of wireless communication, carrying information at a higher bandwidth than radar, and can do so across distances that scientists can now tune using the group's device.

MIT researchers have discovered how the brain represents the complex world in simple shapes. Ila Fiete, a professor of brain and cognitive sciences and a member of the McGovern Institute, used topological modeling to transform the activity of large populations of noisy neurons into a data cloud in the shape of a one-dimensional ring. This ring represents the current direction of the head relative to the external world, providing the brain with an abstract compass.

Elly Nedivi, the William R. (1964) and Linda R. Young Professor of Neuroscience in the Picower Institute and the Department of Brain and Cognitive Sciences, showed that mice who were engineered to lack the CPG15 gene only exhibited one behavioral deficiency: They learn much more slowly than normal mice. With CPG15, neurons can more easily incorporate experience-driven neural activity to form synapses—connections crucial for learning and memory.

In new research, Tanja Bosak, a professor in the Department of Earth, Atmospheric and Planetary Sciences, investigated the evidence behind global proliferation of photosynthetic microbes capable of splitting water to make molecular oxygen. Her findings suggest that ancient manganese oxide may not be a reliable proxy for the evolution of oxygen-producing lifeforms as previously believed.

Awards and Honors

Faculty Awards and Honors

Every year, academic and professional organizations honor numerous School of Science faculty members for their innovative research as well as their service to the community. Individual reports from the School's departments, labs, and centers will document these awards more completely, but several notable awards deserve additional mention.

When the Event Horizon Telescope Collaboration won a Breakthrough Prize in Fundamental Physics for the direct observation of a black hole in 2019, the winners included one School of Science professor and two alumni. Maxim Metlitski, assistant professor of physics, received a portion of this early career achievement in condensed matter theory. Other breakthrough prizes awarded to School of Science faculty included a Special Breakthrough Prize in Fundamental Physics in 2019 that went to professor of physics emeritus Daniel Z. Freedman for his role in the discovery of supergravity, which he shared with two collaborators.

The BBVA Foundation announced winners of its Frontiers of Knowledge awards in several categories. Kerry A. Emmanuel, Cecil and Ida Green Professor of Atmospheric Science, earned the BBVA's Climate Change Award for his "fundamental contributions to the understanding of tropical cyclones and how they are affected by climate change." David Sabatini, professor in the Department of Biology and a member of the Whitehead Institute and the Koch Institute, shared with a colleague his award in Biology and Biomedicine for the discovery of a protein kinase that regulates cellular metabolism and growth. Peter Shor, the Morss Professor of Applied Mathematics, was recognized in the Basic Sciences category, along with two colleagues at other institutions, for his role in the development of quantum computation and cryptology.

Rebecca Saxe, an associate investigator of the McGovern Institute and the John W. Jarve (1978) Professor in Brain and Cognitive Sciences, was awarded a 2020 fellowship from the John Simon Guggenheim Foundation. This honor will go toward funding her work on understanding how regions of the brain process abstract concepts within human social cognition.

Four faculty members from the School of Science received 2019 Presidential Early Career Awards. The award, the highest honor bestowed by the US government to science and engineering early career professionals, went to Mitsui Career Development Professor Joseph Checkelsky in Physics, Associate Professor Yen-Jie Lee in Physics, Associate Professor Tracy Slatyer in Physics, and Associate Professor Yogesh Surendranath in Chemistry.

A 2019 MIT Bose award, named after Amar G. Bose '51, SM '53, ScD '56 was granted to Associate Professor of Biology Mary Gehring, who works on crop innovation using epigenetic engineering, to "support visionary projects that represent intellectual curiosity and a pioneering spirit."

Three members of the MIT community were elected to the National Academy of Sciences for 2020. The two recipients from the School of Science were Bonnie Berger, the Simons Professor of Mathematics, and Roger Summons, the Schlumberger Professor of Geobiology in the Department of Earth, Atmospheric and Planetary Sciences. The

American Academy of Arts and Sciences also elected a few School of Science faculty into their membership, including Catherine Drennan, professor of biology and chemistry, and Joshua Tenenbaum, a professor in the Department of Brain and Cognitive Sciences.

Tenenbaum also received a 2019 MacArthur Fellowship. This "genius grant" provides a monetary prize that he will apply to his research on human cognition and AI.

The National Academy of Inventors selected neuroscientist Li-Huei Tsai, director of the Picower Institute and a professor in the Department of Brain and Cognitive Sciences, as a member of its 2019 class of new fellows for her "highly prolific spirit of innovation in creating or facilitating outstanding inventions that have made a tangible impact on the quality of life, economic development and welfare of society."

