MIT

Science AT MIT

Summer 2020 **Published twice yearly**

LOST WITHOUT A RING: CODING A MENTAL COMPASS

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To comprehend multidimensional information about an external environment, the brain simplifies the information into a simple abstract object, like the one shown here. This one-dimensional ring generated by a circuit, discovered by MIT neuroscientist Ila Fiete and others, acts as an “abstract compass.” Image: courtesy of the researchers

SCHOOL OF SCIENCE
Massachusetts Institute of Technology

TABLE OF CONTENTS

Letter from the Dean

Dear Friends,

I am writing to you in difficult times. Who could have imagined, a few short months ago, that today all of us would be living through a terrible pandemic? Here at MIT, the campus is almost completely empty. Most students have returned to their families. Faculty and staff are staying home. The infinite corridor, usually a hubbub of activity day and night, is quiet.

But, remarkably, the MIT spirit lives on. Classes are conducted online, and much of our research continues remotely. Collaboration thrives virtually. I am proud and thankful to see our community pull together, overcome obstacles, and regain our footing despite the present challenges. We are all working hard to continue our mission to advance knowledge, educate our students, and serve the world.

In the School of Science, many have refocused their research priorities to address COVID-19 investigations and have actively sought out collaborations to develop innovative solutions, as sampled on pages 9–13. Our faculty includes several medical personnel in local hospitals, and from them, we learn where we can help. Our laboratories have joined others at MIT to donate supplies to local health centers. Our mathematicians recently launched a new class on data science, AI, and modeling to study COVID-19. Our neuroscientists are developing tests using CRISPR tools. Our biologists are developing drugs to help treat those suffering from the new virus. To learn about these and other efforts to confront the crisis, visit science.mit.edu.

Before COVID-19, Biology Professor Amy Keating was employing a mix of computation and laboratory synthesis to develop mini-proteins and peptides that could disrupt and potentially treat diseases like cancer. Keating's lab has shifted toward computation during social distancing and she finds that teaching virtually has new and interesting hurdles that MIT students are willing to overcome. You can read about her research and dedication to her students on page 4.

In other ongoing work, I'm a big enthusiast for research on the human brain. It is constantly absorbing information through our senses, analyzing that input, and coding a response. Neuroscience Professor Ila Fiete has made extraordinary progress in decoding how brains store information. She has analyzed a large amount of neural data to determine that the head's direction is tracked by an internal code that can be interpreted as a ring in multidimensional space — acting as an internal compass. On page 6, she explains how tracking this neurological process is like watching a school of fish.

See pages 14–21 for additional activities across the School of Science. On the planetary front, our graduate students are using telescopes to observe space, models to predict how glaciers move and melt, and chemicals to degrade plastic pollution. A fund in the memory of former Professor Frank Peterson and his wife, Marilyn Peterson, provides mathematics students the opportunity to pursue their own curiosity-driven research, while former faculty and alumni describe life in Physics in the 1900s on page 22.

As you know, I plan to step down this summer from my position as Dean of Science. I will return full time to my role as a regular faculty member to focus on advancing my own research and devoting more time to education. Serving as dean has been a great privilege, and I've enjoyed working with my colleagues and with many of you. I thank you for your readership and support. The generosity of our alumni and friends enables us to work together to advance our knowledge of the world and to pursue answers to questions both immediate and immemorial. Over these last six years of service, I am proud to have led the School of Science through extraordinary achievements as well as challenges. The current crisis gives us even more reason to invest in scientific research, because furthering our understanding of our world is crucial to finding a solution. I believe that science, in addition to its value as a source of inspiration and wonder, is the key to improving our lives.

On behalf of the School of Science, I wish you all the best, now and in the future.

Michael Sipser, Dean of MIT School of Science

Bringing computers into the protein fold

In the lab, Biology Professor Amy Keating researches the interactions of proteins with a mix of modeling and synthetic lab work and diverse minds

Laura Carter | School of Science

Almost everything in biology is a multistep process, from the metabolization of carbohydrates and fats as fuel to information transcription from DNA and RNA. Without proteins and their interactions, cells couldn't perform any of these biological tasks. But how do proteins establish their individual roles? And how do they interact with each other? These questions drive Professor Amy Keating's research, and both lab experiments and computational modeling are helping her reveal the mysteries behind the basic functions of life.

In Keating's field of research, as with most areas of science, the use of artificial intelligence is a relatively new — and growing — trend. "It's pretty scary how fast new methods in machine learning are changing the landscape," says Keating, who holds appointments in both the Department of Biology and the Department of Biological Engineering. "I think that we will see a disruptive change in protein modeling over the coming years." She has found that incorporating basic machine learning methods in her own work has generated some success in uncovering how protein sequences determine their interactions.

However, there are limits to using only computational modeling due to the complexities of protein-protein interaction and a general need for empirical data to calibrate the models. Her lab group integrates computation with biological engineering in a laboratory setting. Keating's team often starts by using computational modeling to narrow down their search from a massive collection of protein structure models. This step limits their output from an effectively infinite space ($\sim 10^{30}$) to something on the order of 10^6 potential promising molecules that can be experimentally tested. They can feed the results of experiments into other algorithms that help designate the specific features of the protein that prove important. This process is cyclical, and Keating emphasizes that experimental efforts are crucial for improving the success rate of this kind of work. That is where the lab comes in. There, they do what the computer cannot: they build proteins.

With the disruption of the COVID-19 crisis, the Keating lab has focused their attention on computational projects, as well as on reviewing the literature and writing up papers and theses. The members are also using their time at home to brainstorm and plan their research. "We are having multiple group meetings per week by Zoom, including a 'Keating Group Idea Lab,' at which everyone throws out ideas, ranging from practical suggestions about current projects to out-there new concepts, for group discussion," says Keating. "We are confident that we can use this time productively, to advance our science, even as we make long lists of things that we are eager to do as soon as we can get back into the laboratory."

A topic of current interest to Keating and her group members is interactions among proteins with "short linear motifs" or SLiMs, which are abundant — more than one hundred thousand such motifs are thought to exist in one human. One family of these SLiM-binding proteins regulates movement of cells within the body and is implicated in the spread of cancer cells to a secondary location (metastasis). The lab's novel mini-protein and peptide designs aim to disrupt these protein interactions and could be useful for eventually disrupting and treating cancer and other diseases.

Fostering multiple interactions

Currently, Keating's research team consists of six students who have backgrounds in almost as many different cultures. Her students' diversity, which stems not just from different focuses in formal training but also from life experiences, is integral to their success, according to Keating. She wishes that more women like herself and members of underrepresented minority groups who love STEM would consider pursuing academic careers. "It's hard work, but it's very rewarding," she entices. The best thing about being a faculty member, she believes, is having a team of bright minds who contribute unique ideas and insights to a problem and provide information beyond her own areas of expertise.

"I learn facts that they know and I do not. I learn interesting ways of thinking about science and also ways of doing science," she says, noting that novel ideas in methodology lead to advances in research. "I've learned a lot of things about computer science from my students. I'm happy that one of my former biology students is [now] a professor of computer science," she admits, appreciating his expertise as a benefit in frequent collaborations. "I love that students at MIT question everything." Keating's ever-expanding knowledge builds on top of a diverse background gleaned during her time as a student.

Keating's bachelor's degree from Harvard University is in physics. During her PhD at University of California at Los Angeles, she shifted to chemistry — specifically computational physical organic chemistry. When browsing for a postdoctoral position, she discovered the work of former MIT Department of Biology faculty and Whitehead Institute member Peter Kim and joined him. She maintained her interest in computation as a tool for biological research, concurrently co-advised by MIT Professor of Electrical Engineering and Computer Science Bruce Tidor. It was somewhat down to chance that her academic job search led her to MIT. "I certainly never thought I would be a biology professor, especially at MIT," she remarks of her convoluted career path through the wide world of science.

But it is an unexpected result for which Keating is grateful. "My undergrad self would have been surprised by the MIT School of Science," she muses, which makes MIT "so much more than 'just' the world's best engineering school." That is something of a common misconception about the Institute, she feels. "I think a lot of people outside of MIT don't know how outstanding our basic science programs are." Keating is a part of the strong science education at MIT, which is constantly adapting to keep up with the digital age, which led to her receiving the most recent Fund for the Future of Science Award.

