The Welch Foundation

2024 ANNUAL REPORT

Advancing Chemistry, Improving Life

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Robert A. Welch

For
70 years
The Welch Foundation has upheld its commitment to advancing fundamental chemical research across Texas.

The Welch Foundation stands as a lasting testament to the foresight of oilman and philanthropist Robert A. Welch, who believed deeply in the power of chemistry to improve lives. The Foundation reflects his faith in the power of scientific discovery and his love for the state of Texas.

Robert Alonzo Welch was a self-made man who overcame the difficult circumstances of his childhood in South Carolina to achieve success through initiative, hard work and discipline. Born in 1872, Welch was a determined person. He began working at just 12 years old, and at 14 he traveled to Houston to seek his fortune, which he found in oil and minerals.

While he never went on to higher education himself, Mr. Welch was capable, knowledgeable and good friends with many well-educated peers. He lived most of his adult life in an era of incredible scientific progress and saw amazing discoveries grow out of research, particularly in chemistry. He recognized that scientific breakthroughs could make a better life for all.

Welch was a talented investor; when he wrote his will, he decided to dedicate his legacy to a sound and wise investment that would be repaid many times in valuable benefits to humankind. In recognition of the role they played in his business success, Welch left a generous portion of his estate to his employees and their families when he died in 1952. The remainder he dedicated to the creation of a foundation that would support fundamental chemical research in Texas: The Welch Foundation.

2024 Highlights

The Welch Foundation marked its 70th year in 2024. With an endowment of $886 million at fiscal year end, the Foundation has invested more than $1.1 billion since its inception to support fundamental chemical research in Texas.

In February, The Welch Foundation presented Livia S. Eberlin, Baylor College of Medicine, with the 2024 Norman Hackerman Award in Chemical Research *(see page 9)* for her work in developing the MasSpec Pen, an analytical device that is improving cancer surgery outcomes.

Dr. Eberlin is a trailblazer in the field of analytical chemistry, particularly in advancing mass spectrometry and chemical analysis for biomedical research. With her team, she has developed advanced mass spectrometry techniques, paying particular attention to revolutionizing methods that can perform chemical mapping of a surface. This innovation allows a non-destructive analysis of tissues by detecting and identifying various chemical compounds on their surfaces. These technologies have led to transformative discoveries in cancer research, uncovering diagnostic, prognostic and treatment response-related metabolic signatures across multiple cancer types.

Eric N. Jacobsen, Harvard University, was honored as the 2024 recipient of the Robert A. Welch Award in Chemistry *(see page 6)* for his groundbreaking work in organic chemistry. The award was presented in October during the Foundation's annual gathering.

Dr. Jacobsen's research is dedicated to the discovery and analysis of practical catalytic reactions. Using innovative mechanistic and computational techniques, he has uncovered general principles for future catalyst design, laying the foundation for the rational design of functional molecules. He pioneered the field of synthesis and homogeneous catalysis, revolutionizing how we understand, implement and study small molecule chiral catalysts, thus creating a paradigm shift in the field of asymmetric catalysis. His reactions have been applied in large scale, late-stage synthesis on numerous FDA approved drugs, including for AIDS and other diseases.

The Welch Conference on Chemical Research, held in October, delved into new discoveries in the field of catalysts with potential benefits to society. The 67th conference, "Frontiers in Molecular Catalysis," *(see page 12)* was chaired by Welch Scientific Advisory Board member Melanie S. Sanford, Moses Gomberg Distinguished University Professor and Arthur F. Thurnau Professor of Chemistry, University of Michigan.

Now in its second year, the Catalyst for Discovery Grant Program provides $1 million a year for up to five years to multidisciplinary research teams. The grants are designed to accelerate progress in fundamental

Livia Eberlin displays her Hackerman Award. | Eric Jacobsen receives Welch Award. | Melanie Sanford opens Welch conference.

chemical research by supporting collaborative approaches to tackling major questions at the leading edge of chemistry. After four awards were made to jump-start the program in its first year, Welch approved two new Catalyst Grants in 2024:

- Yi Lu, The University of Texas at Austin, “Artificial Dinitrogen Transferases: Leveraging Bio-Inspired Nitrogen Fixation to Directly Transfer N_2 into Organic Molecules” *(see page 30)*, and
- Damian W. Young, Baylor College of Medicine, “Innovation in DNA-Encoded Chemistry Technology to Enable More Effective Ligand Discovery.”

The second Welch eXperimental (WelchX) Collaboration Retreat in summer 2024 welcomed 26 mid-career tenured or tenure-track Texas researchers. The retreat is intended to help build and strengthen connections in the Texas chemistry community and leverage their combined expertise to brainstorm on the retreat’s theme, “Chemistry of Life.” Five of the proposals developed from interactions during the retreat received a one-year, $100,000 collaboration pilot grant to kickstart the joint projects:

- Ilya Finklestein, The University of Texas at Austin, and Zhao Wang, Baylor College of Medicine, “Mapping Sub-Cellular Genotype-Phenotype Relationships with Correlated Spatial Sequencing and Electron Cryo-Tomography,”
- Anna Konovalova, The University of Texas Health Science Center at Houston, and Tian Qin, The University of Texas Southwestern Medical Center, “Cost-Effective Tool for Bacterial Reverse Vaccinology” *(see page 25)*,
- Stanton McHardy, The University of Texas at San Antonio, and Jonathan Sczepanski, Texas A&M University, “Development of PROTACS with Programable Oligonucleotide-Based Linkers,”
- Joshua Tropp, Texas Tech University; Ben Keitz, The University of Texas at Austin; and Melissa Zastrow, University of Houston, “Unraveling the Role of Iron in the Gut Microbiome using Iron-Selective Organic Electrochemical Transistors,” and
- Lauren Webb, The University of Texas at Austin; Sheena D’Arcy, The University of Texas at Dallas; and Hao Yan, University of North Texas, “Molecular Mechanisms of Life in the Deep Sea: Understanding Protein-Lipid Structures and Dynamics at High Pressure” *(see page 27)*.

The Foundation also expanded the reach of two other new programs, awarding three, three-year Welch Postdoctoral Fellows of the Life Sciences Research Foundation *(see page 53)* and 29 Equipment Grants to supplement its Departmental Research Grants to small- and mid-size colleges and universities *(see page 52)*.

Carloyn C. Sabat joined the Welch Board of Directors after the retirement of William F. McKeon. Ms. Sabat currently serves as secretary and director.

The Foundation also welcomed two new members to its Scientific Advisory Board in 2024: Squire J. Booker, Eberly Family Chair in Science and an Evan Pugh Professor of Chemistry and of Biochemistry, The Pennsylvania State University, and Sharon Hammes-Schiffer, A. Barton Hepburn Professor of Chemistry, Princeton University. James A. Skinner, University of Wisconsin-Madison, retired from the SAB.

The Welch Foundation is deeply appreciative of the contributions of both Mr. McKeon and Dr. Skinner to its mission.



The WelchX program encourages cross-university collaboration. | David Allen was named to a Welch chair at UT Austin. | Postdoc Kayla Goforth studies magnetic field navigation with Welch funding.

The Welch Foundation: Advancing Chemistry for a Better Tomorrow

Created through the foresight and generosity of Texas oilman Robert Alonzo Welch, The Welch Foundation has provided unwavering support for fundamental chemical research at Texas universities, colleges and institutions since its founding in 1954.

The Welch Foundation's dedicated Board of Directors, Scientific Advisory Board and Foundation staff continue to honor Mr. Welch's intent to advance chemistry within the state of Texas and to shape a legacy of fueling discoveries that improve lives everywhere. With more than $1.1 billion having been invested in research grants and programs, the Foundation does more than fund science—it nurtures talent, enables innovation and honors a commitment to the public good. Every grant and award reflects Mr. Welch's belief that basic research is a wise investment—one that pays dividends in knowledge, opportunity and progress for generations to come.

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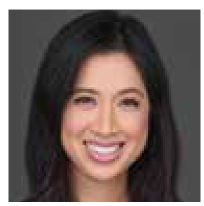

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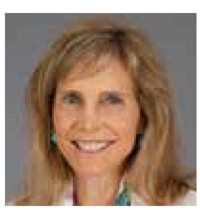

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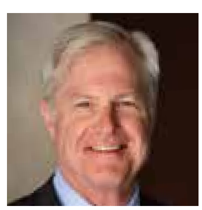

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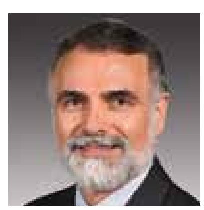

ADAM KUSPA
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As stewards of The Welch Foundation's mission and resources, the Board of Directors maintains the integrity and drive of the original Foundation trustees to ensure that chemical research in Texas is offered every opportunity to benefit humankind.

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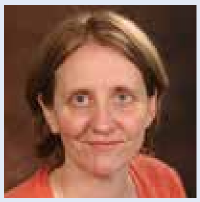

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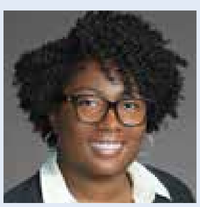
The Scientific Advisory Board, comprised of nationally renowned scientists, provides expert counsel to the Board of Directors on scientific matters central to the Foundation's mission. Members rigorously evaluate research proposals, recommend award recipients and guide key programs such as the annual Welch Conference, which brings together global leaders in chemistry.

Foundation Staff



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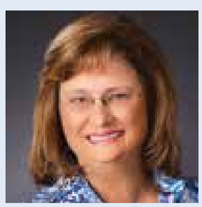

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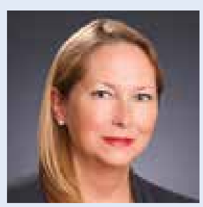

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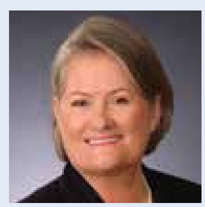

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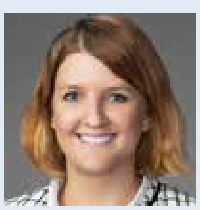

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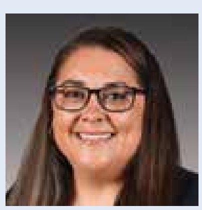

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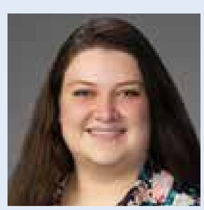

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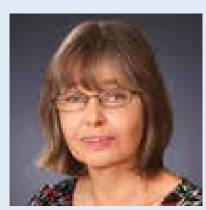


SHERRY WHITE
Senior Accountant

Behind every Welch Foundation program, award and grant is a team of dedicated staff, led by President Adam Kuspa, who ensure the Foundation's work is carried out with excellence, efficiency and purpose. With professionalism and care, they support the Foundation's mission to advance chemical research and uphold the legacy of its founder.

Welch Award: Advancing Rational Catalyst Design

Eric N. Jacobsen pioneered the field of synthesis and homogeneous catalysis, revolutionizing how we understand, implement and study small molecule chiral catalysts and creating a paradigm shift in the field of asymmetric catalysis. Dr. Jacobsen has connected how these catalysts impart selectivity and reactivity to biological systems and established the cooperativity of interactions required to accelerate selective pathways.

Using mechanistic and computational approaches, this Harvard University researcher has helped uncover general principles for rational catalyst design, including electronic tuning of selectivity, cooperative homo- and hetero-bimetallic catalysis, privileged catalysis, hydrogen-bond donor asymmetric catalysis, and anion-binding catalysis. He has provided a guidebook to other scientists on how to continually evolve small molecular asymmetric catalysis.

"Professor Jacobsen is a trailblazer in the field of chemistry, and his work with small molecule catalysts has been revolutionary for understanding how they work," said Fred Brazelton, Chair, The Welch Foundation Board of Directors. "The Welch Award aims to recognize the top minds in the field of chemistry, and Eric is a natural pick. We are excited to honor his contributions to chemistry."

Asymmetric catalysts are "handed"—very much like how our right and left human hands are mirror images of each other—and they react very differently depending on their handedness. This makes them particularly useful in creating drugs to target biological molecules, which also are handed. To control the rate of reactions, it is critical to control the transition state—Dr. Jacobsen calls this the "mountain peak" that must be scaled to create products. Catalysts lower that peak.

Early in his career, he discovered a new reaction to make epoxides, a class of compounds widely used in biological applications and industrial processes. Years later, Dr. Jacobsen discovered a second means of making epoxides by bringing two different catalysts together to work cooperatively, a less expensive and greener approach than his original method. Once again, this new approach was quickly adopted for practical applications. As importantly, it also opened the door to use this principle in new ways.

This prolific researcher's most recent breakthrough involves non-covalent catalysis that works using weak forces and without making discrete bonds, mimicking a process enzymes use extensively in nature. This discovery creates a very fertile new area of chemistry and brings us closer to bridging the worlds of biological and chemical catalysts.

"Professor Jacobsen's work has had profound impacts on how we understand small molecular catalysts and their role in asymmetrical catalysis, which in turn has changed our lives as chemists and human beings alike," said Catherine J. Murphy, Chair, The Welch Foundation Scientific Advisory Board. "A leader in the space, Eric's work has not only set the standard for evolving small molecular asymmetric catalysis, but his work also

The

$500,000

Welch Award celebrates the outstanding achievements of scientists whose research has significantly improved lives.

Eric Jacobsen accepts the 2025 Welch Award saluting his work with small molecule catalysis. | Celebrating with Dr. Jacobsen are Cathy Murphy, Virginia Jacobsen, and Adam and Julie Kuspa.

Commemorating the 2025 award are SAB members *(from left)* Kevan Shokat, Ann McDermott, Cathy Murphy, Xiaowei Zhuang, Welch awardee Eric Jacobsen, Melanie Sanford and Squire Booker.

Frances Arnold, conference keynote speaker, congratulates Eric Jacobsen on receiving the Welch Award.

impacts our day-to-day lives through applications such as the use of his reactions in large scale, late-stage synthesis on numerous FDA approved drugs."

Looking ahead, Dr. Jacobsen plans to keep investigating non-covalent catalysis and the many exciting possibilities it offers.

"My group and I have been dedicated to discovering catalytic reactions and to applying state-of-the art mechanistic and computational techniques to understand how those reactions work," Dr. Jacobsen said. "I am deeply indebted to my mentors, to special colleagues at Illinois and Harvard who guided and inspired me and to the remarkable scientists throughout the world whose work in selective catalysis continually surprises and motivates me. I am most grateful to the graduate students and postdocs who placed their trust in me to be part of their journey as scientists and who did the work that is being celebrated with this prize."

Over three-plus decades, Dr. Jacobsen has demonstrated how rigorous physical organic studies can inform catalyst design in organic synthesis and how cooperativity and noncovalent interactions can be harnessed to devise functional molecules. With more than 270 papers and book chapters published and research cited more than 71,000 times, his work continues to have wide-ranging impacts on the field.

Dr. Jacobsen earned an undergraduate degree in chemistry from New York University and a PhD from the University of California, Berkeley under the direction of Robert G. Bergman (2014 Welch Award recipient) in the field of mechanistic organometallic chemistry. He completed a National Institutes of Health postdoctoral fellowship with Barry Sharpless at Massachusetts Institute of Technology, where he participated in the discovery of the osmium-catalyzed asymmetric dihydroxylation reaction. He began his independent career at the University of Illinois at Urbana-Champaign in 1988 before moving to Harvard as a full professor in 1993. He was named the Sheldon Emory Professor of Organic Chemistry in 2001 and served as Chair of the Department of Chemistry and Chemical Biology between 2010 and 2015.

