SCIENCE CONNECTION

Mellon College of Science Magazine | Volume 16 | Winter 2025

Carnegie Mellon University

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SCIENCE CONNECTION

Mellon College of Science
Volume 16 | Winter 2025

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FROM THE DEAN

Welcome! I hope this letter finds you well. I am thrilled to join you as the Glen de Vries Dean of the Mellon College of Science. As head of the Neuroscience Institute, I have watched MCS build a solid foundation that will allow us to make transformative impacts in areas where we excel.

A wholehearted thank you to Curtis Meyer, who has served as interim dean since July 2022, and to Rebecca Doerge, whose leadership lead to the development of the Richard King Mellon Hall of Science, for which construction is moving along, and Carnegie Mellon's Future of Science Initiative, which Carnegie Mellon University has embraced and made a strategic priority.

This issue of Science Connection is about entrepreneurial spirit — an area where our faculty, students and alumni excel. The lead feature shows how faculty and students are leaning into commercializing discoveries developed in labs to solve real-world problems. Many of the stories showcase our people earning accolades and new funding for innovative work.

Seven new faculty members joined MCS in 2024, and two of our most esteemed are moving on to retirement. Sadly, we also lost Alan Waggoner and Josef Dadok, both innovators in their fields. Former colleagues are continuing the work of these icons, honoring their foundational contributions to science.

Our people are our greatest assets. You can learn more about some of our fantastic faculty and students in these pages. Our new webinar series, Threads of Inquiry, also highlights cutting-edge research going on. I look forward to working with this extraordinary MCS community and ensuring that they have the resources and support they need to continue to flourish.

I want to share my enthusiasm for the work happening here locally, nationally and abroad. One of my goals as dean is to make certain that we are not keeping the amazing people and groundbreaking research happening in MCS a secret. Science has the power to transform lives, solve global challenges, and inspire future generations, and it is up to all of us to communicate the importance of science at every opportunity.

As we chart our course for the next 5 to 10 years, it is crucial that we carefully choose areas of focus where we can be truly exceptional. By concentrating our efforts and resources on these key areas, we can continue to make fundamental contributions.

I'll be heading out of Pittsburgh later this year on a cross-country dean's tour, where I hope to meet many of our alumni and families of our students. This tour will be a wonderful opportunity to connect, share a vision for the future and celebrate our collective achievements.

Thank you for your continued support and belief in our mission. Together, we can ensure that our college remains a hub for excellence and innovation for years to come.

Warm regards,

Barbara Shinn-Cunningham
Glen de Vries Dean of the Mellon College of Science

RESEARCH BRIEFS

RADIO TELESCOPES' EARTHBOUND PERSPECTIVE CLOUDS DISCOVERY OF FAST RADIO BURSTS

CMU researchers have discovered that there's not only a bias in how telescopes 'see' but also in how they 'hear.'

Fast radio bursts (FRBs), millisecond blasts of energy from deep space, are one of astronomy's greatest mysteries. Recent research from Carnegie Mellon has found that, like optical telescopes that are more likely to detect brighter objects, radio telescopes tend to detect fast radio bursts from galaxies that fully face the Earth.

"In the universe, galaxies do not have a preferred orientation, so from Earth we should view them at random angles," said Mohit Bhardwaj, a postdoctoral fellow at Carnegie Mellon's McWilliams Center for Cosmology and Astrophysics. "But when we studied a sample of galaxies from which FRBs have come, we discovered an excess of face-on galaxies and a paucity of edge-on galaxies."

According to Bhardwaj, this leads to a significant underestimation of the FRB rates reported in the literature. Their analyses revealed that the estimated rate of FRB production has been underestimated by a factor of at least two.

Bhardwaj and Jimin Lee, a junior at Carnegie Mellon and co-first author on the Nature paper, carried out extensive analyses using different mathematical and statistical tools to determine the inclination angles of 23 FRB host galaxies. Junior Kevin Ji also was involved with the research, which began as an undergraduate project.

STUDY SUGGESTS BACTERIA'S INTERNAL DIALOG CONTROLS EXTERNAL MESSAGING

Bacteria may have been following the old adage "think before you speak" for millions of years.

Bacteria communicate in an incredibly complex chemical language, making and sending chemical messages to neighboring bacteria. Those conversations can be about deciding whether there's enough of them to launch an attack against the host or if it's time to lay low and keep eating, dividing and growing the community.

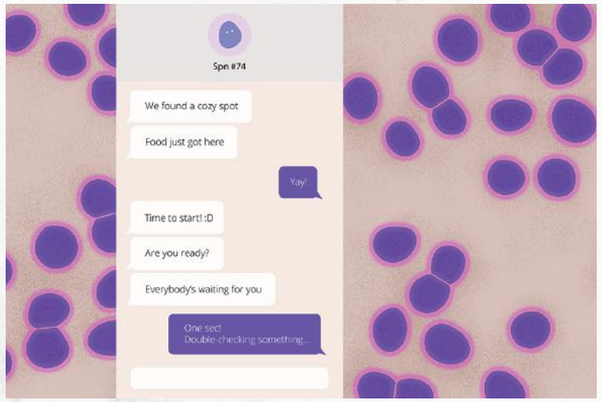
Research from CMU scientists reveals that individual bacterial cells coordinate their messaging internally before sending it out to neighbors.

And, as an individual bacterial cell is orchestrating how it is 'talking,' it is still 'hearing' what the rest of the nearby bacterial community is saying.

"It can still respond to signals from other cells, but it's controlling how it's transferring information to the world. It's very elegant, very intricate," said N. Luisa Hiller, associate professor of biological sciences.

The findings, published in Cell Reports, may have important implications for strategies to develop antibacterial drugs and vaccines.

Karina Mueller Brown, a Carnegie Mellon alumna and a postdoctoral research scholar at the University of Pittsburgh School of Medicine, studied multiple signaling pathways in parallel. In doing so, she identified a common thread that connects two key signaling pathways, both of which contribute to Streptococcus pneumoniae's ability to set up shop in a host and cause disease.



While an individual S. pneumoniae bacterial cell is orchestrating how it is "talking," it is still "hearing" what the rest of the nearby bacterial community is saying.

Example of an Anton supercomputer. Designed and built by D.E. Shaw Research, the third-generation Anton supercomputer will simulate biomolecules roughly 100 times faster than general-purpose supercomputers.

NEW MOVES IN NEUROSCIENCE

According to Carnegie Mellon neuroscientists, there is a clear leader and sidekick when it comes to generating movements.

During purposeful movement, like reaching for a cookie, two parts of the brain are vital, the motor cortex and the striatum. These brain areas are a dynamic duo for controlling movement, yet despite their importance for movement, their relationship with each other is not well understood.

To understand their connection, researchers damaged the motor cortex in mice and observed its impact on behavior and striatal activity. They found that the striatum relies heavily on cues from the motor cortex to control movement. Mice with damaged motor cortexes exhibited reduced striatal activity and struggled with tasks requiring fine motor skills. Though activity improved somewhat over 10 days, it never returned to normal levels. The mice displayed altered behavior such as clinical freezing of gait (FOG), which occurs during conditions such as Parkinson's disease.

"This series of experiments gave us some key insights, but it still only gives us a fairly broad perspective," said Eric Yttri, Eberly Family Associate Professor of Biological Sciences. "We will be following up with more in-depth studies of the freezing of gait effects and the communication between these areas. The goal is to get down in the finer details, to better establish the connections of elements of the circuit."

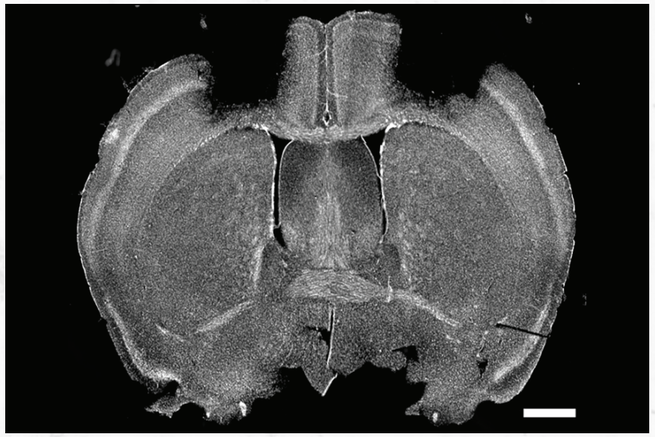
PSC TO HOST THIRD-GENERATION ANTON SUPERCOMPUTER

A third-generation Anton supercomputer (Anton 3), developed by D. E. Shaw Research, will arrive at the Pittsburgh Supercomputing Center (PSC) in 2025. Thanks to a $3.15-million, five-year award from the National Institutes of Health, the system will be available without cost for non-commercial use by biomedical researchers at U.S. universities and other not-for-profit institutions.

Time on the machine will be allotted on the basis of research proposals submitted to an independent expert committee convened by the National Research Council at the National Academy of Sciences. Philip Blood and Marcela Madrid are the project leads at PSC, a joint center of Carnegie Mellon University and the University of Pittsburgh.

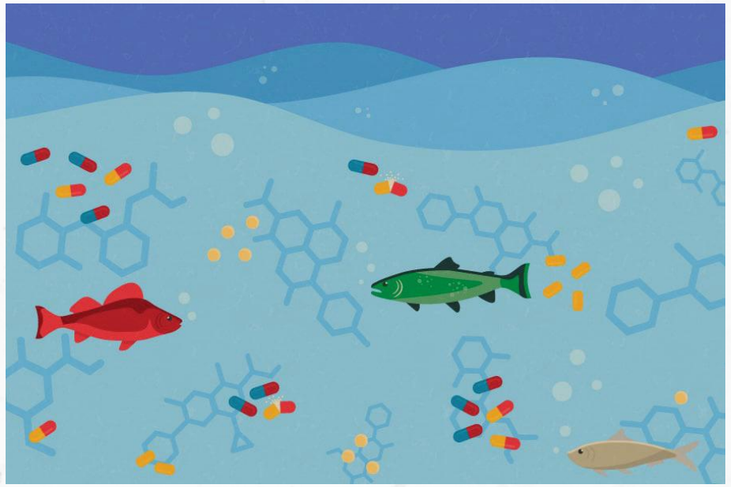
The Anton family of supercomputers was specially designed for atomic-level simulation of molecules relevant to biology (for example, DNA, proteins and drugs). The technology gives scientists the ability to simulate interactions between biomolecules that inform disease research, basic science, and drug design two orders of magnitude faster than possible with general-purpose supercomputers. Like its predecessors, the new Anton was designed from the ground up around a new custom chip to best exploit the capabilities offered by new technologies.

Since the beginning of the Anton project at PSC in 2010, users nationwide have used the system to obtain long-timescale simulations resulting in more than 440 papers with 20,000 citations.



Neuroscientists removed the motor cortex from mice to investigate the role of the motor cortex in conscious movement (image courtesy of Mark Nicholas and Eric Yttri).

TAML CATALYSTS EFFICIENTLY BREAK DOWN PHARMACEUTICALS IN POLLUTED WATERS

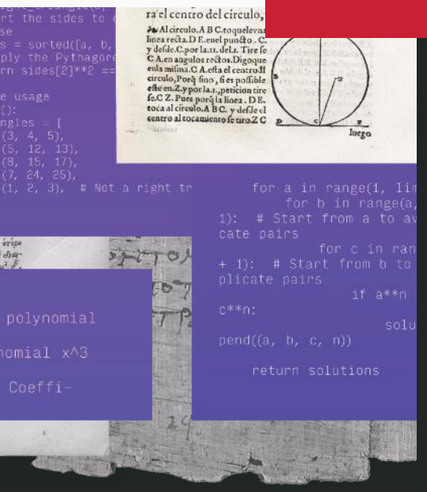


CMU scientists have found that an environmentally friendly process involving a TAML catalyst and hydrogen peroxide effectively degrades several antibiotics and other drugs found in municipal secondary wastewater and contaminated river and lake water. The drugs are representative of the hundreds of chemical micropollutants of concern found globally in wastewater as well as in rivers and streams that supply drinking water.