"I was thrilled, and pretty surprised, to receive the award; my fantastic colleagues in the School of Science are not people that you want to be competing with." This support is invaluable to her research on the foundations of biological interactions, and to ensure a robust team that has what it needs to develop important advances. The curious minds with which she collaborates are equally as invaluable.

"The people at MIT are amazingly smart, curious, and focused on things that I value," Keating adds, "like good ideas, intellectual rigor, discovering new things, and education." ○

Professor Amy Keating. Photo: courtesy of the Department of Biological Engineering

Finding the brain’s compass

Undaunted by complex neural datasets, Ila Fiete’s lab is uncovering how we interact with the world

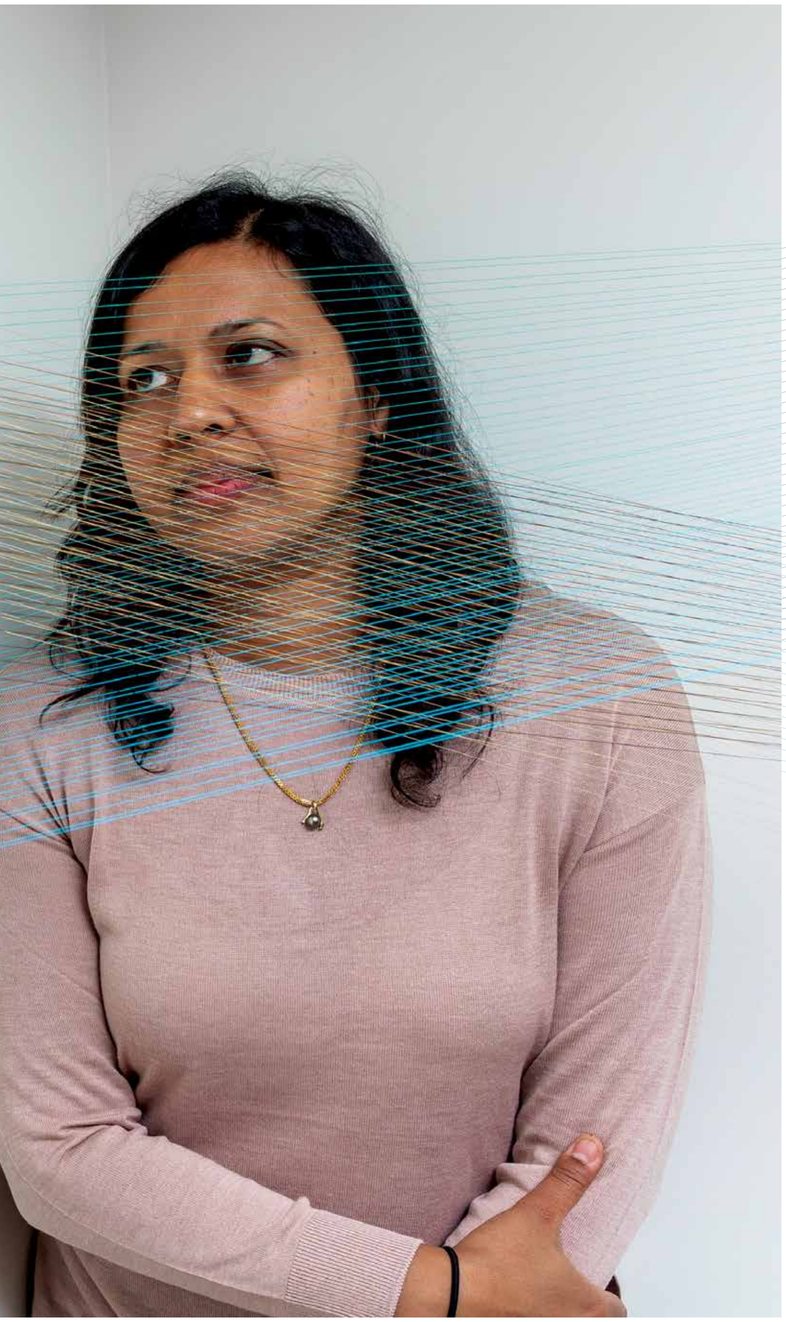
Sabbi Lall | McGovern Institute for Brain Research

Professor Ila Fiete behind an art piece in her office, designed by her daughter, that was inspired by her research and titled “Manifold.” Photo: Caitlin Cunningham

The brain is constantly making complicated calculations, reasoning about our place in the world. Mining vast volumes of neural data to uncover how neural dynamics and coding interact and underlie these calculations is daunting, but it promises fascinating insight into the workings of the brain.

Ila Fiete and her lab relish this challenge and are adding to the growing range of theoretical tools available for it. Broadly speaking, they build theoretical models and tools that unpack the brain’s computations, even as it interacts with the world. Fiete’s focus includes describing how neural plasticity shapes networks to perform computations, and a key goal is to understand how the brain represents and manipulates this information. The field of spatial navigation by the brain is currently providing a trove of data that likely contains insight into these computations. By forging new approaches to analyzing complex datasets, Fiete, an associate professor in MIT’s Department of Brain and Cognitive Sciences, and colleagues are helping to access the circuits underlying a range of phenomena including short term memory and reasoning. Most recently, they have made strides in uncovering how the brain stably tracks the direction the head is facing.

This is a seemingly simple problem for the brain to solve, but the world is constantly bombarding our senses with information. How our brain extracts meaning from this information remains elusive. How do neurons transform raw visual input into a mental representation of an object — like a chair or a dog? The Fiete lab recently identified a brain circuit in mice that distills such “high-dimensional” complex information about the environment into a simple abstract object in the brain.



"There are no degree markings in the external world. Our current head direction has to be extracted, computed, and estimated by the brain," explains Fiete, who is also an associate member of the McGovern Institute for Brain Research. "The approaches we used allowed us to demonstrate the emergence of a low-dimensional concept, essentially an abstract compass in the brain."

This abstract compass, according to the researchers, is a one-dimensional ring that represents the current direction of the head relative to the external world.

Schooling fish

Trying to show that a data cloud has a simple shape, like a ring, is a bit like watching a school of fish. By tracking one or two sardines, you might not see a pattern. But if you could map all the sardines and transform the noisy dataset into points representing the positions of the whole school of sardines over time, and where each fish is relative to its neighbors, a pattern would emerge. This model would reveal a ring shape, a simple shape formed by the activity of hundreds of individual fish.

Fiete used a similar approach, called topological modeling, to transform the activity of large populations of noisy neurons into a data cloud in the shape of a ring.

Simple and persistent ring

Previous work in fly brains revealed a physical ellipsoid ring of neurons representing changes in the direction of the fly's head, and researchers suspected that such a system might also exist in mammals.

In a new mouse study, Fiete and her colleagues measured hours of neural activity from scores of neurons in the anterodorsal thalamic nucleus (ADN) — a region believed to play a role in spatial navigation — as the animals moved freely around their environment. They mapped how the neurons in the ADN circuit fired as the animal's head changed direction. Together these data points formed a cloud in the shape of a simple and persistent ring.

"This tells us a lot about how neural networks are organized in the brain," explains Edvard Moser, Director of the Kavli Institute of Systems Neuroscience in Norway. Moser recently shared the Nobel Prize for Medicine for discovering cell types linked to navigation and was not involved in Fiete's study. "Past data have indirectly pointed towards such a ring-like organization but only now has it been possible, with the right cell numbers and methods, to demonstrate it convincingly," says Moser.

Their method for characterizing the shape of the data cloud allowed Fiete and colleagues to determine which variable the circuit was devoted to representing, and to decode this variable over time, using only the neural responses.

"The animal's doing really complicated stuff," explains Fiete, "but this circuit is devoted to integrating the animal's speed along a one-dimensional compass that encodes head direction. Without a manifold approach, which captures the whole state space, you wouldn't know that this circuit of thousands of neurons is encoding only this one aspect of the complex behavior, and not encoding any other variables at the same time."

Even during sleep, when the circuit is not being bombarded with external information, this circuit robustly traces out the same one-dimensional ring, as if dreaming of past head direction trajectories.

Further analysis revealed that the ring acts as an attractor. If neurons stray off trajectory, they are drawn back to it, the system quickly correcting itself. The ring's property of attraction means that the representation of head direction in abstract space is reliably stable over time, a key requirement if we are to understand and maintain a stable sense of where our head is relative to the world around us.

"In the absence of this ring," Fiete explains, "we would be lost in the world."