Dr. Jacobsen has received numerous awards and recognitions including the Packard Fellowship (1991), the Baekeland Medal (1999), the ACS Award for Creativity in Synthetic Organic Chemistry (2001), election to the American Academy of Arts & Sciences (2004), the Mitsui Catalysis Science Award (2005), election to the National Academy of Sciences (2008), the ACS H.C. Brown Award for Synthetic Methods (2008), the Noyori Prize (2011), the Chirality Medal (2012), the Remsen Award (2013), the Esselen Award (2015), the Award for Creativity in Molecular Design and Synthesis (2016), the ACS Arthur C. Cope Award (2016), the Humboldt Research Award (2020) and the Willard Gibbs Medal (2024). He has also delivered more than 90 plenary and named lectureships from institutions, foundations, and companies around the world.

The 2024 Welch Award salutes Dr. Jacobsen's prodigious scholarship, varied scientific discoveries and academic leadership, all directed at expanding knowledge and enhancing life.

Hackerman Award: Real-Time Lab Analytics in the Operating Room

Associate Professor of Surgery at Baylor College of Medicine, Livia S. Eberlin's work bridges basic chemical research with transformative clinical applications—most notably, through the development of the MasSpec Pen, a groundbreaking device designed to detect cancerous tissue in real time during surgery. Her research group has continued to extend the applications of MasSpec Pen technology into other procedures, creating new devices that democratize access to previously lab-exclusive analyses.

Dr. Eberlin, recipient of the 2024 Norman Hackerman Award in Chemical Research, is redefining the role of analytical chemistry in modern medicine. Her work exemplifies the powerful intersection of chemistry, innovation and compassionate science—transforming both how diseases are understood and how lives are saved.

"Anywhere in the world, you'll see mass spectrometers in very specialized research labs, but you won't see them in an operating room or in hospitals. My mission now in my lab is to develop these interfaces that enable medical doctors, pathologists and surgeons to use mass spectrometry and obtain information from metabolites and lipids, which we know are diagnostic of disease, without having to turn knobs and do physical chemistry," said Dr. Eberlin.

Her research journey began in Brazil, where her undergraduate fascination with gas-phase organic reactions led her to mass spectrometry.

"It was a lab-built system that was very difficult to learn how to use," she recalled, "and I had to adjust every single knob and voltage. That experience gave me a deep understanding of the technology's physical and chemical principles, and it also left me with a desire to do more with it."

Livia Eberlin and her team work to extend the applications of her MasSpec Pen technology.

This early hands-on immersion laid the foundation for a career focused not only on chemical analysis but on expanding access to it.

Dr. Eberlin's scientific trajectory evolved during her graduate and postdoctoral training when she began applying mass spectrometry to complex biological problems—especially in cancer metabolism. Cancer cells are different from healthy cells. They grow very quickly and use a lot of energy; then as they grow, the cells' membrane composition, and even the shape, evolve. Mass spectrometry captures those changes by profiling molecules that are in different abundance in cancer cells.

Named in honor of the long-time chair of Welch's Scientific Advisory Board, the

$100,000

Norman Hackerman Award in Chemical Research recognizes the accomplishments of chemical scientists in Texas who are early in their careers.

Livia Eberlin with Graham Cooks, her PhD advisor at Purdue University. | Dr. Eberlin celebrates with her children.

SAB Chair Cathy Murphy and Welch Chair Fred Brazelton congratulate Dr. Eberlin.

By the time she launched her independent research program, Dr. Eberlin had a singular vision: To make mass spectrometry clinically accessible.

"The MasSpec Pen was born from a simple idea: Could we create an interface that allows non-spectrometrists—surgeons, pathologists—to harness the power of mass spectrometry?" she asked.

With the MasSpec Pen, Dr. Eberlin's group became the first to develop a liquid extraction-based device that can be used in the human body for tissue analysis. The technology is particularly transformative in determining the surgical margins, which are critical for cancer prognosis and recurrence prevention.

The MasSpec Pen is an elegantly simple yet technically sophisticated device similar in size and shape to a Sharpie. A surgeon uses the MasSpec Pen by touching a patient's tissue in different areas to identify the boundaries between healthy and cancerous tissue—the "surgical margins"—in real time in the operating room. As the surgeon touches the tissue, a droplet of solvent extracts small molecules such as lipids and metabolites from that tissue, which then are suctioned into the connected mass spectrometer. Within seconds, the system analyzes the chemical profile of the tissue, allowing surgeons to make educated decisions with unprecedented speed and precision.

Dr. Eberlin's innovations already have impacted a variety of surgical procedures. The Eberlin Lab for Medical Mass Spectrometry at Baylor College of Medicine has developed specialized versions of the MasSpec Pen for use in minimally invasive surgeries, including laparoscopic and bronchoscopic applications.

"We recently created a device just 2 millimeters wide that fits through a bronchoscope to help diagnose lung cancer," she said.

These advances enable clinicians to make immediate, informed decisions without requiring expertise in analytical chemistry.

While her work has high clinical impact, Dr. Eberlin emphasized its chemical roots: "The Welch Foundation's commitment to chemical research has been critical in allowing us to develop precise, high-performance methods based on deep chemical knowledge that translate directly to patient care."

Dr. Eberlin received her undergraduate degree in chemistry from the State University of Campinas in Brazil before pursuing her doctoral degree in analytical chemistry at Purdue University. She completed a postdoctoral fellowship at Stanford University with Richard Zare, the 1999 Welch Award recipient.

She started her independent career at The University of Texas at Austin, where she remains an adjunct professor of chemistry after moving to Baylor College of Medicine in 2021. In 2023 Dr. Eberlin also became an adjunct associate professor in the Department of Genitourinary Medical Oncology at The University of Texas MD Anderson Cancer Center.

Her work has been recognized with numerous awards including *The Analytical Scientist's* Power List 2023—Innovators and Trailblazers, and Power List 2022—40 under 40; the Richard J. Cleveland MD Patient Impact Award Winner from the B*Cured Foundation; 2019 Arthur F. Findeis Award for Achievements by a Young Analytical Scientist from the American Chemical Society; a 2018 MacArthur Fellow; and 2018 Emerging Inventor of the Year, The University of Texas at Austin, among many others. She has more than 100 publications in peer-reviewed journals. She also serves as a board member of the American Society of Mass Spectrometry.

The $100,000 Hackerman Award recognizes young scientists for their innovative research in Texas.

Welch Conference: Exploring Advances in Molecular Catalysis

The Welch Foundation's 67th annual research conference, "Frontiers in Molecular Catalysis," delved into new discoveries in the field of catalysts with potential benefits to society. World-leading scientists shared their work across many sectors of catalysis research, with applications ranging from drug developments to petrochemicals. Held October 21-22, the conference was once again both in person and online, with more than 700 in attendance.

Over the past 100 years, catalysis has had an enormous impact on society. Catalytic transformations are foundational to the synthesis of nearly all current pharmaceuticals as well as many agrochemicals, fine chemicals and materials. As such, advances and innovations in this field have immediate implications for a wide variety of applications.

"This conference featured speakers working at the forefront of the design, applications and mechanistic studies of novel catalysts and catalytic processes," said program chair Melanie S. Sanford, Moses Gomberg Distinguished University Professor and Arthur F. Thurnau Professor of Chemistry, University of Michigan, and member of the Foundation's Scientific Advisory Board. "Catalysts play a vital role in everything from human life to manufacturing energy and chemicals. Thanks to our many distinguished speakers who shared their latest findings with us."

Frances H. Arnold, California Institute of Technology and Nobel laureate, delivered the keynote address October 21. She discussed her seminal work on directed evolution and how this is driving the discovery of enzyme catalysts, "Innovation by Evolution: Bringing New Chemistry to Life." On the second day of the conference, participants heard from the 2024 Welch Award in Chemistry recipient, Eric N. Jacobsen, Harvard University, on "Selectivity and Generality in Asymmetric Catalysis."

The conference was divided into four broad research areas over the two days, including asymmetric catalysis, organometallic and mechanistic pathways, transition metal catalysis as well as emerging modalities and applications.

Kicking off the conference, the "Asymmetric Catalysis" session featured three presenters discussing their work with a particular emphasis on how advances in data science and physical organic chemistry are driving innovation and catalyst design in this space. Discussion was led by Osvaldo Gutierrez, Texas A&M University.

The afternoon session, "Organometallic Chemistry and Mechanisms," led by Sharon Neufeldt, Montana State University, explored the research that leverages deep interrogation of organometallic pathways and mechanistic pathways for new catalyst discovery.

The second day opened with "Transition Metal Catalysts," with three presenters showcasing how innovations in high-throughput experimentation, biocatalysis and electrochemistry are uncovering new catalysts and transformations with unprecedented reactivity and selectivity. Makeda A. Tekle-Smith, Columbia University, was the session leader.

Wrapping up the conference, presenters in the "Emerging Modalities and Applications" session focused on the design of transition metal catalysts for applications ranging from the valorization of carbon feedstocks to the asymmetric functionalization of alkenes. Discussion was led by Sophie Rousseaux, University of Toronto.

For
67 years
The Welch Foundation has hosted a research conference which draws leading scientists from around the world.

Conference attendees review poster session materials. | SAB member Kevan Shokat *(right)* discusses research advances with fellow attendee during a conference break.

Frances Arnold, Nobel laureate, gives a fascinating presentation of her research into directed evolution.

Welch Conference Poster Session Highlights Innovative New Research

For the second year, the Welch research conference featured a poster session that drew 62 entries in four categories: undergraduate, graduate, postdoctoral trainee and laboratory head. Conference attendees could schedule appointments with the poster presenters, virtually or in person, to discuss the work.

Foundation judges awarded prizes of $2,500, $1,000 and $500 for up to three places in each category based on scientific impact, clarity of presentation and contribution of the author to the overall project.

And the winning entries are:

UNDERGRADUATE STUDENTS

1. **Will Smith** (Baylor University)—"Hydrogen-Tunneling with Low KIE Measured in the Mediated Decay of the $Co(CH_3COOH)$+Complex"
2. **Haley Fossett** (Wayland Baptist University)—"NO RADIOACTIVITY REQUIRED! A New Approach to RecA Mediated DNA Strand Exchange"
3. **Nafisa Azizi** (Rice University)—"Characterizing Different Group 1 Intron Ribozymes for a Novel Ribozyme Antibiotic"

GRADUATE STUDENTS

1. **Bo Couture** (UT Dallas)—"Radical-Mediated Regiodivergent C(sp3)–H Functionalization of NSubstituted Indolines via Enzymatic Carbene Transfer" and **Macayla Guerrero** (Texas A&M University)—"Dicarbofunctionalization of Vinyl Azaarenes Using a Multicomponent Iron-Catalyzed Cross-Coupling Approach to Synthesize 1,1-Diarylalkanes"
2. **Jaeyul Kim** (University of Houston)—"One-pot Synthesis of Ga,Al-*BEA Zeolites as Novel Catalysts for Upgrading Biomass to Value-added Chemicals Reaction" and **Zurwa Latif** (UT Dallas) —"Two-Phase Strategy for the Enantioselective Total Syntheses of the Vallesamidine and Schizozygane Alkaloids"
3. **Rafiqul Islam** (University of Houston)—"Polyurethane-Based Shape-Memory Polymers with Embedded Au-Ag Nanoshells for Triggerable Structural Transformations" and **Samya Samanta** (Texas A&M University)—"β-Phenethylamine Synthesis: N-Pyridinium Aziridines as Latent Dual Electrophiles"

POSTDOCTORAL SCIENTISTS

1. **Ting Ma** (Texas A&M University)—"A Conjugated Ladder Polymer For Acidic Polymer-air Batteries"
2. **Venkata Ramankrishna Gujjula** (UT Dallas)—"Streamlined Strategy for Scalable and Enantioselective Total Syntheses of the Eburnane Alkaloids"
3. **Mamta Bhandari** (Rice University)—"CCC Carbene Pincer Mg Complexes and Reactivity: NHC Ring Expansion and Decarbonization"

LABORATORY HEADS

1. **D. Emma Fan** (UT Austin)—"Continuous Metabolite Monitoring and Drug Response Enabled by Massively Parallel and Versatile Microbubble Nano-Assembly"
2. **Catherine Schein** (UTMB Galveston)—"Physicochemical Property Consensus (PCPcon) Proteins for Alphaviral Vaccines and Diagnostics"
3. **Ruibin Liang** (Texas Tech University)—"Development of Multiscale Simulation Approaches for the Characterization of Photochemical Reactivities in Biomolecules"

Pictured are some of the winners from the four poster session categories.

Welch Programs: Supporting Chemistry Across Texas

Since its establishment in 1954, the Foundation has provided more than $1.1 billion in funding to enhance science in Texas through long-standing programs such as the Foundation's endowed chairs, research grants and departmental support, among other initiatives.

Last year, Welch launched several new programs to further expand its support for research across the state. Both the Catalyst for Discovery Program Grant and Welch eXperimental (WelchX) Collaboration Retreats and Pilot Grants are designed to spur collaboration and help build a connected network of scientists to tackle tough research challenges. Welch also created one-time equipment grants to broaden its impact on smaller colleges and universities and began awarding research grants to postdoctoral fellows.

The Foundation also offers a number of other programs, both longstanding and new, that are intended to inspire future and existing researchers and build a pipeline of creative minds in science. These initiatives range from the Welch Summer Scholar Program for high school students to grant programs supporting undergraduate and graduate students to the new Welch Postdoctoral Fellows of the Life Sciences Research Foundation Grants aimed at researchers on the cusp of their independent academic careers.

"We are pleased to see the enthusiasm these new programs have generated in the Texas research community," said Adam Kuspa. "We now support chemistry from the earliest stages, by introducing high school and college students to research and helping young and mid-level researchers advance their careers. Other Welch programs are designed to help attract and retain top-level scientists performing crucial research and educating the next generations. These new programs also acknowledge that today's most important challenges take a range of knowledge and expertise to solve them. The recent significant cuts in federal funding only emphasize the importance of our work."

Texas A&M Welch-Hagler Fellows: Sparking a Chemical Reaction

In a new initiative, The Welch Foundation provided $10 million to Texas A&M University's Hagler Institute for Advanced Study. The funds will support Welch-Hagler Fellows, leading scholars selected from national academy-level researchers in chemistry and allied fields where advances in chemistry enable multidisciplinary research. The scholars will work with Texas A&M faculty and students to further foster an innovative research culture.

In 2024, the first two Welch-Hagler Fellows were named: Marsha I. Lester, University of Pennsylvania, and Jeffrey R. Long, University of California, Berkeley.

Welch's bequest is augmented by a $5 million matching investment from alumnus Jon Hagler to establish an endowed chair position providing financial support to a Welch-Hagler Fellow who comes to Texas A&M for up to one year. Additionally, the university has allocated $200,000 per year for at least 10 years to support fellowships for graduate students working directly with the Welch-Hagler Fellows.

"To create a partnership like this with Texas A&M's Hagler Institute is a compelling opportunity for the Welch Foundation," said Fred Brazelton, Welch chair and director. "With this funding, we hope to make a meaningful and enduring impact on the students, faculty and future research at the institute."

70 years in, The Welch Foundation's

$1.1 billion$+

in funding for chemistry research continues to spur innovative thinking with a range of programs.

Welch Summer Scholars gain hands-on experience. | The 26 participants in the WelchX Collaboration Retreat network with researchers from other institutions across Texas.

The revamped Welch Hall: Matter & Motion attracts record crowds in its first full year of operation.

Overall, the multimillion-dollar investment will enable the institute to build synergy that enhances faculty research productivity as well as graduate and undergraduate education and accelerate research in chemistry, chemical engineering, biomedical engineering, materials science, medicine and biomedical sciences.