"This work presents a low-cost, broadly applicable, safe and sustainable solution for purification of pharmaceutical-contaminated waters using an extremely low concentration of catalyst and peroxide," said Terry Collins, the Teresa Heinz Professor of Green Chemistry and Director of the Institute for Green Science at Carnegie Mellon.

The results, published in the journal ACS Sustainable Chemistry and Engineering, show that a next-generation TAML catalyst, called NewTAML, exhibits unprecedented efficacy in activating hydrogen peroxide (H_2O_2) at ultra-low concentrations. Because of a quirk with the catalyst — it lasts longer and does more work as its concentration is lowered — the amounts of TAML and H_2O_2 needed to run the entire process can be dropped substantially in consequence, which ultimately will reduce operating costs.

Past studies with TAMLs have shown their enormous potential to provide clean, safe, more effective alternatives to existing industrial and commercial practices and to provide ways to remediate other pressing environmental problems that currently lack solutions.



NSF Research Training Group Team

Dejan Slepčev, *professor of mathematical sciences and associate dean for Faculty and Graduate Affairs*

Irene Fonseca, *Kavčić-Moura University Professor of Mathematics and director of Center for Nonlinear Analysis*

Gautam Iyer, *professor of mathematical sciences and associate director of the Center for Nonlinear Analysis*

Robin Neumayer, *assistant professor of mathematical sciences*

Noel Walkington, *professor of mathematical sciences*

Sivaraman Balakrishnan, *associate professor of statistics and data science*

Keenan Crane, *associate professor of computer science and robotics*

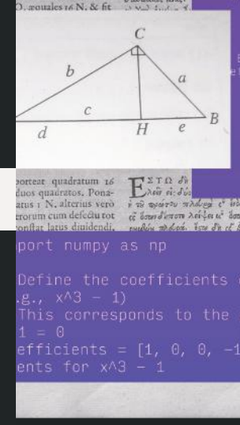
Kaushik Dayal, *Walter J. Blenko Senior Professor of Civil and Environmental Engineering*

Giovanni Leoni, *professor of mathematical sciences*

Matthew Rosenzweig, *assistant professor of mathematical sciences*

Mykhaylo Shkolnikov, *professor of mathematical sciences*

Michael Young, *associate professor of mathematical sciences and associate dean for Diversity, Equity and Inclusion in the Mellon College of Science*



MATH RESEARCHERS AWARDED $2.5M GRANT

Funds from NSF's Frontiers in Applied Analysis program will establish a new cross-disciplinary research training group

The agility of machine learning, discovery of new materials, efficiency of transportation, diagnostic power of medical devices and delight of animated movies can all be attributed to applied analysis research in advanced mathematics.

Researchers at Carnegie Mellon University were awarded a multiyear grant from the National Science Foundation (NSF) to establish a new research training group (RTG) in applied analysis. The effort crosses colleges and delves into the use of sophisticated mathematical models to solve next-generation challenges in science and technology.

Frontiers in Applied Analysis RTG is a five-year program receiving $1.5 million for the first three years, with an additional $1 million in funding considered for the last two years.

Carnegie Mellon's Department of Mathematical Sciences leads the RTG with Professor Dejan Slepčev as the principal investigator, with University Professor Irene Fonseca, Professor Gautam Iyer, Professor Noel Walkington and Assistant Professor Robin Neumayer as co-principal investigators.

"Math is a rigorous study of structures," Slepčev said. "One defines structures and proves theorems about them — nowadays there are people at CMU in engineering, computer science and statistics who are mathematicians by that token. We want to form a better connection between what we do in the department and what is important in the applied fields."

A dozen senior-level faculty are involved across disciplines, including nine from math and one each from statistics and data science, civil and environmental engineering and computer science.

The Center for Nonlinear Analysis (CNA), led by Fonseca, will host several RTG activities. Through the RTG grant, CNA added the Mathematics Outside of Mathematics (MOMA) seminar in the fall of 2024. The monthly series includes speakers from industry, national labs and other academic units who rely on mathematics in their work.

"We want to learn more about mathematical tools that already exist, along with how other disciplines are using them," Fonseca said. "Second, we want to learn more about the problems other disciplines want to resolve, so that we can develop new mathematical tools to address them."

The grant will support a rich ecosystem of activities with opportunities to engage faculty, postdoctoral fellows and students in the advancement of research, applications and workforce development.

Training will take place in different forms. The Frontiers in Applied Analysis Workshop, scheduled for June 2025, is one of three biennial workshops that will invite participants from the U.S. and international partners to share research. Summer school programs will take place for postdoctoral fellows, graduate students and advanced undergraduate students in 2026 and 2028. The RTG will hold the Undergraduate Math Research and Opportunities Conference (UMROC) in 2026 and 2029 to ignite enthusiasm for future career and research opportunities.

Postdoctoral researchers and graduate students also will participate in exchange programs at partner institutions such as the University of Cambridge in the U.K., École Polytechnique Fédérale de Lausanne in Switzerland, Hausdorff Center for Mathematics in Germany and the Max Planck Institute for Mathematics in the Sciences in Germany.

"Our RTG is interdisciplinary and international," Fonseca said. "We hope that with these bridges that we already have we can bring some of the best talent and the best expertise that exists in the world in the RTG areas to come to Carnegie Mellon for periods of time to work with us."

Vertical integration will involve postdoctoral researchers and graduate students in the planning and implementation of RTG activities to allow them to mentor undergraduate students as well as be mentored by faculty.

"It's important to support our postdocs," Iyer said. "In math, it's necessary after earning a Ph.D. to broaden your set of tools in a postdoc position as a proving ground and an extension of your research direction."

Overall, the RTG will help attract students to applied mathematics and will create a technically trained U.S. workforce with expertise in advanced tools of applied analysis ready to engage with future challenges that arise in applied disciplines.

Ann Lyon Ritchie

PHYSICS MAJOR TEES UP EARLY SUCCESS

SAMANTHA WANG NAMED DIVISION III NATIONAL WOMEN'S GOLF FRESHMAN OF THE YEAR

Samantha Wang checks scores obsessively when competing in golf tournaments. On the last round of the 2024 Women's Division III National Golf Championships, she kept even closer tabs on how the Carnegie Mellon University team was doing.

"I was sitting there clicking the refresh button almost after every shot," said Wang, a sophomore majoring in physics. "After I hit my shot on hole 17, I had to check to know. And when I saw the score, in my mind, there was no way we could lose."

The Carnegie Mellon women's team won their first national championship that day, with Wang being named as Division III National Women's Golf Freshman of the Year, and she was recognized nationally by the Women's Golf Coaches Association.

Wang became interested in golf growing up in Singapore. She received a set of toy clubs at the age of 5. Her real passion started when she joined her father on the links.

At 13, she started beating her father. In high school she joined the varsity team and competed in tournaments against students from other international schools in southeast Asia.

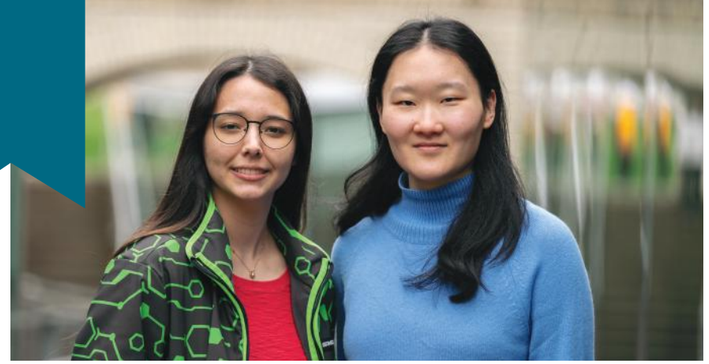
When she started her college search, she said golf was a factor. She met Dan Rodgers, Carnegie Mellon's coach of the men's and women's golf teams, on a visit to Pittsburgh, and she said that his demeanor and attitude helped her realize that Carnegie Mellon was the right fit.

Wang competed in her first collegiate tournament in fall 2023. She said she struggled during her first semester, both in her golf game and with the transition to college. With the help of teammates, she found herself growing in confidence both in her sport and in the classroom. She won two tournaments as an individual.

Wang is looking forward to the future and wants to conduct research into astrophysics and cosmology. Ultimately, she said she has her eye on being team captain, so she can provide teammates the same support she received.

Kirsten Heuring

PHYSICS STUDENTS NAMED GOLDWATER SCHOLARS



Carnegie Mellon University physics students Yunshu Li and Katherine Parry have been selected to receive the 2024 Barry Goldwater scholarship. The students were selected from a pool of more than 5,000 applicants for the federally endowed award, which provides full coverage for tuition, fees, books, and room and board.

The award from the Barry Goldwater Scholarship and Excellence in Education Foundation is specifically given to sophomores or juniors who display academic rigor and a strong commitment to pursuing education in the natural sciences, engineering or mathematics.

Yunshu Li, a physics senior, is a Pittsburgh native whose academic research has spanned multiple fields at Carnegie Mellon and the University of Pittsburgh.

Li received the Robert W. Kraemer Award for her work as a first-year student. Her first research experience at CMU was in Stephanie Tristram-Nagle's experimental biophysics lab, where she studied novel antibiotic treatments for multidrug-resistant bacteria. She continued to make progress in the study of novel antimicrobials in the laboratory of Dr. Berthony Deslouches at Pitt.

Li currently conducts research into the effects of attention on different levels of the auditory processing pathway in the Lab in Multisensory Neuroscience at CMU.

Katherine Parry is a senior studying electrical and computer engineering and physics. Her research focuses on designing faster computers based on alternative approaches to computation.

Parry is not a stranger to research. At the age of 16, she presented findings related to the computation of a square at the IEEE Symposium on Computational Arithmetic, resulting in her first published paper.

At Carnegie Mellon, she has co-authored papers in the Computational Arithmetic community. She said the reputation and resources at Carnegie Mellon have helped her further establish herself as a researcher.

Alex Johnson & Krista Burns

PHONEPRASERT WINS GILMAN AWARD

Claire Phoneprasert wants to help others. During college she did just that as a member of the Carnegie Mellon University Emergency Medical Services (CMU EMS) and as a teaching assistant in biological sciences.

"Both of these experiences really taught me that I wanted to help people," said Phoneprasert, a recent neurobiology graduate.

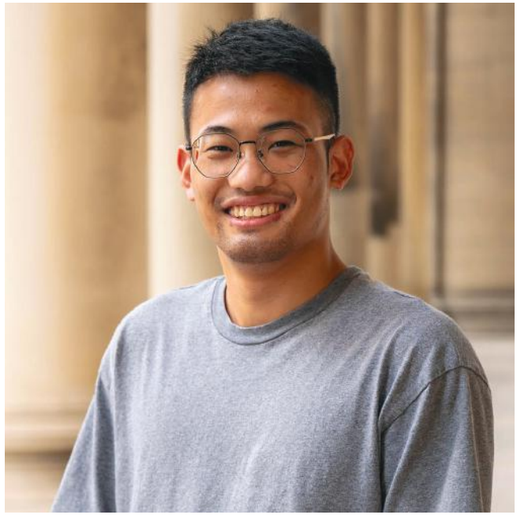
She learned from both. As part of CMU EMS, she learned the value of having a good bedside manner and the importance of treating both physical and emotional needs of patients. As a teaching assistant and a supplemental instructor for a range of courses covering biology and psychology, she learned about making everyone feel supported.

"The Department of Biological Sciences is amazing," said Phoneprasert, who intends to apply for medical school in fall 2025. "I had a really great experience in my bio labs, and it felt really gratifying to come back and make an impact as a TA."

Phoneprasert earned the 2024 Mellon College of Science Gilman Award, which is given to a graduating MCS student who has demonstrated exceptional commitment as a scholar, professional, citizen and person.

Kirsten Heuring

LUO RECEIVES McWILLIAMS FELLOWSHIP



Carnegie Mellon University doctoral student Lianshun (Evan) Luo finds value in gold quantum rods.

Luo, whose research focuses on understanding the unusual optical and electronic properties of non-spherical gold nanoclusters, works in Chemistry Professor Rongchao Jin's lab, which develops new methodologies to create gold nanoparticles with precise numbers of atoms.

For his work, Luo received the Bruce McWilliams Graduate Fellowship, which provides tuition, a stipend and fees for one academic year to a graduate student in the Mellon College of Science who is studying an area where Carnegie Mellon has a comparative advantage and where research is at an emerging or critical stage.