Shaping the future

Fiete's work provides a first glimpse into how complex sensory information is distilled into a simple concept in the mind, and how that representation autonomously corrects errors, making it exquisitely stable. But the implications of this study go beyond the coding of head direction.

"Similar organization is probably present for other cognitive functions. So, the [study] is likely to inspire numerous new studies," says Moser.

Fiete sees these analyses and related studies carried out by colleagues at the Norwegian University of Science and Technology, Princeton University, the Weitzman Institute, and elsewhere as fundamental to the future of neural decoding studies. With this approach, she explains, it is possible to extract abstract representations of the mind from the brain, potentially even thoughts and dreams.

"We've found that the brain deconstructs and represents complex things in the world with simple shapes," explains Fiete. "Manifold-level analysis can help us to find those shapes, and they almost certainly exist beyond head direction circuits."

The Fiete lab's recent study demonstrates how complex neural data from systems neuroscience can be unlocked to reveal how the brain encodes head direction. This gives us a glimpse into how we view ourselves relative to the world at large, and this glimpse can be expanded to better understand how other attributes are encoded.

Ila Fiete is an associate professor in the Department of Brain and Cognitive Sciences and a member of the McGovern Institute for Brain Research at MIT. Her research focuses on brain circuitry, using computation and theory to understand how the brain computes and codes information with respect to the shape and plasticity of neural circuits, as well as errors in that code, to understand the dynamics of learning.

> **"Fiete's work provides a first glimpse into how complex sensory information is distilled into a simple concept in the mind, and how that representation autonomously corrects errors, making it exquisitely stable."**

Combating COVID-19 with Chemistry

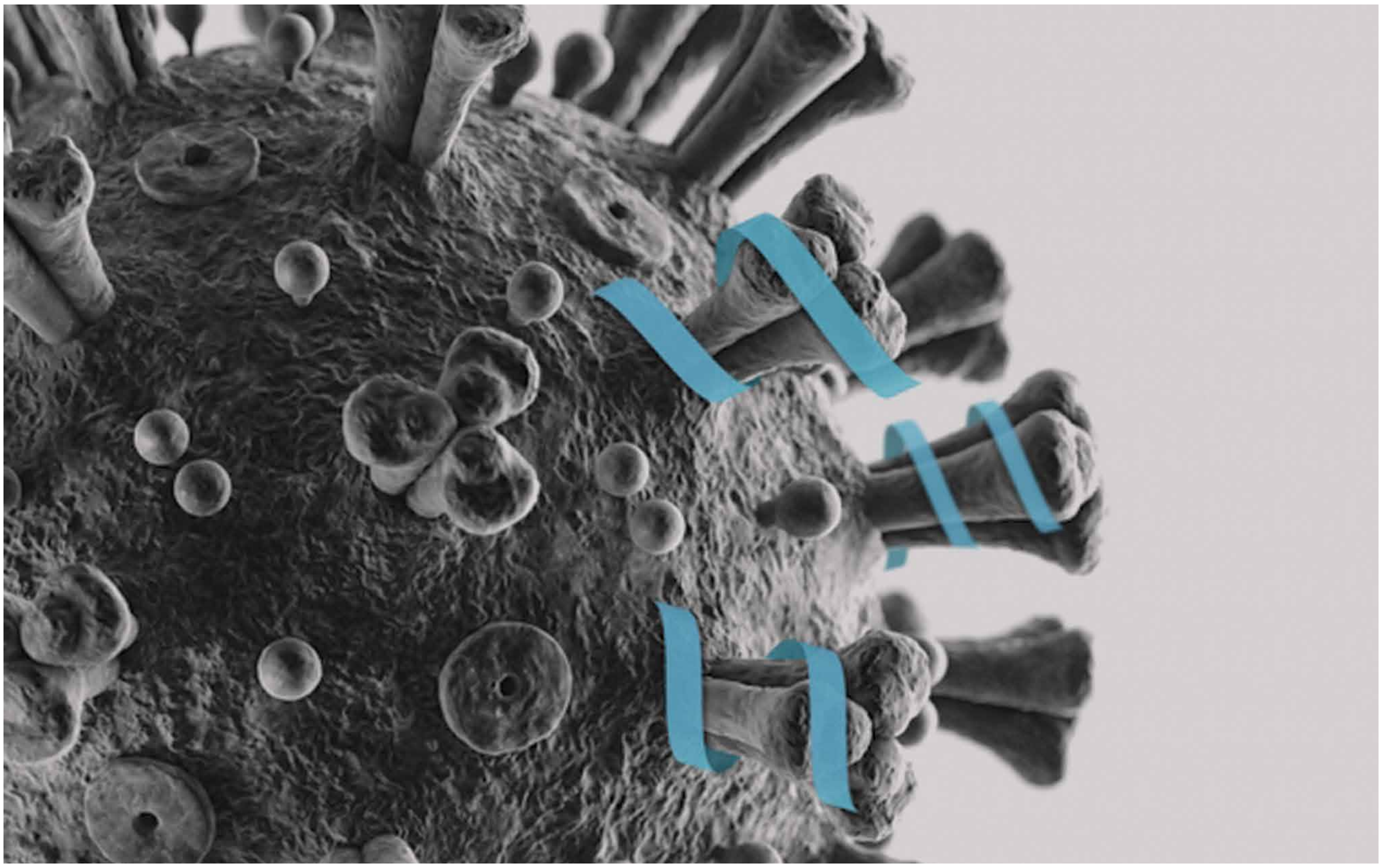
Danielle Randall Doughty | Department of Chemistry

Despite MIT's desolate campus, members of the Hong, Kiessling, Pentelute, and Shalek labs continue to pursue a solution to the global pandemic.

In March of this year, MIT's open Cambridge campus, typically abuzz with tourists and visitors in addition to members of the Institute's community, became a ghost town practically overnight. In a matter of days, students were sent home, classes were moved online, and the community shifted to an entirely work-from-home format for the vast majority of staff, students, faculty, and researchers in response to the COVID-19 global pandemic.

As most of the world stayed inside, sheltering in place, venturing out of their self-isolation only for essential food and supply runs, a select few members of the Department of Chemistry — those in a race to discover possible solutions to the world's viral crisis — were granted special permission to carry on their research on campus at a responsible social distance. Efforts from the labs of Professor of Chemistry Mei Hong, Novartis Professor of Chemistry Laura L. Kiessling, Associate Professor of Chemistry Bradley L. Pentelute, and Pfizer-Laubach Career Development Associate Professor of Chemistry Alex K. Shalek aim to contribute to resolving COVID-19.

Left to right: Professors Mei Hong, Laura Kiessling, Bradley Pentelute, and Alex Shalek lead the Department of Chemistry's charge against COVID-19.
Photos: Justin Knight



MIT chemists have designed a peptide that can bind to part of the coronavirus spike protein, which they hope may prevent the virus from being able to enter cells.
Image: Christine Daniloff

The Hong group

Since mid-March, Professor Mei Hong's research group has directed its membrane protein expertise to investigate the structure of an essential SARS-CoV-2 protein, the envelope protein E. The E protein is one of the three SARS coronavirus membrane proteins and is involved in several aspects of the coronavirus lifecycle, including virus assembly, budding, and pathogenesis. The protein forms a cation channel in the lipid membrane, which can be blocked by several small-molecule drugs. In addition, it causes membrane curvature, which is required for releasing new progeny viruses from the Golgi membrane of the cell. The envelope protein's channel activity has been implicated in the ability of SARS-CoV-2 to overstimulate the inflammation pathways of the host cell, with deadly consequences. Deletion of the E gene from the virus has been shown to reduce virus titers, attenuate infection in animal models, and confer protection in hamsters and mice.

Currently, little is known about the three-dimensional structure of the E protein in lipid membranes. Knowing this structure will allow rational design of E-targeting antiviral drugs to stop virus propagation. The Hong group is cloning and purifying the E protein and will employ multidimensional NMR spectroscopy to determine its membrane-bound structure.

The Kiessling group

A feature of enveloped viruses, including coronaviruses, is their high levels of glycosylation. Viral glycosylation plays multiple roles in virus pathology, and infection by the novel SARS-CoV-2, the virus that causes COVID-19, is mediated by the viral spike glycoprotein. Viruses have glycosylation patterns that differ from those of the host, so they can be recognized by host proteins. Professor Laura Kiessling and her research group are investigating whether human carbohydrate-binding proteins (lectins) limit viral infection. Human lectins are present at mucosal barriers, including in the lungs. The levels of these proteins can differ between individuals in response to age or polymorphisms (changes in the genetic coding) that alter their production or stability.