UT Austin Lecture Series: Sharing Insights from Emerging Leaders

In 2024, The University of Texas at Austin wrapped up a two-year, Welch-sponsored visiting speaker series that brought emerging stars in chemical sciences from outside Texas to Austin. Hosted by the departments of Chemistry, Chemical Engineering, Molecular Biosciences and Neuroscience, the visitors presented their latest research while on campus. The program also served to introduce future leaders to the university's chemistry research.

Speaker selection emphasized scientists and engineers who could fill future professorship and chair vacancies and potentially lead programs in key areas. Visiting scientists in 2024 included:

- Kimberly Prather, University of California, San Diego
- Eranda Nikolla, University of Michigan
- Heather Allen, Ohio State University
- Ellen Matson, University of Rochester
- Justin Wilson, Cornell University
- Juan Du, Van Andel Institute
- Corey Wilson, Georgia Institute of Technology
- Alice Ting, Stanford University

Welch Hall: Bringing Science to Life

The Welch Hall: Matter & Motion, presented by the Ting Tsung and Wei Fong Chao Foundation at the Houston Museum of Natural Science has been a major hit. In its first year, this immersive exploration of the chemical and physical sciences has welcomed more than 1 million visitors.

First funded by Welch in 1967, the now-revamped exhibition debuted in March 2024. Expanded to 16,000 square feet, the hall includes 10 immersive galleries that highlight the profound impacts of chemistry and physics on people, streets and business, bringing science to life for visitors.

The exhibit also enhances the museum's educational outreach, including playing host to 3,342 field trips, 3,171 students participating in hands-on science labs, 1,883 students in 34 chemistry- and physics-themed summer camps and chemistry and physics demonstrations taken "on wheels" to 34 schools, among other outreach initiatives.

The museum considers Welch Hall "one of the most transformative additions" in its history.

WSSP: Inspiring High School Students

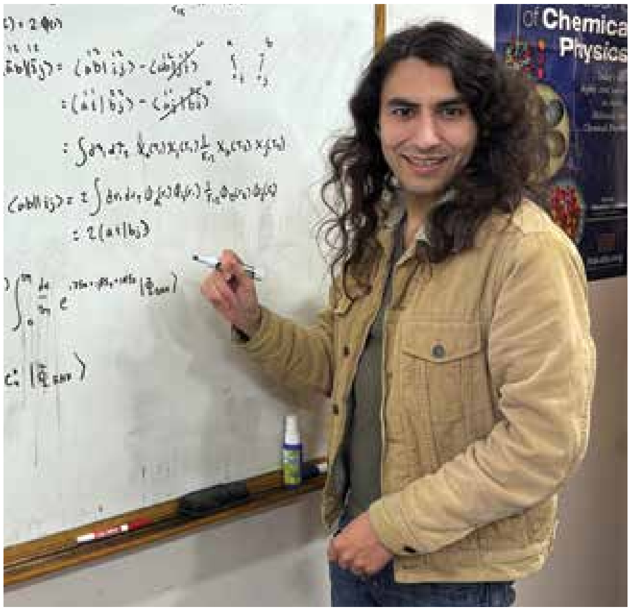
Since 1984 the Welch Summer Scholar Program (WSSP) has introduced more than 2,500 talented high school students to independent research in chemistry through a summer program on five college campuses: The University of Texas at Austin, Dallas and Arlington, as well as University of Houston and Texas Tech University. In 2025, the program will expand to a new university, Texas A&M University's College Station campus, which plans to host 10 students in its first year.

This past summer, 38 rising juniors and seniors were selected as summer scholars, or "Welchies," from 348 applicants, an increase of almost 40 percent in the number of students applying to the program.

"We are excited to see our efforts to increase the applicant pool really paying off," said Lauren J. Webb, WSSP state director and Joseph & Jeanne Lagowski Professor in Chemistry, UT Austin. "This is testament to the stellar, longstanding reputation of WSSP in secondary education communities, augmented by our advertising campaign and other school-related outreach. Certainly, the need for high-quality STEM graduates will only grow in years to come and it is so satisfying to open the door to science for such talented young people."

The students spend five weeks living on campus, providing them with a preview of college life. Guided by faculty and graduate student mentors, the students also gain exposure to high-level research while learning modern laboratory practice, collaboration and teamwork, safety and scientific communication.

For the fourth year, the on-campus lab research was complemented by an online summer seminar series featuring Texas researchers sharing their work. Presenters are chosen for their mentorship and good communication skills. Speakers included Lauren Webb, UT Austin; Filippo Romiti, UT Dallas; Junha Jeon, UT Arlington; Livia Eberlin, Baylor College of Medicine and 2024 Hackerman Award recipient; and Dimitri Pappas, Texas Tech.



Brad Ganoe, Rice University, is developing new theoretical tools to answer questions in chemistry.

Postdoctoral Fellows: Supporting Next-Generation Researchers

In the second year of the program, the Foundation awarded three, three-year Welch Postdoctoral Fellows of the Life Sciences Research Foundation grants. The funding is designed to provide a jumpstart to the research of young scientists on the cusp of beginning their independent academic careers.

The grants support groundbreaking research across a range of fields including:

BRAD GANOE, RICE UNIVERSITY

"If we had enough computational power and mathematical knowledge, we could use wave equations to solve all the open questions in chemistry," enthused Brad Ganoe, postdoctoral fellow in James Shee's lab at Rice University.

However, since those capabilities are far off—if even achievable—Dr. Ganoe is working to create new, easy-to-use theoretical tools to develop better approximations that can then help focus experimental research. His research draws upon his expertise in many-body quantum mechanics, the field that underpins the description of chemistry from first principles and the basis of theoretical chemistry.

While much of chemistry is well-described by traditional orbital models, many interesting systems involve strong correlations, which present difficult cases for traditional wavefunction and density functional theory methods. In many-body physics, with two or more quantum particles, the math becomes too difficult to solve so a researcher needs a good approximation of many-body waves, starting from a trial wave function.

"For example, we can't accurately solve around half of transition metal complexes today, important in the development of catalysts, drugs and other materials," he said. "Improved theoretical techniques could prove valuable to many current problems in chemistry."

He is combining two relatively new techniques, auxiliary-field quantum Monte Carlo (AFQMC) and correction of spin contamination via polynomial-scaling projection, in clever ways to provide better information for experimental research.

AFQMC-based methods, which Dr. Shee was instrumental in developing, have a stochastic framework using iterations to converge on an answer for quantum mechanical systems. Their major drawback, however, is that if the starting point isn't accurate, the errors compound and the convergences become too imprecise to be useful. And while spin projection can provide good analytical approximations, there is room to further explore its usefulness for the stochastic method in AFQMC.

Dr. Ganoe is developing novel spin projection techniques by extending imaginary-time evolution, the technique traditional AFQMC and some quantum algorithms are based on, to the spin domain. He computes a spin-projected state "ansatz," or educated guess, to provide a good trial wavefunction before proceeding to the energy calculation. This then can significantly reduce the precision error in the iterative calculations in the stochastic process.

"What I do is very basic research," Dr. Ganoe said. "The Welch grant is amazing. It gives me time to sit down and think. We are tool makers, creating what applied chemists need to solve the questions they find fascinating."

Oxygenase, the process by which plants turn carbon dioxide into oxygen, is one important strongly correlated problem that traditional methodologies have not been able to answer. Dr. Ganoe hopes improved theoretical techniques could help researchers unravel how biology does it.

KAYLA GOFORTH, TEXAS A&M UNIVERSITY

Kayla Goforth set her sights on becoming a biologist at the age of five, inspired by a mother who loved animals and a father who was a chemist.

During graduate school at The University of North Carolina at Chapel Hill, she became fascinated by sea turtles' natal homing and how they use Earth's magnetic field to return to their birthplace to lay eggs. Her doctoral research sought to "teach" sea turtles to return to specific geographic areas for food using a conditioning assay—turtles were only fed in one specific magnetic field for two months. Using this assay and a second assay that requires turtles to orient in specific magnetic fields, she then provided the first evidence that two different mechanisms of magnetoreception underlie the magnetic map and magnetic compass senses in sea turtles.

"Many animals exploit Earth's magnetic field for navigation, both as a compass to determine direction and as a map to determine geographic position," she explained. "This is the last sense for which we don't understand the mechanism, and the only one that doesn't have an underlying sensor identified, such as how a nose is used for olfaction or eyes for vision."

As a postdoctoral researcher at Texas A&M University, she switched from studying sea turtles to research with monarch butterflies, as much more is already known about their neurology. Now in her second year in Christine Merlin's lab, she is studying the specific genetic mechanisms involved in the butterflies' ability to use the magnetic field to migrate.

"Chemical magnetic reception is light-dependent and we suspect that complex chemical reactions underlie animals' magnetic sensing," Dr. Goforth said. "Magnetoreception is the last great mystery of animal biology. Another fascinating question: do, or did, humans have the same ability?"

A previous postdoc in Dr. Merlin's lab (Guijun Wan) identified the C-terminal domain of cryptochrome as necessary for sensing magnetic fields. Dr. Goforth is building on that discovery to investigate whether this protein is sufficient or if other proteins are involved. She is investigating ultraviolet opsins, using a "knockout" approach to determine if particular opsins are required for magnetoreception.

"These projects have the potential to reveal key genes and mechanisms governing magnetoreception in monarchs and possibly other animals," she said.

Dr. Goforth's goal is to stay in academia and continue her work in the field.

Kayla Goforth, Texas A&M, hopes to learn how animals use the earth's magnetic field to navigate.

"I love what I do and really want to understand how magnetic sensing works. It's fun—if challenging at times—to work with animals, troubleshoot experiments and develop creative approaches. I really appreciate The Welch Foundation's support for this work," she said.

Departmental Grants: Broadening Research's Reach

Welch's Departmental Research Grants are designed to help create enriching, hands-on research opportunities for students at small- and mid-size Texas colleges and universities. These schools are an important channel for introducing many Texans to chemistry, including women, minority and first-generation college students, but often are constrained by limited resources of time, funding, laboratory equipment and supplies. In 2024, Welch grants were awarded to 43 institutions, supporting research by 243 faculty members mentoring 589 students.

To further bolster this long-standing departmental support, last year the Foundation launched a program to further enhance smaller schools' research capabilities by providing funding for research equipment. In 2024, the program's second year, Welch provided supplemental funding of more than $872 million in cost-sharing equipment grants to 29 schools.

Read about how two universities are leveraging their Welch departmental research and equipment grants.

TEXAS A&M UNIVERSITY – TEXARKANA

Texas A&M University hired Greg Hogan in 2016 to establish a chemistry program at its Texarkana campus, working from the ground up.

"It has been a daunting and difficult task, but very personally rewarding," Dr. Hogan said. "My goal has been to keep up the A&M name in our small town and ensure our students get a quality science education. I firmly believe that requires giving them the opportunity to conduct hands-on research."

Instrumentation has been the department's greatest limitation in building a well-functioning lab and this is the area where Welch has helped enormously.

Dr. Hogan used his first Welch Foundation departmental grant to purchase a thermogravimetric analyzer to facilitate research in his field and he has incorporated its use into three upper-level classes.

Eight years after its start, the department includes two faculty members, Dr. Hogan and an instructor, after it unfortunately lost its only other tenure-track professor the summer of 2024.

"Luckily, our part-time instructor was able to join us full-time to fill in—my wife," he laughed. "We originally met as chemistry students, and while she didn't go on to pursue a doctorate, her master's degree in chemistry with an emphasis in instrumental inorganic chemistry makes her a good fit for our program."

The 2024 Welch equipment grant supported the purchase of a powder X-ray diffractometer, important for Dr. Hogan's work and useful for expanding students' research experience.

Dr. Hogan's research focuses on developing hydrogen-bonded metal organic frameworks (MOFs), establishing new crystalline structures, and then incorporating various molecules. His lab collaborates with Joe Reibenspies at the main campus of Texas A&M University for analysis. He experiments with changing the distance between layers in the MOFs to finetune the frameworks to accommodate larger molecules, and to determine the relative selectivity MOFs have for a variety of guest molecules. In the last year and a half, his lab has produced 10 new metal-organic frameworks.

"The Welch Foundation has been right there along our journey," he said, "helping us out to establish the program and support our students. I love being in the lab and sharing research with students. We have had a couple of publications accepted and are working on another.

Texas A&M – Texarkana students document research findings.

It is such a great experience for the students: They conduct experiments, analyze data on the computer and write sections of the papers we submit."

He proudly notes that all but one chemistry major has gone on to graduate school.

"I find chemistry fascinating, and I like to study new things," Dr. Hogan said. "Welch has really helped showcase research to students and spur their interest in chemistry because they enjoy discovery. I find satisfaction in helping mold and shape the program to prepare our students for the next steps in their education and careers."

HUSTON-TILLOTSON UNIVERSITY

When Yalan "Christie" Ning joined Huston-Tillotson University (HT) as an assistant professor a decade ago, she was challenged to build a chemistry laboratory essentially from scratch. With a 150-year history in East Austin, HT is a private, historically Black university currently serving 1,000 students.

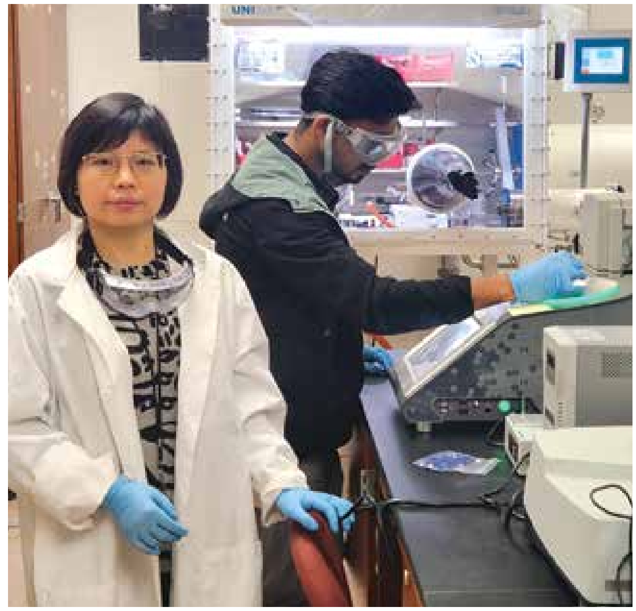
"The school has such limited resources, the only items in the 'lab' were some dusty beakers and old glassware," she recalled. "Those first years, I worked as a visiting professor at DOE (Department of Energy) and Air Force labs in the summer so I could involve my students in research. Support from The Welch Foundation was absolutely essential in helping me create the opportunity for our students to do research on campus."

Thanks to long-standing support from The Welch Foundation, she has been able to secure three National Science Foundation grants to further support her students' research.

Dr. Ning proudly points to equipment purchased thanks to Welch funding, including a sonicator, NMR tube washer, refrigerator for chemicals, rotary evaporator with chiller, centrifuge, vacuum oven, Milli DI water purification system and two types of beam balances.

A Welch equipment grant in 2024 allowed the school to purchase an analysis bench NMR spectrometer and a UV-vis spectrometer to further increase the lab's research capabilities.

Dr. Ning earned her PhD at Colorado State University and completed a postdoctoral fellowship at Northwestern University. When her husband's job took them to Austin, she joined HT. As program head, she has taught 18 chemistry courses, mentored more than 30 undergraduates with their research, and 12 faculty in their teaching.



Christie Ning has built student research capacity at Huston-Tillotson with Welch help.

Despite her heavy teaching load, she relishes the opportunity to work with students on research in her lab.

Drawing on her background in inorganic and organometallic chemistry, Dr. Ning involves students in catalyst design and functionalization experiments.

"We focus on relatively simple processes with two to three steps," she explained. "Students learn to prepare, synthesize, characterize and polymerize iron complexes."

