

2021-22 Annual Report

Chemistry AT ILLINOIS



A DEDICATION TO *excellence* AND *innovation*...



in the chemical sciences has always defined Illinois chemistry, from educating the next generation of brilliant chemists to ground-breaking research that pushes forward the frontiers of modern chemistry. This 2021-22 overview shares some of the high points in that tradition of excellence that continues today.

Just over 180 students graduated this past year increasing our alumni network to 9,778 people spread across 54 countries around the globe, and the department welcomed another 166 new students in Fall

2022, both undergraduate chemistry majors and graduate students. The number of incoming undergraduate majors is the highest in at least five years, and the Class of 2026 includes 21 first-generation college students and 19 students who are underrepresented in the chemical sciences. Recently, UIUC was designated a First-Gen Forward Institution, and received the 2022 Higher Education Excellence in Diversity (HEED) Award.

I am so thankful for our alumni and friends who so generously support our faculty, students, programs and research. The \$7.7 million in gifts received this past year was also the most in five years.

Image: Azzaya Khasbaatar and Prapti Kafle

And the number of research projects plus the funding for those projects was the highest in five years – a result of the ingenuity, enthusiasm, and dedication of our faculty members, post-doctoral researchers and students.

Those 48 research projects that received new funding embody a rich variety of visionary interdisciplinary science, a hallmark of our department for decades. The projects include efforts to explore molecular therapeutics for cystic fibrosis, genomics-accelerated natural product discovery, machine learning for quantum chemistry, new ways to do energy conversion, more efficient catalysis and drug discovery and nano-target fabrication for radioisotope production. Other researchers are investigating how to combat neurotoxic effects of dietary mercury, harness light and model endosymbiosis to produce natural products, develop degradable polymer materials for recycling and upcycling, develop new breast cancer treatments, discover new methods and materials to capture and release carbon dioxide, develop a saliva-based diagnostic test to detect oral cancer, and optimize materials properties by exploiting the defects inherent in the materials.

As both Head and an alum, I am proud to be part of this diverse scientific community at Illinois and hope you enjoy reviewing this summary of our achievements over the past year.

Catherine J. Murphy

Head, Department of Chemistry
Larry R. Faulkner Endowed Chair in Chemistry

2021-22 HIGHLIGHTS

Jefferson Chan and David Sarlah promoted to associate professor

Joaquín Rodríguez-López named an IAspire Leadership Academy fellow



Mei Shen wins Scialog Award



Lisa Olshansky named a Vallee Scholar

During Homecoming Week, the Alumni Association honors inaugural Young Alumni Award winner Markita Landry (PhD, '12)

Jonathan Sweedler, Rohit Bhargava make list of world's top analytical scientists



Alumni Lecture featuring Dr. Robert Yu (PhD, '67, Carter); he later passed away on May 18, 2022

Danielle Loving, Alexis Lower, Marya Ornelas, and Amy Wahlmeier awarded National Science Foundation Graduate Research Fellowships



So Hirata and Prashant Jain awarded Guggenheim Fellowships

Jefferson Chan named Camille Dreyfus Teacher-Scholar

First in-person convocation in three years, features Jennifer Holmgren (PhD, '86) as keynote speaker



Alumni Career Panel: Chemistry and Beyond – Dr. Karla Ewalt (BS, '89); Dr. Kaitlyn Gray (PhD, '11); and Dr. Nicholas Ndiege (PhD, '08)

Tepora Su'a joins Department as Assistant Director of Diversity, Equity and Inclusion in the Chemical Sciences

2021

JULY

AUGUST

SEPTEMBER

OCTOBER

NOVEMBER

DECEMBER

2022

JANUARY

FEBRUARY

MARCH

APRIL

MAY

JUNE



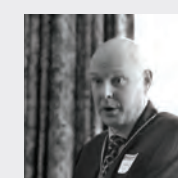
Professors Martin Burke, Paul Hergenrother and lab technician Kelsie Green receive UI Presidential Medallions for university COVID-19 response