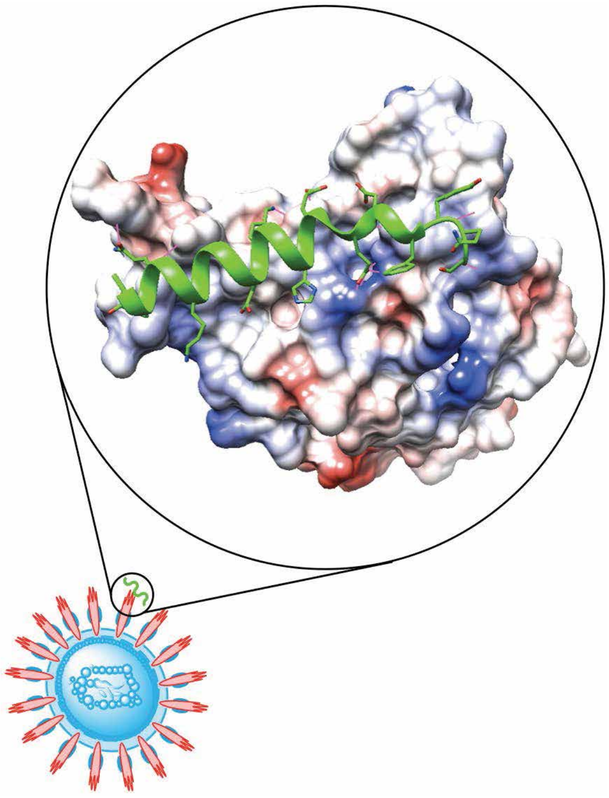
The Kiessling group anticipates that these lectins can function in vitro as tools to capture virus and in vivo as immunomodulators. Thus, understanding those lectins that can bind coronaviruses from human patients will lay the groundwork to elucidate fundamental aspects of human immune responses to the virus. Moreover, because the lectins the group proposes to examine are human proteins, they do not expect them to have problematic effects. If they block viral infectivity (or effectively modulate immune responses), they are unlikely to have major deleterious effects such as toxicity or immunogenicity.

The group has made some models that suggest the lectins have the right alignment. This computational model is tantalizing in that the spacing looks excellent for binding.

The Pentelute group

Researchers in Professor Bradley Pentelute's lab are focused on delivering safe and effective peptides for prophylactic treatment and rapid early therapeutic intervention against COVID-19 infection. They approach this goal by design of peptide binders specific to the spike protein of the SARS-CoV-2 coronavirus. Disrupting the SARS-CoV-2 spike protein interaction with its human cell membrane receptor can prevent virus cell entry, offering a promising therapeutic modality.

With collaborators in the tenOever lab at the Icahn School of Medicine at Mount Sinai and the Hacohen lab at the Broad Institute of MIT and Harvard, they are testing the activities of these peptide binders in live- and pseudo-virus inhibition assays, respectively. A path to clinical trials was identified in collaboration with Dr. Robert Shoemaker at the National Institute of Health, in which the most potent and least toxic peptide will be produced under GMP conditions and formulated in nasal and spray inhalers for evaluation in humans. The Pentelute lab approach will ensure COVID-19 treatment by blocking SARS-CoV-2 interaction with human cells.



The Penteute group is using peptide drugs to block the entry of coronavirus into human cells. Image: Genwei Zhang

> “As humanity continues to await the end of the pandemic and the beginning of living in coexistence with this virus, the Department of Chemistry is proud to be home to those who are contributing to a solution to this crisis.”

The Shalek group

Professor Alex Shalek's group has three projects pertaining to COVID-19. First, they are studying the cellular correlates and pathophysiology of novel therapeutics and vaccines against SARS-CoV-2. Next, they are working to identify an actionable host-pathogen interplay, and finally, they hope to understand the correlates of a clinical outcome.

The Shalek lab seeks to fundamentally transform the study and engineering of human immune responses. To do this, they create and implement cutting-edge experimental and computational platforms to elucidate cellular and molecular features that inform tissue-level (dys)function across the spectrum of human health and disease. The team is actively working on three major COVID-19 related projects at MIT, the Ragon Institute, and the Broad Institute and are helping with others.

First, with partners at the Wyss Institute, Brigham and Women's Hospital, and the Icahn School of Medicine at Mount Sinai, they are examining whether different experimental antiviral treatments and current FDA approved drugs can be used to make host cells less amenable to viral entry and release for rapid repurposing.

Second, with members of the Human Cell Atlas Lung Biological Network, they are examining which specific cells in different tissues become infected with SARS-CoV-2 to uncover targetable host factors for controlling infection.

And, third, the team is working with partners around Boston and the world to understand why some individuals with preexisting conditions (e.g., high blood pressure, cancer, or other risk factors) develop severe disease while some populations (e.g., pediatric) are seemingly resistant to severe infection to realize better treatments and cures.

As humanity continues to await the end of the pandemic and the beginning of living in coexistence with this virus, the Department of Chemistry is proud to be home to those who are contributing to a solution to this crisis. ○

Computational thinking class enables students to engage in COVID-19 response

Nearly 300 students join an open course that applies data science, artificial intelligence, and mathematical modeling using the Julia language to study COVID-19

Sandi Miller | Department of Mathematics

Left to right: Department of Mathematics Professor Alan Edelman, his co-instructor and family corgi Philip, and Visiting Professor and long-time Julia Lab collaborator David Sanders, have altered their computational thinking course to encourage input on COVID-19 responses. Photos: courtesy of Edelman and Sanders

When an introductory computational science class, which is open to the general public, was repurposed to study the COVID-19 pandemic this spring, the instructors saw student registration rise from 20 students to nearly 300.

Course 6.S083/18.S190 (Introduction to Computational and Mathematical Thinking), which applies data science, artificial intelligence, and mathematical models using the Julia programming language developed at MIT, was introduced in the fall as a pilot half-semester class. It was launched as part of the MIT Stephen A. Schwarzman College of Computing's computational thinking program and spearheaded by Department of Mathematics Professor Alan Edelman and visiting professor David P. Sanders. They were quickly able to fast-track the curriculum to focus on applications to the COVID-19 response, and students were equally fast in jumping on board.

"Everyone at MIT wants to contribute," says Edelman. "While we at the Julia Lab are doing research in building tools for scientists, Dave and I thought it would be valuable to teach the students about some of the fundamentals related to computation for drug development, disease models, and such."

The course is offered through MIT's Department of Electrical Engineering and Computer Science and the Department of Mathematics. "This course opens a trove of opportunities to use computation to better understand and contain the COVID-19 pandemic," says MIT Computer Science and Artificial Intelligence Laboratory Director Daniela Rus.

The fall version of the class had a maximum enrollment of 20 students, but the spring class ballooned to nearly 300 students in one weekend, almost all from MIT. "We had a tremendous response," Edelman says. "This definitely stressed the MIT sign-up systems in ways that I could not have imagined."

Sophomore Shinjini Ghosh, majoring in computer science and linguistics, says she was initially drawn to the class to learn Julia, "but also to develop the skills to do further computational modeling and conduct research on the spread and possible control of COVID-19."

"There's been a lot of misinformation about the epidemiology and statistical modeling of the coronavirus," adds sophomore Raj Movva, a computer science and biology major. "I think this class will help clarify some details and give us a taste of how one might actually make predictions about the course of a pandemic."

Edelman says that he has always dreamed of an interdisciplinary modern class that would combine the machine learning and AI of a "data-driven" world, the modern software and systems possibilities that Julia allows, and the physical models, differential equations, and scientific machine learning of the "physical world."

He calls this class "a natural outgrowth of Julia Lab's research, and that of the general cooperative open-source Julia community." For years, this online community has collaborated to create tools to speed up the drug approval process, aid in scientific machine learning and differential equations, and predict infectious disease transmission. "The lectures are open to the world, following the great MIT tradition of MIT open courses," says Edelman.

So when MIT turned to virtual learning to de-densify campus, the transition to an online, remotely taught version of the class was not too difficult for Edelman and Sanders.

> "This course opens a trove of opportunities to use computation to better understand and contain the COVID-19 pandemic."

