

Carnegie
Mellon
University


MAKE
POSSIBLE

THE CAMPAIGN FOR
CARNEGIE MELLON UNIVERSITY

THE MELLON
COLLEGE *of*
SCIENCE



THE MELLON
COLLEGE *of*
SCIENCE



“The future of science lies in combining the foundational sciences with automation, big data and technology. No other university is positioned to do this as well as Carnegie Mellon.”

REBECCA W. DOERGE
Glen de Vries Dean of the Mellon College of Science

**CREATING NEW
METHODOLOGIES.
DRIVING
BREAKTHROUGHS.**

**MAKING *discovery*
POSSIBLE.**

As we enter a new decade, science is ready for a revolution. The pace of discovery is accelerating, and the problems that face the world are growing more complex. Meeting those challenges begins with individuals who are both forward-looking scientists and innovative collaborators.

Combining its long tradition of strength in the foundational sciences with partnerships that harness the university's excellence in data science, automation and technology, the Mellon College of Science is leading the charge into a bold future. Your philanthropic support of MCS through *Make Possible: The Campaign for Carnegie Mellon University* will enable us to:

- Create an environment for foundational science and interdisciplinary research.
- Pioneer new scientific fields.
- Educate and equip future scientists.

The people of CMU's Mellon College of Science have a passion for discovery and a hunger to do transformational science for the good of the world.

**TOGETHER, WE WILL
MAKE IT POSSIBLE.**

CREATE AN ENVIRONMENT FOR FOUNDATIONAL SCIENCE AND INTERDISCIPLINARY RESEARCH

WHEN WE UNITE *to*
ANSWER HUMANITY'S
TOUGHEST QUESTIONS,
**WE CHANGE
THE WORLD**
for the **BETTER —
FASTER.**

By collaborating with partners from across campus and using machine learning, engineering and data analytics, our scientists will accelerate both the process and the impact of scientific research. The Mellon College of Science is creating an environment where human ingenuity meets cutting-edge technology to solve the world's toughest challenges.



WITH AUTOMATION
ON OUR SIDE, *we can*
DEVOTE MORE
ENERGY TO ASKING
“WHAT IF?”

At the Mellon College of Science, we're radically changing how science is done, to make the journey from idea to conclusion faster and more direct — and to accelerate the potential of science to solve critical problems.

It all starts with reimagining the lab.

The current research process requires tremendous time and resources, and it can be prone to human error. An idea leads to an experiment. The experiment is conducted — often involving manual tasks that are repeated over and over. Data is recorded and analyzed. Discovery often comes only after dead ends are explored, failures are overcome and significant effort is invested.

Carnegie Mellon aims to be the first university to host its own cloud lab — a shared, central facility where experiments are largely conducted by robots. Scientists design experiments from a classroom or office. Technicians set up the experiments on location, and the cloud lab executes them efficiently. The data generated is sent to cloud-based servers, where scientists can access it from any place, at any time.

Bruce Armitage, professor of chemistry and co-director of the Center for Nucleic Acids Science and Technology, and graduate student Dmytro Kolodieznyi have already experienced firsthand the benefits of such next-generation technology on their research.

Armitage — whose lab focuses on the design and synthesis of molecules to bind DNA and RNA — says that, using traditional methods, he might synthesize up to three compounds a week. “With robotic technology and automation, we could increase that a hundredfold,” he says. “It greatly increases our chances of finding a compound that’s really successful in the applications that we’re pursuing.”

“If you need to reproduce something, you just ask the robots again,” Kolodieznyi says. “With human performance, in the same experiment, you’re not always getting the same results.”

By automating the process of research, scientists can focus more of their time on asking questions and designing experiments, moving science closer to solving problems like efficiently delivering drugs to cells or treating genetic and infectious diseases. Working with a cloud lab, researchers and students could do dozens of experiments in the same amount of time it takes for a single experiment using traditional methods.