Catching Up with Chemistry: Virtual event for alumni and friends

Iain C. Paul, Emeritus Professor of Chemistry, passes away

Martin Burke elected American Association for the Advancement of Science fellow

Lisa Olshansky named a Cottrell Scholar



Douglas Mitchell honored as John Witt Professorship in Chemistry during Investiture ceremony

Bronze Tablet graduates: Evan Dray, Andrew Feng, Austin Huang, and Jacob Wolf



Ralph Nuzzo named Kavli Prize Laureate in Nanoscience

Catherine Murphy wins Royal Society of Chemistry prize

9778 ALUMNI FROM 54 COUNTRIES
(9275 – 95% ARE IN U.S.)

Image: Brittney Gorman



Chemistry at Illinois graduates land first destinations

A specialized chemistry major in the Class of 2022, Maya Chatteraj graduated in May and is now a PhD student at MIT. Her goal is to have a career in research combining materials and physical chemistry with projects that combat environmental issues. Chatteraj was an undergraduate researcher in the Department of Chemistry this past year. In the lab of professor Prashant Jain, Chatteraj worked on the electroreduction of CO₂ to value-added chemical fuels using intermetallic gold-copper nanoparticles as the catalyst. She learned to

synthesize nanoparticles, characterizing them with ultraviolet-visible spectroscopy, X-ray power diffraction, and transition electron microscopy, ran CO₂ reduction reactions and used gas chromatography to identify products. She said she chose to attend UIUC in chemistry because of the “amazing research opportunities” available to undergraduates.

“My research work has given me the opportunity to learn a wide variety of skills under the guidance of my advisor and my graduate student mentor,” Chatteraj said. “I really value my research experience, which has given me insight into the research process and prepared me well for graduate school.”

GRADUATE SUCCESS

CLASS OVERVIEW

Secured First Destination	97%
---------------------------	-----

PRIMARY STATUS

Employed	61%
Continuing Education	36%
Seeking	3%

FULL TIME EMPLOYED SALARY

Average Salary	\$ 69,790
25th Percentile	\$ 65,500
50th Percentile	\$ 72,000
75th Percentile	\$ 75,000

Top 5 U.S. States for ALUMNI

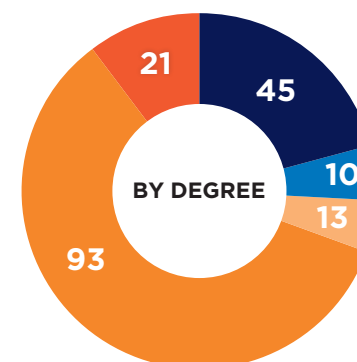
	#	% of U.S. total
Illinois	3440	37%
California	825	9%
Texas	335	4%
Pennsylvania	329	4%
Michigan	256	3%
Total of Top 5	5185	56%

WHERE DID RECENT GRADUATES GO TO WORK?