"Even though we have run open remote learning courses before, it's never the same as being able to see the live audience in front of you," says Edelman. "However, MIT students ask such great questions in the Zoom chat, so that it remains as intellectually invigorating as ever."

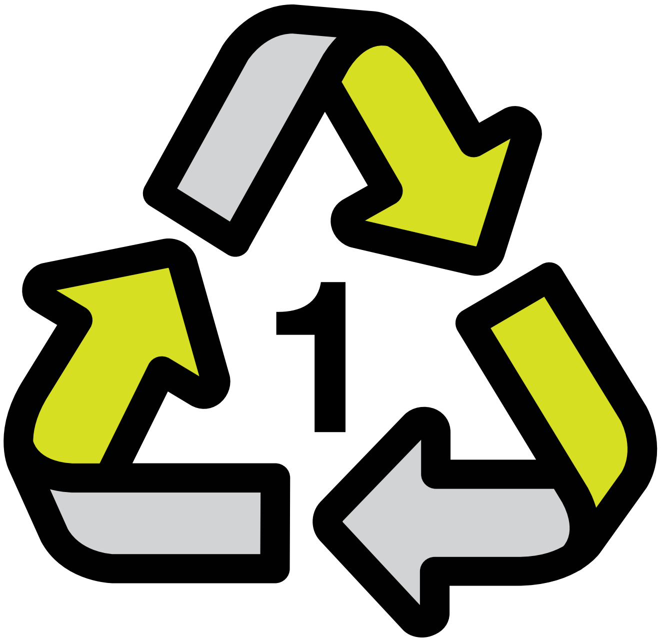
Sanders, a Marcos Moshinsky research fellow currently on leave as a professor at the National University of Mexico, is working on techniques for accelerating global optimization. Involved with the Julia Lab since 2014, Sanders has worked with Edelman on various teaching, research, and outreach projects related to Julia, and his YouTube tutorials have reached over 100,000 views. "His videos have often been referred to as the best way to learn the Julia language," says Edelman.

Edelman will also be enlisting some help from Philip, his family's corgi, who until recently had been a frequent wanderer of MIT's halls and classrooms. "Philip is a well-known Julia expert whose image has been classified many times by Julia's AI Systems," says Edelman. "Students are always happy when Philip participates in the online classes." ○

Engineering a plastic devourer

The Ally of Nature Fund supports graduate student Linda Zhong and Biology Professor Anthony Sinskey in their research on recycling

Fernanda Ferreira | School of Science



It was during a cruise in Alaska that Linda Zhong realized that the world didn't have to be full of plastic. "I grew up in cities, so you're very used to seeing all kinds of trash everywhere," says the graduate student in microbiology. Zhong, who is Canadian and lived in Ottawa growing up and in Toronto during college, routinely saw trash in the waters of the Ottawa River and on the beaches around Lake Ontario. "You never see it as anything other than normal."

Alaska changed that. Seeing the pristine, plastic-free landscape, Zhong decided to find a way to get rid of plastic waste. "I'm a biologist, so I approached it from a biological standpoint," she says.

Plastic pollution is a global problem. According to the United Nations Environment Programme, an estimated 8.3 billion tons of plastic have been produced since the 1950s. More than 60 percent of that has ended up in landfills and the environment. A major type of plastic is polyethylene terephthalate, or PET, which most water bottles are made of. Even though PET is easy to recycle compared to other types of plastic, in reality, it isn't.

"There are two ways to recycle PET: one is mechanical, and the other's chemical," says Zhong. Chemical recycling, which converts PET back to its original raw materials, is theoretically a closed loop in terms of material flow, but not so in practice. "For the most part, no one uses it right now because it's so costly," explains Zhong.

Mechanical recycling involves the melting of PET into small pellets that can be used to make new products. It's a much cheaper process but, as Zhong says, it can't be done infinitely. "Companies can recycle a bottle into another a handful of times before the material is too degraded to make bottles," she says. When this happens, the degraded material is thrown out, ending up in landfills or in the ocean. Zhong's ultimate goal is to reduce that massive material loss.

Before arriving at MIT, Zhong began looking for organisms that could degrade plastic and learned that a group in Japan had published a paper on *Ideonella sakaiensis*. "It's this weird environmental microbe that really likes digesting weird compounds," says Zhong. One of those weird compounds is PET.

With the organism found, Zhong set her sights on the enzyme produced by *Ideonella sakaiensis* that digests plastic: PETase. When Zhong got into MIT, she brought the project with her and proposed it to her advisor, Professor of Biology Anthony Sinskey.

As Zhong delved into the project, her aims changed. “At the beginning, I really wanted to do a screen and rapidly evolve this enzyme to make it better,” she says. That is still ongoing, but as Zhong learned more about PETase, she realized that there was a huge gap in the field’s understanding of how it works. “I keep finding myself stumbling over what the literature says and what my results show,” says Zhong.

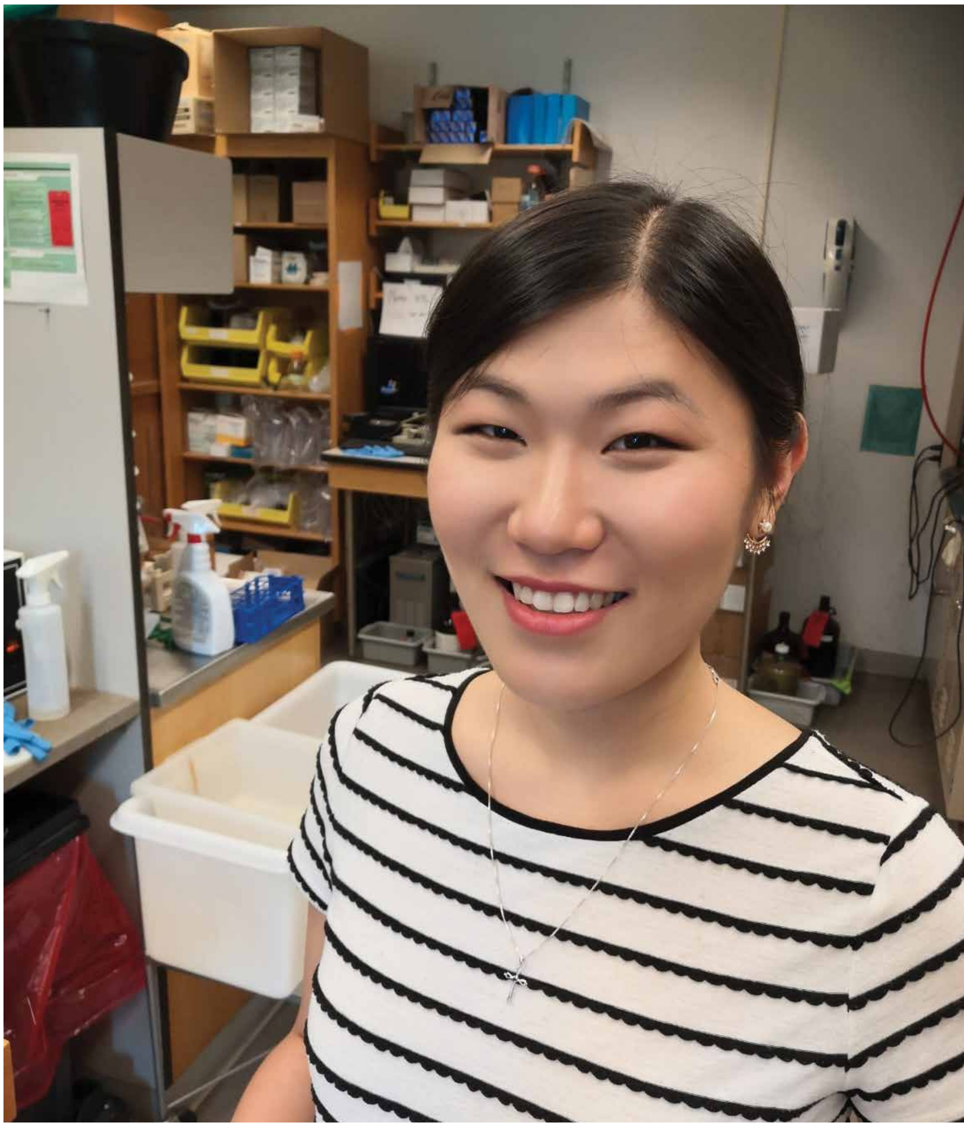
This led Zhong to shift her experiments to more fundamental questions. “I started developing methods to study this enzyme in more detail,” says Zhong. Previous assays that looked at PETase would measure the breakdown of plastic 24 hours after the enzyme was added. “My method allows me to start taking measurements within 30 minutes, and it shows me a lot more about what the enzyme does over time.” Zhong explains that understanding how PETase truly works is essential before engineering it to digest plastic more efficiently. “So, getting that fundamental picture of the enzyme and establishing good methods to study it are what I’m focusing on.”