The research explores the complexes' role in metal-organic frameworks (MOFs) for polymerization. MOFs' versatility opens up potential applications in gas storage, gas separation, chemical sensing, drug delivery and catalysis. Her current focus is on synthesizing less expensive, greener industrial catalysts to produce lubricants and gasoline products.

Leveraging the Welch and National Science Foundation grants, she can hire up to 10 undergraduate students each year, focusing on work related to course-based undergraduate research experiences (CUREs).

"It has been so rewarding to build a research program here," Dr. Ning said. "It would have been impossible without Welch support. But watching students get excited about chemistry and research makes it so worthwhile."

Over the last 10 years, two of her lab alumni have had summer internships at the DOE and most have found lucrative jobs in industry or pursued graduate education.

Research Grants: Championing Curiosity

Welch research grants are a cornerstone of the Foundation's support for fundamental chemical research. The Welch Foundation awarded $100,000 grants to 95 principal investigators at 19 institutions in 2024, for a total of $28.5 million in new research grant funding. Together with ongoing grants, The Welch Foundation supported 329 principal investigators at 21 institutions.

The Welch research grant program funds basic chemical research at educational institutions within the state of Texas. These three-year grants provide generous financial support, giving researchers the stability and flexibility to pursue interesting chemical research questions that advance human knowledge and lead to innovative breakthroughs.

Grant recipients often use Welch funding as seed money to support early exploration of new ideas. When those ideas pan out, they then can leverage the data from Welch-funded studies to secure additional grants. For example:

FRANÇOIS P. GABBAÏ, TEXAS A&M UNIVERSITY

François Gabbaï, Arthur E. Martell Chair of Chemistry and Distinguished Professor at Texas A&M University, became fascinated with Lewis acids during his PhD, when he studied under Professor Alan H. Cowley, who held the Robert A. Welch Chair of Chemistry at The University of Texas at Austin. The intrinsic properties of Lewis acids—electron-deficient molecules with a propensity to bond with electron-rich anions—piqued his interest and have retained it for over two decades.

Courtesy of TAMU College of Arts & Sciences Communications Team

François Gabbaï has spent decades studying Lewis acids, focusing on their interaction with anions.

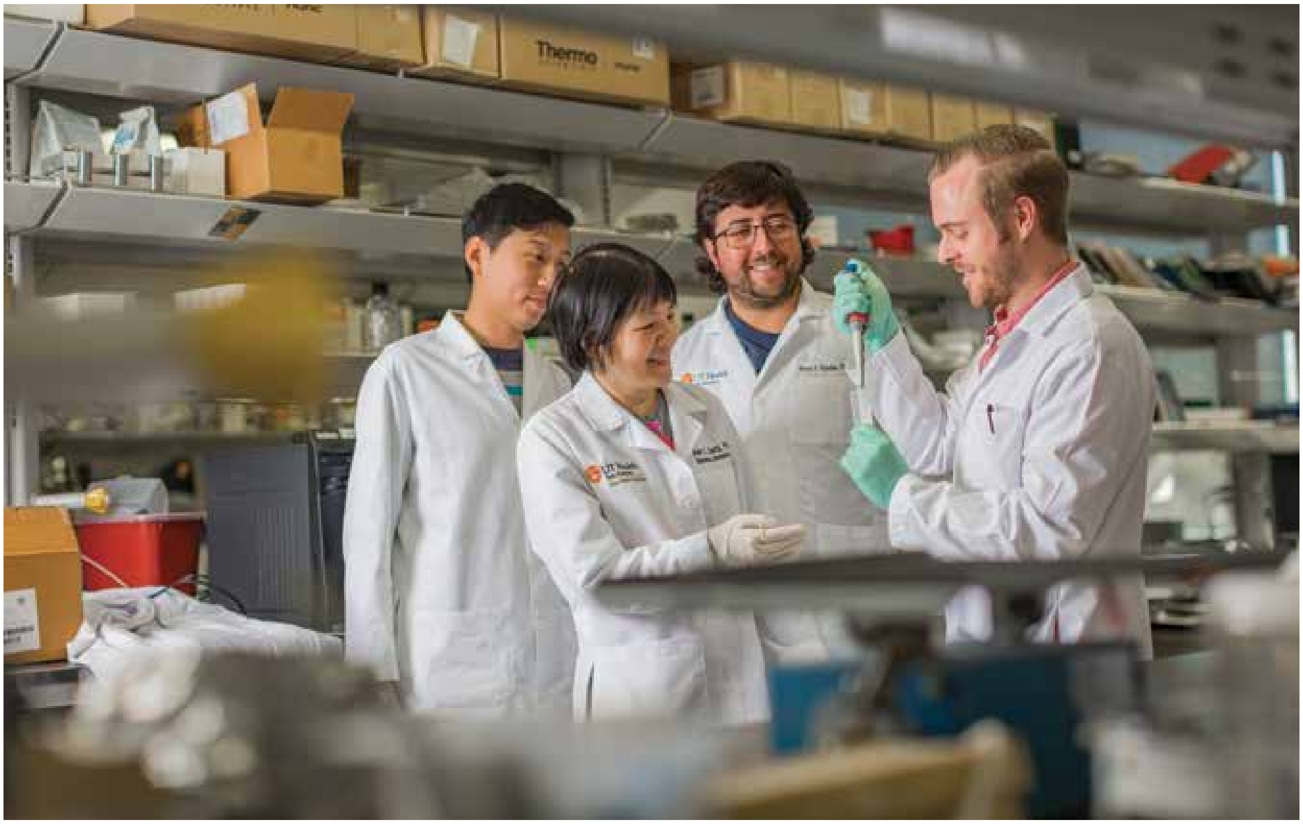
His current work, supported by The Welch Foundation, focuses on developing bismuth-based Lewis acids to transport chloride ions across biological membrane mimics. Chloride is an essential electrolyte that maintains the body's balance between acid and base. Humans have a natural balance in their healthy tissues, where the concentration of chloride is much lower inside than outside each cell. Therefore, the ability to modulate concentrations of chloride ions across biological interfaces such as cell membranes has far-reaching implications.

One possible application of chloride-transport research is cancer therapy. For example, using an artificial chloride transporter to disrupt cancer cells' natural chloride balance may be an effective way to program the death of those cancer cells. This creates a very motivating backdrop for Dr. Gabbaï's research, which focuses on the interaction of Lewis acids with anions across many materials and applications.

"My group remains very fundamentally oriented in terms of its research. We are fascinated just by the bonds formed between two atoms. We are nerds," he said. "We look very carefully at the way acids and bases associate, the base being the anion and the acid being the Lewis acid, for example, bismuth. And sometimes we look at very, very niche situations. Having the Welch Foundation grant allows us to depart a little bit from the mainstream and look at these more unique topics. The stability that The Welch Foundation provides is very important for us."

Dr. Gabbaï's group in the past challenged the notion that Lewis-acid chemistry could only be carried out in a nitrous environment. They decided to test the organometallic chemistry between a Lewis acid and a base in water, which is not a typical environment because water, as a base, could interfere with the reaction. So, the team made boron compounds and threw them in water to see whether they could still capture anions. With this research, they learned to tune the properties of Lewis acids such that they remain available to bind with a base even in the presence of water.

Recently, Dr. Gabbaï and his team characterized a bond between two atoms that is stable at two lengths. This is very remarkable because a bond is typically stable at only one length. But they used a phosphine oxide (the Lewis base) and a carbenium ion (the Lewis acid) to



Jean Jiang and her team explore the mechanisms that regulate cell communication.

create a bond that was bistable, with two forms of the bond (the Lewis adduct). Tying this new discovery back into his other work, Dr. Gabbai said, "It's not applied yet to anion transport, but we are thinking about using some of these systems also, again, to fall back into anion-transport topics."

In another previous investigation, Dr. Gabbaï's group worked to detect low concentrations of anions like fluoride or cyanide in water, which has many applications in clean water treatment.

"Many of my efforts over the past 25 years have been supported by The Welch Foundation. I would say that The Welch Foundation is central to everything that we do in the lab, even if not directly connected to the topic. We use the synthetic expertise, for example, that we develop as part of the Welch program on other projects. There is always synergy," he said.

JEAN X. JIANG, THE UNIVERSITY OF TEXAS HEALTH SCIENCE CENTER AT SAN ANTONIO

Distinguished University Professor, Vice Chair of the Department of Biochemistry and Structural Biology and Zachry Distinguished University Chair in Cancer Research

Jean Jiang explores the mechanisms that regulate cell communication. Cells communicate via gap junctions—clusters of channels made of connexin (a protein) that connect the cytoplasm of adjacent cells. These connexin channels are necessary for cell survival and regulation of cellular functions. Un-apposed halves of gap junctions are called hemichannels.

Dr. Jiang is especially interested in these hemichannels, which mediate communication between the inside and outside of cells, especially under stress conditions. For example, mechanical stress on bones can stimulate the hemichannels on bone cells to transmit signals for bone formation and remodeling.

Dr. Jiang pioneered the modulation of hemichannel activation using targeting antibodies. Her team discovered two targeting antibodies: one to open the hemichannels and another to block. While other teams have been able to block hemichannels, Dr. Jiang's team was the first to activate and open the hemichannel.

Hemichannels are very promising drug targets for treating multiple disease indications. Studies from Dr. Jiang's lab and others have found that abnormal opening of these channels can result in neurological damage, such as secondary injuries after spinal cord trauma, which could be mitigated by closing the hemichannels. In another study, opening hemichannels on osteocytes allowed the bone cells to release factors that target cancer cells, potentially suppressing cancer-cell growth and metastasis.

"I am very, very grateful to The Welch Foundation because it has been supporting my research for years. It really motivates me to continue to explore new directions," she said.

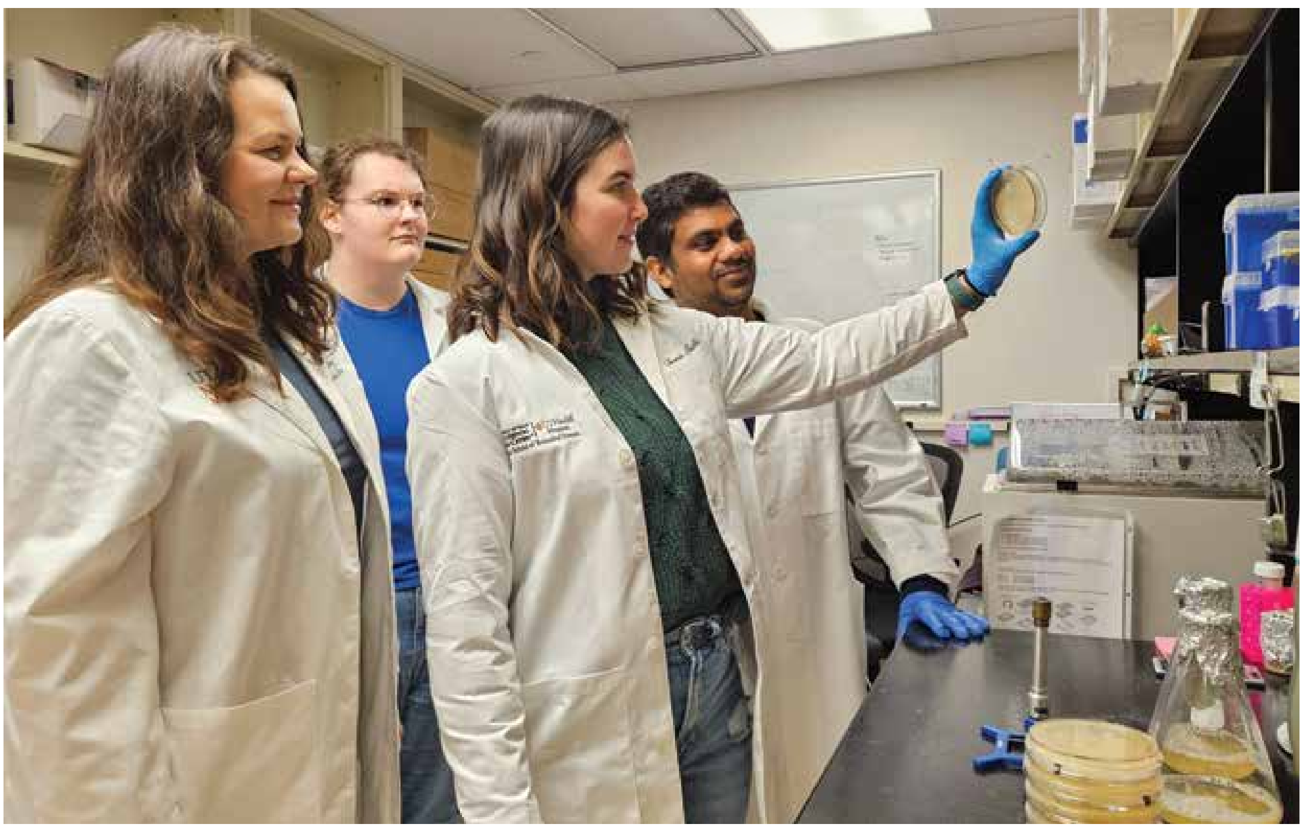
While Dr. Jiang's team has clarified the antibodies' functions—the power to inhibit or activate hemichannels—further work is needed in structural biology, study of the antibodies and microscopic approaches to identify the exact amino acids the antibodies are binding to on the connexin protein.

"This is both to further our basic understanding and also to help us design better drugs," she explained. "For example, if we identify the specific binding site, then we can design reagents for use in therapeutics to specifically target that unique location and cause the channel to open or close to treat diseases."

If Dr. Jiang's team successfully illuminates the gating mechanism of connexin hemichannels—if they define the structure on the cell membrane and identify the key amino acid that regulates opening and closing of the hemichannels—they will claim another first.

Welch support and advances in technology have allowed Dr. Jiang to overcome challenges associated with studying cell structure and interactions on the cell membrane at high resolution.

"The Welch Foundation grant helps us tremendously because Welch is willing to invest in projects that could be high risk but also have the potential for very high impact, projects that would not be funded by traditional grants," she said. "One of the ways we mediate this risk is by switching approaches. Welch is terrific because they allow us to have this kind of flexibility."



Microbiologist Anna Konovalova's *(left)* WelchX pilot grant research, with Tian Qin, explores how to prevent and defend against antibiotic-resistant infections by accelerating bacterial vaccine development.

Welch eXperimental (WelchX) Collaboration Retreat & Pilot Grants: Synergizing Chemical Research

Together, the WelchX retreat and grants are designed to stimulate interdisciplinary collaborations, foster lasting connections and encourage basic research by cultivating ties across different institutions in Texas.

In summer 2024 in Austin, the Welch Foundation hosted 26 of Texas' brightest tenured faculty at the second annual WelchX retreat. During the immersive retreat, the researchers engaged in dynamic discussions and intentional networking related to the year's theme, "Chemistry of Life." The activities sparked creative ideas for addressing chemistry challenges related to biological processes, bio- and cellular chemistry, structural and chemical biology, molecular biology and biophysics.

The retreat acts as a research incubator for innovative projects in pioneering areas of chemistry that endure far beyond the retreat itself. Five research proposals developed by teams formed during the retreat received one-year $100,000 WelchX Pilot Grants.