182 graduated 2021-22

127
Undergraduate
Degrees

55
Graduate Degrees



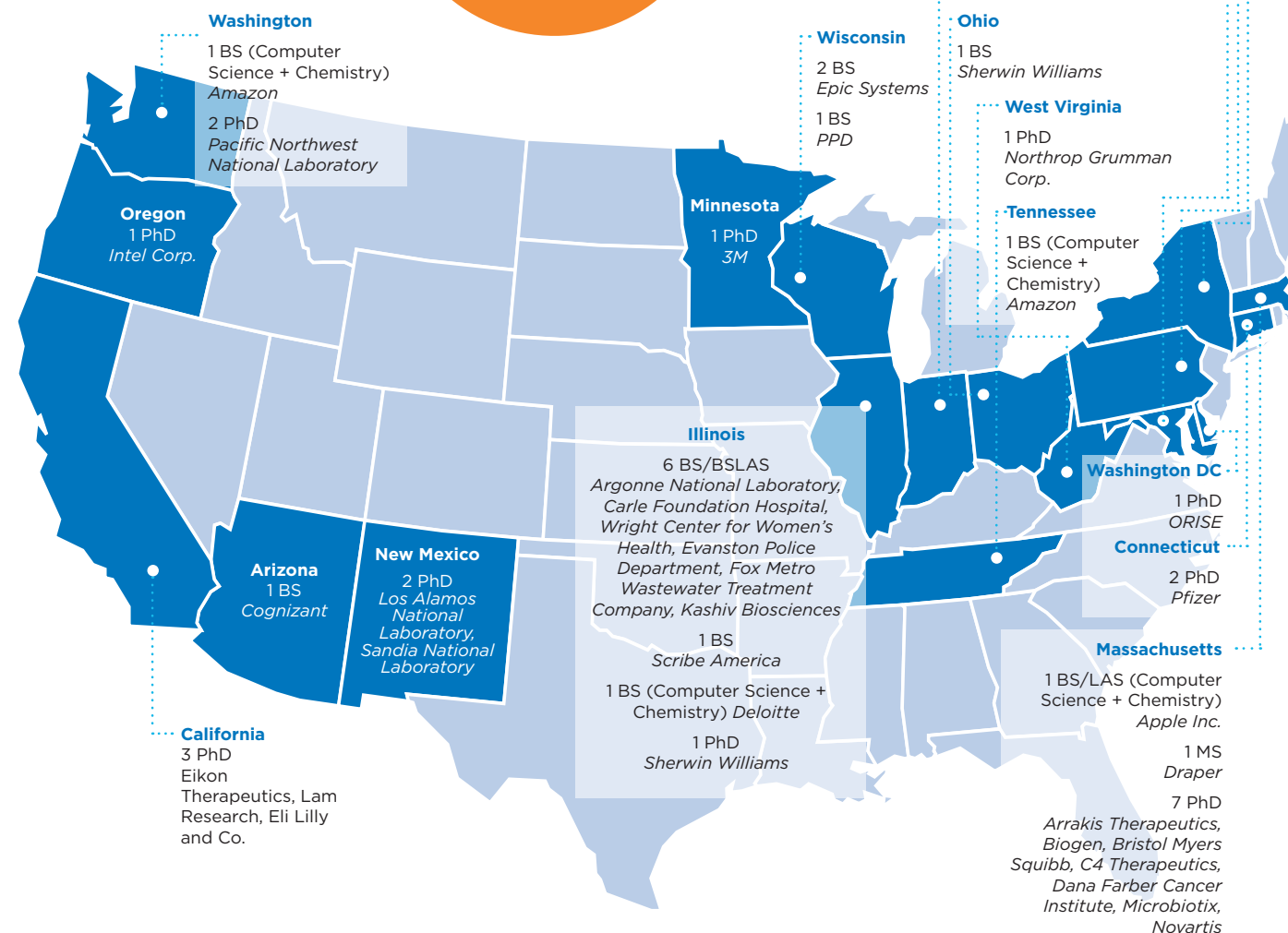
BS: Chemistry

BSLAS: Chemistry

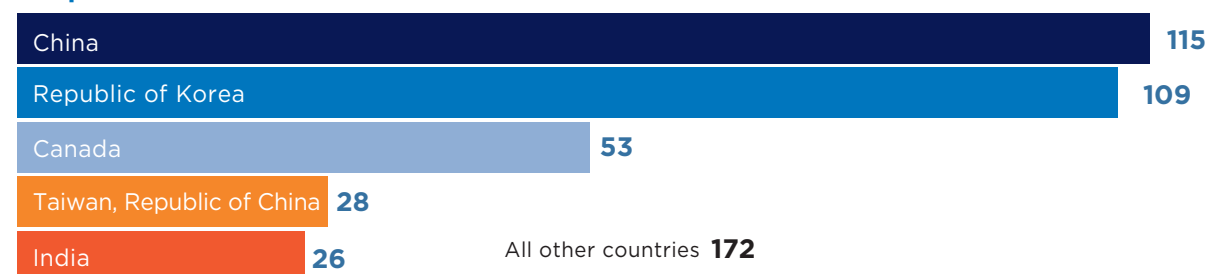
BSLAS: Computer Science + Chemistry

MS: Chemistry

PhD: Chemistry

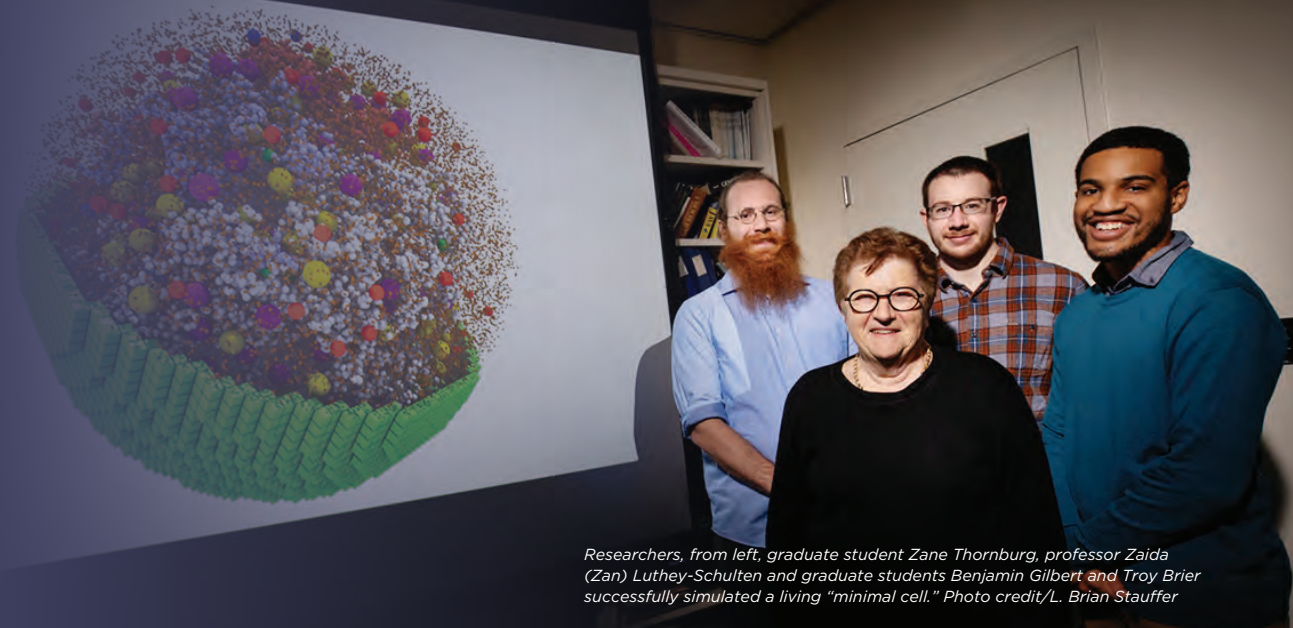


Top 5 countries outside U.S. for Alumni



Faculty + Research

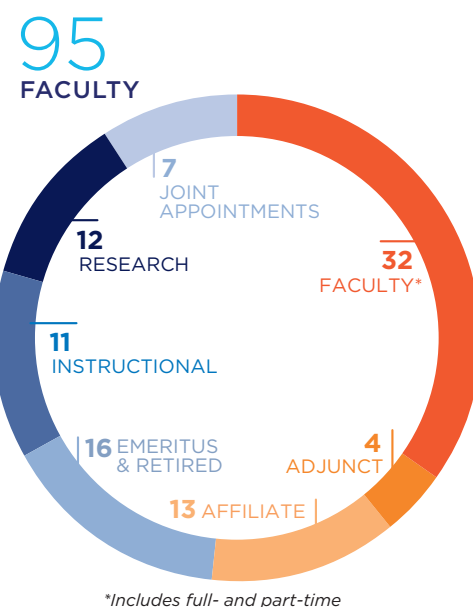
Image: Moeen Meigooni



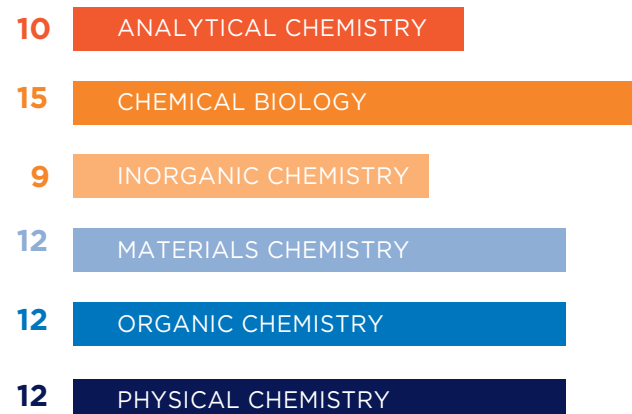
Researchers, from left, graduate student Zane Thornburg, professor Zaida (Zan) Luthey-Schulten and graduate students Benjamin Gilbert and Troy Brier successfully simulated a living "minimal cell." Photo credit/L. Brian Stauffer

The number of research projects funded and the total amount of funding in 2021-22 is more than the previous four years – 48 proposals totaling \$26.8 million. One of the NSF funded projects included Professor Zaida Luthey-Schulten's lab where researchers built a living "minimal cell" with a genome stripped down to its barest essentials and a computer model of the cell that mirrors its behavior. By refining and