Right now, Zhong is working from home due to the COVID-19 health crisis, balancing her time between reading papers and cooking. “It’s sort of my replacement for experiments since it’s something I do with my hands at a bench,” says Zhong. But cooking isn’t a perfect substitute and she still can’t wait to get back to the lab. “I really want to find the answers to the questions I’ve just started exploring,” Zhong says.

In 2019, Zhong and Sinskey received a grant from the Ally of Nature Fund to help fund the PETase project. The fund was established in 2007 by MIT alumni Audrey Buyrn ’58, SM ’63, PhD ’66 and her late husband Alan Phillips ’57, PhD ’61 to provide support for projects whose purpose is to prevent, reduce, and repair humanity’s impact on the natural environment.

According to Zhong, the fund was a boon. “Because it was a new project in the lab, we had no funding,” she says. The Ally of Nature grant also has no spending restrictions, which is ideal for a project that has moved beyond bioengineering to encompass biochemistry and fundamental biology. “I didn’t have a budget, because I didn’t know what I needed,” says Zhong. “But now I can buy what I need when I need it.” ○

> “‘Companies can recycle a bottle into another a handful of times before the material is too degraded to make bottles,’ [Zhong] says. [It then ends] up in landfills or in the ocean. Zhong’s ultimate goal is to reduce that massive material loss.”



Graduate student Linda Zhong working in Professor Anthony Sinskey’s biology lab.
Photo: courtesy of Linda Zhong

A gift that keeps on giving

Franklin Peterson, a former professor in the Department of Mathematics, and his wife Marilyn support graduate students at the Institute

Stacy Boedigheimer | School of Science

When a member within the MIT community gives back to the Institute, it speaks volumes. A generous and worldly couple with active social and intellectual lives, Frank and Marilyn Peterson always knew they would leave a portion of their estate to the institutions that were most meaningful to them. For former MIT Professor Frank Peterson, the Department of Mathematics was one of those places.

Foundations, friends, and fashion

An internationally respected algebraic topologist, Frank specialized in the study of cohomology operations. The complex interplay between geometric and algebraic topology was a hallmark of his work, and many of the fundamental structures of both subjects bear his imprint.

Frank was a professor at MIT for more than 40 years. He was deeply involved not only in teaching and research but in the administration of the Mathematics Department. He served as chair of the hiring committee, as chair of the graduate admissions committee, and he co-created a seminar in algebraic topology — Frank's area of specialty — with Edgar Brown, an emeritus professor of mathematics at Brandeis University, which continues to this day.

"Frank did everything. He was a wonderful administrator," says Professor of Mathematics Haynes Miller, a colleague at MIT and a good friend of Frank's. On top of the wide variety of ways in which Frank served the MIT community, he was approachable, friendly, and willing to answer even the simplest of questions. "He was a terrific optimist," Miller recalls.

Frank's service extended beyond MIT to the greater mathematics community. He acted as treasurer of the American Mathematics Society (AMS) for nearly 25 years. Despite Frank's sensible business acumen, "he was a pretty informal guy," remembers Miller, save for one exception: his "old-school professor" look. Essential preparation before Frank walked in to give a lecture included affixing his signature bow tie.

"Frank Peterson's joy in doing mathematics as an individual as well as with other people had a profound positive impact on the lives of many of his friends," says Fred Cohen, Professor of Mathematics at the University of Rochester, in a November, 2001 notice to the AMS.

Marilyn Peterson enjoying a glass of wine from the couple's extensive collection. Photo: courtesy of Haynes Miller

Ships, shapes, and sherry

Frank and Marilyn made a great match, sharing an interest in adventure, good food, and good wine. When he met her, Marilyn was working for the CIA. "She always kind of had that 'spy' background," says Miller. But, while Frank focused on mathematics, Marilyn's passion was studying shipwrecks, which took them on great escapades around the world.

Her dedication to this study led Marilyn to seek a home in Cambridge, Massachusetts near the Widener Library. She also took classes in paleography — the study of ancient writing systems and historical manuscripts — at the British National Archives in England nearly every summer. In order to investigate a particular shipwreck, she even spent time in northern Canada. Frank accompanied her on this trip but left early due to the harsh living conditions. Marilyn recalled to Miller that they had outhouses there, but one had to take a shotgun with them "because of the polar bears."

By the ends of their lives, the financially conscious couple had amassed a large estate — and many lifelong friends. Frank Peterson passed away on September 1, 2001, and Marilyn Peterson joined him on July 6, 2014.

Gifts, grads, and gratitude

In honor of Frank, Marilyn reserved nearly a third of their trust to create the Franklin Peterson Mathematics Fund, a sum amounting to more than $2.3 million. The fund is endowed and available to the Department of Mathematics for discretionary use. Discretionary funding is essential to addressing the greatest needs of the department. In recent years, that greatest need has rung out loud and clear: graduate fellowships.

"We've always had around 120 [graduate] students here. It fluctuates a little bit. And what's happened in the last 15 to 20 years is that the level of support of an NSF (National Science Foundation) fellowship has declined, especially relative to the actual costs at MIT. So, an increasing proportion of the department's budget is going to supporting graduate students," says Miller.

The Peterson gift has already supported seven graduate students and is slated to support an eighth student this fall.

"The Peterson Fund covered my tuition as a first year graduate student, allowing me to focus on classes and qualifying exams without the additional workload of teaching or grading," says Jie Jun Ang, a third-year graduate student studying under Leighton Family Professor of Mathematics Scott Sheffield. He added that the fellowship made his transition to graduate school at MIT, including relocating to a brand-new city, much smoother.

The Franklin Peterson Mathematics Fund will continue to support graduate students into the foreseeable future, lessoning the burden both on the department as it strives to attract the best talent, and on our students as they start graduate work.

> "The Peterson gift has already supported seven graduate students and is slated to support an eighth student this fall."

Kaavya Valiveti, a fourth-year graduate student studying under Professor of Mathematics Richard Melrose, expressed her appreciation directly to the couple. "If I could, I'd love to share the following message: Dear Frank and Marilyn, I would like to express my deepest gratitude to both of you for your support during part of my graduate studies, but more generally for your support of mathematics research at MIT over the past several years. People like you are truly one of the main reasons the Institute remains at the center of the highest levels of research all across the sciences and engineering, and continues to be such a rewarding, exciting place for graduate students like myself to study."

Miller agrees with the sentiment. "It's very significant when an individual does something of [this] scale, millions of dollars," he says. And it comes straight from the heart. "[Frank] loved the department and devoted himself to it, and so did [Marilyn]." ○

Capturing stardust

Danielle Frostig, a physics graduate student and 2018–2019 Whiteman Fellow, is developing an instrument to study how the heaviest elements in the universe are produced

Fernanda Ferreira | School of Science

Danielle Frostig spent the last Friday in February with the rest of the Astronomical Instrumentation Team at MIT, carefully packing an astronomical instrument bound for Chile. This instrument, a prototype of the larger, complete spectrograph, which will image some of the faintest and oldest stars, will be mounted on the Magellan Telescope in Las Campanas, Chile. "I've never thought of shipping crates or tax forms before," confesses Frostig, a physics graduate student in Director of the MIT Kavli Institute for Astrophysics and Space Research and Francis Friedman Professor of Physics Rob Simcoe's group, "but I'm happy to be involved." Those boxes are currently sitting at the observatory waiting for the stay-at-home rules and travel restrictions to lift so the team can fly down and install it on the telescope.

Working with astronomical instruments has allowed Frostig to delve into all aspects of a research project, from designing and building the actual instrument, shipping it to a different state or country, and working with the data it collects. "I really understand what I'm doing with my science from the basis of: 'what is this instrument doing?' and 'how does it work?'" Frostig says.

