UROP Impact Report

Life-changing connections. Meaningful discoveries. Impactful research.

Massachusetts Institute of Technology

UROP MIT Undergraduate Research Opportunities Program

"UROP has provided me with the tools to investigate questions that fascinate me, and the projects I've worked on have played a big role in shaping my interests as a researcher."

AMELIA HOW '27
Economics and Mathematics Major

Fueling our students' intellectual and personal growth

MIT is an institution with a well-deserved reputation for scholarship and research excellence. For more than 150 years, we have been a community committed to advancing knowledge and educating students in science, technology, and a range of other areas. The Undergraduate Research Opportunities Program (UROP) is an important part of how we deliver on that promise.

UROP allows our undergraduate students to apply what they learn in the classroom to exciting research projects throughout the Institute. By taking part in research across multiple academic disciplines, students gain a deep understanding of how research is conducted and develop crucial technical and analytical skills.

But research rigor is only one part of the UROP equation. At MIT, we're committed to educating the whole student. To educate the whole student means that we, as an institution, must support not only our students' intellectual development, but also their professional and personal growth. UROP is a vital component of that mission.

UROP allows MIT students to pursue their passions and uncover new interests while also engaging in consequential research with real-world implications. Working side-by-side with faculty and researchers who become mentors, role models, and sounding boards, our undergraduates build their confidence along with their research acumen. UROPs help students grow their networks and self-esteem while developing the communication, collaboration, problem-solving, and interpersonal skills that today's world demands.

This report highlights student researchers who have leveraged their UROP experiences to hone their skills, expand their perspective, and make a difference, as well as the MIT faculty who are providing students with guidance and support throughout their research journeys. I am deeply grateful to the dedicated researchers and mentors who work tirelessly to provide these opportunities to our students. And I am thrilled to see how our students continue harnessing their research experience to make positive change in the world after graduation.

We hope that you enjoy the enclosed profiles highlighting this important work, and thank you for your ongoing engagement and support.

Sincerely,

Melissa Nobles
Chancellor and Class of 1922 Professor of Political Science

UROP Student

Grace Hu ’26

Restoring vision. Transforming lives.

Grace Hu ’26 helps uncover new insights into human vision while researching the effects of sight-restoration treatments on older blind children in India.

Before even arriving at MIT in the fall of 2022, Grace Hu was well aware of Professor Pawan Sinha’s important vision and site-restoration research. Pawan, from MIT’s Department of Brain and Cognitive Sciences, founded the humanitarian initiative Project Prakash to offer life-changing eye care to blind children in India, where childhood blindness is a widespread challenge. By providing children with sight-restoration treatments and studying the impact of those treatments, Pawan and his team are gaining valuable new insights into human visual development and plasticity.

“I thought it was a really cool project, and since I was already considering a career in academia, I knew I wanted to get research experience,” Grace recalls. “So I reached out to Dr. Sharon Gilad-Gutnick—my future supervisor and mentor—to talk about my interests and where they overlapped with ongoing projects in the Sinha Lab. It was a good match.”

Grace began her UROP in the Sinha Lab by immersing herself in vision test results and sharpening her organizational, coding, and data analysis skills. But she also learned the importance of asking questions and seeking advice. “At first, I didn’t want to take up anyone’s time,” she admits. “But I’ve grown more comfortable asking Sharon questions—not only about the project, but also about my career and life in general. She’s more than just a project mentor. Even if I later move on to a different UROP, I’ll still look to her for advice.”

The power of shared knowledge and cooperation

Collaborating closely with her supervisor and other researchers in the Sinha Lab, Grace began identifying new patterns in the data. “Because I sat with the data for so long and sifted through every photo and video, I was starting to see common threads that could tell us what deficits the kids might still have and where their vision was improving,” she says.

“The experience of being part of a lab and part of a community, seeing how everyone works together, has been so rewarding.”

“During discussions with Sharon, I’d bring ideas to the table and we’d talk through them. Whenever we’d reach roadblocks, we’d connect with other graduate students or postdocs working on similar projects, and they’d offer really helpful guidance. Or we’d meet with Prof. Sinha and he’d set us in the right direction.”

Together, Grace and her peers in the Sinha Lab have identified significant improvements in children’s vision that are having a profound impact. Traditionally, doctors believed that if blind children didn’t receive sight-restoration surgery before the age of five or six, they’d never learn to see, even if they underwent surgery later in life. However, the Sinha Lab’s research challenges these long-held notions about the nature of eyesight development.

“Our research suggests that while the children’s vision won’t be what it would’ve been if they’d received surgery earlier, there are huge improvements that no one expected,” Grace explains. “Not only are they taking in visual input, but they’re also processing that information and eventually developing enough functional vision to go to school and access opportunities that they wouldn’t have had otherwise.”

During her UROP with the Sinha Lab, Grace has contributed to important research, sharpened her skills, and joined a community she can look to for support, mentorship, and advice. “The research itself is really important,” she says. “But the experience of being part of a lab and part of a community, seeing how everyone works together, has been so rewarding.”

↓ Dr. Sharon Gilad-Gutnick, Grace Hu, and Prof. Pawan Sinha (left to right).