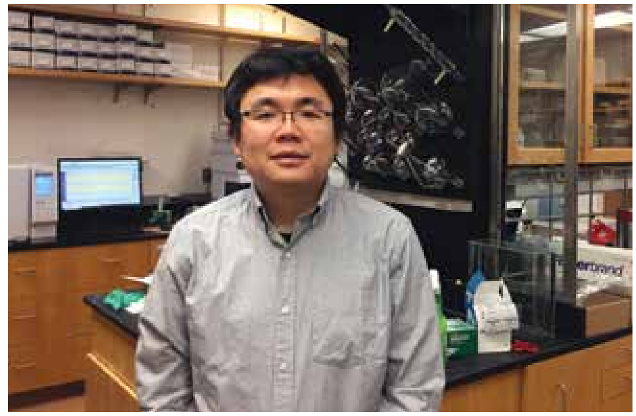
Two of the collaborative projects receiving pilots grants are:

ANNA KONOVALOVA, THE UNIVERSITY OF TEXAS HEALTH SCIENCE CENTER AT HOUSTON & **TIAN QIN**, THE UNIVERSITY OF TEXAS SOUTHWESTERN MEDICAL CENTER

To help prevent and defend against antibiotic-resistant infections, two scientists—microbiologist Anna Konovalova and synthetic chemist Tian Qin—are developing new strategies to accelerate the development of bacterial vaccines. Their project aims to solve a critical bottleneck in infectious disease research: identifying surface-exposed proteins in gram-negative bacteria, which can cause deadly infections such as pneumonia and food poisoning.

"This project is a long-term dream of mine," said Dr. Konovalova. "It addresses a really important need in infectious disease: how to identify good vaccine targets for bacteria. It's a lot trickier than for viruses."

Unlike viruses, which have relatively simple structures with clear vaccine targets, gram-negative bacteria have a complex outer membrane that makes them highly resistant to both antibiotics and the human immune system. This unique barrier has contributed to the Centers for Disease Control and the World Health Organization listing gram-negative bacteria as urgent public health threats. However, vaccines that protect against bacterial disease remain scarce because it is very difficult to pinpoint which proteins the vaccines should target.

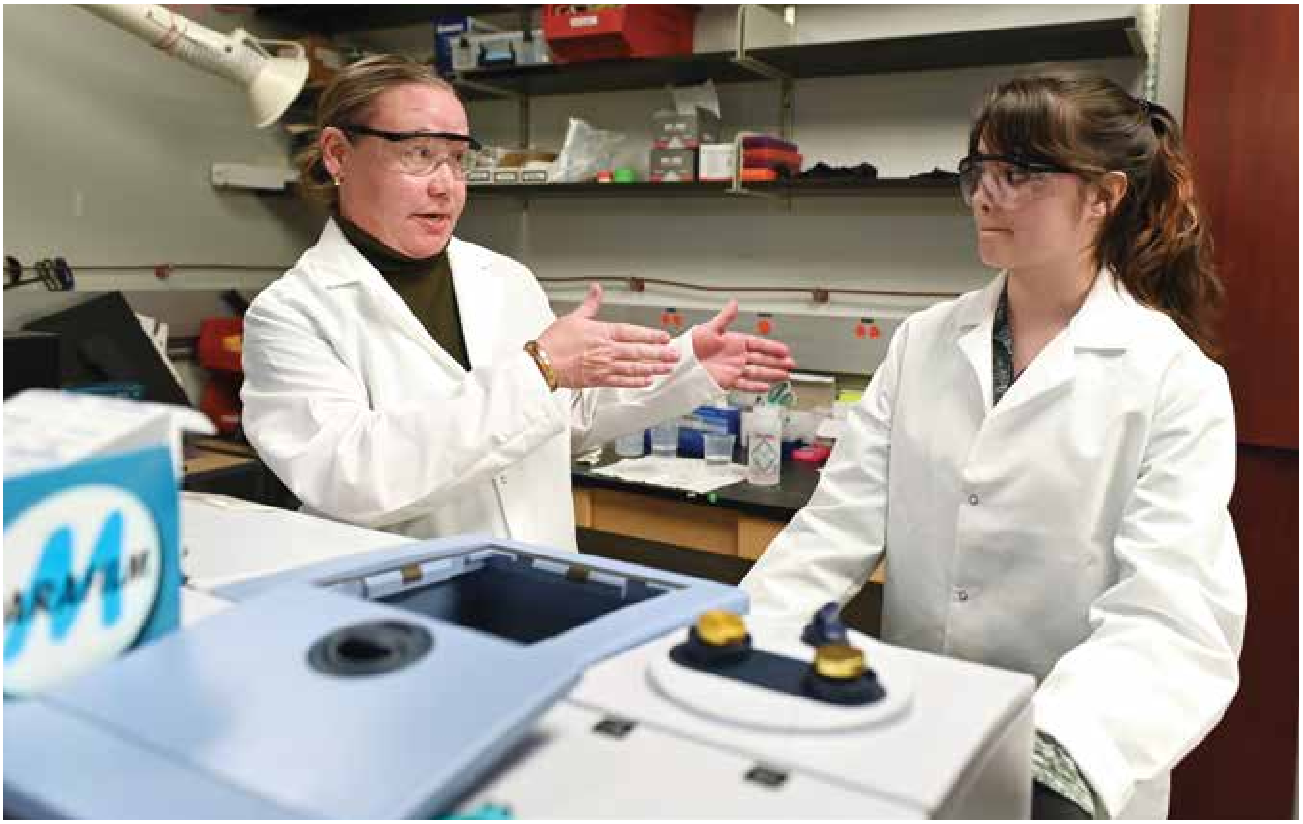


Tian Qin brings his synthetic chemistry expertise to the research collaboration.

Existing methods for identifying these proteins are costly, time-consuming and technically challenging. Many key surface-exposed proteins, particularly lipoproteins, cannot be predicted using bioinformatics alone, making experimental validation essential.

"A major goal of the project is to develop a cost-effective approach. It's not impossible to find these proteins, but the amount of human labor and cost are so high that you cannot do it on a systematic basis," said Dr. Konovalova. "One famous example is the vaccine for the bacteria that causes meningitis. A pharmaceutical company developed a vaccine for it. But since they didn't know what proteins were on the cell surface, it took many years of work and almost a billion dollars. That is inaccessible for routine applications."

To overcome these challenges, Drs. Konovalova and Qin are developing highly selective chemical probes designed to target proteins on the bacterial surface without penetrating deeper into the cell. Their approach leverages mass spectrometry workflows to map the topology of the outer membrane, distinguishing surface-exposed proteins from those embedded within the membrane. By enhancing sensitivity to low-abundance proteins, reducing false positives and enabling cost-effective multiplexing, their method could revolutionize bacterial vaccine development.



Lauren Webb *(left)* is part of a three-person research team using a WelchX pilot grant to understand how lipid bilayer membranes operate under high pressure *(see facing page).*

"This type of project requires an interdisciplinary approach. I'm a biologist. Tian, with his organic chemistry expertise and experience in developing so many different chemical probes for translational applications, was a perfect match," said Dr. Konovalova.

Dr. Qin agreed, "We create different versions of the compounds and generations of the probe to synthesize. We give that probe to Anna, and then, based on her results, we further modify the structure."

The team is currently testing their probes in *E. coli* and *Pseudomonas aeruginosa*, two well-characterized bacteria that serve as proof-of-concept models. They aim to refine a list of surface-accessible proteins that can be used as a foundation for vaccine development and research for other gram-negative pathogens, including those flagged by global health organizations. Beyond vaccine development, their work could also inform predictive computational models for identifying bacterial surface proteins directly from genomic data.

Their work represents a vital step toward a replicable method for developing vaccines to protect against deadly bacterial infections. If successful, the method could facilitate the identification of vaccine targets and make bacterial vaccine development far more accessible by reducing the high cost and labor associated with current methods.

The WelchX pilot grant played a crucial role in supporting this high-risk, high-reward research, allowing the team to test their first-generation probe, develop an improved version, and bring on additional researchers. Drs. Konovalova and Qin also credited the WelchX retreat for fostering the kind of interdisciplinary collaboration needed to tackle such a complex challenge.

"This has been a wonderful experience" Dr. Qin said. "At WelchX, we had all these scientists sitting together, thinking about ideas that were totally new and creative, but also definitely a bit risky. It was my first time at WelchX; I had never been there before. After I came back, I recommended it to all my colleagues."

LAUREN J. WEBB, THE UNIVERSITY OF TEXAS AT AUSTIN; **SHEENA D'ARCY**, THE UNIVERSITY OF TEXAS AT DALLAS; & **HAO YAN**, THE UNIVERSITY OF NORTH TEXAS

Life on Earth began in the deep sea, where extreme conditions shaped the earliest organisms. Sheena D'Arcy, Lauren Webb and Hao Yan are diving into this deep-sea world to understand how lipid bilayer membranes—essential components of living cells—function under high pressure versus standard pressure. Their work could provide insights into the origins of life, the search for extraterrestrial organisms and medical techniques such as organ preservation.

"The deep-sea organisms we see today have similarities to our own cells but with key differences that allow them to survive under immense pressure," said Dr. Webb. "They have life cycles that look a lot like what you would find in our bodies, yet have chemical structures that are sometimes very, very different and are existing under these conditions where we know the lipids in our bodies would be completely nonfunctional. So, we're asking questions about these changes in the chemical structure of an individual molecule."

By identifying these differences, the team hopes to refine scientific understanding of how life transitioned from the ocean to land.

Each of the collaborators brings unique expertise to the project. Dr. Webb's group uses various kinds of spectroscopy to study mechanisms of biological macromolecules that lead to the complex properties of living systems. Dr. Yan's lab is interested most in the mechanisms governing chemistry under mechanically extreme conditions. Dr. D'Arcy's team monitors how proteins move and how this movement can change depending on the environment.

Sheena D'Arcy explores the environmental impacts on protein movements.

Dr. Webb explained, "Ours are extremely complementary approaches that, again, can all be done on the same sample, so we don't have to invent different experiments and try to tie them together after the fact."

The WelchX retreat was critical to the formation of the project. Dr. Webb said, "[The project] felt like it just came together, but the days we spent together at the retreat were very well organized to catalyze that happening."

Hao Yan is an expert on chemistry in extreme conditions.

Beyond the collaboration among the principal investigators, the WelchX Pilot Grant is allowing their students to perform research in each other's labs and work on equipment they would not have access to otherwise. "It's a fantastic opportunity for the students to gain hands-on experience with methods they wouldn't normally encounter," said Dr. Webb.

The research has profound applications, especially for organ donation. Currently, the organs must be transplanted within hours due to rapid cellular degradation. However, understanding how pressure affects cell membranes could lead to new preservation techniques, potentially extending the viability of donated organs. Dr. Webb explained, "If we understood better how living cells change as a function of pressure because we've done these very specific experiments, then we can hypothesize how changes in pressure can contribute toward preserving these vital assets."

Looking further into the future, the project could also affect the search for alien lifeforms. Scientists searching for life beyond Earth often look for water, but it is possible they should be searching for other biochemical signatures. "If we know what life looks like under extreme conditions here, it gives us better clues about what to look for on other planets," said Dr. Webb. "This is why you do fundamental research, right? You have a question that's interesting, and you study it in part just because you're curious and want to answer that question. But the places it could go … who knows?"

Welch Endowed Chairs: Keeping the Best Chemists in Texas

Welch has endowed 53 chairs across 21 Texas institutions to attract and retain outstanding research scientists in the state. Forty-six of these positions are currently occupied, providing valuable support for accomplished researchers in Texas to advance their work and explore exciting new directions in chemistry and allied sciences.

In 2024, two professors were named to Welch chairs:

- David Allen, Norbert-Dittrich-Welch Chair in Chemical Engineering, The University of Texas at Austin, and
- Lane W. Martin, Welch Chair in Materials Science, Rice University.

Two Welch chairs appointed in 2023, Rudi Fasan and David J. Tweardy, are pioneering innovative chemical solutions to pressing and persistent medical challenges.

RUDI FASAN, THE UNIVERSITY OF TEXAS AT DALLAS

Rudi Fasan was recently recruited to Texas as a Cancer Prevention and Research Institute of Texas (CPRIT) Scholar in Cancer Research and the Robert A. Welch Distinguished Chair in Chemistry at The University of Texas at Dallas. He focuses on developing more efficient, sustainable and innovative enzyme-based approaches for chemical synthesis. His research explores the use of biocatalysis to generate complex, biologically active molecules with pharmaceutical applications, such as the synthesis of compounds for cancer and malaria treatments.

A key focus of Dr. Fasan's research is the development of biocatalytic methods for synthesizing chiral molecules—critical building blocks in high demand for the discovery, manufacture and synthesis of new drugs by the pharmaceutical industry. Traditionally, organic chemists have relied on chemical catalysis using rare and sometimes toxic metals. Dr. Fasan's research has pioneered the use of enzymes to achieve these transformations in a more sustainable and selective manner.

About a decade ago, his team began exploring "new to nature" chemistry, a concept at the forefront of the biocatalysis field that repurposes natural enzymes—or even non-enzymatic metalloproteins—to carry out chemical transformations that do not occur naturally in biological systems. This approach has significant advantages, including environmental sustainability (especially when replacing rare or toxic metals in reactions) and enhanced selectivity in molecular synthesis. For example, his work on enzymatic "new to nature" chemistry has led to more efficient methods for producing complex chiral molecules with high stereoselectivity.

With Welch support, Dr. Fasan's group is expanding these approaches to new classes of enzymes, aiming to unlock new synthetic capabilities that were previously

Rudi Fasan, new Welch chair at UT Dallas, focuses on improving enzyme-based methods of chemical synthesis.

thought impossible. His work has already demonstrated that enzymatic systems can rival, and in some cases surpass, traditional synthetic methods.

A central theme in modern organic chemistry is the selective functionalization of carbon–hydrogen (C–H) bonds to develop high-value compounds in a more efficient, less wasteful reaction. Dr. Fasan has engineered enzymes that catalyzed challenging C–H functionalization reactions for bioactive molecules with record-high efficiency.

While catalysis with engineered enzymes provides more efficient routes for the production of active pharmaceutical agents, the potential of biocatalysis to assist in early-stage drug discovery campaigns remains largely untapped.

"It's uncharted territory. There are many opportunities where, by using chemical intuition, we can utilize enzymes for functions they did not evolve for. We find that incredibly exciting because it's really open to the creativity of organic chemists," said Dr. Fasan. "There's so much to discover—we've just scratched the surface of what's possible. One of the key benefits granted by the Welch Chair is the opportunity to explore."

Recent advances in Dr. Fasan's lab have led to the discovery of novel bioactive molecules with promising anticancer properties. Moving forward, his team aims to elucidate the molecular mechanisms underlying their selectivity toward specific cancer cell lines, with the ultimate goal of developing more targeted cancer therapies.

"Part of my research is working on the discovery of new bioactive molecules, with a specific focus on anticancer and antiviral compounds, in addition to chemical synthesis and for asymmetric synthesis," he said. "And with one of the best medical schools nearby, there are many opportunities for synergy."

Dr. Fasan is passionate about fostering interdisciplinary collaborations. At UT Dallas, he has played a key role in establishing the Center for High-Throughput Reaction Discovery and Synthesis (HT-RDS), an initiative designed to accelerate the discovery of new methods and catalysts by screening many reactions simultaneously and experimenting with machine learning.

"It has been amazing to connect with this vibrant community of chemists across Texas and through The Welch Foundation. That was one of the key factors that attracted me to Texas," he said.

David Tweardy and his research team at MD Anderson specialize in understanding intracellular signaling to create new cancer treatments.

DAVID J. TWEARDY, THE UNIVERSITY OF TEXAS MD ANDERSON CANCER CENTER

David Tweardy, Welch Chair in Chemistry, specializes in identifying the structural and biochemical features of signaling proteins and oncoproteins that render them susceptible to modulation by small molecules for disease treatment. Over two decades, his groundbreaking work on cytokine signaling, and especially the STAT3 protein, have deepened scientific understanding of intracellular signaling and led to promising therapeutic candidates now in clinical trials.