Astronomical instruments have also allowed Frostig to combine her love of math and astrophysics with creating art. Growing up with the University of California at Irvine (UCI) campus in her backyard, Frostig would go to visitor nights at UCI's observatory with her dad. At the same time, she also attended an arts middle and high school. "Art was a huge part of my life for a long time, but when I was diving into astrophysics in college, I wasn't creating much art," Frostig remembers. That's where astronomical instrumentation comes in. "I get to build things, which I've always loved doing, and do astrophysics," she says.

Frostig has worked on parts of the Large Lenslet Array Magellan Spectrograph (LLAMAS) imaging tool prototype, but the main focus of her research is WINTER, a wide-field camera mounted on a telescope that will survey the cosmos for infrared light. "The question we're trying to solve with WINTER is: How are the heaviest elements in the universe produced?" says Frostig.

The lighter elements in the periodic table, from hydrogen up to iron, are created in the cores of massive stars. As for those elements that are heavier than iron? Science is still figuring that out. "We suspect that they are produced by the r-process, which is the rapid neutron-capture process," says Frostig. Direct evidence for neutron star mergers as the origin of r-process elements comes from only one event: Gravitational Wave 170817 (GW170817) detected by the Laser Interferometer Gravitational-Wave Observatory (LIGO) in August 2017.

Unlike previous gravitational waves observed by LIGO, which were produced by the collision of two black holes, GW170817 was caused by the merging of two neutron stars, which are the smallest and densest stars, holding a mass 10 to 29 times greater than our sun. "The two neutron stars spiraled into each other, merged, and created a big explosion that we could 'hear' in LIGO gravitational waves but also see with conventional telescopes," says Frostig. Most significantly, there's evidence that the collision of these two neutron stars generated enough energy to produce the heavier elements.

> “The lighter elements in the periodic table, from hydrogen up to iron, are created in the cores of massive stars. As for those elements that are heavier than iron? Science is still figuring that out.”

Graduate student Danielle Frostig in Las Campanas, Chile. Photo: courtesy of Danielle Frostig

“But right now we only have one data point,” Frostig says. The purpose of WINTER is to locate more of these events in the sky and Frostig and her group believe infrared light is the way to find them. As the neutron stars circle each other in ever increasing speeds, they’re torn apart, with their remnants forming a cloud of dust that glows infrared. It’s this cloud of dust that WINTER will detect. “We’re taking this infrared imaging technology from the defense sector and applying it to astronomy, so that we can be on the sky on the right wavelength to study how these elements are formed,” Frostig says.

WINTER will work in collaboration with LIGO during its fourth observing run, which starts in 2022. “LIGO is expecting to see these gravitational waves once or twice a month, and they can tell us an ‘uncertainty contour’ that looks kind of like a banana shape in the sky,” says Frostig. This uncertainty contour points to the region of the cosmos where the gravitational wave most likely came from and, within seconds of receiving an alert from LIGO, WINTER can start surveying that region to look for evidence that the gravitational wave was generated by a neutron star merger.

Currently working from home due to the COVID-19 pandemic, Frostig and her lab mates are focusing on WINTER’s software and tinkering with the camera’s final design. “For us, science looks similar to what it looked like before social distancing, but dispersed,” says Frostig, who now has a circuit board and oscilloscope sitting on her coffee table. Once the lab is back up and running on campus, they’ll focus on WINTER’s hardware, which can’t be done remotely.

Unlike LLAMAS, which will be attached to the much larger Magellan Telescope, WINTER will have its own dedicated telescope, a one-meter PlaneWave telescope that can swing rapidly to look at any part of the sky. Both WINTER and the PlaneWave telescope will be shipped to Palomar Observatory in California later this year, and Frostig hopes it will be studying space by 2021. “We’re very excited to have this dedicated telescope so that we can find these events as soon as possible and tell other telescopes to also look,” says Frostig.

Dedication is something Frostig, as a 2018–2019 Whiteman Fellow, understands. George J. Elbaum ’59, SM ’63, PhD ’67 and his wife Mimi Jensen established the Whiteman Fellowship (named after Elbaum’s mother, Pauline Whiteman) specifically to give graduate students the opportunity to dedicate themselves to their research projects. Receiving the fellowship has allowed Frostig to decide what aspect of her graduate education to focus on during each year. “The benefit of the fellowship is the flexibility,” says Frostig. While teaching is an area she wants to explore, the fellowship “gives me the agency to decide when I want to teach versus when I’d rather focus on research,” Frostig adds. It also helped convince her to come to MIT. “Being offered that fellowship as a prospective student, showed me that the department wanted me here and really valued me as a researcher.”

Elbaum’s experience was similar when he received a fellowship from his employer to pursue graduate work at MIT. “The doctoral fellowship allowed me to select a thesis that interested me and resulted in three very exciting years of my life. So now I want to give this opportunity to some talented graduate students.” ○

Ice, ice, maybe

EAPS graduate student Meghana Ranganathan zooms into the microstructure of ice streams to better understand the impacts of climate change

Laura Carter | School of Science

Graduate student Meghana Ranganathan in front of a glacier. Photo: courtesy of Meghana Ranganathan

From above, Antarctica appears as a massive sheet of white. But if you were to zoom in, you would find that an ice sheet is a complex and dynamic system. In the Department of Earth, Atmospheric and Planetary Sciences (EAPS), graduate student Meghana Ranganathan studies what controls the speed of ice streams — narrow, fast-flowing sections of the glacier that funnel into the ocean. When they meet the ocean, losing ground support, they calve and break off into icebergs. This is the fastest route of ice mass loss in a changing climate.

Looking at the microstructure, there are many components that can affect the speed with which the ice flows, Ranganathan explains, including its interaction with the land the ice sits on, the crystalline structure of the ice, and the orientation and size of the grains of ice. And, unfortunately, many models do not take these minute factors into consideration, which can impact their predictions. That is what she hopes to improve, modifying the mathematics and building models that eliminate assumptions by fleshing out the details of exactly what is happening down to a microscopic level.

Ranganathan is equipped to handle such a topic, holding a bachelor's degree in mathematics from Swarthmore College where she generated food chain models to investigate extinction levels. She left her undergraduate studies with a "desire to save the world" and knew she wanted to apply her knowledge to climate science for her graduate degree. "We're one of the first generations that grew up hearing about the climate crisis, and I think that made quite an impact on me," she says. It's also a "sweet spot," she claims, in terms of being both a scientifically invigorating problem — with a lot of mathematical complexities — and a societal issue: "My desire to use math to discover things about the world, and my desire to help the world intersect in climate science."

A climate of opportunity

EAPS allowed Ranganathan the flexibility to choose her field of focus within the wide range of climate science. "EAPS is a great department in diversity of fields," she says. "It's rare for one department to encompass so many aspects of earth and planetary sciences." She lists faculty addressing everything from hurricanes to climate variability to biological oceanography and even exoplanetary studies. "Even now that I've found a research focus, I get to learn about other fields and stay in touch with current research being done across the earth sciences," she adds.

Flexibility is something she also attributes to her fellowship. Currently, Ranganathan is sponsored by the Sven Treitel Fellowship, and it's this support that has allowed her the opportunity to develop and grow her independence, transitioning from student to researcher. "Graduate school is arguably not necessarily to learn a field, but rather to learn how to build on your own ideas," she explains. Without having her time consumed by writing grant proposals or working on other people's funded projects, she can divert her full attention to the topic she chooses. "This fellowship has really enabled me to focus on what I'm here to do: learn to be a scientist."

The Sven Treitel Graduate Student Support Fund was established in 2016 by EAPS alum Arthur Cheng ScD '78 (XII) to honor Sven Treitel '53, SM '55, PhD '58. "Sven Treitel was a visiting professor at MIT when I was a graduate student and he was a great role model for me," says Cheng. Treitel's contributions to making seismograms more accurate are considered instrumental to bringing about the "digital revolution" of seismology.

Years of change

Currently in her third year, Ranganathan has passed her qualifying exam and is now fully devoted to her project. That includes facing some challenges in her research, like producing new models or, at least, new additions to preexisting models to make them suitable for ice streams. She also worries about what she calls a dearth of data needed to provide her model some benchmarks. Her excitement isn't deterred, though, and she's invigorated by the prospect of self-directing how she tackles these technical obstacles with input from her advisor, Cecil and Ida Green Career Development Professor Brent Minchew.