testing their model, the scientists are developing a system that can predict how changes to the genomes, living conditions or physical characteristics of live cells will alter how they function. Minimal cells have pared-down genomes that carry the genes necessary to replicate their DNA, grow, divide and perform most of the other functions that define life, said Luthey-Schulten, the Murchison-Mallory Endowed Chair in Chemistry.

"What's new here is that we developed a three-dimensional, fully dynamic kinetic model of a living minimal cell that mimics what goes on in the actual cell," Luthey-Schulten said.



TENURE-TRACK FACULTY BY RESEARCH AREA*



*Several faculty conduct research in multiple areas

2021-22 RESEARCH ACHIEVEMENTS



FUNDED RESEARCH PROPOSALS

48 = \$26.8 million

FUNDING AGENCY		NUMBER OF PROJECTS
DEPARTMENT OF DEFENSE	\$ 694,166	2
NATIONAL INSTITUTES OF HEALTH	\$ 13,066,906	9
NATIONAL SCIENCE FOUNDATION	\$ 7,250,427	14
PRIVATE FUNDING	\$ 2,134,650	18
U.S. DEPARTMENT OF ENERGY	\$ 3,682,590	5

FUNDING AGENCY	2017 - 18 #	2017 - 18 \$	2018 - 19 #	2018 - 19 \$	2019 - 20 #	2019 - 20 \$	2020 - 21 #	2020 - 21 \$