When nominating Luo for the fellowship, Jin wrote that "Evan's ingenious work has led to a success in achieving a series of atomically precise, anisotropic nanoclusters of metals."

Luo synthesized a series of gold quantum rods that strongly absorb and emit in the near-infrared, making them 100 times stronger than commercially available organic dyes. The work was published in the Proceedings of the National Academy of Sciences in February of 2024.

The near-infrared photoluminescence of the rod-shaped nanoclusters holds potential in applications such as noninvasive biomedical imaging and boosting silicon and organic solar cell efficiency.

Tricia Miller Klapheke

MACKENZIE RILEY WINS RESNIK AWARD

As a member of Professor and Chemistry Department Head Bruce Armitage's group, recent alumnus Mackenzie Riley worked on multiple projects in the lab, and her independent research focused on RNA imaging and a DNA configuration known as G-quadruplex structures.

She created a variant of a molecule known as a peptide nucleic acid (PNA) that selectively binds to damaged quadruplexes. During her senior year, she worked with Armitage and Huaiying Zhang, assistant professor in the Department of Biological Sciences, to develop fluorescent PNA that can bind to RNA originating from telomeres, the end points of the chromosome.

Being able to tag this RNA, known as TERRA, will allow for visualization of TERRA's function within cells. Because of Riley's work, the Zhang lab will study the function of TERRA in cancer and tumor formation.

For Riley's efforts in the lab and as a supplemental instructor and peer tutor for the Student Academic Success Center, she won the Carnegie Mellon's 2024 Judith A. Resnik Award, named for Challenger astronaut and alumna Judith Resnik. The award recognizes an exceptional undergraduate woman graduating in a technical course of study.

Riley is now pursuing a Ph.D. in chemistry at the Massachusetts Institute of Technology. Armitage said that he was proud of Riley and her work.

Kirsten Heuring

PAYTON DOWNEY WINS FUGASSI AND MONTEVERDE AWARD

Payton Downey lights up when it comes to chemistry research.

"I like understanding something I didn't before," said Downey, who graduated from the Department of Chemistry. "There's a lot to enjoy in this field of work, and when I see my ideas work, it's really satisfying."

Downey conducted research with Stefan Bernhard, professor of chemistry, to investigate the fluorescence of different chemical compounds. In the course of their research, Downey used computational models to find that the chiral molecules constantly spin around their bonds, which affect luminescence.

Outside of the lab, Downey was part of the Carnegie Mellon chapter of PRISM, an LGBTQ+ student organization with chapters across the country. In their first year, the organization helped them find a community, even when the COVID-19 pandemic prevented students from meeting in person. Their senior year, Downey served as president of the organization, hoping to give back to the group that made a large impact on their own Carnegie Mellon experience.

For their work, Downey was honored with the Dr. J. Paul Fugassi and Linda Monteverde Award.

Downey graduated as part of the B.S.-M.S. program in chemistry. In fall 2024, they joined the Max Planck Institute in Dresden, Germany, to pursue their Ph.D.

■ *Kirsten Heuring*

GRACE BENKART WINS CARNEGIE MELLON WOMEN'S ASSOCIATION AWARD

Recent CMU alumna Grace Benkart wants to make a big impact, and she started by making a difference in the lives of Pittsburgh children and teens.

Benkart, who majored in neuroscience, volunteered with Strong Women Strong Girls (SWSG) and worked for the University of Pittsburgh Medical Center (UPMC) Children's Hospital.

SWSG partners with local universities to pair elementary school girls with a college-age female mentor. Benkart became part of SWSG and quickly started to take on leadership roles such as supply manager, social chair and chapter director, where she helped organize a field trip for girls participating in SWSG to visit Carnegie Mellon.

Benkart also worked as a health unit coordinator in the oncology unit at the UPMC Children's Hospital.

In recognition of her commitment and hard work, Benkart was awarded the Carnegie Mellon Women's Association Award.

She plans to apply to medical school and continue to work in a field involving pediatrics. For now, she is taking a gap year to work as a patient care technician in UPMC Children's Hospitals oncology unit.

"I'm excited to expand the way I'm working with patients and hopefully be able to make a bigger impact on these families," Benkart said.

■ *Kirsten Heuring*

RAFAEL GUZMAN-SORIANO WINS K&L GATES PRIZE

The future is bright for Rafael Guzman-Soriano, Carnegie Mellon University's 2024 K&L Gates Scholar, whose time at Carnegie Mellon left him feeling prepared for what's next.

The $5,000 prize is given to one graduating undergraduate student who has inspired their fellow students to love learning through a combination of intellect, scholarly achievement, engagement with others and character.

Guzman-Soriano started college in the fall of 2020, at the height of the COVID-19 pandemic. He said he experienced loneliness and imposter syndrome despite earning top marks in his courses. Support from faculty helped him through.

His academic adviser, Karen Stump, recommended him for the Mellon College of Science's Leadership Development Seminar, taught by Michael Murphy, distinguished service professor and executive director of the Center for Leadership Studies.

"One takeaway from the seminar was a lesson on phrasing your success," Guzman-Soriano said. "I used to say 'I got lucky' a lot, but it's more, like, 'being ready.' I use the skills, resources and everything that I've learned from prior experiences to seize opportunities and succeed in them."

As a Tartan Scholars Ambassador and a peer tutor in the Student Academic Success Center, Guzman-Soriano helped other students avoid the struggles he experienced.

■ *Ann Lyon Ritchie*

GRADUATE STUDENT AWARDS

GUY C. BERRY RESEARCH AWARD

Ting-Wei Chao is rarely satisfied, and such a quality is perfect for discrete mathematics.

Chao, who graduated with his Ph.D. from the Algorithms, Combinatorics and Optimization Program at Carnegie Mellon University, applied his remarkable persistence to make a meaningful contribution to extremal combinatorics.

Chao said he enjoys theoretical work "behind the scenes" to come up with techniques to be used by researchers like computer scientists who want to confirm their algorithms.

About three years into his graduate studies, Chao had co-written several papers. Mathematical Sciences Professor Boris Bukh, Chao's advisor, said he was ready to lead his own work.

"He set himself to prove the sharp bounds for the 'joints problem,' which is the most basic result in that area," Bukh said. "Ting-Wei and his collaborator did succeed, and in doing so they found unexpected connections to the 'entropy method.' The math they created is a kind of math that other mathematicians are likely to read and use."

Chao is the 2024 recipient of the Guy C. Berry Graduate Research Award, which recognizes excellence in research by MCS graduate students and was established in 2005 by Guy C. Berry, emeritus university professor of chemistry.

HUGH D. YOUNG TEACHING AWARD

Carnegie Mellon University's Zoe Wellner inspires others to give mathematical sciences a try.

"I try to break down any fear or discomfort in approaching the material," said Wellner, who graduated with her doctorate from the Department of Mathematical Sciences. "Students not only heal their relationship with math, but also get a lot more out of their mathematical studies and other subjects."

Wellner served as a teaching assistant for the Introduction to Mathematical Concepts course, a primary instructor for Calculus I, and taught at Canada/USA Mathcamp, an international summer program that introduces areas of advanced mathematics to high school students.

Clive Newstead, assistant teaching professor of Mathematical Sciences, described Wellner's contributions to the department and to the university as a "jaw-dropping number."

"Zoe has a constant drive to bring mathematics to the masses, to advise and mentor others and to make strides to improve diversity, equity and inclusion along the way," Newstead said.

She is the 2024 recipient of the Hugh D. Young Teaching Award. The Young Award was established in 1995 in honor of Hugh D. Young, a professor of physics at the Mellon College of Science and is presented to one MCS Ph.D. student annually.

■ *Ann Lyon Ritchie*

MS-DAS STUDENT AIMS TO CHANGE THE FACE OF PROGRAMMERS

Cleft lips and palates are the most common facial malformation of newborns and affect more than an estimated 200,000 infants globally. Without reconstructive surgery, infants can be at risk for problems eating and breathing and have speech or language delays.

Carnegie Mellon University master's student Gayatri Chabra wants to join the community of researchers studying cleft palates in utero.

"Data science can play a huge role in building interactive models to detect abnormalities and make treatment more accessible," she said.

Chabra, who graduated from the M.S. in Data Analytics for Science (MS-DAS) program, was born with a cleft lip and a cleft palate. She underwent a series of operations and medical challenges and wants to be part of a solution for families impacted by this birth anomaly.

"This work requires statistical means and decoding the DNA sequence. I believe my studies will prepare me to develop algorithms and build data science models. That's why I need this program at CMU," she said.

Chabra packed in all the learning and experience she could, aiming to work in industry and build her own skills in data analytics. A graduate of the University of Delhi's Jesus and Mary College with a bachelor's degree in mathematics, she is excited to combine her love of the discipline with her passion for biomedical research.

At college, which was an all-girls environment, Chabra said she was awed by the powerful woman all around her.

"It's so motivating," she said. "You feel like doing so much more." One upper-class student created a math newsletter for the whole college, breaking down concepts in articles that were interesting for the entire student body. Chabra

was inspired by a project that made students interested in learning more about her favorite subject.

"I immediately got involved and was eventually promoted to editor-in-chief of the newsletter," she said.

The extracurricular project grounded Chabra at a time when she was struggling with pure and abstract math. She said she craved something she could apply practically in the real world and began looking at other fields. She discovered data analytics and data science, built upon linear algebra, statistics and probability — math concepts she loved. As Chabra completed internships, she reached out to graduate programs around the world.

Carnegie Mellon's MS-DAS program stood out to her because of the diverse backgrounds of the enrolled students. Degree candidates come to the one-year program with backgrounds in disciplines such as biology and other foundational sciences in addition to engineering and, in Chabra's case, mathematics.

"Students come to the MS-DAS program with a broad range of talent," said Manfred Paulini, MCS associate dean for research, MS-DAS executive director and professor of physics. "Gayatri is exactly the type of student we strive to enroll. She is not only academically strong but more importantly somebody who cares about others around her. She will use the data analytic tools and machine learning skills acquired in MS-DAS to keep solving societal problems."

Before she enrolled, Chabra said she learned that some of the master's degree candidates volunteer with a Pittsburgh chapter of Girls Who Code. The combination of service, fostering a community of women in STEM, and the MS-DAS curriculum sealed the deal, she said.

"We need more women in STEM, and Girls Who Code aims to close the gender gap in technology. To essentially change the image of what a programmer looks like and does," Chabra said.

Middle school girls enrolled in the program learn to code in Python over the course of a semester. Chabra helped teach loops and tables, emphasizing project management and presentation skills along the way. Teaching young girls the basics of programming benefitted Chabra's own studies.

"They tend to ask questions from a fresh perspective, and I hadn't paid attention to those nitty gritty details before. It was a good learning experience for me as well," she said.

Her professors in the MS-DAS program agree.

"Gayatri was an inquisitive, goal-oriented, and highly capable student in my Computational Linear Algebra course in the Fall of 2023," said Jason Howell, a teaching professor in Carnegie Mellon's Department of Mathematics. "I was very impressed with her commitment to learning, and she excelled at all aspects of the course."

■ *Katy Rank Lev*

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FROM IDEA TO INDUSTRY

CMU Supports MCS Researchers Transforming Ideas Into Opportunities

Stefanie Sydlik's first research lab experience shaped her trajectory as a scientist-inventor.

As a junior at Carnegie Mellon University, she joined Rick McCullough's lab, which was developing regioregular polythiophenes — plastics that conduct electricity. A few years before Sydlik joined the lab, McCullough co-founded Plextronics, Inc., a company that used his polymers to produce electronics such as solar panels and organic light emitting diodes. Plextronics was acquired by Solvay in 2014.

She recalls McCullough's advice: simplify your synthesis for potential commercialization and, when you make something new, consider if it is patentable.

"I don't think most chemists are taught to think: Is this an invention? You're thinking, I'm mixing A and B and making C. Well, if no one's ever made C before, that's something new. It's an invention," said Sydlik, associate professor of chemistry and biomedical engineering at Carnegie Mellon. "His approach colored my whole career."