Fara Alade ’25

UROP Student

Fostering intellectual growth and exploration

Fara Alade ’25 leverages her UROP experiences to explore her academic interests and expand her professional horizons.

Fara Alade’s journey is a case study in how UROP equips MIT students with essential skills and competencies, while simultaneously empowering them to consider and explore unique academic paths.

Fara’s first UROP, with the Department of Urban Studies and Planning, saw her collecting and analyzing data on the impact of Neighborhood Action Plans being implemented across a community in Ohio. “I’m actually an economics major, but in my first year at MIT, I didn’t have any of the skills that are valued in economics research, and I really had no idea what the research process looked like day-to-day,” she says. “So having the opportunity to do a UROP early on was really helpful.”

That project not only sharpened Fara’s research and analytics skills, but also provided her with insights that shaped her larger academic journey. “As part of the project, I recorded qualitative interviews with community members about their experiences during and after the implementation of Neighborhood Action Plans in their city,” she says. “In my urban studies classes, when we’d discuss theories and get excited about ideas, I’d remember what people said in those interviews. It helped me step back and consider the possible impact these ideas could have on communities. It gave me a different perspective.”

An opportunity to explore

In her sophomore year, Fara shifted gears, transitioning to a research project led by Associate Professor of Political Science, Ariel White. That change in direction was an intentional effort on her part to explore a full range of intellectual interests.

"My first UROP exposed me to the Department of Urban Studies and Planning and inspired me to minor in that subject," she says. "But now, with my UROP in the Department of Political Science, I've been thinking more about what I want to do in the future and whether that may involve political science. Both of my UROPs have given me the opportunity to try different things and widen the scope of my future profession. It isn't just about the projects themselves, but exploring career options that those projects touch on."

Her UROP with Ariel investigates voter engagement in marginalized communities in the United States. In collaboration with grassroots organizations, Fara collects and compiles voter registration data to gain insight into who is and isn't taking that first step to vote. "My work with Prof. White aims to better understand and support the democratic process in this country," she says. "We're examining voting systems and processes to identify what's stopping people in marginalized communities from voting, and we're thinking of ways to encourage people to make their voices heard."

Building a diverse skill set

Fara credits UROP with making her a better researcher, noting that she has strengthened her data analysis and coding skills and has actively contributed to literature reviews. "It's been great getting a deeper understanding of the research process from people who've been doing it for a very long time and have been published in acclaimed papers."

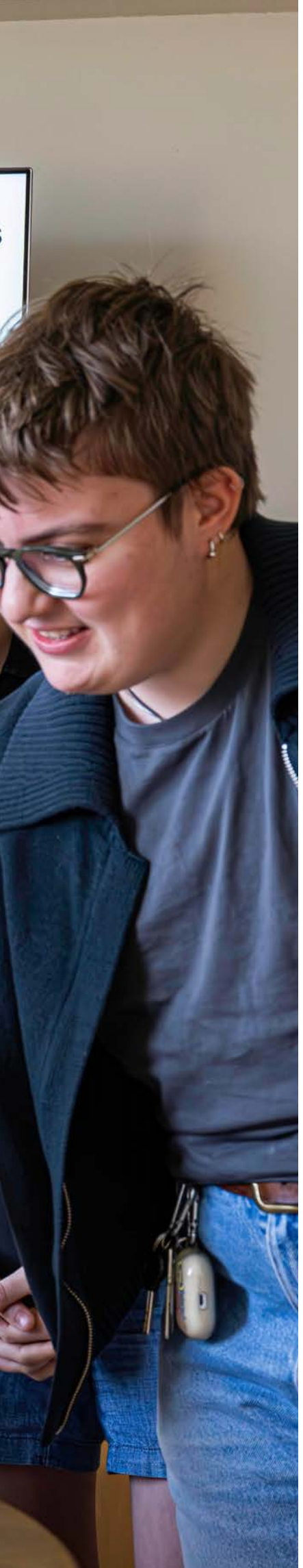
But UROP has also helped Fara build interpersonal, communication, and problem-solving skills that will serve her well in whatever career she pursues. "I have become more comfortable presenting my work to a group, including professors who are at the top of their fields," she says. "And I've learned how to communicate in a way that's succinct, accurate, and digestible." She's seen firsthand the power of adaptability, resilience, and learning from mistakes. "Observing and learning from professors while they come up with questions, seek answers, and problem-solve when they hit roadblocks has been incredibly useful," she says.

"I haven't decided what I want to do for my future career yet, but my UROP experiences will definitely inform whatever direction I choose to pursue."

"Both of my UROPs have given me the opportunity to try different things and widen the scope of my future profession. It isn't just about the projects themselves, but exploring career options that those projects touch on."

Professor

Raffaele Ferrari



Looking into the future of climate change

With vital support from UROP researchers, Professor Raffaele Ferrari is developing tools to help predict the future of Earth's climate.

Professor of Oceanography and Director of the Program in Atmospheres, Oceans, and Climate, Raffaele Ferrari has been collaborating with UROP students on cutting-edge climate research for over two decades. Currently, he's leading three different climate projects that bring together undergraduate researchers from a wide range of disciplines.