During the COVID-19 crisis, Ranganathan appreciates the EAPS Department and her advisor for ensuring that events and check-ins remain a regular occurrence in addition to prioritizing mental health. Although she has adjusted her hours and workflow, Ranganathan believes she has been relatively lucky while MIT campus has limited access. "My work is quite easy to take remote, since it is entirely computer-based work. So, my days haven't changed too much, with the exception of my physical location," she notes. "The biggest trick I've learned is to be okay with everything not being exactly the same as it would have been if we were working in person."

Ranganathan still meets with her office mate every morning for coffee, albeit virtually, and continues to find encouragement in her fellow lab mates, whom she describes as smart, driven, diverse, and brought together by a love for ice and glaciers. She considers the EAPS students in general a warming part of being at MIT. "They're passionate and friendly. I love how active our students are in science communication, outreach, and climate activism," she comments.

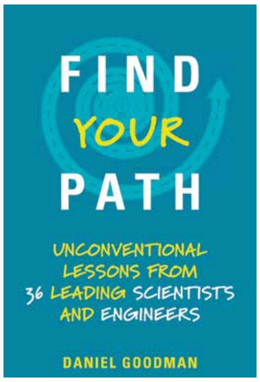
Ice sheets of paper

The co-president of the WiXII (Women in Course 12 group), Ranganathan is well-versed in communication and outreach herself. She enjoys writing — both fiction as well as journalism — and has previously contributed articles to *Scientific American*. She uses her writing as a means to elevate awareness of climate issues and generally focuses on the interplay between climate and society. Her 2019 TEDx talk focused on human relationships with ice — how the last two decades of scientific study has completely changed how society understands ice sheets.

Amazingly, all of Ranganathan's knowledge of earth science, climate science, and glaciology, she has learned since joining MIT in 2017. "I never realized how much you learn so quickly in graduate school." She hopes to continue down a similar track in her future career, addressing important aspects of glaciology that still need answers. She might want to try fieldwork someday. When asked what's left to accomplish, she joked, "Do the thesis! Write the thesis!" ○

Alumni recount pivotal career moments in new book of essays

Slice of MIT | MIT Alumni Association



When Daniel Goodman PhD ’89 first conceived of the book that became *Find Your Path: Unconventional Lessons from 36 Leading Scientists and Engineers* (MIT Press, December 2019), his intent was to provide career guidance to students. But as the project progressed, Goodman writes in his introduction to the volume, “I realized that through their first-person stories our role-model scientists and engineers are actually providing valuable *life guidance* for readers at any stage in their career.”

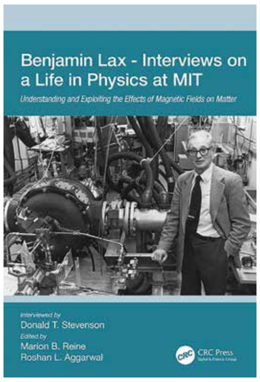
Find Your Path includes Goodman’s own story, recounting how he went from studying plasma physics at MIT to his current role as director of advanced technology at ASM-NEXX in Massachusetts (as well as a director of the Fannie and John Hertz Foundation, which provides graduate fellowships in applied science, and helped inspire the book project). The collection also contains chapters based on Goodman’s interviews with six other MIT alumni [including Rainer Weiss ’55, PhD ’62, Nobel laureate and MIT physics professor emeritus].

As Goodman writes, “Although their challenges vary from subject to subject, one commonality is the love these role models have for scientific discovery and their desire to use science and technology to understand and improve the world.”

This is a section of an article originally posted by MIT Alumni Association on Slice of MIT. Find Your Path: Unconventional Lessons from 36 Leading Scientists and Engineers *(editor, Daniel Goodman), published by MIT Press in 2019. Copyright: MIT Press. All rights reserved.*

Interviews with MIT Physics alumnus and professor depict life in the department

Laura Carter | School of Science



In a series of autobiographical interviews published in the book *Benjamin Lax — Interviews on a Life in Physics at MIT: Understanding and Exploiting the Effects of Magnetic Fields on Matter* (CRC Press, December 2019), former Professor Benjamin Lax PhD ’49 reveals what life was like in the MIT Department of Physics over his 60-year career.

A centenarian, Lax was born in Hungary in 1915 and passed in 2015 in the United States after his family emigrated to New York. His first introduction to MIT was during his service in the U.S. Army at the MIT Radiation Lab as a radar officer. He continued his studies on the generation of radar, completing a graduate degree in 1949 under Sanborn C. Brown in the Department of Physics.

In the 1950s, he played a major role in the construction of MIT Lincoln Laboratory’s semiconductor and ferrite research groups, became head of the Solid-State Division in 1958, the founding director of the MIT Francis Bitter National Magnet Laboratory, established in 1960, and in 1964, took on the role of associate director at Lincoln Labs. Lax then became a professor in the Department of Physics for over 20 years until his retirement.

In his interviews, Lax discusses the challenges, opportunities, and people he encountered on his journey through solids in magnetic fields, including a wide array of members of MIT Physics, research colleagues, students he mentored (which number above 50), and personal friends. Lax gives insight into life within MIT’s Department of Physics as well as a glimpse into his notable research and the many lives he impacted during his long life.

Benjamin Lax — Interviews on a Life in Physics at MIT: Understanding and Exploiting the Effects of Magnetic Fields on Matter *1st Edition, (interviewer, Donald Stevenson; editors, Marion Reine, Roshan L. Aggarwal), published by CRC Press in 2019. Copyright: CRC Press. All rights reserved.*

How you can help

As COVID-19 continues to impact lives across the world, efforts to respond to the virus continue to grow. Several MIT faculty members, research scientists, investigators, postdocs, and graduate students are working on projects related to the SARS-CoV-2 pandemic. From personal protective equipment and logistics to searching for vaccines and therapies, the MIT community has stepped up to the plate.

If you would like to support these efforts, MIT has two newly created funds specifically designed to contribute to COVID-19 research and innovation projects.

Halie Olson, a Brain and Cognitive Sciences graduate student in the labs of John Gabrieli and Rebecca Saxe, in her home office with her pet dog Winston. Olson studies how early life experiences and environments impact brain development. Photo: courtesy of Halie Olson

MIT COVID-19 Research Fund

A gift to the COVID-19 Research Fund will support MIT faculty and researchers as they address various aspects of the SARS-CoV-2 pandemic, including vaccine development, portable ventilators, AI solutions, and improved personal protective equipment.
Fund number: 3887105

MIT Student Life, Wellness and Support Fund

A gift to this preexisting fund will address student financial needs that have been exacerbated by the crisis. In addition, the fund continues to support efforts focused on improving student wellness, mental health, and support services.
Fund number: 4031630

MIT COVID-19 Emergency Fund

A gift to the COVID-19 Emergency Fund supports MIT's community response to the crisis, including providing equipment, space, expertise, and other resources to local area hospitals and other health care providers. Contributions to this fund will supplement Institute resources that are already being applied to these immediate medical needs.
Fund number: 3776735

The MIT Staff Emergency Hardship Fund

While MIT has largely been able to maintain payroll stability, many staff and postdoc families are facing financial challenges from a spouse's or partner's job loss, unexpected child care expenses, medical expenses, and more. This fund is designed to assist any MIT staff member who is facing an acute financial hardship due to COVID-19.
Fund number: 2732211

Many individuals and families in the MIT community are facing new and unexpected challenges due to the virus. The sudden shift in how we carry out our daily lives has had myriad consequences, from the emotional toll of, among other things, sudden displacement, the loss of loved ones, and heightened uncertainty about what the future holds to the strain caused by a severe loss of income and financial stability.

If you would like to contribute to the immediate financial relief of those who have been hit the hardest in this difficult time, please consider a gift to one of MIT's existing community hardship funds.

To make a gift to the COVID-19 Research Fund, the COVID-19 Emergency Fund, or the Student Life, Wellness and Support Fund, please visit giving.mit.edu/covid19/#giving-options. To make a gift to the Staff Emergency Hardship Fund, please visit hr.mit.edu/worklife/hardship-fund. You can find opportunities to get involved at alum.mit.edu/covid-19-how-help. If you wish to speak directly with Elizabeth Chadis, Assistant Dean for Development for the MIT School of Science, please call 617-817-6516 or email echadis@mit.edu. ○

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Members of MIT Departments of Mathematics and Physics share photos of their pet co-workers during social distancing.
Photos: courtesy of contributors to @physicsmit and @mitmathematics on Instagram