DEPARTMENT OF DEFENSE	3	\$703,767	3	\$2,217,624	1	\$1,999,007	0	0
NATIONAL INSTITUTES OF HEALTH	9	\$16,142,214	14	\$13,762,845	9	\$3,610,709	7	\$15,903,733
NATIONAL SCIENCE FOUNDATION	8	\$3,605,895	5	\$2,250,915	9	\$3,368,902	8	\$3,511,613
PRIVATE FUNDING	20	\$3,465,035	14	\$2,151,437	21	\$3,013,234	15	\$2,862,376
U.S. DEPARTMENT OF ENERGY	5	\$1,365,430	6	\$695,000	5	\$921,065	5	\$619,473
NASA	0	0	1	\$45,000	0	0	1	\$349,543
	45	\$25,282,341	43	\$21,122,821	45	\$12,912,917	36	\$23,246,738

Students

Image: Professors Zhaleh Ghaemi, Emad Tajkhorshid and Martin Gruebele and student Dara Nafiu, Carle Illinois College of Medicine

Micah Robinson



Highlights of Chemistry at Illinois' newest class of undergraduates, graduates

730
students

443
undergraduate

36
(8%) received a departmental/
donor-funded scholarship

\$174,500
awarded in departmental/
donor-funded scholarships

114
undergraduate researchers

This number includes undergraduates from other UIUC departments and/or from other higher education institutions who conducted research with Department of Chemistry faculty.