These students come to Raffaele's lab with diverse knowledge and backgrounds but are united by the opportunity to do work that makes a positive impact. "Over time, students are engaging more and more with our climate research," Raffaele says. "They want to see that the work they're doing isn't just state of the art, but also useful for society. That's a major benefit of UROP. These opportunities allow students to apply their knowledge to solving problems they care about."

↑ Andre Souza, Raffaele Ferrari, Lucy Brock, and Gosha Geogdzhayev (left to right).

The next generation of predictive climate modeling

Accurately predicting how the climate will change in response to current and future human activity is essential to effectively mitigating and adapting to climate change. As part of the Climate Modeling Alliance—a collaborative research effort among MIT, the California Institute of Technology, and NASA's Jet Propulsion Laboratory—Raffaele and his UROP students are developing an entirely new global model to predict the climate of the next century.

This global model will leverage advances in artificial intelligence to make predictions about the planet's future climate with unprecedented accuracy. "Through AI, we've become very efficient at learning from large sets of data," Raffaele says. "Now, we can use all the available information we have from the present-day climate systems to tune the global model, making its findings more credible than past iterations."

Raffaele's UROP students played a vital role in this research by making instrumental contributions to training the global climate model with machine learning algorithms. "We found algorithms that are much more efficient and can calibrate a model on a much shorter timescale."

"Bringing Computation to the Climate Challenge"

While this new global model is designed to be more accurate than past versions, running scenarios is expensive and time-consuming. Luckily, Raffaele and his team are tackling this challenge as well, through a second project called Bringing Computation to the Climate Challenge. With this research, Raffaele, his team, and UROP students are using model simulations of future climates to train emulators, with the goal of making climate projections more accessible and able to address a wider range of climate questions. "The emulator allows you to adjust the emission scenario however you want in order to explore different outcomes," he says. "Now you can run thousands of scenarios with pre-selected variables and get results in a matter of seconds."

Through these and other research projects, Raffaele and his team have given UROP students the chance to harness their growing skills and knowledge toward solving global climate challenges. While reflecting on the contributions of past and current UROP students, Raffaele emphasizes the benefit of students applying different perspectives to their work. "Students are really bringing their own experience and background to this research. When they have a research problem to tackle, many of our UROP undergraduates are just as dedicated as any PhD student."

"They want to see that the work they're doing isn't just state of the art, but also useful for society. That's a major benefit of UROP. These opportunities allow students to apply their knowledge to solving problems they care about."

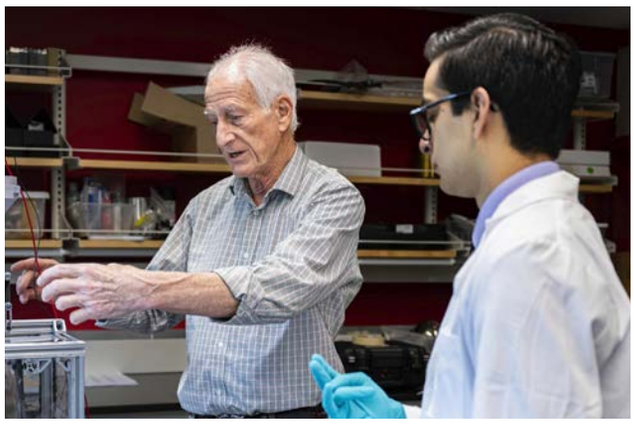
Words from our students and faculty

"I've built valuable research skills through my UROP experience, including data analysis, image analysis, tensile testing, microscopy, sample preparation, and machining."

PABLO HU '27
Materials Science and Engineering

"Working with UROP students has helped me become a better mentor. The strengths, weaknesses, backgrounds, and skills of each student are unique, and good mentoring comes from recognizing how to best tailor my approach to their individual needs."

DAVID L. DES MARAIS
Associate Professor
Department of Civil and Environmental Engineering



↑ Prof. Jeffrey Hoffman and Cesar Meza

"Nothing teaches you more about science, engineering, and problem-solving than wrestling with a real-world problem in an environment that is open, supportive, and guided by fundamental knowledge."

ED BOYDEN
Professor
Department of Brain and Cognitive Sciences

"As a student who'd only taken introductory programming classes, I was unsure if I'd be able to advance AI research. However, with the help of my UROP supervisor, I gained a lot of experience working with Large Language Models, and now I'm writing a paper on the topic that might get published."

KAILEY SIMONS '27
Computer Science, Economics, and Data Science + Business Analytics Majors

↑ Grace Hutter and Prof. Ellen Roche

"UROP students—especially those who cross departmental lines—enrich and add new dimensions to our work."

SVETLANA BORISKINA
Principal Research Scientist
Department of Mechanical Engineering

"Participating in UROPs allows students to develop and explore their interests across a wide spectrum of disciplines, which helps them discover what they're most passionate about and what they'd like to pursue after graduation."

JUDITH BARRY
Professor, Department of Architecture

"UROP has given me insights into what career paths in different fields of science are like, which has been crucial for my professional development. I've also been able to directly apply exciting concepts I learn in class to the lab, demonstrating MIT's hands-on motto."