For her graduate and postdoctoral training, she sought out mentors who addressed real-world problems that ultimately had commercial value. When she sought an institution for her career, one of her key factors was the university's tech transfer ecosystem and policies. Her undergrad alma mater stood out.

"Carnegie Mellon has a really supportive environment for inventing and for inventors," she said. "It encourages us to look and see if our research is patentable and provides the resources for helping us understand the business and entrepreneurship side. Not every university does."

Today, Sydlik leads her own group at Carnegie Mellon that focuses on commercializable technologies for solving societal concerns. Her first start-up company, BioBind, is developing a therapy to treat low-level lead poisoning.

BENCHWORK TO BUSINESS CONCEPT

For scientist-inventors, having an innovative idea is the beginning. Knowing what to do with it comes next.

Carnegie Mellon's Center for Technology Transfer and Enterprise Creation (CTTEC) guides faculty and students through the process of transferring invention to industry where they can be developed into commercial products.

The CTTEC team works to protect discoveries through patent work and advances them by licensing intellectual properties to existing private companies or creating new start-ups.

"When someone comes to me with this kernel of an idea that just needs to be matured, I get invested into it right away. I want to see it prevail," said Brad Runyon, CTTEC's manager of business development and licensing for MCS. "And those of us in the tech transfer office have the correct skill sets and competencies to do that."

Over the past 20 years, the CMU tech transfer team has assisted faculty and students with thousands of patent applications, licenses, options and other agreements. In 2022, Carnegie Mellon was ranked first in university technology transfer and commercialization by Heartland Forward, an economic development nonprofit. The group touted the university's unique entrepreneurial culture and focus.

"CTTEC is simply spectacular," said Terry Collins, the Teresa Heinz Professor of Green Chemistry and director of the Institute for Green Science at Carnegie Mellon. "I wouldn't be surprised if it's the best office in the country given its impact on the university and on regional innovation."

Collins has worked with CTTEC for 30 years to protect and commercialize his invention — TAML catalysts. The bio-inspired, environmentally friendly molecules can remove harmful chemicals from the environment and then vanish once their work is done. More than 10 U.S. and over 100 international patents cover TAML technology. In 2021, Carnegie Mellon entered a licensing agreement with Sudoc, LLC to market it.

Sudoc has operations in Cambridge, Massachusetts; Charlottesville, Virginia; and Pittsburgh, Pennsylvania. The company is developing a range of TAML-based products that will — among other applications — treat mold, clean

Dilute Oxidation Technology™ uses TAML® catalysts to make high-powered, low-chemical formulas that address difficult cleaning problems (Image courtesy of Sudoc).

wastewater and mineralize waste pharmaceuticals. Sudoc received Fast Company's 2022 World Changing Ideas Award and was named one of 10 Startups to watch by Chemical & Engineering News in 2021.

Robert Wooldridge, Carnegie Mellon's associate vice president and head of CTTEC said that he was "delighted to find a group of investors and entrepreneurs in Sudoc so well-suited to carrying out the commercialization efforts needed to bring this remarkable chemistry to market."

Sydlik's BioBind and Collins' Sudoc are two of a dozen companies spun out by Mellon College of Science faculty over the last 10 years.

FROM RESEARCH TO REVENUE

Runyon said he receives emails daily from undergraduate and graduate students, faculty and alumni who are looking for advice or who have a potential invention. An important first step is to determine if they have something new. If so, the next step is to take the necessary steps to protect it.

"But you also have to think about the other side, which is: do people actually want or need a solution to this problem?" Runyon said.

Sydlik learned this firsthand as part of the National Science Foundation Innovation Corps (I-Corps) program, which helps researchers investigate commercial potential of their work. Carnegie Mellon's NSF I-Corps Hub Program is offered through the Swartz Center for Entrepreneurship.

During the seven-week, entrepreneurial training program, Sydlik and two of her team, Stephen Schmidt (Chemistry Ph.D. 2023) and Brian Holt (BME Ph.D. 2015, Chemistry Postdoc 2019) conducted customer discovery interviews with more than 100 people.

"We talked to them about the problem that our solution was trying to address and ascertained if they wanted the solution," she said. Many of Sydlik's technologies address heavy metal remediation, either with a systemic chelation treatment or technologies that remove heavy metals from food or water.

In this case, Sydlik was assessing the market viability of a cobalt chelator she designed to treat metallosis, a condition caused by the buildup and shedding of debris when metal joint replacement devices rub against each other. The interviews showed them that there wasn't a market there.

Metal-on-metal prosthetics are no longer used, and people with them either have them replaced or are happy.

"No one wanted our solution," Sydlik said. "Our customer discovery led us to realize, people do want to get rid of all the other heavy metals, though. It's not that big of a difference between cobalt and lead or mercury or arsenic."

The end result? BioBind.

A number of Carnegie Mellon graduate students and postdoctoral researchers have gone through the I-Corps program, including Amber Lucas, who earned a Ph.D. in 2018 in biological sciences. Lucas co-founded Impact

Impact Proteomics' ProMTag Multiomics DNA, RNA, Protein Sample Prep kit (Image courtesy of Impact Proteomics).

Proteomics with Biological Sciences Professor Jonathan Minden. Recognized by the innovation intelligence firm StartUs Insights as one of the top five biotech startup companies advancing biochemistry solutions globally, Impact Proteomics' technology for immune-profiling and antigen discovery enables researchers across academia and industry to identify new therapeutic and diagnostic targets in a way that existing immunoassays cannot.

The university's technology transfer ecosystem provides opportunities for students to participate in translational research, gain experience in the process of obtaining a patent and work with industry, start-ups and manufacturers.

Raman Bahal, who graduated with a Ph.D. in chemistry in 2012, was a student in Chemistry Professor Danith Ly's lab during the time Ly was developing peptide nucleic acid (PNA) technologies that would go on to become the basis of his first start-up company NeuBase, which developed antisense therapies to address genetic diseases.

"Danith Ly is incredibly brilliant on the industry side and his inventions have had valuable impact," Runyon said.

"I feel so lucky that I was part of that journey," said Bahal, associate professor in the Department of Pharmaceutical Sciences at the University of Connecticut. "I saw everything: how the gamma-PNA evolved in terms of synthesis, biological activity and startups from Danith's lab."

As a director of his own lab, Bahal modifies gamma-PNA molecules, using them to target oncogenic DNA, a root cause of cancer. He also has discerned that PNA can be used as a combination therapy for cancer treatment. He is working on patents for his technologies and is talking with venture capitalists about licensing the technology or launching a startup to get the therapies to patients.

Like Bahal, Sydlik said she lucked out in ending up with Rick as a mentor.

"I really credit a lot of the formative ways that I think about research to Rick and to my experiences as an undergrad at Carnegie Mellon. And the tech transfer office really helps expose us to that other side of entrepreneurship beyond just being an inventor," Sydlik said.

■ *Amy Pavlak Laird*

ACTIVE MCS START UPS & PIPELINE

Anactisis
Chemistry

Ansatz
Chemistry

BioBind
Chemistry

Biocognon
Chemistry

BioHybrid Solutions
Chemistry

Chement
Physics

Impact Proteomics
Biological Sciences

Liquid X
Chemistry

LumiShield
Chemistry

Magnify Biosciences
Biological Sciences

Sharp Therapeutics
Chemistry

Sudoc
Chemistry

BARTH, TETALI ELECTED 2023 AAAS FELLOWS

Two Mellon College of faculty members were elected as 2023 fellows of the American Association for the Advancement of Science (AAAS).

ALISON BARTH

Barth was recognized for distinguished contributions to the field of cellular and systems neuroscience, particularly in linking molecular mechanisms of synaptic plasticity to behavioral learning.

Barth, who joined Carnegie Mellon in 2002, holds the Maxwell H. and Gloria C. Connan Professorship in the Life Sciences along with appointments in the Department of Biomedical Engineering and the Neuroscience Institute.

She has been a pioneer in developing molecular methods to understand brain-scale neural circuit plasticity and function. Her recent work has focused on understanding brain algorithms that enable learning, and using these circuit principles to design robust and efficient engineered systems.

PRASAD TETALI

Tetali was recognized for contributions to discrete mathematics and service to the scientific community. The Alexander M. Knaster Professor and head of the Department of Mathematical Sciences, Tetali focuses his research on probability theory, discrete mathematics and approximation algorithms.

In 2021, Tetali came to Carnegie Mellon from Georgia Tech, where he had been a member of the School of Mathematics faculty since 1994 and held a joint appointment in the College of Computing since 2000.

Tetali has published more than 100 research papers. Among his research honors, Tetali was named a fellow of both the American Mathematical Society and the Society for Industrial and Applied Mathematics.

ISAYEV NAMED INAUGURAL CARL & AMY JONES PROFESSOR OF INTERDISCIPLINARY SCIENCE

Olexandr (Oles) Isayev uses interdisciplinary approaches to drive rapid advancement in the field of drug discovery and materials science. He has been named the inaugural Carl & Amy Jones Professor of Interdisciplinary Science.

Isayev joined the Department of Chemistry as an assistant professor in 2020. He has a joint appointment in the Department of Materials Science and Engineering and is affiliated with the Department of Computational Biology.

The chair is named for 1956 Mellon College of Science alumnus Carl and his wife, Amy, Jones. Through a generous gift they established an endowment that supports the chair and the future of science through interdisciplinary collaborations and the Carl & Amy Jones Lecture in Interdisciplinary Science.

MCS FACULTY HONORED WITH PROFESSORSHIPS

Five Mellon College of Science faculty members have been honored with professorships to support their work in biological sciences, mathematical sciences and physics. Theresa C. Anderson, Alan Frieze, Diana Parno, Ira Rothstein and Fangwei Si were recognized at a reception Sept. 16 in the Cohon University Center.

“Professorships are among the highest academic honors that the university can bestow upon a member of our faculty,” said James H. Garrett Jr., provost and chief academic officer. “They allow our recipients to access resources that will expand their research and generate meaningful work.”

Frieze and Rothstein received endowed professorships that will support their work at Carnegie Mellon. Anderson, Parno and Si received career development professorships that support scientists at the beginning of their careers.

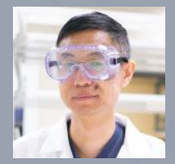
“As I look at the recipients sitting in front of me, I get really excited about what they represent for the Mellon College of Science, for Carnegie Mellon and for the advancement and future of research,” said Curtis Meyer, then-interim dean of MCS.

THERESA C. ANDERSON
The Gregg Zeitlin Associate Professor of Mathematical Sciences at Carnegie Mellon University

ALAN M. FRIEZE
Orion Hoch, S 1952, University Professor of Mathematical Sciences

DIANA PARNO
Falco DeBenedetti Associate Professor of Physics

IRA ROTHSTEIN
Buhl Professor of Theoretical Physics



FANGWEI SI
Cooper-Siegel Assistant Professor of Physics

KEN HOVIS RECEIVES ASHKIN AWARD

Neuroscientist and CMU alum Ken Hovis studies deep parts of the brain, but the potential he recognizes in all first-year students has made him a remarkable teacher.

“When you’re a student, four years seems like forever, but the amount of growth you see in students over those four years is really incredible,” Hovis said.

Hovis is the assistant dean of educational initiatives at the Mellon College of Science.