287
graduate

FUNDING

46
Full Fellowships

139
Research
Assistantships

102
Teaching
Assistantships

FELLOWSHIPS (full & partial)

21
Campus

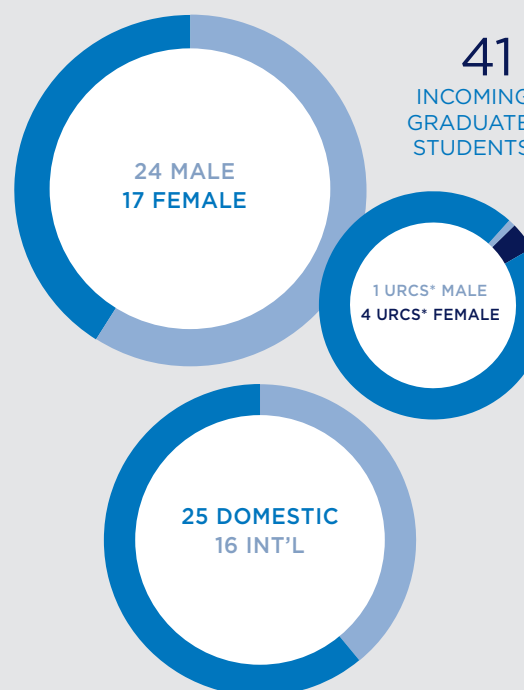
148
Departmental/Donor-
Funded

9
External: NSF

10
External: Other

INCOMING GRADUATE STUDENTS

422 → 180 → 41
APPLICANTS OFFERS ACCEPTED



GET TO KNOW OUR INCOMING UNDERGRADUATE STUDENTS

125
INCOMING
UNDERGRADUATE
STUDENTS



11
TRANSFER

- 11 ILLINOIS
- 0 NONRESIDENT
- 0 INTERNATIONAL

0 URCS*
TRANSFER

- 5 FIRST
GENERATION

19 URCS*
FRESHMEN

- 21 FIRST
GENERATION

*This data is for our newest class of students—
incoming in 2022-2023.*

**Underrepresented in the Chemical Sciences
(URCS)*

The 2022-23 incoming class of 7,957 first-year students at UIUC is the second-largest-ever, bringing the university's total student enrollment to 56,644 – a record-sized total. Numbers are also up in the Department of Chemistry. The 2022-23 incoming class of first-year chemistry students is the largest in five years – 125 (114 freshmen and 11 transfers). And 26, or 20.8 percent, of those incoming students are first-generation college students. UIUC was recently designated a First-Gen Forward institution by the Center for First-generation Student Success – a program acknowledging higher education institutions for their commitment to first-generation success. Also, 15 percent of the incoming undergraduates in chemistry are students traditionally underrepresented in the chemical sciences. And underrepresented students comprise 12 percent of the incoming graduate student cohort. For the second consecutive year, the newest graduate student class includes a former St. Elmo Brady Summer Research Scholar, Micah Robinson, who graduated from Tougaloo College in Mississippi with high honors and was the 2022 Chemistry Academic and Leadership Excellence Award winner. Robinson said her summer research experience at UIUC was a big reason she chose Illinois to pursue her PhD.

"I enjoyed my time last summer. It also helps that UIUC's analytical chemistry track is ranked high in the country," Robinson said.

Thank You

Image: Aastha Sharma

A gift establishing a new endowed chair and planned gifts supporting faculty and undergraduate research led the way to a record-breaking \$7.76M in gifts and commitments in 2021-22 – more than twice Chemistry’s average total over the past five fiscal years.

This year also saw the launch of new initiatives – like the data science class featured here – and the continued generosity of the hundreds of you who choose to give year after year.