STAT3, a member of the signal transducer and activator of transcription (STAT) protein family, plays a vital role in transmitting signals from cytokines to the cell nucleus, where it regulates gene expression. STAT3 is critical in cytokine signaling and also plays a role in inflammation and cell survival. Dr. Tweardy's early discoveries highlighted the efficiency of STAT3's recruitment to activated receptors.

"As a biochemist, I was very interested in how a region on STAT3 allows for its recruitment to the activated receptor at the atomic level. In one fell swoop, you spark a pretty complicated cascade of signaling events. That became this long, long pathway to understand the molecular interactions," he explained.

Since STAT3 is ubiquitous and essential for embryonic development, genetic "knockout" experiments proved impractical for studying its functions. Instead, Dr. Tweardy turned to chemical genetics to selectively inhibit STAT3 in adult mice. This approach, while challenging, enabled his team to identify a novel small-molecule inhibitor capable of disrupting STAT3's function without genetic manipulation.

Dr. Tweardy and his team analyzed STAT3's phosphopeptide-binding domain using a structure-based approach, leveraging computational docking experiments to screen almost one million potential compounds. They discovered a novel STAT3 inhibitor that is now in Phase II clinical trials for liver cancer and idiopathic pulmonary fibrosis (IPF).

"We started docking small molecules into a peptide-binding pocket that was very distinct and separate from anybody else's," he said. "And it turns out, in virtually every model where STAT3 was critical for the pathogenesis, our molecule to target it [STAT3] worked."

If successful, the drug will be the first small-molecule inhibitor targeting an Src-homology (SH) 2 domain to reach clinical application. The implications extend beyond STAT3, opening new avenues for targeting other SH2 domain-containing proteins, which play roles in numerous diseases. The ultimate goal is to develop a broader class of inhibitors that could be applied across multiple disease contexts, including cancer and inflammatory diseases.

In other new projects, Dr. Tweardy continues to drive innovation in drug discovery by blending molecular biology, chemistry and artificial intelligence (AI). Dr. Tweardy and his team are utilizing AI-driven modeling techniques to predict and optimize drug interactions at an atomic level. By incorporating AI into their structural analysis, they aim to accelerate the identification of new drug candidates and improve the efficiency of small-molecule design.

"With Welch support, we can look at different SH2 domain-containing proteins that are biologically important in disease," Dr. Tweardy said. "If we focus on the atomic-level interaction and have a really good structure [of the protein] developing, then we can establish what small-molecule compounds might effectively interfere with that interaction. We're really excited that we may be able to fill this gap using AI."

As his STAT3 inhibitor progresses through clinical trials and his team expands their AI-driven drug discovery efforts, Dr. Tweardy continues to push the boundaries of what is possible in biochemistry and medicine.

Catalyst for Discovery: Jumpstarting Creative Collaborations

The Catalyst for Discovery Program Grants are intended to speed progress in fundamental chemical research. They underwrite multi-year research programs by collaborative research teams tackling significant problems at the leading edge of chemistry. Each year, up to two grants of up to $5 million each are awarded, with the goal of reducing barriers to discovery and providing flexibility with minimal administrative burden.

Invitations to submit proposals are issued in January to Texas institutions with substantial chemical research programs (external research funding in chemistry, Welch research grants, Welch endowed chairs and PhD programs in chemistry and/or related fields). The Welch Scientific Advisory Board reviews the proposals and the top-scoring investigator teams are invited to a secondary review by videoconference. Following a final programmatic review, awards are announced in late July with a start date of August 1.

In 2024, Welch awarded two new Catalyst grants to multidisciplinary teams in Texas while continuing to fund the four inaugural grants from the program's first year.

YI LU, PROGRAM DIRECTOR, THE UNIVERSITY OF TEXAS AT AUSTIN

The University of Texas at Austin Professor Yi Lu and his Welch Catalyst Grant team have an ambitious goal: turning an abundant and free nitrogen source directly into useful chemicals and pharmaceuticals. Today, with the help of a Catalyst Grant, the team is making progress with this high-risk, high-reward research.

Nitrogen gas (N_2), which makes up approximately 78 percent of air, is present in most classes of biomolecules, natural products and synthesized compounds. Plants convert atmospheric nitrogen to more useful compounds through nitrogenase (N2ase), but scientists have yet to successfully adapt this enzymatic process to the laboratory. In the early 1900s, researchers developed the Haber-Bosch process to convert nitrogen into ammonia, which is primarily used in fertilizer production. While instrumental in dramatically improving plant yields, the process uses 1 to 2 percent of global energy and creates about 1.4 percent of the world's carbon dioxide (CO_2) emissions.

Dr. Lu's team aims to not only make ammonia production more sustainable by carrying out this reaction

Program director Yi Lu *(left)* and three of his catalyst team members, Mike Rose *(standing)*, Kami Hull and Tom Cundari, are excited by early research findings.

at ambient temperature and pressure, but to take this challenge a step further, moving directly from N_2 to high-value chemical products. The plan is to take N_2 from air and transfer one or both nitrogen atoms to organic substrates by designing a new class of enzymes called artificial dinitrogen transferases (ArtN_2Tases).

While there are numerous enzymes and chemical catalysts capable of activating oxygen (O_2) and directly transferring its O to organic substrates or biomolecules, to date there is no artificial enzyme or catalyst capable of a direct N_2 transfer reaction (DN_2TR). This program has the potential to transform the chemistry of "nitrogenation" by developing a new paradigm for N_2 activation and DN_2TR. This would allow for the biocatalytic production of a wide variety of important chemical compounds.

Andy Ellington brings synthetic biology expertise to the team.

"Despite its enormous potential, the program is high risk as it is much more difficult to activate N_2 and capture/transfer its intermediates than commensurate processes for O_2," explained Dr. Lu.

He pointed to major barriers to engineering naturally occurring N_2ases. Their complex overall structure and elegant active site, a so-called "metallocofactor" containing seven irons and a molybdenum, complicate mutagenesis and heterologous expression that might be used in bioprocessing. There are chemical barriers as well. It is very difficult to synthesize small molecule catalysts that replicate the essential chemical environment around the metallocluster.

Dr. Lu further clarifies that tightly controlling and tuning these primary and secondary coordination spheres is essential to putting highly reactive intermediates—such as hydrazine (N_2H_4) and diazene (N_2H_2)—to good use in high-value chemical reactions.

Dr. Lu says he was fortunate to assemble a team of "top notch" Texas researchers with expertise in the five disparate fields needed to tackle the problem:

- Metalloprotein design/engineering (Dr. Lu)
- Synthetic organometallic chemistry (Michael J. Rose, associate professor, UT Austin)

- Organic chemistry of nitrogen transfer reactions (Kami Hull, associate professor, UT Austin)
- Computational chemistry to understand reaction mechanisms (Thomas R. Cundari, Regents Professor of Chemistry, University of North Texas) and
- Synthetic biology to optimize enzymes using machine learning and directed evolution (Andrew Ellington, Kathry M. Fraser Endowed Research Professor of Biochemistry, UT Austin).

This specialized and collaborative team is leveraging its range of complementary expertise: Dr. Lu is working with Dr. Rose to design ArtN_2Tases that bind synthetic metal clusters for N_2 reduction; Dr. Hull is identifying reactions and designing strategies that will promote reactions between organic substrates and the transient N_2 reduction intermediates; and Dr. Ellington is using a new generation of non-canonical amino acids and directed evolution to improve the nascent ArtN_2Tases. In parallel, there are efforts to improve the fundamental chemistry of nitrogen reduction. Drs. Lu and Rose will perform structural, spectroscopic and mechanistic studies of ArtN_2Tase—guided by Dr. Cundari's computations—and work with Dr. Hull to capture the intermediates for DN_2TRs.

"This unparalleled expertise and our close collaboration allow us to exploit recent advances in chemical/biochemical methods, making this the right time and the right team to tackle this major challenge at the leading edge of chemical catalysis and biocatalysis," Dr. Lu said.

The research team is taking a novel approach to designing ArtN_2Tases—drastically different from both current engineered N_2ases and synthetic models—using small, robust proteins free of other subunits or metallocofactors and whose mutants are readily constructed, expressed and purified in *E. coli*.

Given nitrogen's strong bonds and nitrogenase's complex structures, chemistry and reaction mechanisms, this is a challenge no single group could do," Dr. Lu added. "It needs a whole team with a wide range of expertise. We will be revolutionizing fundamental knowledge in chemistry and biology as capturing N_2 intermediates from the nitrogenase reaction has never been done before. This research is way out there, and we are so excited that Welch believed in us and had the vision to fund it."

MICHAEL ROSEN, PROGRAM DIRECTOR, THE UNIVERSITY OF TEXAS SOUTHWESTERN MEDICAL CENTER

While much is known about the parts of the cell that have membranes, such as the nucleus, more mysterious are the biomolecular condensates that collect and organize molecules without them. These condensates concentrate specific collections of proteins, RNAs and small molecules into discrete compartments to promote diverse processes; defective condensates play a role in neurodegeneration, cancer and viral infection.

A group of scientists at The University of Texas Southwestern Medical Center have been studying how these thousands of molecular processes in cells are organized in space and time, a central problem in biology, from their different research perspectives. Some four years ago, they started a monthly "condensate club" to compare notes. Now, thanks to the Welch Catalyst Grant awarded in 2023, the group has created a broader multidisciplinary platform to advance this work, involving both experimental and computational approaches.

Principal investigator Mike Rosen explained, "Our goal is to explore how the 30 different types of condensates in a cell achieve specificity, which is needed for control of diverse functions such as transcription, cell division and DNA replication, among others. This is a complex challenge, and the best experimentation isn't enough; we need computational analysis leveraging AI (artificial intelligence) and machine learning."

Dr. Rosen is a founder of the field of biomolecular condensates and an expert in analyses of protein and small molecule partitioning into condensate. His lab is biochemically reconstituting condensates and developing high-throughput screens to see which proteins are enriched in them and learn whether patterns of small molecules partitioning can be used to characterize condensates. His findings provide information for the other Catalyst Grant team members' research into the biology of the condensates.

On the computational front, Assistant Professor Qian Cong brings her expertise in machine learning-based prediction of protein-protein interactions and bioinformatics to the team. While condensates are a new area for her, Dr. Cong says the Welch grant has "catalyzed" her work. She is using an evolutionary lens to delve into how protein-protein interactions define condensate compositions.

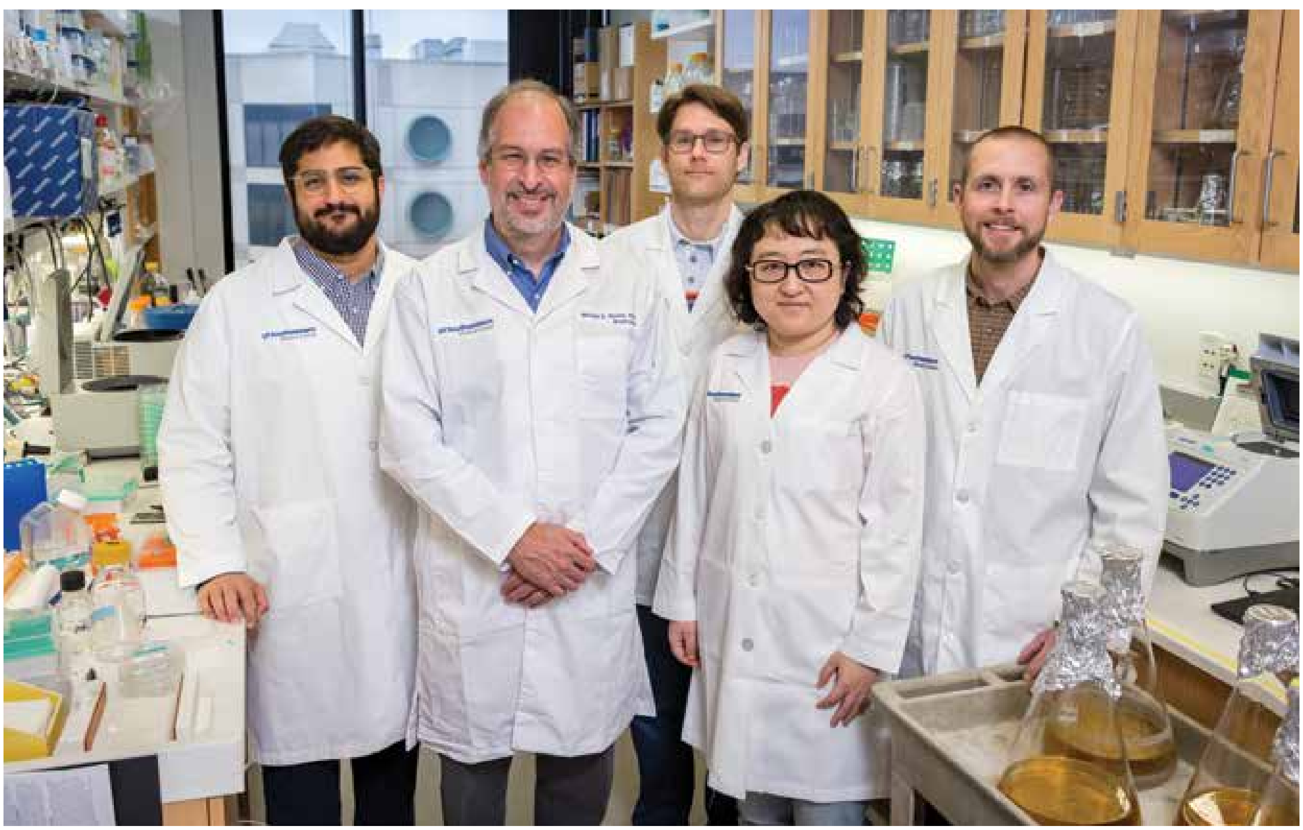
Matthew Parker, assistant professor of biophysics, is applying both experimental and computational approaches to study what he calls "non-random conversations" taking place among many proteins. His goal is to determine if this "gibberish" is interpretable and, if so, to decode it to understand how it mediates the process of DNA replication.

Benjamin Sabari is an expert in mechanisms of gene activation and condensate-regulated transcription. The assistant professor is studying intrinsically disordered regions of proteins to learn how they assemble to regulate transcription. He is interested in how the different groups cooperate at the same time and in the same space, hypothesizing they must be able to communicate.

Rounding out the team is Assistant Professor Jeffrey Woodruff, an expert in chemical crosslinking and reconstitution of coiled-coil regions of proteins in the pericentriolar material (PCM), the outermost layer of centrosomes, which control DNA segregation in mitosis. While other team members are looking at how condensates are distinguished from one another, Dr. Woodruff's focus is on how protein-protein interactions occur within condensates. He is using biochemical techniques to map how condensate proteins bind with each other to determine how they produce the PCM.

Condensate functions are defined by the specific collections of molecules within the condensates and the internal physicochemical environment the components produce. The team has two primary objectives: to crack the condensate specificity code and define how composition and physicochemical properties control reactions. Ultimately, their goal is to determine the sequence, chemical and physical features underlying condensate compositions and functions, and advance understanding of condensate-controlled chemistry across scales, from atoms to cells.

"The Welch Foundation has long been a terrific partner in UT Southwestern's chemical research," said Dr. Rosen. "The new Catalyst Grant is an amazing resource for cross-disciplinary investigations into important and complex issues. For our team, it is providing the glue to bring together outstanding scientists to address fundamental chemical questions in biochemistry through development of new experimental and computational tools, yielding a whole that is truly greater than the sum of its parts."



With a Welch Catalyst grant, this UT Southwestern team hopes to advance understanding of condensates: *(from left)* Benjamin Sabari, Mike Rosen, Jeff Woodruff, Quian Cong and Matthew Parker.