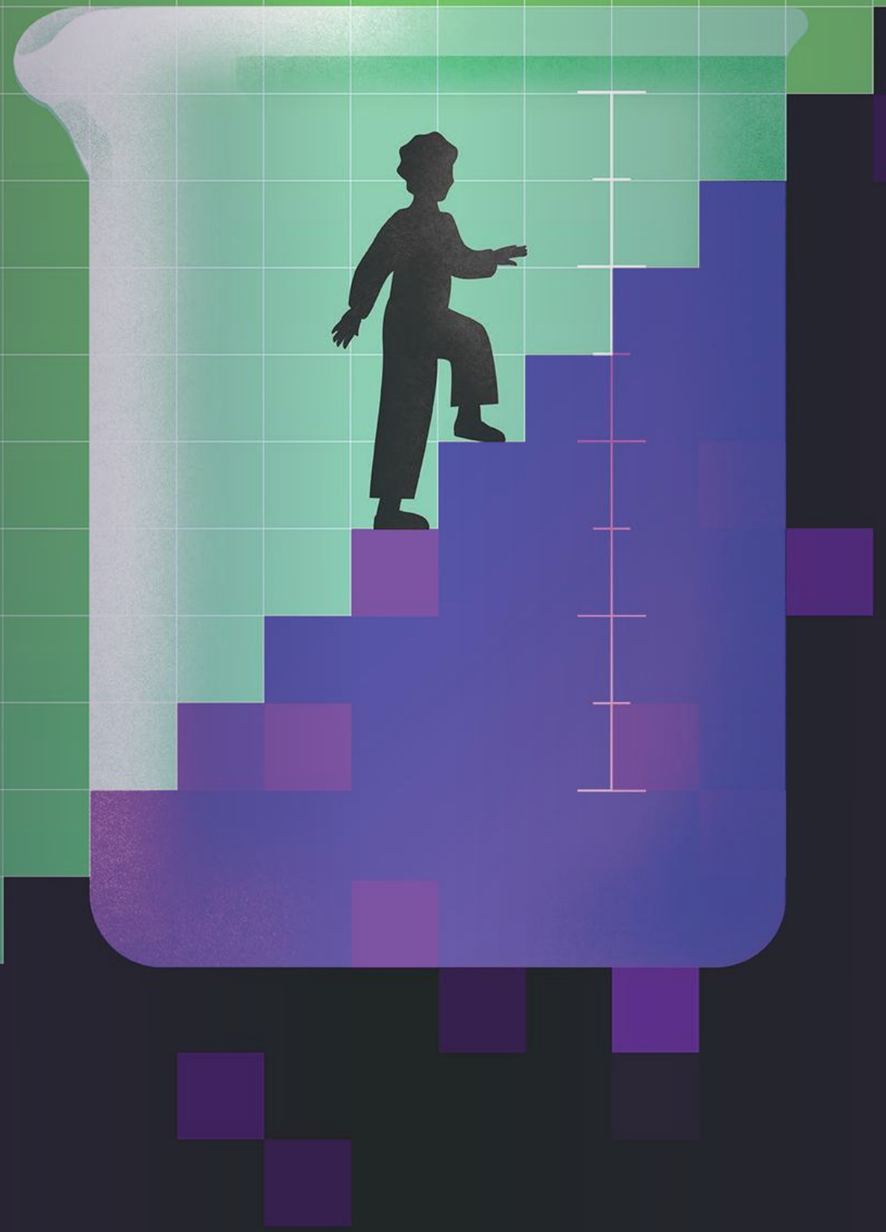
“One of the things I love and respect about the culture at CMU is that we always want to improve,” Hovis said. “We have made significant changes: to courses, to requirements, to policies and to various aspects. I can see the positive impact those changes have had day to day, and year after year, on campus and in the community through our never-say-die attitude.”

Advising first-year students and helping them acclimate is another important aspect of his job.

“I’m most proud of the changes we have done to make the student experience better,” he said.

Hovis was honored with this year’s Julius Ashkin Award that is presented to a Mellon College of Science faculty member who has shown unusual devotion and effectiveness in teaching undergraduate students.

TEACHERS BRING INTRODUCTORY CHEMISTRY TO THE DIGITAL AGE



Carnegie Mellon Professor David Yaron advocates for a hybrid approach to chemistry education, combining in-person instruction with virtual learning to enhance and redefine how students learn foundational science.

"For over two decades, my colleagues and I have been dedicated to using online courseware to substantially increase student success," Yaron said. "With REAL Chem, I believe we are now closer than ever to achieving this goal."

Yaron helped design REAL Chem, courseware for introductory chemistry classes that marries in-person instruction, demonstration and lab work with online instruction and practice. The approach is changing how chemistry is taught in community colleges and universities. The courseware allows students to learn at their own pace, build on what they already know, and apply what they are learning in real-world contexts.

The platform enables instructors to combine in-person and online teaching without the hassle of creating online content, which Yaron noted was a challenge after the COVID-19 pandemic. REAL Chem's online components allow instructors to focus on what they are doing in class and how to better connect with students.

REAL Chem, rooted in ChemCollective and Carnegie Mellon's Open Learning Initiative — platforms Yaron helped start in 2000 — focuses on effective teaching methods. For example, Yaron said students learn better with interactive content than with textbooks.

Carnegie Mellon research also shows that students learn at the same rate, regardless of their previous knowledge. A student who didn't take Advanced Placement chemistry, for example, will need more time to learn the same material than someone who took it, Yaron said, but this is only because they have more to learn, not because the lack of background slows their learning.

Gizelle Sherwood, contributor to REAL Chem and director of Undergraduate Studies and laboratories in the Department of Chemistry, teaches primarily first- and second-year chemistry. She said the REAL Chem courseware is an equalizer.

"It didn't quite matter what high school you were at, whether you did AP chem or not AP chem or what your experiences have been in the past," she said. "The courseware felt like a base foundation for everyone. I've had students who literally have not had that much experience with chemistry and students who've had that experience, and assigning these as pre-reading meant that they were coming into the classroom feeling equivalent to each other."

High school, community college and college teachers across the U.S. are integrating REAL Chem and related programs into classes. At the University of California, Riverside, Assistant Professor of Teaching Joshua Hartman started using OLI in his undergraduate chemistry classes in the fall of 2022. His general chemistry courses have about 250 students, mostly majoring in STEM fields other than chemistry.

Hartman said students take mastery exams at the end of each unit. If they are unsatisfied with results, they can review the concepts in OLI and retake the exams later in the quarter.

"Say the student doesn't get the score that they would have liked, of course the lecture portion of the class and lab are moving on through the content that follows," Hartman said. "So what we've done is essentially link students back to the appropriate content in REAL Chem or in OLI."

Hartman said the method leads to a growth mindset and has led to higher grades in the course, particularly for first-generation college students, a group that improved a full letter grade on the final exam.

During the spring semester of 2024, two of his sections were included in a study comparing teaching methods. One class required students to use the interactive online materials, while the other class had access to the materials but only needed to be familiar with them. On the midterm exam, the class requiring online materials scored almost two letter grades higher.

"This two-letter grade difference also mapped back to students using practice exams. They'd been going back to OLI to strengthen their understanding and taking the mastery exams," he said. "This other group, more or less, was not engaging with the content. They're doing the minimum they need to turn in a homework assignment."

As Yaron sees more results from professors using the REAL Chem material, the platform continues to evolve. With the support of grants from the Bill and Melinda Gates Foundation and the National Science Foundation, Yaron is developing a hybrid course for the second semester of first-year chemistry and a course on general organic and biological chemistry for nurses and others who earn two-year degrees to work at hospitals. The new offerings will learn from data they received using generative artificial intelligence in past classes.

Generative AI in the courseware is similar to ChatGPT, where students can ask questions. It also knows what page the student is on and what assignments are coming due. Data is generated showing which students use the online tools and how they used them, and at the end of each semester Yaron and Sherwood said they have noticed that A and B students are the ones who use it the most.

"At midterm after the first exam, we often put up a plot where the Y axis is the grade on the exam and the X axis is how many interactions people had with REAL Chem. We show this correlation to encourage more students to utilize the platform," Yaron said.

Tricia Miller Klapheke

BARBARA SHINN-CUNNINGHAM NAMED MELLON COLLEGE OF SCIENCE DEAN

Barbara Shinn-Cunningham has been named Carnegie Mellon University's Glen de Vries Dean of the Mellon College of Science (MCS), effective Jan. 1, 2025.

Shinn-Cunningham, the eighth dean to lead MCS, joined Carnegie Mellon in 2018 as the founding director of the Neuroscience Institute and the George A. and Helen Dunham Cowan Professor of Auditory Neuroscience. She holds courtesy appointments in the departments of Psychology, Biomedical Engineering and Electrical and Computer Engineering.

"Dr. Shinn-Cunningham's appointment as the next dean of MCS marks an exciting next chapter for the college," said Carnegie Mellon Provost James H. Garrett Jr. "Her distinguished research background and proven leadership skills position her to propel the Future of Science Initiative forward and guide MCS toward even greater heights."

A LIFETIME OF SCIENTIFIC DISCOVERY

Before joining CMU, she spent 21 years on the faculty of Boston University. In addition to directing the Neuroscience Institute at Carnegie Mellon, Shinn-Cunningham leads two large-scale Multidisciplinary University Research Initiative projects funded by the Office of Naval Research, each of which uses researchers from different backgrounds at different institutions to address problems that cannot be solved through individual disciplines.

"Interdisciplinary approaches erase boundaries that have traditionally separated fields of study, thereby accelerating scientific discovery. Such collaboration is part of CMU's DNA, a fact that attracts some of the most creative and broad-thinking scientists to the Mellon College of Science. I am thrilled and humbled to lead MCS in its next phase of innovation," Shinn-Cunningham said.

An author of more than 200 scientific articles, she is recognized for her expertise in spatial hearing, auditory attention and sensory hearing deficits. She has degrees in electrical engineering from Brown University and the Massachusetts Institute of Technology. Her research combines behavioral, neuroimaging and computational methods to understand how the brain processes sound. She has received honors from the Alfred P. Sloan Foundation, the Whitaker Foundation and the Vannevar Bush Fellows program.

Shinn-Cunningham is the president of the Acoustical Society of America (ASA), and in 2019, she accepted its Helmholtz-Rayleigh Interdisciplinary Silver Medal in Psychological and Physiological Acoustics, Speech Communication and Architectural Acoustics. She previously served as the treasurer/secretary of the Association for Research in Otolaryngology. Her mentorship has been recognized by awards from both the ASA and the Society for Neuroscience. She is a Fellow of the ASA, a Fellow of the American Institute for Medical and Biological Engineering and a lifetime member of the National Research Council. She serves as a senior editor for eLife.

THE SEARCH FOR THE NEXT DEAN OF MCS

Shinn-Cunningham was selected following a yearlong search led by Keith Webster, the Helen and Henry Posner, Jr. Dean of the University Libraries.

"I am grateful to the search committee for leading a thorough search. They carefully listened to the needs of the MCS community, fielding a strong applicant pool to ultimately identify Barb Shinn-Cunningham as the best person for this critical leadership role. I appreciate the time and thoughtfulness they put into their work," Garrett said.

She succeeds Rebecca Doerge, who served as dean from 2016-23 prior to being named provost of Rensselaer Polytechnic Institute in Troy, New York. Curtis Meyer, the Otto Stern Professor of Physics and associate dean for research, has served as interim dean since Aug. 1, 2023. Meyer has been a member of the MCS faculty for more than 30 years and will return to his faculty position.

"Curtis Meyer has done an outstanding job stepping in as interim dean, leading the college during this important transition period," Garrett said. "I am thankful for his leadership and grateful for his service in this interim capacity as we conducted the search."

A HOME FOR THE FUTURE OF SCIENCE

Carnegie Mellon's Mellon College of Science is at the forefront of the university's future of science initiative, a decade-long effort to revolutionize and accelerate research and education, leading to innovations and breakthroughs that will benefit humankind.

MCS currently has more than 900 undergraduate students and 470 graduate students. The college offers more than a dozen graduate programs to prepare students for careers in the sciences.

"Science education and exploration benefit by leveraging CMU's strengths in computation, machine learning, engineering and data analytics to address opportunities in foundational science. I look forward to celebrating and supporting the successes of MCS students, staff and faculty," Shinn-Cunningham said.

Heidi Opdyke

MEET OUR NEW MCS FACULTY

Catherine Armbruster joined the Department of Biological Sciences as an assistant professor in January 2024. Her lab investigates the ecology and evolution of opportunistic pathogens in biofilms, especially *Pseudomonas aeruginosa*, as they transition from the environment to the host and vice versa.

Armbruster earned her Ph.D. in microbiology from the University of Washington and her master's degree in public health at Emory University. Prior to joining Carnegie Mellon, she completed her postdoctoral training in the laboratory of Jennifer Bomberger at the University of Pittsburgh and Dartmouth College, where she studied how bacteria evolve in cystic fibrosis biofilm infections.

For her research, Armbruster has earned a K22 career transition award from the National Institutes of Health and a Postdoc-to-Faculty Transition Award from the CF Foundation.