PARIDHI LATAWA '26
Computer Science and Molecular Biology

UROP Student

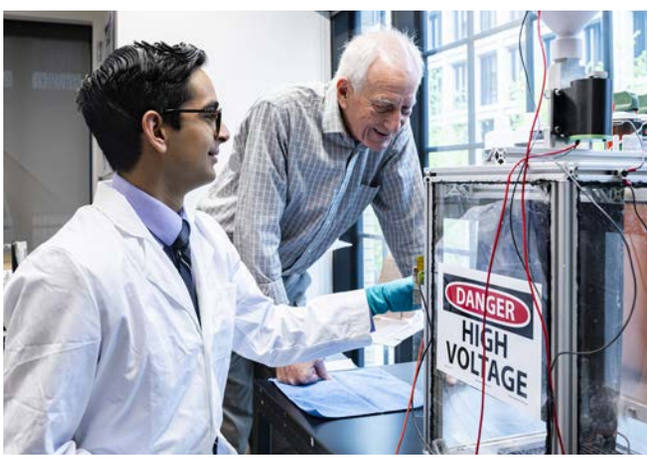
Cesar Meza ’25

Research powered by passion

Scientific exploration takes Cesar Meza ’25 from ice shelves on Earth’s southernmost continent to future construction projects on the surface of the moon.

Like many MIT students, Cesar Meza arrived at the Institute eager to learn by doing. “I came to MIT ready to take on real problems and learn about the world through experimentation and designing things,” says Cesar, who is studying aeronautics and aerospace. “I was really drawn to the MIT idea of ‘mens et manus,’ working with mind and hand. And I wanted to contribute to science while getting that hands-on experience.”

At the start of his first year, Cesar joined a UROP led by Professor of the Practice of Aerospace Engineering, Jeffrey Hoffman. He spent two years working in Jeffrey’s Antarctic Seismo-Geodetic Ice Penetrator (SGIP) Lab, helping test air-droppable sensors intended to measure how ice shelves in Antarctica behave and collapse.



> "I've always loved space, and I've always loved making things," he says. "So, I began thinking about the processes and technologies we'd need to manufacture up there."

Cesar felt lucky to be immersed in such a supportive and edifying research environment. "Working with people at the top of their field was intimidating at first," Cesar admits. "But my UROP experience really helped me break free of that feeling. I realized that my contributions were making an impact and that my ideas were valuable. It definitely helped build my confidence."

As his first UROP concluded, Cesar found himself eager to take on greater responsibility and try something completely different. "I'd been doing research under other people for a while," he says, "but now I wanted to be in control—defining the problem, designing the experiment, and executing the results on my own."

That determination inspired Cesar to take his research to the next level and dive into his own SuperUROP project.

Making discoveries that are out of this world

The first step in pursuing a SuperUROP is choosing a topic to investigate—and Cesar had a clear idea of where he wanted to go. "I've always loved space, and I've always loved making things," he says. "So, I began thinking about the processes and technologies we'd need to manufacture up there."

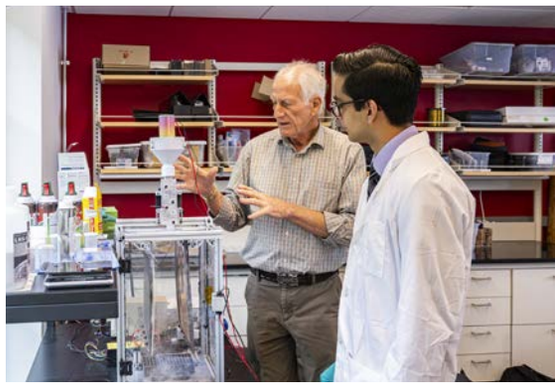
Prof. Jeffrey Hoffman and Cesar Meza (left to right). →

Cesar's interest in the mechanics behind construction in space led him to investigate lunar soil beneficiation—the process of enriching iron in soil on the moon for future extraction. The extracted iron can be used to make steel to support infrastructure projects.

After completing early research and consulting with subject matter experts, Cesar learned that while there are hypothesized methods for lunar soil beneficiation, there isn't a well-defined, large-scale process for enriching the soil to extract a greater amount of iron. This gap inspired him to focus his research on addressing that challenge in preparation for future lunar manufacturing.

Cesar hopes his SuperUROP, which continues going strong after two semesters, leads to longer-term research. "If all goes well, within the next 10 years, I'd like to continue this project for NASA or other contractors to develop a spaceflight-ready version so that we can test my research on the moon," Cesar says.

And he has even grander ambitions as he looks 40 to 50 years into the future, imagining a world where his work enables manufacturers to operate more effectively on the moon. "We wouldn't have to rely on transporting iron from Earth, which is very, very expensive," Cesar notes. "It would be another way to make the space economy more sustainable and increase our capacity to establish permanent presences on the moon and even on Mars. That's the dream, right?"