Statements of Financial Position

AS OF AUGUST 31, 2024 AND 2023

	2024	2023
ASSETS		
CASH AND CASH EQUIVALENTS	$ 484,672	$ 1,560,059
INVESTMENTS	887,201,857	839,270,415
RECEIVABLES		
Investment transactions	214,865	201,393
Interest and dividends	87,425	201,330
Other	256,639	373,109
Total receivables	558,929	775,832
OTHER ASSETS		
Right of use assets	1,808,237	2,295,570
Other assets	1,970,067	1,834,641
Total other assets	3,778,304	4,130,211
TOTAL ASSETS	$ 892,023,762	$ 845,736,517
LIABILITIES AND NET ASSETS		
LIABILITIES		
Unpaid grants	$ 37,996,829	$ 23,138,990
Current and deferred federal tax payable	3,499,817	2,495,607
Operating lease liability	2,048,374	2,443,122
Accounts payable and other	620,679	586,677
Total liabilities	44,165,699	28,664,396
NET ASSETS	847,858,063	817,072,121
TOTAL LIABILITIES AND NET ASSETS	$ 892,023,762	$ 845,736,517

Statements of Activities

AS OF AUGUST 31, 2024 AND 2023

	2024	2023
REVENUES, INCOME, AND GAINS (LOSSES)		
Interest and dividends	$ 9,010,230	$ 7,830,919
Oil and gas royalties and other	4,969,093	6,710,799
Net realized gains on sales of investments	22,870,042	33,076,410
Unrealized appreciation (depreciation) of investments	58,395,437	(20,182,125)
Unrealized appreciation (depreciation) of other assets	949	(16,314)
Investment management expenses	(2,991,050)	(3,256,471)
Federal income and excise tax provision	(431,335)	(367,090)
Total revenues, income, and gains	91,823,366	23,796,128
EXPENSES		
Grants approved, net	55,667,853	60,998,155
Grant cancelled and refunds	(1,071,818)	(85,212,769)
Grants administration	3,138,142	2,857,039
General and administrative	2,457,234	1,936,858
Total expenses	60,191,411	(19,420,717)
DEFERRED FEDERAL EXCISE TAX PROVISION ON UNREALIZED CAPITAL GAINS	(846,013)	2,664
CHANGE IN NET ASSETS	30,785,942	43,219,509
NET ASSETS, beginning of year	817,072,121	773,852,612
NET ASSETS, end of year	$ 847,858,063	$ 817,072,121

For the Foundation's complete audited financial statements, please visit www.welch1.org.

Research Grants

The Welch Foundation supported 329 active research grants at 21 institutions in 2024.

PRINCIPAL INVESTIGATOR	INSTITUTION	TITLE OF RESEARCH
Girish S. Agarwal	*Texas A&M University*	Correlated Supersensitive Absorption, Fluorescence, and Polarization Microscopy with Quantum Illumination
Michalis Agathocleous	*The University of Texas Southwestern Medical Center*	The *In Vivo* Requirement and Cell Type Specificity of the Citric Acid Cycle
Caroline Ajo-Franklin	*Rice University*	Elucidating the Chemical Principles That Underlie Multiscale Assembly of Living Materials
Alison Altman	*Texas A&M University*	Chemistry at Small Energy Scales: Controlling Magnetic Interactions in F-Elements Through Inverted Ligand Field Environments
Neal M. Alto	*The University of Texas Southwestern Medical Center*	Post-Translational Modification of Host Enzymes by Bacterial Effector Proteins
Mauricio S. Antunes	*University of North Texas*	Establishing the Biochemical Determinants of microRNA Long-Distance Mobility in Plants
Xiaochen Bai	*The University of Texas Southwestern Medical Center*	Developing Insulin-Alternative Molecule for Effective Treatment of Diabetes
Carlos R. Baiz	*The University of Texas at Austin*	Studies in Biophysical Chemistry: Applications of Ultrafast Infrared Spectroscopy
Lane A. Baker	*Texas A&M University*	Quantifying Single-Entity Electrocatalysts
Matthew Baker	*The University of Texas Health Science Center at Houston*	Structural Characterization of Chimeric Antigen Receptors and Their Interactions with Tumor Associated Antigens
Edoardo Baldini	*The University of Texas at Austin*	Mapping Vibrational Couplings in Two-Dimensional Semiconductors
Zachary T. Ball	*Rice University*	New Strategies for Catalytic Bond Formation
Laura A. Banaszynski	*The University of Texas Southwestern Medical Center*	Characterizing the Role of Novel H3.3 Interacting Proteins in Enhancer Activation
Sarbajit Banerjee	*Texas A&M University*	Anion Intercalation as a Means of Dynamically Reconfiguring Electronic Structure in Metastable Solids
David P. Barondeau	*Texas A&M University*	Elucidating the Mechanism of Fe-S Cluster Biosynthesis with Time-Resolved Native Mass Spectrometry
Brian Belardi	*The University of Texas at Austin*	Towards a Synthetic Cell: *In Situ* Reconstruction of Membrane Proteins
Eric R. Bittner	*University of Houston*	Quantum Entanglement and Many-Body Dynamics in Low-Dimensional Molecular Assemblies
Joshua D. Bocarsly	*University of Houston*	Discovery and Control of Quantum Materials Using Electrochemical Intercalation
Steven Boeynaems	*Baylor College of Medicine*	Dissecting the Biochemistry of Innate Immune Activation
Joan F. Brennecke	*The University of Texas at Austin*	Ion Dissociation in Ionic Liquids and Its Impact on Physical Properties and Phase Behavior
Jakoah Brgoch	*University of Houston*	Activating Nobel Metal Charge Transfer Toward Unusual Oxidation States
Jennifer S. Brodbelt	*The University of Texas at Austin*	Dynamic Structures of Macromolecules in the Gas Phase

PRINCIPAL INVESTIGATOR	INSTITUTION	TITLE OF RESEARCH
Maurice S. Brookhart	*University of Houston*	Pd(II)- and Ni(II)-Catalyzed Olefin Polymerizations and Copolymerizations
Kevin Burgess	*Texas A&M University*	New Approaches to Peptide Helix and Loop Mimicry for Impeding Protein-protein Interactions
Cassandra E. Callmann	*The University of Texas at Austin*	Carbohydrate-Polymer Conjugates as New Chemical Biology Tools and Biomimetic Scaffolds
Brad Carrow	*University of Houston*	Modular Catalytic Approach to Telechelic Polymers and Improved Plastics Recycling
Can Cenik	*The University of Texas at Austin*	Transcriptome-Wide Measurement of Translation Using a Novel On-Chip Isotachophoresis Approach
Elif Sarinay Cenik	*The University of Texas at Austin*	Beyond Ribosome Biogenesis: Role of RNA Polymerase I in Germline Chromosome Condensation
Maria Chahrour	*The University of Texas Southwestern Medical Center*	Decoding Social Communication Networks Through Forward Genetics
Julia Y. Chan	*Baylor University*	Topology, Magnetism, and Electron Correlations in a Hybrid Kagome Lattice
James Chappell	*Rice University*	Recording Intracellular Chemicals Across Microbial Consortia Using Programmable Allosteric Ribozymes
James R. Chelikowsky	*The University of Texas at Austin*	New Computational Methods for Molecular Fingerprinting of Complex Hydrocarbon Mixtures
Songtao Chen	*Rice University*	Fluorescence and Spin Properties of Quantum Defects in Silicon
Zhijian J. Chen	*The University of Texas Southwestern Medical Center*	Regulation of NF-$_{\kappa}$B by Liquid-Liquid Phase Separation
Kwan H. Cheng	*Trinity University*	Understanding Molecular Mechanisms of Amyloid Diseases from Multiscale Simulations of Early Aggregation of Disordered Protein on Lipid Nanodomains
Jae-Hyun Cho	*Texas A&M University*	Deep Mechanistic Understanding of How SARS-CoV-2 Evades Host Innate Immune Responses
Yuh Min Chook	*The University of Texas Southwestern Medical Center*	Karyopherin-Mediated Nuclear Import of Ribosomal Proteins
Melanie H. Cobb	*The University of Texas Southwestern Medical Center*	Regulatory and Catalytic Properties of MAP Kinase Cascades
James J. Collins III	*The University of Texas Southwestern Medical Center*	Regulation of Parasite Reproduction by a Non-Ribosomal Peptide
Robert J. Comito	*University of Houston*	Complex Amine Synthesis by Catalytic Imine Photochemistry
Maralice Conacci-Sorrell	*The University of Texas Southwestern Medical Center*	Elucidating the Molecular Functions of the Tryptophan Metabolite Indole-3-Pyruvate
Qian Cong	*The University of Texas Southwestern Medical Center*	Identification of New Regulatory Proteins for Enzymes in Human Pathogens
Jacinta C. Conrad	*University of Houston*	Non-Equilibrium Dynamics of Soft Nanoparticle Glasses
Lydia M. Contreras	*The University of Texas at Austin*	Expanding *in Vivo* Structural Characterization Tools to Map Complex Molecular Features and Cellular Networks That Support RNA Function
David R. Corey	*The University of Texas Southwestern Medical Center*	Identifying RNA-DNA Regulatory Switches and Controlling Their Formation with Small Molecules

PRINCIPAL INVESTIGATOR	INSTITUTION	TITLE OF RESEARCH
Thomas R. Cundari, Francis D'Souza, and Jeffry A. Kelber	*University of North Texas*	Collaborative Research: Sustainable Ammonia Production from Nitrogen via Electrochemical and Photochemical Methods
Pengcheng Dai	*Rice University*	Transport, Magnetic, and Neutron Scattering Studies of Quantum Materials
Kevin N. Dalby	*The University of Texas at Austin*	Leveraging Entropy for Enhanced Covalent Targeting at a Kinase Protein Binding Site
Gaudenz Danuser	*The University of Texas Southwestern Medical Center*	Computational Models of Morphology-Controlled Cell Signal Transduction
Sheena D'Arcy	*The University of Texas at Dallas*	A Novel HDX Workflow to Study Histone Dynamics in Multi-Nucleosome Systems
Donald J. Darensbourg	*Texas A&M University*	Reactivity Studies of Metal Catalyzed Production of Polycarbonates from Novel Oxiranes and Carbon Dioxide
Marcetta Y. Darensbourg	*Texas A&M University*	Biomimetic Tripeptide Motifs in Control of Polymetallic Topologies and NO Reactivity
Bryan W. Davies	*The University of Texas at Austin*	Discovering Protein Chemistry That Can Thread Through Bacterial Pores
Jef K. De Brabander	*The University of Texas Southwestern Medical Center*	Synthesis and Chemical Biology of Bioactive Small Molecules
Marcos H. de Moraes	*Rice University*	Functional Characterization of Bacterial Deaminase Toxins and Their Use as Genome Editing Tools
Nicole De Nisco	*The University of Texas at Dallas*	Glycosaminoglycan Utilization and Metabolism by the Microbiota of the Urogenital Tract
Daniel J. Dickinson	*The University of Texas at Austin*	Integrative Fluorescence and Mass Imaging of Cellular Protein Complexes
Sheel C. Dodani	*The University of Texas at Dallas*	Discovery and Evolution of Chemoenzymatic Editors for Organofluorine Compounds
Peter M. Douglas	*The University of Texas Southwestern Medical Center*	Intracellular Lipid Surveillance via Nuclear Hormone Receptor Sequestration by RAB GTPase Geranylgeranylation
Michael P. Doyle	*The University of Texas at San Antonio*	Challenging Selective Chemical Reactions of Diazo Compounds
Andrew D. Ellington	*The University of Texas at Austin*	Machine Learning for Improving Protein Stability and Function
Lei Fang	*Texas A&M University*	Synthesis, Coordination Chemistry, and Catalysis of Fully Fused Polypyridine Ligands
Furqan Fazal	*Baylor College of Medicine*	Leveraging RNA Proximity Labeling to Reveal the Principles of Subcellular RNA Localization to Mitochondria
Josephine C. Ferreon	*Baylor College of Medicine*	Disordered Protein Condensates as Novel Nanomaterials
Ilya J. Finkelstein	*The University of Texas at Austin*	On-Demand Cellular Oligonucleotide Synthesis for Precision Genome Engineering
Glenna W. Foight	*Baylor College of Medicine*	Signaling-Responsive Control of Transcription Factors with Designed Protein Inhibitors
Skye Fortier	*The University of Texas at El Paso*	Facile Methods for the Synthesis of Uranium-Carbon Multiple Bonds
Frank W. Foss, Jr.	*The University of Texas at Arlington*	Ion Binding, Mobility, and Single Molecule Fluorescence Sensing at Molecularly Designed Gas-Solid Interfaces

PRINCIPAL INVESTIGATOR	INSTITUTION	TITLE OF RESEARCH
Matthew S. Foster	*Rice University*	Fractal Mechanisms of Coherent Dynamics in Complex Quantum Materials
Benny D. Freeman	*The University of Texas at Austin*	Fundamental Experimental and Modelling Study of Ion and Water Transport in Polymeric Double Network Ion Exchange Membranes
Masaya Fujita	*University of Houston*	Understanding the Functional Roles of Multiple Kinases Controlling a Complex Network of Chemical Processes
François P. Gabbaï	*Texas A&M University*	Bismuth(III) Lewis Acids for the Transport of Chloride Anions Across Biological Membrane Mimics
Matthieu G. Gagnon	*The University of Texas Medical Branch at Galveston*	Chemical and Structural Features in tRNA and mRNA for Accurate Reading of the Genetic Code
Don B. Gammon	*The University of Texas Southwestern Medical Center*	Biochemical Characterization of an Evolutionarily-Conserved Host Antiviral Complex Using Viral Antagonists
Venkat Ganesan	*The University of Texas at Austin*	Fundamental Studies of Self-Assembly in Mixtures of Organic and Inorganic Molecules
Xue Gao	*Rice University*	Mechanistic Study of the Stereochemically Controlled Biosynthesis of Fungal Natural Products
Yang Gao	*Rice University*	Investigating the Catalytic Mechanisms of Mg^{2+}-Dependent Enzymes with Time-Resolved Crystallography
Jeremiah J. Gassensmith	*The University of Texas at Dallas*	Remote Control Over Protein-Viral Nanoparticle Dynamics in Complex Environments
Joseph Gauthier	*Texas Tech University*	Biomimetic Conversion of Carbon Dioxide to Value Added Fuels and Chemicals
Haibo Ge	*Texas Tech University*	Palladium-Catalyzed Enantioselective Isomerization of Alkenes
Feliciano Giustino	*The University of Texas at Austin*	Mechanisms of Light Absorption and Emission in Perovskites
John A. Gladysz	*Texas A&M University*	New Polyyne-Based Allotropes of Carbon
Vishal M. Gohil	*Texas A&M University*	Phospholipid-Protein Interactions in Mitochondrial Bioenergetics
Elizabeth J. Goldsmith	*The University of Texas Southwestern Medical Center*	Isoform Specific Osmotic Activation and Chloride Inhibition of WNKs
Kayla N. Green	*Texas Christian University*	Disguising Small Molecules to Improve Therapeutic Strategies to Target Oxidative Stress
Nick V. Grishin	*The University of Texas Southwestern Medical Center*	Harvesting Unique Chemistries Through Genomic Sequencing and Structure Prediction
Yogesh K. Gupta	*The University of Texas Health Science Center at San Antonio*	Covalent Nucleic Acid Modifications in DNA Repair and Innate Immune Response
Anna-Karin Gustavsson	*Rice University*	Binding Dynamics and Nanoscale Architecture of CaMKII-Actin Network Reorganization at the Single-Molecule Level
Osvaldo Gutierrez	*Texas A&M University*	Unraveling the Mechanistic Complexity of Multicomponent Nickel-Catalyzed Dicarbofunctionalization of Unactivated Alkenes
Jason H. Hafner	*Rice University*	Fingerprint Raman-Active Vibrations for Membrane and Peptide Structure
Naomi J. Halas	*Rice University*	Nanoparticle Growth and Surface Chemistry to Enhance Chemical Reactivities