With your support, the Mellon College of Science will revolutionize how science is done and prepare students for the labs and research of the future. In this way, we can give them career advantages and ensure that their impact on the world will be limitless.



“Today, science is about partnership: combining foundational physics, chemistry, math and biology with computation, automation, artificial intelligence and robotics, making scientific research more transparent and more reproducible. And this approach makes scientific innovation faster. At CMU, we are uniquely positioned to create this future.”

GLEN DE VRIES (S 1994)
CMU Trustee and MCS Alumnus

WHEN WE INVEST IN RESOURCES AND SPACES THAT ENHANCE THE PRACTICE OF FOUNDATIONAL SCIENCE, **WE DRIVE DISCOVERY *and* INVENTION.**

By bringing great minds together and giving them state-of-the-art resources, equipment and facilities, the Mellon College of Science will drive life-changing research forward.

With your support, we will:

Create discovery hubs to solve complex problems.

When CMU's strengths in technology, computation and artificial intelligence meet the Mellon College of Science's expertise in foundational science and research, no problem is too large. We're developing powerful cross-disciplinary teams to focus on emerging areas that are ripe for world-changing breakthroughs.



Construct new spaces for science.

MCS is the place where the future of science will be written. We've updated existing spaces to support research in emerging areas of science — such as recently renovated labs for exploring expansion pathology, evolutionary and developmental biology, and quantum materials. The college's growth also requires a new building and labs equipped with robotic and other cutting-edge technologies, as well as reconfigurable, shared spaces that pool resources and foster collaboration. A leading-edge science facility and elevated lab spaces will remove the boundaries between disciplines and ensure our position as leaders of the scientific revolution, now and into the future.

Advance and expand our use of automation.

By drawing on automation, researchers can design and conduct experiments and collect more precise datasets at greater scales and speeds. With further investment in precision robotics, our faculty and students will be able to conduct work in weeks that previously took years, greatly increasing the potential for success.

YOU CAN UNLEASH INNOVATION.

Help make it possible by providing critical support to our college's faculty and students through:

MAKER SPACES

Establish maker spaces in Mellon Institute and Doherty Hall that will provide students and faculty access to advanced simulation and fabrication tools, so that they can create custom scientific instruments and design novel experiments while integrating engineering and computer science into their work.

DEPARTMENT AND EQUIPMENT FUNDS

Provide our departments with the ability to secure the latest technology and address other areas of critical need, giving students and researchers the resources to explore new questions.



PIONEER NEW SCIENTIFIC FIELDS

WHEN WE INVEST IN
OUTSTANDING FACULTY,
we **SPARK**
INNOVATION *for*
GENERATIONS.

By giving acclaimed researchers and educators a community that challenges them and nurtures their talent and creativity, we help make the impossible possible. It's because of our gifted faculty that discovery has a home at the Mellon College of Science.



“Enhancing our status and worldwide reputation will secure CMU’s leadership in applied analysis — and hence the nation’s — and will enable a transformative leap to respond to contemporary challenges in data science that permeate our daily lives.”

IRENE FONSECA

Kavčič-Moura University Professor of Mathematics
Director, Center for Nonlinear Analysis

GREAT MINDS. COLLABORATIVE TEAMS. BIG IMPACT.



Changing the world can start very small. As small as a fruit fly.

Brooke McCartney, associate professor of biological sciences, sheds light on the hidden functions of the human body — functions that can have a profound effect on our health.

“I want to understand how cellular systems work,” she says. “How cells communicate. How that impacts cell behavior. How the genes and proteins within cells carry out their defined paths.”

In her lab, McCartney uses the fruit fly — which has proved a remarkable model for human biology in the areas of immunity, development and animal behavior — to

study the molecules and mechanisms that govern how healthy cells form, in order to better understand how cancer tears them apart. Her multidisciplinary team, which includes students, also uses the insects to explore the body’s complex bacterial ecosystem and how the symbiotic relationship between human and microbe contributes to our health.