Associate Professor

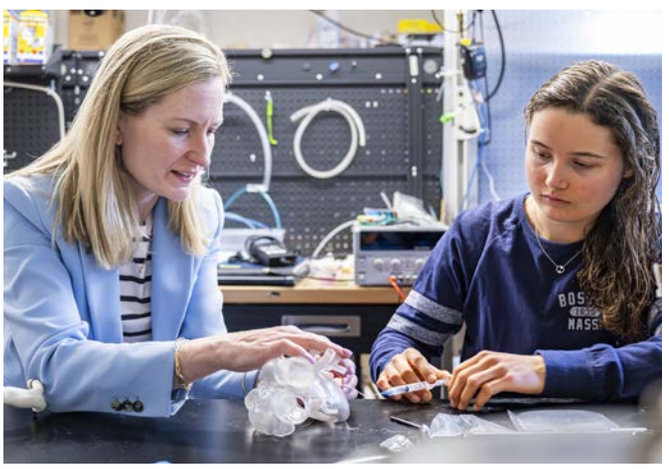
Ellen Roche

The power of new perspectives

UROP students bring fresh insights and new points of view to cardiovascular and respiratory medical device research.

"Our work creates alternative treatment options that are potentially less invasive and improve patient outcomes and quality of life," says Ellen Roche, Associate Professor of Mechanical Engineering and head of MIT's Therapeutic Technology Design and Development (TTDD) Lab. Ellen's lab specializes in developing and testing medical devices that assist or augment cardiovascular or respiratory organ function and repair defects. It's breaking new ground in overcoming some of the challenges inherent in cardiac and pulmonary medicine.

The TTDD Lab conducts extensive research in three main areas: mechanical assist devices, tissue repair devices, and enhanced organ/system models. That means a world of opportunities for UROP students. When they



join the TTDD Lab, undergraduates might find themselves fabricating and testing drug delivery devices, developing wearable devices that prevent sleep apnea, or working on soft robotics and actuators to create artificial muscles. Ellen and her team make the most of this breadth by thoughtfully assigning students to projects that align with their specific skills and interests and with caring graduate student or postdoc mentors.

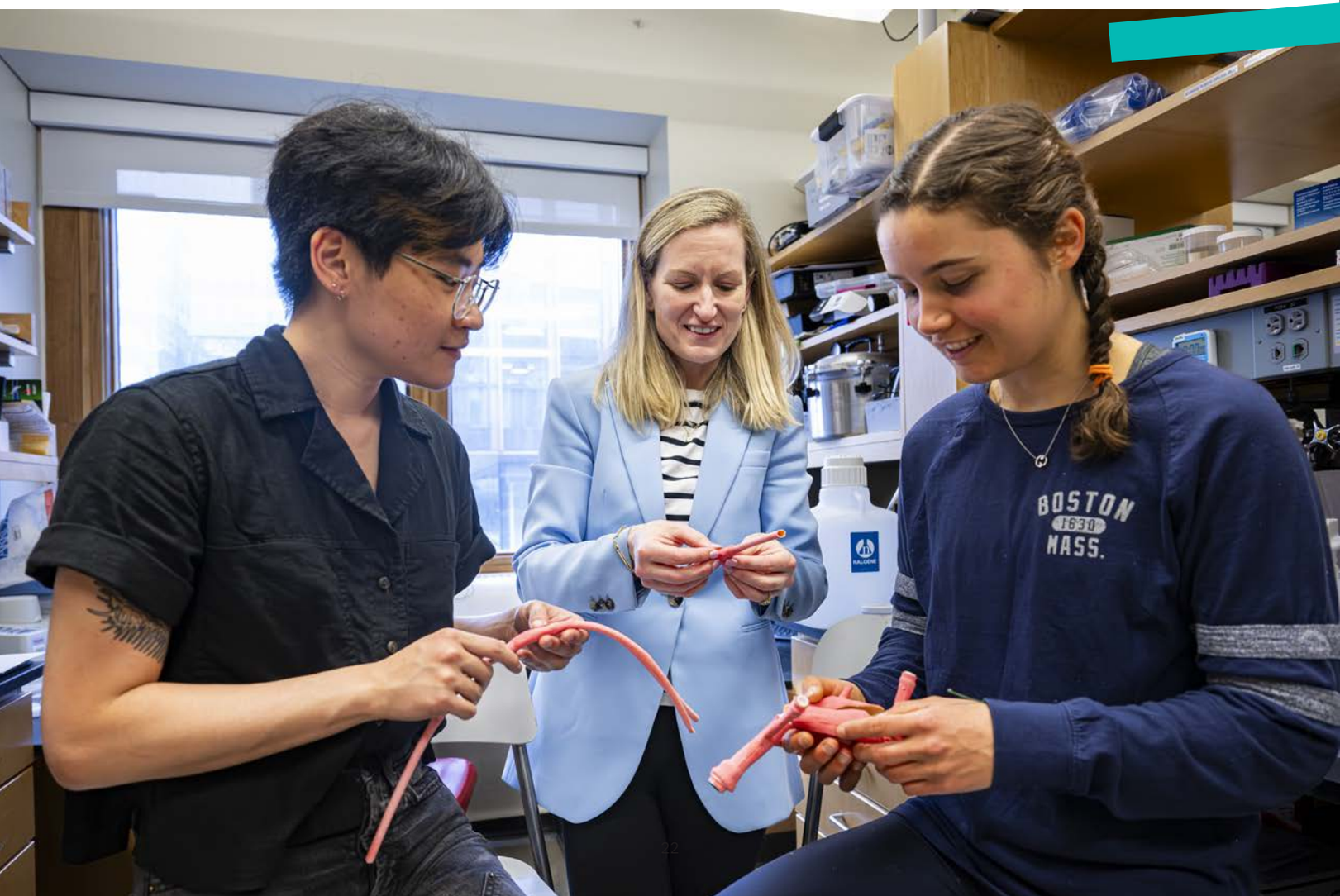
"When it's a good fit, students often stay for many semesters, and sometimes even return for grad school," Ellen says, noting that one of her current graduate students is completing his PhD on a project he was first exposed to through UROP. "It's been five years since he started working with us, and now he's leading the project and mentoring UROP students himself."