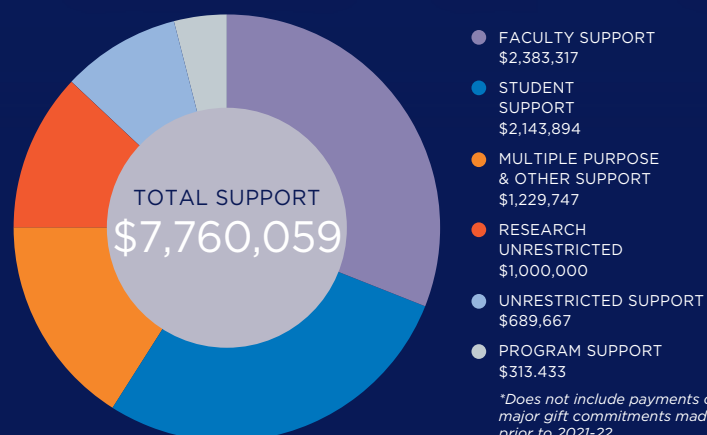
Not only do your gifts directly support our students and faculty, they signify confidence in our ability to excel in teaching, research, and public service, and for that we are grateful. Thank you for your generosity, which is building a better future for us all.

For more information about supporting the Department of Chemistry, please visit chemistry.illinois.edu/giving.

NEW NAMED FUNDS

Andrew Loh Endowed Scholarship Fund
Carolyn J. and David A. Matthews Fellowship Fund for Current Use
Chuanjing Xu Memorial Scholarship Fund
Craig P. Baskin Endowed Undergraduate Chemistry Scholarship Fund
Dr. Sandra Murawski Graduate Student Award Fund
E. Philip Horwitz High Achievement Scholarship in Chemistry Fund
Eunice S. Wu Memorial Scholarship in Chemistry Fund
Jerry A. Walker Endowed Chair Fund
Milan Mrksich Scholarship for Undergraduate Research Fund
Peter and Dorothy A. Kovacic Scholarship Fund
Steven C. Zimmerman Scholarship for Undergraduate Research Fund
T.M. Balthazor Award Fund
Thomas Remec and Susan Morisato Fund for Data Science in the Chemical Sciences

This is a selection only.



**Does not include payments on major gift commitments made prior to 2021-22.*

359
DONORS

503
GIFTS

\$7.76 MILLION
IN GIFTS & COMMITMENTS*

Gifts in Action

Students at UIUC who want to learn data science combined with machine learning and how to apply these techniques to their own research now have the ideal course thanks to a gift from two Illinois alumni.

The Thomas Remec and Susan Morisato Fund for Data Science in the Chemical Sciences was established in July 2021 by **Thomas M. Remec** (BS, '74, Chemistry; MS, '83, Metallurgical Engineering) and **Susan C. Morisato** (BS, '75, general curriculum; MS, '77, Mathematics).

This gift funds a new data science course specific to chemistry for undergraduates and graduate students that began in Fall 2022. And it also funds online technology resources to increase access for students and a summer research experience for Illinois undergraduates in data science and chemistry. The inaugural year Summer 2022 undergraduate scholars were **Ayu Seiya** and **Swaroop Thammineni**.

Remec said this new course teaches skills that can help students put together a research program, and also assist in data analysis that may improve the professionalism and breadth of their theses. Remec explained why he and Susan chose to make this gift.

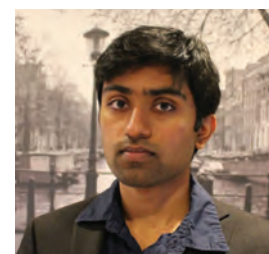


Susan Morisato and Tom Remec

“While the state of Illinois has been more than generous with respect to funding our campus, there comes a time when we who benefitted must step up and make their own contributions in order to spread the financial burden,” he said.

Professor Nick Jackson, who teaches the course in Fall 2022, said the fundamental objective is for students to learn how to “do” machine learning and data science on real experimental data sets using Python. Based on a staple of machine learning methodologies that are standards in academia and industry, Jackson teaches these topics entirely in the context of chemistry, chemical engineering, and materials science applications.

“Provided the way data science and machine learning have transformed and continue to transform our everyday experiences, it is critical that our students at UIUC be educated in many of these techniques so that they are ready to benefit both in their research projects and in the workforce,” Jackson said. “Data science is not a subject that just benefits ‘computer people’ - it has the power to impact nearly every avenue of chemical research and industry.”