The Marble Professor in Cancer Research in Biology and the Koch Institute Angelika Amon was named one of the Carnegie Corporation of New York's 2019 list of 38 Great Immigrants, Great Americans. This goes to naturalized US citizens who "strengthen America's economy, enrich our culture and communities, and invigorate our democracy through their lives, their work, and their examples." Amon is renowned for her work on cell growth and division and complications due to errors in these processes that lead to cancer, aging, and birth defects.

The James R. Killian Jr. Achievement Award, MIT's highest faculty honor, went to Professor Susan Solomon, the Lee and Geraldine Martin Professor of Environmental Studies, who is well known for her pioneering work on climate change and international environmental policy. This honor comes four years after she was one of the team members who won the Nobel Prize for peace for identifying a connection between chlorofluorocarbons and an ozone depletion in the atmosphere.

Two years after his lab's discovery of magic-angle graphene earned the *Physics World*'s 2018 Breakthrough of the Year—a discovery that spurred the formation of the field of twistronics within materials science and physics—Pablo Jarillo-Herrero, the Cecil and Ida Green Professor of Physics, won the 2020 Wolf Prize in Physics. The latest recognition for their work, Jarillo-Herrero and two colleagues at other institutions were chosen for this honor based on breakthrough contributions in experimental work that uncovered unique electrical properties of bilayer graphene.

Jarillo-Herrero also joined another physics professor, Richard Milner, as a recipient of an American Physical Society prize. Jarillo-Herrero received the 2020 Oliver E. Buckley Condensed Matter Physics Prize for the discovery of superconductivity in twisted bilayer graphene. Richard Milner was awarded the 2020 Tom W. Bonner Prize in Nuclear Physics for pioneering work developing and using polarized internal targets in storage rings, and his leadership role in studying the structure of the nucleon in a wide range of electronuclear experiments.

Ankur Jain, the Thomas D. and Virginia M. Cabot Career Development Professor in Biology, received a David and Lucile Packard Foundation Fellowship. He will apply this grant to his work on RNA regulation in the fields of soft-matter physics and cell biology.

Rewards and Recognition

The School of Science Rewards and Recognition program continues to acknowledge the dedication and hard work of the people who fill our departments, labs, and centers and whose efforts are the source of our prestige. The School continues its Spot Awards program, which rewards employees "on the spot" for going beyond the requirements of their normal duties.

Since the Infinite Mile Award program was established in 2001, the School of Science has presented the awards to more than 150 of its members in the last 10 years based on the nominations of grateful colleagues. This year's winners were Maggie Cabral (Biology), Rachel Donahue (Brain and Cognitive Sciences), Slava Gerovitch (Mathematics), Taylor Johns (Picower Institute), Megan Jordan (Earth, Atmospheric and Planetary Sciences), Renée LeBlanc (Picower Institute), Aidan MacDonagh (Physics), Avi Shporer (Kavli Institute), Rebecca Teixeira Drake (Chemistry), and Emily Wensberg (Chemistry).

The Infinite Kilometer Award, which is designated for postdoctoral researchers and research scientists, was added in 2012 to recognize their contributions both to our scientific endeavors as well as to the MIT community as mentors and advisors to students and colleagues. This year's winners were Edgar Costa (Mathematics), Casey Rodriguez (Mathematics), Rachel Ryskin (Brain and Cognitive Sciences), and Grayson Sipe (Picower Institute).

This year, the School added another one-time staff award: COVID-19 Heroes. This award went to those nominated by peers in their department in recognition of their extraordinary efforts to enable a smooth transition to remote working for their colleagues and work groups during the pandemic crisis in late spring. The winners were Laura Carter (School of Science), Edgar Costa (Mathematics), Cesar Duarte (Mathematics), Emma Dunn (Physics), Jennifer Fentress (Earth, Atmospheric and Planetary Sciences), Jennifer French (Mathematics), Michele Harris (Chemistry), Kimeee Heatley (Physics), Ryan Higgins (Physics), Gerald Hughes (Brain and Cognitive Sciences), Megan Jordan (Earth, Atmospheric and Planetary Sciences), Meredith Mahnke (Picower Institute), Brandon Milardo (Earth, Atmospheric and Planetary Sciences), Cathy Modica (Physics), Matthew Mondazzi (Mathematics), Scott Morley (Physics), Barbara Peskin (Mathematics), David Roe (Mathematics), Scott Wade (Earth, Atmospheric and Planetary Sciences), Kerin Willis (Earth, Atmospheric and Planetary Sciences), Mary Ellen Wiltrout (Biology), the staff of the Earth, Atmospheric and Planetary Sciences headquarters, and the Dean of Science's office staff.