McCartney has already gained significant insights into both areas of her research, including connecting alcohol sensitivity with the absence of a particular type of gut bacteria — which could help us better understand triggers for alcoholism.

At the Mellon College of Science, researchers like McCartney join with colleagues to solve real-world problems with global consequences through research and activities in eight multidisciplinary discovery hubs. Built on a foundation of automated science, computation and artificial intelligence, these hubs bring together foundational science researchers, computer scientists, engineers and statisticians from across Carnegie Mellon to work on global-scale problems in collaborative teams.

The results of these collaborations could be profound, leading to innovations like mind-controlled robotic limbs, next-generation batteries and gene-editing techniques based on peptide nucleic acids.

With your support, the Mellon College of Science will enlist more talented, inquisitive faculty like McCartney to bring their considerable skills to these discovery hubs and solve some of the world’s most pressing challenges, one “eureka” at a time.

AMPLIFYING RESULTS THROUGH COLLABORATION.

The Mellon College of Science has eight discovery hubs, each of which pulls together research and researchers from across the university to study challenges in a specific area:

Cosmology

Mathematical Foundations of Artificial Intelligence

Computational Finance

Quantum Computing

Neuroscience

Sustainability Science

Materials of the Future

Life Sciences Breakthroughs

WHEN WE ATTRACT AND
RETAIN THE BRIGHTEST
MINDS, WE SET THE
COURSE FOR THE

THE FUTURE *of* FOUNDATIONAL SCIENCE.

By actively seeking out the best
researchers and most inspiring
educators, we reinvent the
scientific enterprise for the
21st century — and beyond.

**With your support,
we will:**

Strengthen and deepen our research.

By devoting resources to attract dynamic
talent to our college, we will make the
Mellon College of Science an international
destination for top researchers. These
faculty will form deep disciplinary teams
that will drive crucial research and enrich
each department.

Increase seed funding for bigger ideas.

Early-stage, cross-disciplinary research that
addresses fundamental scientific questions is
the first step to scientific breakthroughs. With
resources ready to support these projects, we
will create new avenues to groundbreaking
discovery — and help faculty members bridge
the gap between great ideas and projects ready
for major government or foundation funding.

Boldly recruit and retain new faculty.

To build teams of unparalleled expertise, we
must provide laboratory start-up funding and
other resources that meet the professional
needs of top-tier scientists. This will allow us to
create a haven for experts looking to make an
impact in their disciplines and on the world.



Assistant Professor of Physics
Riccardo Penco studies problems
in physical systems that can be as
small as a beaker and as large as
the universe, finding connections
between seemingly different
phenomena like dark matter,
tides and superfluids. Theoretical
physicists at MCS are poised to
draw on these connections to
reframe how we view and use
the laws of nature.

YOU CAN HELP US BUILD A COLLABORATIVE COMMUNITY OF EDUCATORS AND RESEARCHERS.

Help make it possible by
providing critical support
to our college's faculty
and students through:

ENDOWED PROFESSORSHIPS

Fund faculty to empower their research
and teaching, and help us to recruit and
retain the best professors and scholars.

POSTDOCTORAL AND DOCTORAL FELLOWSHIPS

Bolster the efforts of up-and-coming
researchers by funding studies
and projects that will serve as the
basis for their future careers.

ENTREPRENEURS-IN-RESIDENCE

Spur innovation at MCS with experts
who can help students and faculty
realize their ideas and turn
breakthroughs into businesses.

BREAKTHROUGH FUNDS

Support promising ideas with critical
early-stage funding, encouraging
researchers to push boundaries
and take risks that could lead to
leaps forward in their fields.

WHEN WE ENHANCE STUDENTS' ENTIRE EXPERIENCE, *we will*

NURTURE BETTER SCIENTISTS.

By encouraging students to understand both the process and the consequences of scientific discovery, we help them to fully grasp the implications of their work — and we make sure they're ready to take the lead in the lab, in their communities and in the world.