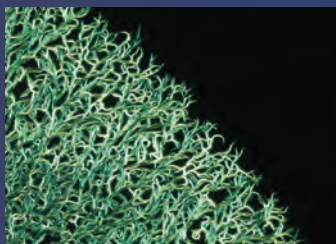


Swaroop Thammineni

Thammineni’s research focuses on proteins, which carry out many biological processes and are linearly synthesized by amino acid sequences.

It is important, Thammineni explained, to model the various dynamic conformations of proteins to understand internal mechanisms and functions that can help design novel drugs and provide insight into diseases. And a new approach for modeling protein dynamics is using machine learning, he said.

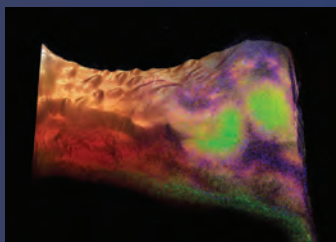
The science images appearing in this report were created by students, faculty, and postdoctoral researchers in the department.



Azzaya Khasbaatar and Prapti Kafle (Ying Diao Lab)

Seizing the Darkness

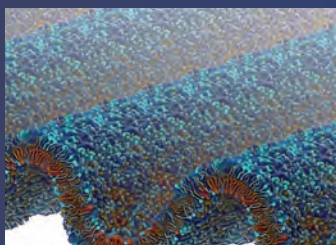
This is a cross-polarized microscopy image of a crystallized anticancer drug material, Amonafide, prepared by solution printing. By tuning the solution printing speed, the crystalline behavior of Amonafide is controlled, and at a very high speed, it forms the as-shown crystallite within the dark amorphous region.



Brittney Gorman (Mary Kraft Lab)

The Creation of a 3D Lipid Map

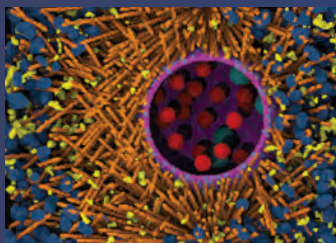
Cellular morphology fades into a 3D map of subcellular cholesterol (green) and sphingolipids (blue & orange). The morphology heights were determined using luminosity in the secondary electron images collected during secondary ion mass spectrometry analysis. Then, the ion signals collected from the cholesterol and sphingolipids were shifted using heights in this morphology.



Moeen Meigooni (Emad Tajkhorshid Lab)

The Great Wavy Membrane

The curvature induced by cardiolipin (red) in a cell-scale model of the mitochondrial membrane bilayer highlights undulations. The image was rendered using VMD and post-processed with neural style transfer in the style of Katsushika Hokusai's famous woodblock print, The Great Wave off Kanagawa.



Professors Zhaleh Ghaemi, Emad Tajkhorshid and Martin Gruebele and student Dara Nafiu, Carle Illinois College of Medicine

The in silico liver cell

This is an image – modeled in a computer – that shows a 15-micron-long liver cell with all its glorious organelles. This computer model is part of a collaborative research project among the image authors.



Aastha Sharma (Josh Vura-Weis Lab)

Behind the Scenes – Light Matter Interaction

These optical instruments are the workhorses behind research in the Vura-Weis Lab where researchers are exploring a better understanding of light and matter interaction – for example, finding a way to harness the tremendous amount of energy that is in sunlight.

On the Cover

Anda Trifan, Defne Gorgun

(Emad Tajkhorshid Lab)

Silver Lining of the SARS-CoV-2 Virus

This image represents the linking of two scales of resolution: Fluctuating Finite Element Analysis (FFEA) and All-Atom Molecular Dynamics (AAMD). These techniques have been combined in a multiscale resolution workflow to uncover the mechanism of function for the replication transcription complex of the SARS-CoV-2 virus.



College of Liberal Arts & Sciences
Department of Chemistry

600 South Mathews Avenue
Urbana, Illinois 61801

(217) 333-5071
chemistry@illinois.edu
www.chemistry.illinois.edu