Personnel

Appointments and Promotions

The following faculty members were promoted to full professor: Tanja Bosak (EAPS), Laurie Boyer (Biology), Mircea Dincă (Chemistry), Ila Fiete (Brain and Cognitive Sciences [BCS]), Jeremiah Johnson (Chemistry), Markus Klute (Physics), and Philippe Rigollet (Mathematics).

The following faculty members were granted tenure: Ibrahim Cissé (Physics), Jörn Dunkel (Mathematics), Mehrdad Jazayeri (BCS), Yen-Jie Lee (Physics), Joshua McDermott (BCS), Yogesh Surendranath (Chemistry), Mark Vogelsberger (Physics), Adam Willard (Chemistry), and Lindley Winslow (Physics)

The following faculty members were promoted to associate professor without tenure: Gloria Choi (BCS), Nikta Fakhri (Physics), Evelina Fedorenko (BCS), Michael Halassa (BCS), Mark Harnett (BCS), Gene-Wei Li (Biology), Michael McDonald (Physics), Andrei Negut (Mathematics), and Gabriela Schlau-Cohen (Chemistry).

The following faculty members joined the School faculty as assistant professors: Netta Engelhardt (Physics), Evelina Fedorenko (BCS), Ronald Fernando Garcia Ruiz (Physics), Erin Kara (Physics), Long Ju (Physics), Pulin Li (Biology), Seychelle Vos (Biology), and Xiao Wang (Chemistry).

The following faculty members joined the School as full professors with tenure: Ruth Lehmann (Biology), Morgan Sheng (BCS), Jonathan Weissman (Biology), and Yukiko Yamashita (Biology).

The following faculty members retired from the School of Science: Min Chen (Physics), Frank Gertler (Biology), Hazel Sive (Biology), and David Vogan (Mathematics)

The following role changes occurred: Troy Van Voorhis was named head of the Department of Chemistry. Ruth Lehmann was announced as the replacement for David Page, who is stepping down as director of Whitehead Institute at the end of the year. Michael Sipser announced he would step down at the end of the year as Dean of Science, and Nergis Mavalvala was named as the next dean.

Faculty Lunch Programs

Tenure-track faculty lunch meetings are intended to help junior faculty members meet their peers in different departments and to provide a forum for discussion of important issues. This year's meetings included faculty presentations by Mark Harnett and Josh McDermott in the Department of Brain and Cognitive Sciences, as well as by Associate Provost Timothy Jamison, the Robert R. Taylor Professor of Chemistry, who discussed diversity, equity, and inclusion issues at MIT and in the sciences.

Additionally, the dean hosts a faculty lunch every semester. This year, Tanja Bosak gave a presentation titled: "Reconstructing the Record of Oxygenic Photosynthesis on the Early Earth." Due to the pandemic, the spring semester event was cancelled.

Learn@Lunch Series

To provide administrative staff the support they need to do their jobs as effectively as possible, the School of Science holds a monthly lunch series for staff members on a variety of subjects. This year, presentations included collaborating to improve the Peer-to-Peer Mentoring Program; a report from the Ombuds Office regarding the results of the report on the Association of American Universities Campus Climate Survey on sexual assault and misconduct; a presentation from the MIT Work-Life Center on the

benefits and resources available to staff; an overview of MIT's community continuity plans for improving diversity, equity, and inclusion in the coming academic year; and a chat with the Working Group on Support Staff about their mission and how to get involved. Due to the unprecedented nature of the spring 2020 semester, other topics included plans for the virtual 2020 Commencement; tips on work-from-home ergonomics; mask making; gardening; and Zoom and Canvas use.

School of Science Peer Mentoring

The Peer-to-Peer Mentoring Program pairs new School of Science staff with mentors who will help them navigate job responsibilities, MIT policies and procedures, and Institute organization and culture. The program provides opportunities for both mentors and new employees to expand their skill sets, increase their confidence, and make connections with School of Science community members outside of their home department, lab, or center. This year, the program was expanded and guidelines and resources added for those interested in participating as mentors, mentees, and/or reference experts.

Michael Sipser
Dean
Donner Professor of Mathematics