Nicholas Boffi joined the Department of Mathematical Sciences as an assistant professor in August of 2024. He studies how generative models can transform mundane tasks, from enhancing photographs to translating lectures in real time. A member of Carnegie Mellon's Center for Nonlinear Analysis he also is an affiliated faculty member in the School of Computer Science's Machine Learning Department.

Boffi has served as an intern at Google Brain, a visiting graduate student researcher at the Massachusetts Institute of Technology, a computational science graduate fellow at Harvard University and a Fulbright Research Scholar at Tel Aviv University. Boffi received a Ph.D. in applied mathematics from Harvard in 2021, and he completed a three-year research and teaching postdoctoral position as a Courant Instructor at New York University.

Christopher Eur joined the Department of Mathematical Sciences as an assistant professor in August of 2024. His research takes a particular interest in matroids, which focuses on algebraic geometry and its intersection with combinatorics, the study of counting of objects. He was awarded research funding from the National Science Foundation (NSF) from 2023 to 2026 to further understanding of matroid theory, which is a way mathematicians describe the property of independence in a space, with uses across mathematics, physics, computer science and more.

Eur was the Benjamin Peirce Postdoctoral Fellow at Harvard University from 2021 to 2024. Eur also worked at Stanford University as an NSF postdoctoral fellow from 2020 to 2021. He earned his Ph.D. in mathematics from the University of California, Berkeley.

Jonathan Henninger joined the Department of Biological Sciences as an assistant professor in January of 2024. He investigates how cells control gene expression, what happens when things go awry as cells take shape and how the cells lose their identity during early stages of disease. His goal is to help scientists understand how RNA contributes to normal gene expression and how defects in this process contribute to human disease.

Henninger earned his Ph.D. at Harvard University in developmental and regenerative biology. Prior to Carnegie Mellon, he joined the Whitehead Institute for Biomedical Research at MIT as a postdoctoral fellow. There, he and his team discovered that RNA molecules born during the early stages of gene expression are intimately involved in their own production.

Irene Kaplow joined the Department of Biological Sciences in August 2024 as an assistant professor.

Kaplow earned her Ph.D. in computer science from Stanford University. After graduation, she joined Carnegie Mellon as a Lane Postdoctoral Fellow in Andreas Pfenning's lab in the Computational Biology Department, where she developed methods to identify regulatory elements whose regulatory activity differences between species are associated with the evolution of neurological phenotypes. She also worked as a research scientist at Duke University, where she helped test the effects of manipulating a candidate myosin gene enhancer on myosin gene expression and cardiomyocyte development. Her research investigates how gene expression has evolved and applies techniques she used at Duke to see the roles of different regions of the genome in evolution.

Brendan Mullan joined the Department of Physics as an associate teaching professor and director of undergraduate laboratories in January 2024. His primary goal is to advance experimental physics courses using data-informed practices and physics education research. Mullan has developed and taught various astronomy, astrobiology and physics courses at multiple universities, incorporating video game, narrative story and inquiry-based elements.

Before joining Carnegie Mellon, Mullan was a faculty member at Point Park University, co-founded and directed science for The Wrinkled Brain Project and directed the Buhl Planetarium and Observatory. Named a National Geographic Emerging Explorer in 2013, Mullan has received awards from the British Council, NASA and the Creative Nonfiction Foundation. He earned his Ph.D. in astronomy and astrophysics from The Pennsylvania State University.

Jonathan Simone joined the Department of Mathematical Sciences as an assistant professor in August of 2024. He explores the landscape of topology, and the construction of 4-dimensional objects — in particular exotic 4-manifolds — intrigues him.

Simone earned his master's degree at Hunter College and his Ph.D. at the University of Virginia. Prior to joining Carnegie Mellon, he held visiting assistant professor roles at the University of Massachusetts, Amherst and the Georgia Institute of Technology.

At Georgia Tech, he earned the Student Recognition of Excellence in Teaching, which goes to faculty members with high scores in students feedback. At UMass he was a two-time distinguished teaching award finalist, and at the University of Virginia he was an all-university graduate teaching award winner.

UNBREAKABLE BONDS

Generations of Chemistry Students Learn from Stump's Guidance

The room was packed with students attending a wellness workshop on ways to deal with stress. Angie Lusk from Carnegie Mellon University's Division of Student Affairs led the discussion.

"What do you do in times of real challenge?" she asked.

A voice called out: "You go to Karen Stump's office!"

It's good advice — just ask any of the many, many students who know the highly regarded teacher, mentor and advisor.

For the past four decades Stump, teaching professor and director of undergraduate programs in the Department of Chemistry, has advised hundreds of chemistry majors and taught thousands of students, including chemistry, biology, engineering and pre-health students. As she heads into retirement, there's no doubt that she has made a lasting impact.

"I would want everyone to have an advisor experience like I had with Karen," said chemistry alumna Erin Gantz, who graduated in 2010. "There is just something about her. She cares deeply about how you're doing as a person. You would go and meet with her, and it would seem like she had all the time in the world for you."

Stump, who graduated from Carnegie Mellon in 1981, returned to the Department of Chemistry in 1983 as a laboratory instructor after spending a few years teaching at Washington and Jefferson College. At the time, there were no women in the department and a faculty teaching-track wasn't yet an option. But Stump loved teaching, meeting and talking with students, so she chartered her own path.

"Looking back, I was creating a career, but I didn't realize at the time that was what I was doing," Stump said. "I would look at things that needed to be done, and I would just kind of start doing them. You're only limited by your own creativity and energy."

Stump has had plenty of both. In addition to teaching and advising, she started a teaching assistant training program, and she brought order to the undergraduate labs by organizing equipment, keeping a detailed inventory and leading staff meetings. This led to the creation of a new position — director of laboratories — for Stump. When it became clear that the labs needing renovating in the late 1990s, Stump rolled up her sleeves and got to work, collaborating closely with the architects designing the new space. The 10-year project was completed in 2003.

"It was quite an undertaking, to even think about building a lab that you know will not be rebuilt for literally decades and to think about what students will need in order to be successful for things you can't even imagine," Stump said.

She also was responsible for administrative oversight of the undergraduate program in chemistry, led educational outreach activities and has been deeply involved in curriculum development for chemistry and the Mellon College of Science.

For her efforts, Stump has won three university-level awards: the 2017 Teaching Innovation Award, the 2011 Award for Outstanding Contributions to Academic Advising and Mentoring and the 2005 William H. and Frances S. Ryan Award for Meritorious Teaching. She also is the 2024 recipient of the Richard Moore Education Award in the Mellon College of Science.

The mother of three and grandmother of two has juggled a lot over the years, and it's that experience — along with a detailed knowledge of the ins and out of what's required to earn a chemistry degree — that has made her so valuable as an advisor.

"I've had students who come to see me pretty regularly for what they call their life-crisis talks. Sometimes it's personal, and sometimes it's academic. I've had students say: this is going to be a long one because I just need to talk out some stuff, and you're the person I do that with, so I need you to solve my life today."

Her overarching advice? Life is a journey, not a destination. Stump said she has lived that philosophy, and she spends a lot of time trying to convince students to live their lives a bit more that way.

Stump has been easing into retirement as she shepherds one last group of advisees through to graduation. She's looking forward to spending more time with her family, including going to the movies with her husband and taking the dogs to pick up the grandkids at the bus stop. But it's a bittersweet time for Stump, as she also has her extended family — her students — to think about.

"I think I get through it simply because — and I always say this at graduation — that I expect that we'll keep in touch. You'll let me know when you can how you're doing. (Post retirement email updates are still most welcome!) And a lot of them do," Stump said. "I'm just so amazed at the types of things they're doing. I'm really proud of them."

Amy Pavlak Laird

AFTER 42 YEARS, FRED LANNI CHANGES FOCUS

Examining cells with a microscope has always been a big deal for Associate Professor of Biological Sciences Frederick Lanni, proving that sometimes the smallest things can have the greatest impact.

Lanni arrived at Carnegie Mellon as a postdoctoral researcher in August of 1982 to work with Professor D. Lansing Taylor. Taylor, along with the late Professor Alan Waggoner and Emeritus Professor Robert F. Murphy, had created the Center for Fluorescence Research in Biomedical Sciences, and Lanni wanted to be part of it.

"The original goal was to bring modern methods of imaging, fluorescence technology, and computer analysis into cell biology where problems in that field could really be addressed," Lanni said.

One of the steps for enhancing cellular imaging was to improve the tools being used to examine cells. When the Fluorescence Center was founded, fluorescence microscopy involved using night vision camcorders to take video of the cells. Then, researchers would photograph the videotape playback and develop and print the film based on what they were attempting to examine.

Lanni and his colleagues wanted a better way to see the structures within a cell, so they developed what they called standing wave fluorescence microscopy (SWFM), an early version of what is now better known as structured illumination microscopy (SIM). This technique allowed researchers to see the 3D structure of cells by fluorescence at a higher resolution than they could before.

"It was a way to use the interference of light to improve the three-dimensional resolution of the fluorescence microscope," Lanni said. "It was the first working instrument to use this principle."

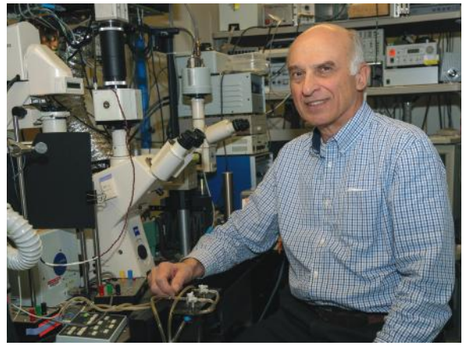
Lanni has taught generations of Carnegie Mellon students, mostly in Modern Biology, the introductory course for students in the Department of Biological Sciences, and a popular science elective for others. He also developed and taught Biological Imaging and Fluorescence Spectroscopy, a course for graduate students and upper-level undergraduates. There, he shared his passion for microscopy with students who needed a research-level understanding of the instrument.

Lanni retired at the end of the fall 2024 semester. He plans to conduct research as an emeritus professor, and he hopes to spend more time with his adult children, who live across the U.S. He said he is proud of the discoveries he has made as a researcher.

"The greatest thing about science is, every once in a while, you realize that you're looking at a result that no one else has ever seen before or gotten before," Lanni said. "I'm so glad I've had those moments."

Kirsten Heuring

After 22 years at CMU. Lanni in his lab, 2004.



After 42 years at CMU. Lanni in his lab, 2024.

REMEMBERING NMR PIONEER JOSEF DADOK

Carnegie Mellon University Emeritus Professor Josef ("Joe") Dadok passed away on Friday, Oct. 4, 2024, in Bloomington, Indiana, from complications of cancer. He was 98 years old.

Dadok was born in Detmarovice, Czechoslovakia, to Ferdinand and Barbora (Seberova) Dadok. A veteran and survivor of WWII, he became an electrical engineer, working in instrumentation at the Institute of Scientific Instruments of the Czechoslovak Academy of Sciences.

Dadok was referred to as the "founder of Nuclear Magnetic Resonance in Czechoslovakia." He built the country's first NMR spectrometers in the 1950s and 60s.

In 1967, Carnegie Mellon Professor Aksel Bothner-By invited him to serve as a visiting fellow at the university's NMR facility. Dadok's wife and two sons visited the U.S. in January 1968. While the family was traveling, the Soviet Union and other members of the Warsaw Pact invaded Czechoslovakia. The family stayed in the U.S., and Dadok became a full-time fellow at Carnegie Mellon.