Teaching (and learning from) students

Over the years, UROP students have made important contributions to Ellen's research. "Often, students come from different departments and academic backgrounds, so they bring a new mindset, which is really helpful," she says. "And with the world changing so rapidly, every incoming cohort offers fresh perspectives and insights that enhance our work. Without UROP and the amazing students who've taken part, we wouldn't have made nearly as much progress as we have."

UROP students have also given Ellen valuable insight into undergraduate life at MIT, a perspective that helps inform her mentoring and advising. "I'm just blown away by what UROP students accomplish in the lab, especially because they're balancing so many classes and extracurricular activities on top of their research. As a mentor, I try to be conscious of everything they have going on and adjust my support style accordingly."

↓ Jessica Wang, Prof. Ellen Roche, and Grace Hutter (left to right).



A win-win

Ellen has come to see UROPs as enormously beneficial to the MIT community on multiple levels. "UROPs provide a very symbiotic, mutually beneficial relationship between the research group and undergraduate students," she says. "While contributing to ongoing research, students gain a unique opportunity to immerse themselves in lab culture."

And she believes that experience working inside a lab benefits students regardless of their ultimate career path. "Even if they don't plan to pursue a career in an academic setting, they're gaining experience working as a team in pursuit of a common goal," she says. "Those skills will be valuable regardless of where their career takes them."

↑ Prof. Ellen Roche and Grace Hutter (left to right).

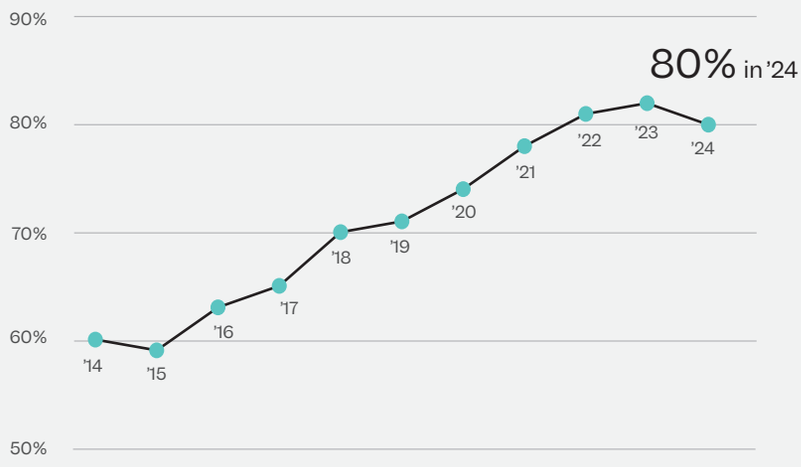
"With the world changing so rapidly, every incoming cohort offers fresh perspectives and insights that enhance our work. Without UROP and the amazing students who've taken part, we wouldn't have made nearly as much progress as we have."

UROP at a Glance

UROP supports nearly 6,300 projects yearly, with 3,200 MIT students participating.