**DEVELOPING
SCIENTISTS *in*
FOUR
DIMENSIONS.**

The accelerated pace of change in the 21st century touches every aspect of life. This leads to the question: What do today's students need to be tomorrow's scientific leaders?

At the Mellon College of Science, the answer starts with our Core Education program, which is designed to help students develop along four dimensions: as scholars, professionals, persons and citizens. Students enter MCS with a genuine excitement about science, and this program builds on that enthusiasm by providing tools that open their minds to new possibilities.

Instituted in 2015, the curriculum complements the strength of the college's academic departments, adding personal and career skills development, and emphasizing hands-on research — from undergraduate students' very first year.

The heart of the Core Education is a series of seminars and colloquia that occur at critical points in our students' education. First- and sophomore-year seminars focus on developing foundational knowledge, skills and perspectives to support their development as scientists and professionals. A junior-year seminar concentrates on societal impact and scientific communication skills.

Throughout their years at MCS, additional requirements connect them to the arts, wellness resources and service opportunities. That means that during their time at the college, students receive deep training in a chosen discipline and the fundamentals of research, as well as opportunities to:

- Become a critical member of a research team.
- Build a strong community of like-minded peers through shared experiences.
- Lead student groups like the MCS Student Advisory Council or Women in Science.
- Gain experience through internships or volunteer service.
- Attend arts and cultural presentations that expand their perspectives and explore diverse cultures.
- Tutor high school or middle school students working on science fair projects.
- Develop skills in interviewing, resume writing, business etiquette and networking.
- Travel around the world, using science to help others.

With your support, the Core Education program's opportunities for student growth and exploration will be endless, preparing students to lead the next era of discovery for the benefit of humankind.

WE ARE EQUIPPING
OUR STUDENTS TO BE

**GOOD
PEOPLE
and GREAT
SCIENTISTS.**

Today's students are entering an increasingly complex and interconnected world. Supported in their professional and personal growth, they will leave our college ready to be the scientists and citizens our world needs.

With your support, we will:

Give undergrads even greater research opportunities.

Undergraduate research is a defining aspect of the Mellon College of Science experience. By giving students more time at the bench, they'll have more opportunities to discover areas of focus, present at conferences, gain experience for their careers and have their work published.



Develop well-rounded scientists.

By creating and funding learning experiences inside and outside the classroom, we can offer students a clearer path to becoming dedicated scholars, accomplished professionals, engaged citizens and respected individuals.

Invest in advising and skills development for students.

Doing good science is only a fraction of what it takes to be a good scientist. Our scholars must also develop skills in proposal writing, oral presentation and other areas, so that they can explain their work to any audience.

YOU CAN MAKE THE UNDERGRADUATE LEARNING EXPERIENCE A TIME OF BOLD DISCOVERY.

Help make it possible by providing critical support to our college's students through:

UNDERGRADUATE RESEARCH AND ENRICHMENT FUNDS

Enhance and diversify the classroom experience and enable undergraduate students to pursue their own lines of creative inquiry.

SCHOLARSHIPS

Secure an MCS education for tomorrow's talented scientists, regardless of their financial circumstances, and help build a student body that reflects the world they will influence.

PROGRAM SUPPORT

Strengthen our diversity initiatives, student advising programs, and student training and development resources, which impact the MCS experience for all of our scholars and ensure their success in the classroom, in the laboratory and beyond.



**WHAT REVOLUTIONIZES SCIENCE
AND LEADS TO WORLD-
CHANGING BREAKTHROUGHS
is what we MAKE POSSIBLE.**

**JOIN US.
TOGETHER, *we will make this*
UNPRECEDENTED FUTURE
for THE MELLON COLLEGE
of SCIENCE**

POSSIBLE.



**“The Mellon College of Science
will lead the charge into a
bold new future of scientific
discovery. Through its
revolutionary interdisciplinary
research and its dynamic
approach to education, the
college’s students and faculty
are poised to break new
ground and change the world.”**

FARNAM JAHANIAN
President
Henry L. Hillman President’s Chair

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