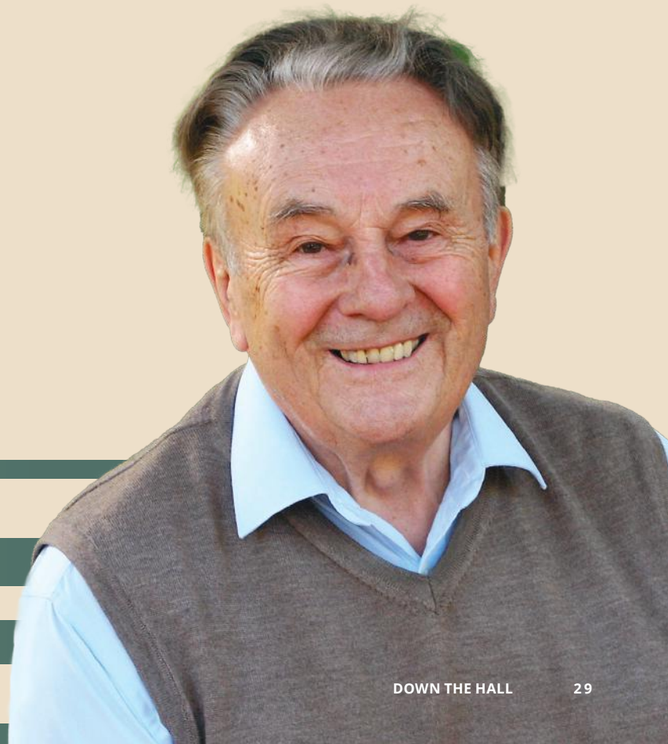
Dadok continued his research at Carnegie Mellon, where he and Bothner-By constructed a multinuclear NMR spectrometer, equipped with a superconducting magnet operating at 250 MHz, in the late 1960s.

In 1976, Dadok was named technical director of the National NIH NMR Facility for Biomedical Studies at Carnegie Mellon. Bothner-By and Dadok collaborated with Intermagnetics General Corporation in 1976 to lead the team that built the first 600 MHz spectrometer. Housed at Carnegie Mellon, the 600 MHz spectrometer was the world's most powerful system for many years and was used for leading-edge chemistry and biology research.

In 2013, the Central European Institute of Technology in Brno, Czech Republic, named its NMR center after Dadok. The Josef Dadok National NMR Centre focuses on using nuclear NMR to study the atomic structure of biologically significant molecules.

Dadok is survived by his sons, Jiri and Ludek, daughters-in-law Carolyn Begley and Debra (Beauchamp) Dadok, seven grandchildren and three greatgrandchildren. He is interred next to his wife, Marie (Janouskova) Dadok, at the Clear Creek Cemetery, Bloomington, Indiana.

Heidi Opdyke



REMEMBERING ALAN WAGGONER

Alan Waggoner, emeritus professor of biological sciences at Carnegie Mellon University, died peacefully at home surrounded by family on Tuesday, May 21, 2024. He was 82 years old.

Waggoner, the former Maxwell H. and Gloria C. Connan Professor in the Life Sciences, helped transform the fields of biomedical research and cell biology through his development of fluorescent probes that have allowed scientists to delve into the mysteries hidden inside cells. Waggoner invented cyanine-based dyes called CyDyes, which detect macromolecules like proteins and nucleic acids in cells and tissues. His dyes have greatly contributed to our understanding of how gene and cellular functions are regulated.

Born in Los Angeles in 1942, he graduated from the University of Colorado in 1965 and earned his Ph.D. in chemistry in 1969 at the University of Oregon. After completing postdoctoral work at Yale University, Waggoner taught at Amherst College where he served the Department of Chemistry chairman until 1982 when he joined the Carnegie Mellon faculty.

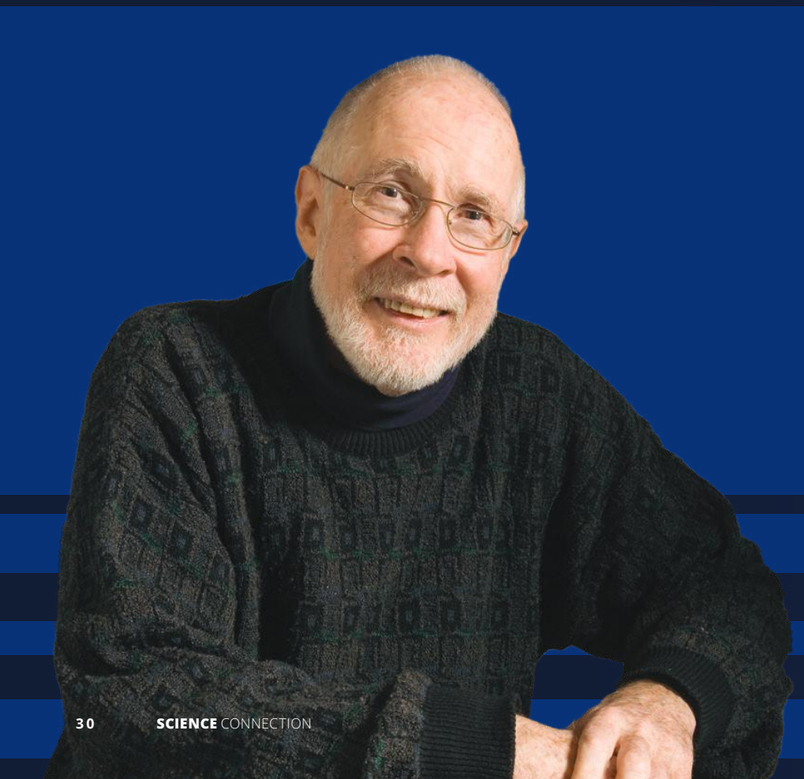
He left Carnegie Mellon in 1992 to become vice chairman of Biological Detection Systems, Inc. In 1994, the start-up was bought by Amersham PLC, and Waggoner joined Amersham as principal scientist and head of fluorescence.

In 1999, Waggoner returned to Carnegie Mellon as the director of the Molecular Biosensor and Imaging Center. He retired from teaching in 2018. He also created Sharp Edge Labs, a spin-off company he started with the late Biological Sciences and Chemistry Professor Marcel Bruchez and Chemistry alumnus Scott Sneddon.

Waggoner is the holder of 27 patents and the recipient of numerous awards. In 2010, Waggoner received the International Society for the Advancement of Flow Cytometry's distinguished service award.

Waggoner is survived by his wife of 58 years, Karen, and by children Shemariah Little (Waggoner) and Eben Waggoner, grandchildren Melina and Marc Little, sisters Diana Davies and Teri Nebeker and his beloved cats, Junior and Minnie.

Heidi Opdyke



PHILIP E. CASTLE HONORED AT 2024 **ALUMNI AWARDS**

The 2024 Carnegie Mellon University Alumni Award honorees embody the CMU philosophy of putting their "heart in the work." From revolutionary research that could be the key to treating neurodegenerative diseases to achievements in the performing arts to strengthening the bonds that connect the Tartan community around the world, these 11 alumni are making a difference through their service, philanthropy and professional accomplishments.

Among this year's nominees is Philip E. Castle, a 1986 graduate of the Mellon College of Science.

Castle is a world-renowned, transformative leader in cancer epidemiology, research and prevention. As the director of the Division of Cancer Prevention (DCP) and senior tenured investigator in the Division of Cancer Epidemiology and Genetics (DCEG) at the U.S. National Cancer Institute (NCI), he focuses his research on epidemiology of the human papillomaviruses (HPV) and cervical/anogenital cancers, science and translation of cancer prevention strategies, cancer screening, international health, health services research and evidence-based medicine.

Castle graduated from Carnegie Mellon with a bachelor of science in biological sciences and went on to earn a doctorate in biophysics from Johns Hopkins University. He began his career as a cancer prevention fellow at DCP/NCI while pursuing a master of public health in epidemiology at Johns Hopkins. He later served as a senior, tenured investigator and tenure-track investigator at DCEG/NCI, professor in the Department of Epidemiology and Population Health at Albert Einstein College of Medicine and chief scientific officer of the American Society for Clinical Pathology. Over the course of his career, he has conducted cancer screenings and treatment research and activities in more than a dozen countries on six continents.

Beyond his work at DCP/NCI, Castle regularly participates in the development of national and international guidelines for cervical cancer prevention and has served as an advisor to several ministries of health. He has published more than 500 papers on HPV and cervical and anogenital cancers and contributed articles to the New England Journal of Medicine, Lancet, British Medical Journal and Cancer Research, among others. His seminal publication in the New England Journal of Medicine on the need for an Essential Diagnostics List led to the World Health Organization establishing the list.

For his contributions to science and public health, Castle has received numerous accolades including a EUROGIN Distinguished Service Award; an NIH Merit Award; the Arthur S. Flemming Award for Exceptional Achievement in Federal Government Service for Applied Science, Engineering and Mathematics; and NCI's Director's Award for Outstanding Leadership of the Division of Cancer Prevention during the COVID-19 pandemic.

"When a Carnegie Mellon University education meets a passion for knowledge and service it is an unbeatable combination," said Joanna D. Lovering, CMU Alumni Association Board president. "The way this incredible group of Alumni Award honorees are impacting the world through their vocations and service to others is an inspiration to the entire Tartan community. They make us proud."

MELLON COLLEGE OF SCIENCE ALUMNI ARE RISING TO THE CHALLENGE

From operatic stages and virtual worlds to industrial warehouses and medical research labs, Carnegie Mellon University's 2024 Tartans on the Rise are transforming the planet through their artistic expression, scientific exploration, entrepreneurial spirit and visionary innovations.

In its third year, Tartans on the Rise celebrates alumni who graduated in the last 10 years and are making an impact on their organizations and in their communities, across the nation and around the world through leadership, innovation and career accomplishments.

"Alongside the entire Carnegie Mellon University community, I congratulate this year's class of Tartans on the Rise," said President Farnam Jahanian. "The passion, creativity and leadership of these remarkable Tartans truly embody the CMU spirit. We're inspired by their successes to date and eager to see how they'll shape the future."

These recent alumni are reducing workplace accidents with computer vision, developing technology to prevent HIV infections and promoting inclusion in beauty and cosmetics. They're driving data-centric solutions to improve air quality and helping veterans to transition successfully to civilian life. And they're breaking barriers that create systemic poverty and amplifying underrepresented voices through architectural design.

"CMU's Tartans on the Rise are elevating and enhancing industries, communities and people everywhere," said Teresa Trombetta (HNZ 2018), assistant vice president for alumni and constituent engagement. "I am so thrilled to celebrate the contributions of these incredible members of our Tartan community."

The 2024 cohort includes alumni who have founded multiple companies and others who have been honored with such prizes as the H&M Foundation's Global Change Award and the Metropolitan Opera's Eric and Dominique Laffont Competition for emerging artists.

One has been selected for Poynter Institute's Leadership Academy for Women in Media and another designed costumes for a Sundance Film Festival-winning movie. One starred in one of Netflix's most-streamed shows, another drafted award-winning pieces for Scientific American and Massive Science and one creates YouTube content enjoyed by millions.

They've been recognized as Forbes 30 Under 30 leaders and in the publication's AI 50 listing, and by Fast Company for their startups' top-ranking AI innovations. Others have been recognized by Publisher's Weekly, MIT Review Young Innovator and the Global Economic Forum.

Four Mellon College of Science graduates are among the 30 alumni identified for the Tartans on the Rise recognition:

ANANYA KAPUR (MCS 2021), Chief Executive Officer, Type Beauty

MEREDITH SCHMEHL (DC 2018; MCS 2018), Neuroscientist and Science Communicator

CARTER SHARER (MCS 2016), Creator, Innovator and Entrepreneur

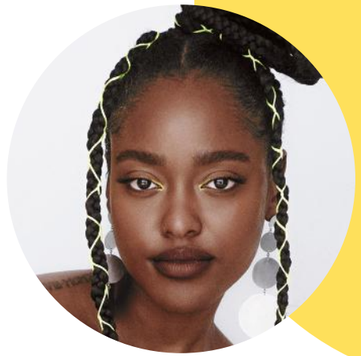
ARSEMA THOMAS (MCS 2016), Actor; Founder, Enki

Amanda S.F. Hartle

ANANYA KAPUR

MEREDITH SCHMEHL

CARTER SHARER



ARSEMA THOMAS

ALUMNUS HONORED WITH FULBRIGHT SCHOLARSHIP

Triple Carnegie Mellon University alumnus Shaun Ranadé spent six months in Nepal for his Fulbright project. He graduated in 2016 with a master's degree in biomedical engineering, and before that, he earned bachelor's degrees in biological sciences and Japanese studies.

Currently a medical student, Ranadé is treating gestational diabetes by implementing continuous glucose monitoring in Nepal. Nepal has a 20% higher rate of gestational diabetes than neighboring countries, and the government has prioritized treating it, which made it an ideal place for him to implement telemonitoring to improve the health of mothers and infants.

Gestational diabetes is a personal issue for Ranadé, since it has affected the lives of many people he knows.