Percentage of Paid UROP Projects

Academic years 2014–2024

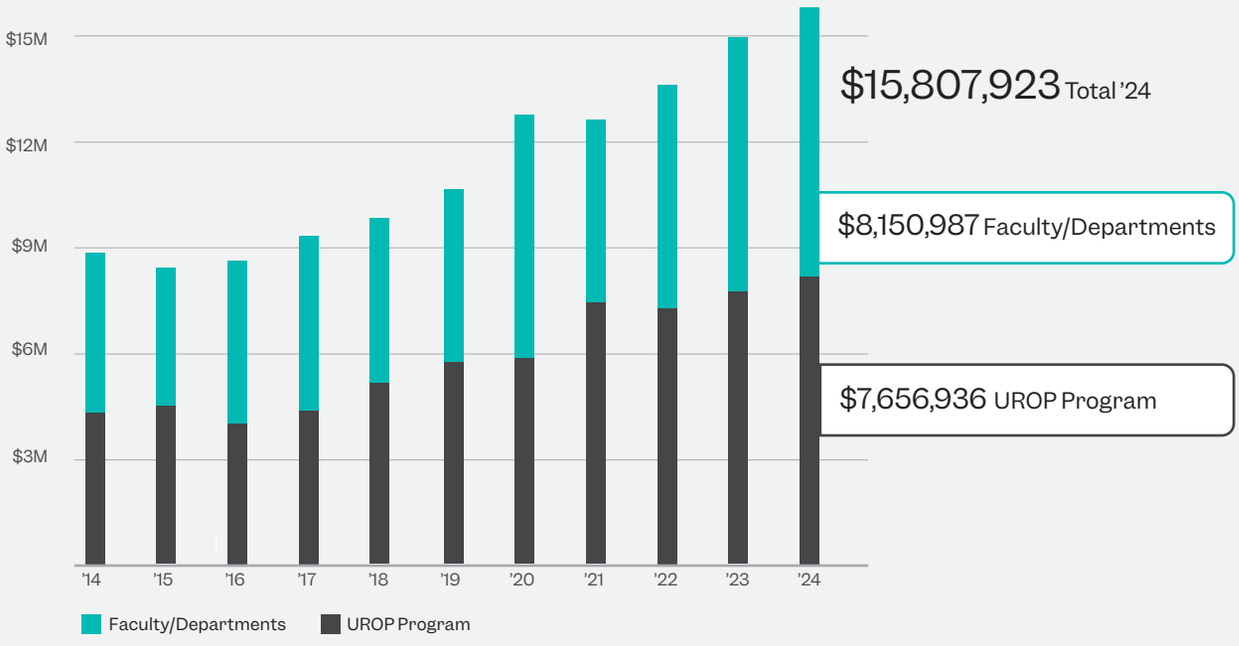


The Partnership Model

Supported through Institute funds and faculty research expenditures, UROP enables students to work as full-fledged members of the MIT research community.

Total Funding

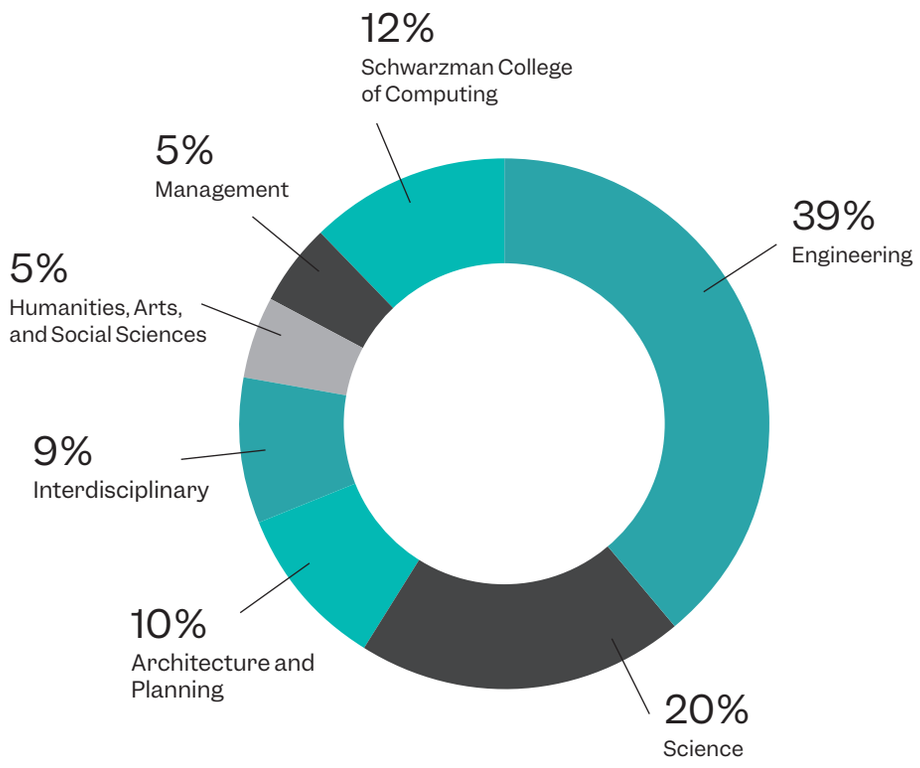
Academic years 2014–2024



Report photography by Ben Gebo. Design by Leone Design. Writing by 43,000 Feet.