"I am motivated by the potential to level the playing field and give children a healthy start in life," he said.

While in Nepal, he completed the Annapurna Circuit 11 day trek. He covered roughly 120 miles of rugged, rocky paths and steep inclines, which included going through the Thorong La Pass, one of the world's highest trekking passes at 17,769 feet — about the equivalent of stacking 14 Empire State Buildings and even higher than Everest Base Camp.

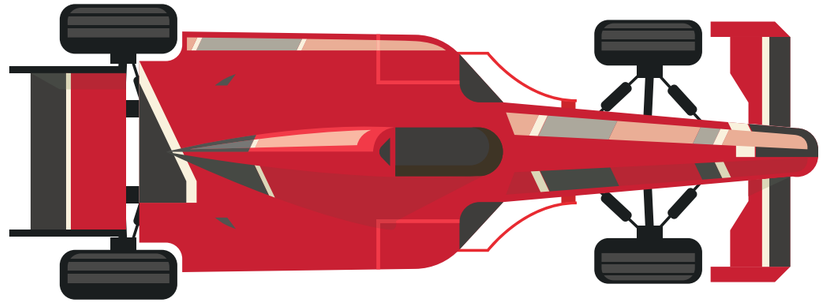
He was very involved in the CMU community during his time as a student: beyond his three degrees, he co-founded CMU's chapter of Global Public Health Brigades. He believes "medical knowledge, cultural competence and compassion are essential for effective physicians," and this ethos has informed his degree choices and other activities, including this Fulbright. He said his interdisciplinary CMU experience across three colleges prepared him for his work, which has not just included medical school, but also in fields such as biotechnology investment consulting, biotechnology intellectual property law and in cellular therapeutics research and development.

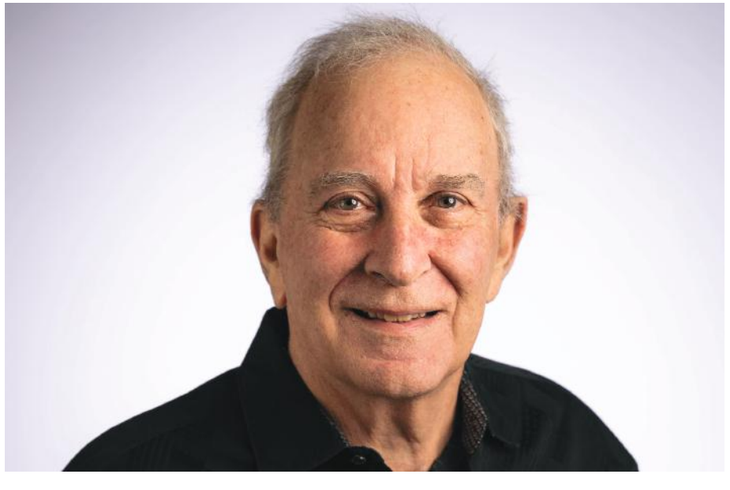
"The supportive environment and rigorous curriculum have equipped me with the skills and confidence to engage with key opinion leaders, subject matter experts, and practicing physicians," he said.

In addition to this year's Fulbright, he was awarded an NIH Fogarty Fellowship in Public Health and the Northern Pacific Global Health Fellowship.

Sarah Maenner

FROM SPACECRAFT TO RACECARS: PHYSICIST PUSHES VEHICLE LIMITS





Faster, higher, stronger – together. Those words make up the Olympic motto, but they also describe Jim Hamilton's career.

"I've been a part of some unusual and extraordinary teams," he said. "There has to be the joy of working together and respecting what everyone else is doing."

Hamilton, a 1965 graduate of Carnegie Mellon University's Department of Physics, has helped build interstellar probes and championship race cars. Throughout a career that spans nearly six decades, he has pushed the envelope of innovation.

"I use physics absolutely every day. I still have a sense of wonder about many aspects of physics," Hamilton said. "It is in everything. My world has been mostly in classical physics, and it's been really helpful for me working with engineers who know more about applied physics. But it always goes back to the some of the first principles."

Physics is the basis of Hamilton's lifelong work in supporting vehicles that operate under extreme conditions, but it was Alan J. Perlis, a pioneer in computer science who won the first Turing Award, who showed him how to harness it.

"He looked and acted like an extraordinarily intelligent man from Mars. He just set the place on fire," Hamilton said.

Perlis was head of the Association for Computing Machinery and Carnegie Mellon's Department of Mathematical Sciences while Hamilton was a student.

"So much of my career has turned out to be based on his teaching," he said. "I had an advantage because he taught software. That really helped me into my first forays into aerospace."

In an undergraduate computer course, Perlis taught octal, a number system with a base of 8 used to represent binary numbers, which allows for more compact programming instructions.

In his first job after graduation, Hamilton worked at Space Technology Laboratories, a division of Thompson Ramo Wooldridge Inc. As part of the guidance and mission simulation department, he worked as a programmer on NASA's Gemini and Apollo programs.

With Gemini, he used classic physics to help understand Hohmann transfers, a maneuver that shifts a spacecraft from one orbit to another in the same plane. It's the type of move that gets a spacecraft from the Earth to the moon.

"It was very simple classic physics. It was just a matter of conservation of energy," Hamilton said. "How much energy do you have to exert? In what direction and at what time do you need to make that happen?"

The language those onboard spacecraft computers used? Octal.

"I was one of only a few people working hundreds of hours a week. Innovation can happen a little bit easier in those compression situations," he said.

For Apollo, it was about storing a collection of trajectories to help astronauts out if a mission needed to be aborted.

The work he did on the Gemini and Apollo missions set him up for understanding how to patch ellipses and parabola orbits together. That knowledge helped send Pioneer and Mariner satellites out to explore the Solar System and Voyager satellites to go interstellar.

"Some of those are still flying," he said.

Another set of satellites explored much closer to home. Hamilton was part of Project Corona, the first series of American photographic spy satellites. Declassified in 1995, the images preserve a high-resolution view of the world during the 1960s and are used today by researchers studying environmental change and other areas.

"We could see the satellites launched from Redondo Beach — if there was clear sky — and see them go into the ionosphere. It was always near sunset, and you would get this multicolored rainbow scribbling in the contrails."

Hamilton worked out of the Air Force's Satellite Control Facility at Onizuka Air Force Station in California. He was part of the team working on software that made decisions about what photographs to take.

"I was the main troubleshooter for the early missions, and the software was big. It was written in Jovial, based on a version of the international ALGOL language. Again, I was grateful for Alan Perlis," he said.

Hamilton left aerospace and worked on a ship design for the Navy before turning to cars. He led research at both BMW and VW on safety and engineering teams. But his passion for cars started in high school, when he was involved with racing. First, it was an Austin-Healey Sprite that a friend owned, then motorcycles and then a used Lotus 18.

"I wasn't formally involved with Buggy in college, but in our dormitory, there were several teams. I helped them in an informal way with experiments to quantify and improve — to reduce wheel bearing friction and so forth," Hamilton said. "It was so cool."

An amateur racer for most of his life, he served as a race engineer for Dan Gurney's All American Racers, Patrick Racing and PacWest Racing before spending the last 25 years with Chip Ganassi Racing.

Since Hamilton joined the team, Ganassi Racing has won five Indianapolis 500 championships. As a performance engineer on the team, his role requires looking for ways to use simulation data analysis to identify potential innovations and share his results with drivers and lead engineers. Among the drivers he's worked with are some of the sport's best: Jimmy Johnson, Dario Franchitti, Scott Dixon and Alex Palou.

"Everyone respects what everyone else is doing. Teamwork is a huge part of it, and that atmosphere starts from the top," he said, referencing Chip Ganassi, a fellow Pittsburgh native. "Just to be a part of it, especially a part that's off in left field doing new stuff and yet is accepted within the larger frame of teamwork, I'm pretty proud of that."

As part of Ganassi Racing, Hamilton holds four U.S. patents in vehicle dynamic technology, including the Delta wing race car. He gives back to the industry through leadership opportunities like serving on the Society of Automotive Engineers (SAE) Vehicle Dynamics Technical Committee, chairing vehicle dynamic sessions at the SAE Motorsports Engineering Conference and presenting to both the U.S. DOT and the SAE on vehicle safety. He also served for six years as a National Academy of Sciences panel member evaluating US Army Research Laboratory projects in Mechanical Engineering and Air and Ground Vehicle Technology.

Although he wasn't formally involved with Buggy while he was a student, Hamilton was there for another quintessentially Carnegie Mellon race — the world's first robot car race in 2004. Ganassi Racing sponsored Sandstorm, Carnegie Mellon's self-driving Humvee that traveled more than 7 miles during the race.

"It was an unprecedented race. We were happy to get involved," Hamilton said.

■ *Heidi Opdyke*

THREADS OF INQUIRY

Faculty in the Mellon College of Science are transforming foundational science and changing the world. A new webinar series, "Threads of Inquiry," weaves together stories about groundbreaking research from experts who cross boundaries and forge new fields of exploration.

Missed the first few installments? Fear not!

The recordings are archived @ events.mcs.cmu.edu/toi-webinars/archive or scan the QR code on this page.

Stay tuned for more!

ARCHIVED INSTALLMENTS

TRACING OUR PFAS FOOTPRINT: DETECTING AND INTERPRETING SYNTHETIC FLUORINATED ORGANICS IN OUR ENVIRONMENT AND BODIES

Bruce Armitage, professor and head of the Department of Chemistry and co-director of the Center for Nucleic Acid Science and Technology

Carrie McDonough, assistant professor of chemistry

Synthetic fluorinated organics from commercial products have been detected in human blood since the late 1970s. The complex chemistry of per- and polyfluoroalkyl substances (PFASs) has made it challenging to fully understand their presence in humans and animals. This talk explores the sources, exposure routes and accumulation mechanisms of PFASs, aiming to predict and prevent environmental degradation and adverse health outcomes.

UNVEILING THE SECRETS OF CELLS: PHYSICS AT THE INTERSECTION OF LIFE AND DISEASE

Curtis Meyer, Otto Stern Professor of Physics and former interim dean of the Mellon College of Science

Huaiying Zhang, assistant professor of biological sciences

Fangwei Shi, assistant professor of physics

Assistant Professors Huaiying Zhang and Fangwei Si conduct groundbreaking research that deepens our understanding of the building blocks of life. Zhang outlined how changes in cells impact the development of cancer and how these insights could be used to discover new treatments. Si's work uses physics to understand the intelligence of bacteria and to better understand how life emerges from nonliving matter.

DECODING THE MIND: UNCOVERING NEURAL MECHANISMS OF HEALTH AND DISEASE USING MACHINE LEARNING

Veronica Hinman, former head of the Department of Biological Sciences

Eric Yttri, assistant professor of biological sciences

Everything you feel, think and do is the result of interactions between millions of cells in your brain. Eric Yttri and his lab at CMU are applying new tools to understand how neurons across different brain areas interact to orchestrate decisions and movement. To aid this study, they have developed new analysis platforms to extract a range of behaviors from video and link them to the complex neural dynamics they measure. With these techniques and insights in hand, they are developing new approaches to combating diseases like stroke, Parkinson's and OCD.

WORK IN PROGRESS

Significant progress has been made at the construction site for the Richard King Mellon Hall of Sciences. Excavation to carve out space for the lower levels wrapped up in December, and foundation work will be ongoing through February. Things start looking up as a tower crane will be installed during the spring, and the building superstructure will start to take shape.

Construction at the corner of Forbes Avenue and Craig Street is expected to be completed in 2027. The innovative facility will be the new home for departments from the Mellon College of Science and School of Computer Science, and the Institute for Contemporary Art Pittsburgh, creating an environment that facilitates collaboration across disciplines to advance data driven research and creative inquiry.

The Hall of Sciences is the cornerstone of the university's future of science initiative, a decade-long effort to revolutionize and accelerate research and education, leading to innovations and breakthroughs that will benefit humankind. The Mellon College of Science's Biological Sciences and Chemistry Departments, along with the interdisciplinary Neuroscience Institute, will have new, cutting-edge facilities in the building.

Scan QR code to learn more or visit cmu.edu/hall-of-sciences

Scan QR code to watch the progress via live webcams

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