UROP Projects by School

Academic year 2023–2024



UROP by the Numbers 2024

91%

OF THE 2024 MIT CLASS PARTICIPATED IN UROP

66%

OF FIRST-YEAR STUDENTS PARTICIPATED IN UROP

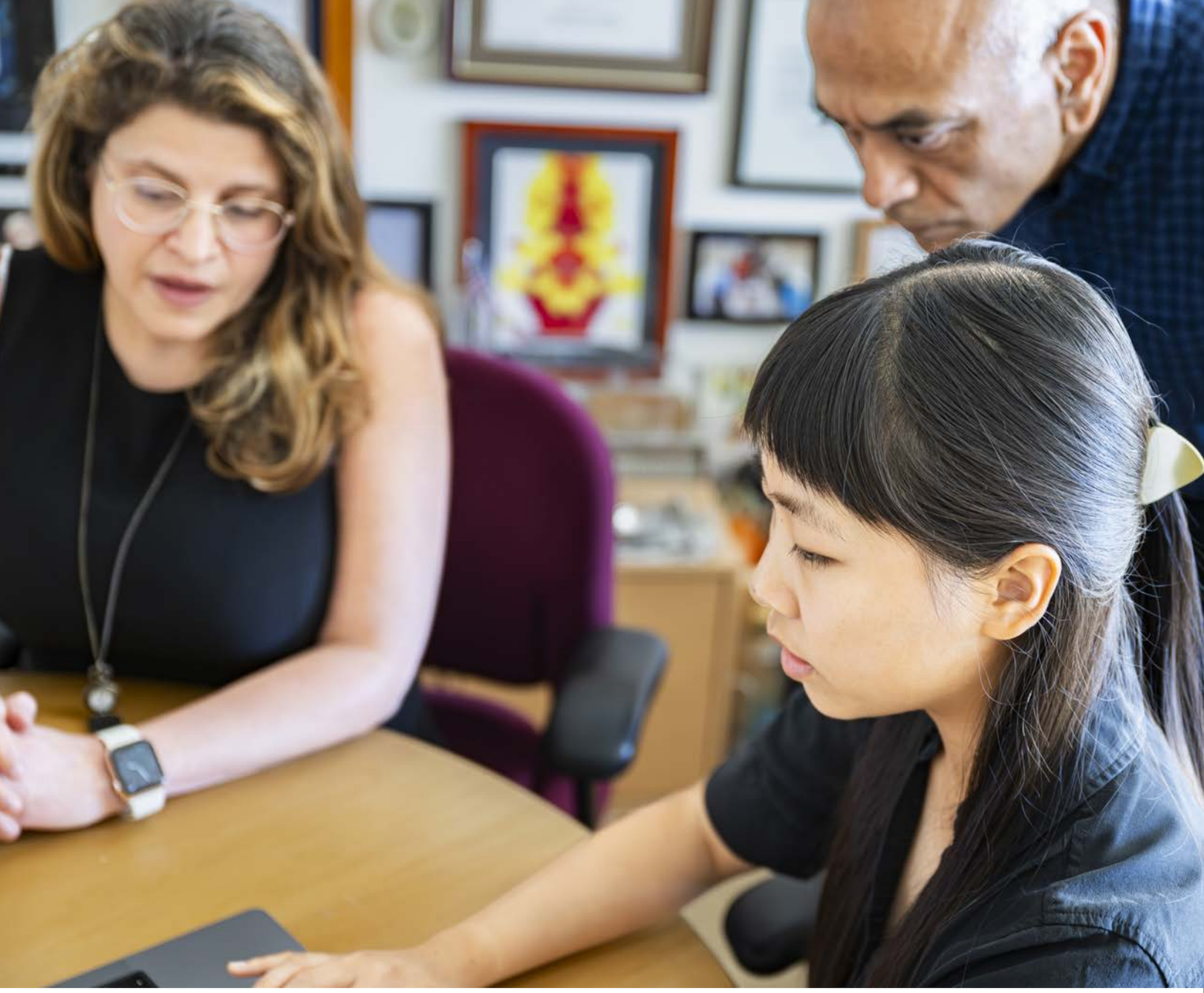
58%

OF FACULTY PARTICIPATED IN UROP AS MENTORS

UROP Empowers

Students tell us that their UROP experiences help them:

- Get to know faculty.
- Develop technical skills.
- Present their work.
- Create research posters.
- Publish their results.
- Prepare for graduate school and careers.



Give today and support the world-changing research—and researchers—of tomorrow

The program costs more than $15 million annually, with nearly three-quarters of UROP's central budget provided by donor support. That's why giving is critical to helping our students pursue their intellectual passions and participate in enriching and—impactful—research opportunities.

Each year, UROP supports over 6,000 projects across MIT, immersing students in pivotal research that examines a diverse range of academic disciplines.

Touching every corner of campus

With 91 percent of undergraduates taking part in at least one UROP before graduation, the program remains MIT's most popular avenue for experiential learning. And as UROP mentors, over half of our faculty cultivate enriching partnerships with student researchers, who bring new perspectives and enthusiasm to cutting-edge research happening across the Institute.

Breaking down financial barriers

For many students, UROP pay is a vital source of financial support, especially in the summer when earning income is essential. However, approximately 15 percent of students who seek UROP funding every year cannot be funded due to budget limitations. With additional donor contributions, the UROP Office aims to meet all student funding requests, ensuring that financial constraints don't limit engagement in undergraduate research.

Making a lasting impact

Endowment contributions will play a vital role in supporting MIT student research for years to come. New funds may be named after the donor or in honor of a particular individual. Based on donor wishes, proceeds from funds and gifts may be allocated to students conducting research in certain fields of study (pending UROP Office approval).

Staying connected, informed, and engaged

The UROP Office ensures that donors see the impact of their giving, helping facilitate communication between donors and UROP fund recipients through presentations, meetings, and other engagement opportunities. In collaboration with donor relationship managers, the office also identifies appropriate annual reporting approaches based on gift size and donor interests.

Giving Level	3.6% Income Yield*	Over One Academic Term Supports	Over One Summer Supports
$100,000	$3,600	1 Student	0.5 Student
$250,000	$9,000	3 Students	1 Student
$500,000	$18,000	7 Students	2 Students
$1,000,000	$36,000	15 Students	4 Students

*Estimates based on UROP student awards of $2,400 (academic year) and $7,680 (summer).

For more information on supporting UROP...

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MIT