PRINCIPAL INVESTIGATOR	INSTITUTION	TITLE OF RESEARCH
P. Shiv Halasyamani	*University of Houston*	Crystal Growth of Functional Inorganic Materials
Michael B. Hall	*Texas A&M University*	Computational Chemistry on Transition Metal Systems
Yimo Han	*Rice University*	Understanding Neuron Signaling at Molecular Level Using Cryo-Electron Microscopy
Rasika M. Harshey	*The University of Texas at Austin*	Bacterial Molecular Motors as Anti-Phage Defense Systems
Jeffrey D. Hartgerink	*Rice University*	A Combined Computational–Synthetic Approach to Nanostructured Assemblies
Eva M. Harth	*University of Houston*	Governing Function and Reactivity of Nickel Complexes in Cross Coupling and Polyolefin Polymerizations
Graeme Henkelman	*The University of Texas at Austin*	Design of Materials for Energy Conversion and Storage
W. Mike Henne	*The University of Texas Southwestern Medical Center*	Mechanisms of LD Sterol Organization and LD-Lysosome Inter-Organelle Trafficking
Raúl Hernández Sánchez	*Rice University*	Carbon Dioxide Reduction Facilitated by C-H Anion Recognition Catalysts
Christian B. Hilty	*Texas A&M University*	Activity and Mechanisms in Micro-and Mesoporous Catalysts by Para-Hydrogen Enhanced NMR
Meagan Hinze	*Sam Houston State University*	Biocatalysis Methodologies for Oxidative Chiral Resolutions
Gary C. Hon	*The University of Texas Southwestern Medical Center*	Mechanisms of Combinatorial Enhancer Function on Bistable Expression States
Lora V. Hooper	*The University of Texas Southwestern Medical Center*	Biochemical Studies of Small Proline-Rich Proteins, a New Class of Endogenous Antibiotics
Gerta Hoxhaj	*The University of Texas Southwestern Medical Center*	Deciphering the Regulatory Mechanisms of NAD Kinase in Metastasis
Kaiwen Hsiao	*Texas A&M University*	Photo-Switchable Nano-Resolution Fast Additive Manufacturing with Controlled Living Radical Polymerization
Ku-Lung Hsu	*The University of Texas at Austin*	Chemoselective Protein Reactions via Sulfonyl-Azole Chemistry
Shengxi Huang	*Rice University*	Unveiling the Charge Interaction Between Molecules and Topological Surface States
Todd Hudnall	*Baylor University*	Exploring the Photochemistry of π-Acidic Singlet Carbenes
Kami L. Hull	*The University of Texas at Austin*	Cu-Catalyzed Carboamination of Olefins
Simon M. Humphrey	*The University of Texas at Austin*	Discovery of Metal-Organic Frameworks with Previously Inaccessible Network Types and Unique Solid-State Characteristics
Oleg A. Igoshin	*Rice University*	Non-Equilibrium Mechanisms Controlling the Selectivity of Biochemical Information Processing
Tatyana Igumenova	*Texas A&M University*	Structure And Mechanism of a Novel Target for Next Generation Anti-Fungal Drugs
Andrea Isella	*Rice University*	Investigating the Origin of the Chemistry of Planets
Dmitri N. Ivanov	*The University of Texas Health Science Center at San Antonio*	Protein Ubiquitylation in Antiviral Immunity and Cancer
Brent L. Iverson	*The University of Texas at Austin*	Dynamic Supramolecular Solids

PRINCIPAL INVESTIGATOR	INSTITUTION	TITLE OF RESEARCH
Junji Iwahara	*The University of Texas Medical Branch at Galveston*	Biomolecular Electrostatics by NMR Spectroscopy
Benjamin G. Janesko	*Texas Christian University*	Virtual Screening Beyond the Rule of Five: Open Computational Workflows Integrating Metadynamics, Model Solvent, and Broadly Accurate Density Functional Theory
Junha Jeon	*The University of Texas at Arlington*	Aryne Formation Through Single-Electron Transfer Coupled with Hydrogen Atom Transfer: Carbon–Heteroatom-Forming Cross-Coupling Reactions
Jenna L. Jewell	*The University of Texas Southwestern Medical Center*	Phosphorylation and Inhibition of mTORC1 by PKA
Jean X. Jiang	*The University of Texas Health Science Center at San Antonio*	Modulating Hemichannel Activities Using Targeting Antibodies
Jin Jiang	*The University of Texas Southwestern Medical Center*	Biochemical Investigation of a Pseudokinase Implicated in Neurological Diseases
Youxing Jiang	*The University of Texas Southwestern Medical Center*	Structural Mechanisms of Gating and Selectivity of Lysosomal Cation Channels
Lukasz A. Joachimiak	*The University of Texas Southwestern Medical Center*	Role of Local Structure in Modulating Assembly of Intrinsically Disordered Proteins
Kayunta L. Johnson-Winters	*The University of Texas at Arlington*	Kinetic Characterization of Promiscuous F_{420}-dependent Sugar-6-phosphate Dehydrogenases
Matthew R. Jones	*Rice University*	Quantifying Chemical Thermodynamics and Kinetics at the Ligand-Nanocrystal Interface
Alamgir Karim	*University of Houston*	Understanding Stabilization and Molecular Transport of RNA and Charged Polymer Across Membraneless Coacervate Droplets
Adrian T. Keatinge-Clay	*The University of Texas at Austin*	Engineering and Harnessing Tetraketide Synthases
Ben K. Keitz	*The University of Texas at Austin*	Evolving Synthetic Reactions Through Extracellular Electron Transfer
Oleg Klykov	*The University of Texas Health Science Center at San Antonio*	Structural Basis for Chemical Signaling in the Brain
Jennifer J. Kohler	*The University of Texas Southwestern Medical Center*	Metabolic Incorporation of Photocrosslinking GalNAc for Glycoconjugate Interaction Discovery
Anatoly B. Kolomeisky	*Rice University*	Theoretical Understanding of Dynamic Catalysis Phenomena
Junichiro Kono	*Rice University*	Optical, Infrared, and Terahertz Spectroscopy of Low-Dimensional Materials
Anna Konovalova	*The University of Texas Health Science Center at Houston*	Mechanism of Signal Transduction Across the Bacterial Cell Envelope
Ivan Korendovych	*Baylor University*	Development of Catalytically-Amplified Biosensors for Metal Ions
Brian A. Korgel	*The University of Texas at Austin*	Nanocrystal Quantum Dots with Infrared Optical Response
Arthur Laganowsky	*Texas A&M University*	Molecular Assemblies of Oncogenic RAS Mutants with SOS and BRAF
Keji Lai	*The University of Texas at Austin*	Nanoscale Electrical Probing of Chemical Reactions in Layered Materials
Alan M. Lambowitz	*The University of Texas at Austin*	Bacterial Reverse Transcriptases

PRINCIPAL INVESTIGATOR	INSTITUTION	TITLE OF RESEARCH
Christy F. Landes	*Rice University*	Orientational Effects on Protein Dynamics at Chromatographic Supports from a Single Analyte Perspective
Laura A. Lavery	*Rice University*	Determining the Mechanism of Altered Chemical Catalysis of DNA Methylation in Mammalian Brain Development
T. Randall Lee	*University of Houston*	2D Nanolayered Structures Based on N-Heterocyclic Carbene-Functionalized Transition Metal Dichalcogenides for Nanodevice Fabrication
Guigen Li	*Texas Tech University*	Multi-Layer 3D Chirality and its Asymmetric Catalytic Assembly
Hongjie Li	*Baylor College of Medicine*	Integrative Multi-Omics to Study Aging- and Alzheimer's Disease-Caused Chemosensory Decline
Nan Li	*The University of Texas Southwestern Medical Center*	Axon-Terminal-Specific and Action-Potential Dependent Functional MRI Reporters
Pingwei Li	*Texas A&M University*	The Structural Basis of Lipopolysaccharide Sensing by the Caspase-4 Inflammasome
Wenbo Li	*The University of Texas Health Science Center at Houston*	Elucidating the Role of RNA m6A Methylation in Enhancer and Chromatin Control
Xiaochun Li	*The University of Texas Southwestern Medical Center*	Mechanisms of Cholesterol Biosynthesis and Trafficking: From Sterol-Sensing Domain to Phosphatidylserine Synthase
Xiuling Li	*The University of Texas at Austin*	Understanding the Spin Defects in Van der Waals Sheets and Quantum-Photonic Integration on a Curved Surface
Ruibin Liang	*Texas Tech University*	Multiscale Simulation of Molecular Photoswitches in Biological Systems
Erez A. Lieberman	*Baylor College of Medicine*	Determining the Mechanistic Basis of Chromatin Looping
Jung-Fu Lin	*The University of Texas at Austin*	Fixation of Single-Bonded Nitrogen Compounds
Paul A. Lindahl	*Texas A&M University*	Copper Trafficking and Regulation in Eukaryotic Cells
Alexander R. Lippert	*Southern Methodist University*	Single Molecule Localization Lithography
Glen Liszczak	*The University of Texas Southwestern Medical Center*	Chemoenzymatic Tools to Study Site-Specific Protein ADP-Ribosylation
Aimin Liu	*The University of Texas at San Antonio*	Characterization of 2-Oxindole Forming Heme Enzyme in the Biosynthetic Pathway of Maremycins
Hung-wen Liu	*The University of Texas at Austin*	Mechanistic Studies of Novel Enzymes
Wenshe R. Liu	*Texas A&M University*	The Exploration of Genetically Encoded Noncanonical Amino Acids for the Cyclization of Phage-Displayed Peptides
Yi Liu	*The University of Texas Southwestern Medical Center*	A Code within the Code: Codon Usage Regulates Co-Translational Protein Folding
Yuanyue Liu	*The University of Texas at Austin*	Realistic Atomistic Simulations of Electrocatalysis at Solid-Water Interface
Jun Lou	*Rice University*	Synthesis, Characterization, and Applications of Ultrathin Crystals
George J. Lu	*Rice University*	Chaperone-Assisted Assembly of Gas-Filled Protein Nanostructures

PRINCIPAL INVESTIGATOR	INSTITUTION	TITLE OF RESEARCH
Vassiliy Lubchenko	*University of Houston*	Omega-Phases and the Puzzles of Solid-to-Solid Transformations
Lloyd L. Lumata	*The University of Texas at Dallas*	Hyperpolarized Magnetic Resonance Tracking of the Altered Biochemistry in Non-Alcoholic Fatty Liver Disease
Xuelian Luo	*The University of Texas Southwestern Medical Center*	Structural and Functional Analysis of the Human STRIPAK
Jodie L. Lutkenhaus	*Texas A&M University*	Unraveling Mixed Ion and Electron Transport in n-Type Conjugated Polymers
Peter Ly	*The University of Texas Southwestern Medical Center*	Mutagenic Chromosomal Rearrangements from Diverse DNA Repair Pathways
Nathaniel A. Lynd	*The University of Texas at Austin*	Design of Biohybrid Macromolecular Non-Colligative Ice Disruptors
Shang Ma	*The University of Texas Southwestern Medical Center*	Targeting Mechanotransduction Pathway for Human Disease
Allan H. MacDonald	*The University of Texas at Austin*	Spintronics in Magnetic Topological Insulators
Dmitrii E. Makarov	*The University of Texas at Austin*	Topics in the Kinetics of Complex Molecular Rearrangements
David J. Mangelsdorf	*The University of Texas Southwestern Medical Center*	Characterizing the Host Sensory Pathway That Governs Parasitic Nematode Infections
Filippo Mangolini	*The University of Texas at Austin*	Temporal Evolution of the Interfacial Nanostructure of Deep Eutectic Solvents
Arumugam Manthiram	*The University of Texas at Austin*	Synthesis and Properties of Transition Metal Oxides with Unusual Valence States
Edward M. Marcotte	*The University of Texas at Austin*	A Mass Spectrometry-Based Map of Protein Assemblies in the Brain
Kevin G. Mark	*The University of Texas Southwestern Medical Center*	The Biochemical Basis of Translational Control by Ubiquitin and Its Significance in Neurodegenerative Disease
Angel A. Marti-Arbona	*Rice University*	Dawn of Photoactive Metal Complex Surfactants: Synthesis, Properties, and Applications
Caleb D. Martin	*Baylor University*	Annihilating Perfluoroalkyl Substances with Aluminum Lewis Superacids
Stephen F. Martin	*The University of Texas at Austin*	Synthesis of Biologically Relevant Molecules
Elisabeth D. Martinez	*The University of Texas Southwestern Medical Center*	Inhibitors of Jumonji Enzymes to Reverse Pathological Heart Remodeling
Andreas Matouschek	*The University of Texas at Austin*	Structure and Function of a Nano-Scale Biological Machine
Devin A. Matthews	*Southern Methodist University*	Understanding X-Ray and Raman Signatures of Disordered Systems
Jennifer A. Maynard	*The University of Texas at Austin*	Determinants of Antibody Folding, Stability, and Activity
David G. McFadden	*The University of Texas Southwestern Medical Center*	Mechanism of Action of Neuroendocrine-Selective Cancer Toxins
Gabriele Meloni	*The University of Texas at Dallas*	Assembly, Plasticity, and Reactivity of "Exotic" Homo-/Hetero-Metallic Protein Metal-Thiolate Clusters
Joshua T. Mendell	*The University of Texas Southwestern Medical Center*	Regulation of Pyrimidine Metabolism by NORAD-Pumilio Bodies

PRINCIPAL INVESTIGATOR	INSTITUTION	TITLE OF RESEARCH
Quentin Michaudel	*Texas A&M University*	Exploring New Macromolecular Space for the Design of Selective Antibacterial Cationic Polymers
Ognjen Miljanic	*University of Houston*	Putting Water to Work: Methane Capture in Stabilized Water Clusters
Delia J. Milliron	*The University of Texas at Austin*	Coupling Plasmonic Metal Oxide Nanocrystals to Molecules and Quantum Dots
David Mitlin	*The University of Texas at Austin*	Fundamental Understanding and Modification of Sodium-Based Solid-State Electrolytes
Jeetain Mittal	*Texas A&M University*	Unraveling Sequence-Encoded Dynamics and Rheology Using Molecular Simulations: From Polymers to Disordered Proteins
Emilia Morosan	*Rice University*	Accelerated Search for Correlated Topological Materials
Yunsun Nam	*The University of Texas Southwestern Medical Center*	Biochemical Probing of Substrate Specificity in RNA Methylation
Douglas Natelson	*Rice University*	Single- and Few-Molecule Vibrational Spectroscopy and Energy Flow
Robert W. Newberry	*The University of Texas at Austin*	Fundamental Chemical Determinants of Protein Beta-Strand Structure and Stability
Kyriacos C. Nicolaou	*Rice University*	Total Synthesis of Bioactive Natural and Designed Molecules
Deepak Nijhawan	*The University of Texas Southwestern Medical Center*	Using Forward Genetics to Understand Mechanism of Action for Anticancer Toxins
Michael Nippe	*Texas A&M University*	Tuning Molecular Electrocatalysts via Secondary Coordination Sphere Modifications
Peter J.A. Nordlander	*Rice University*	Plasmon Enhanced Chemistry
Adam D. Norris	*Southern Methodist University*	New Chemosensory Isoform of a Canonical Mechanosensory Protein
Yuuki Obata	*The University of Texas Southwestern Medical Center*	Deciphering Gut Chemosensory Circuits
Kathryn A. O'Donnell	*The University of Texas Southwestern Medical Center*	Dissecting Novel Mechanisms of Translational Control in Lung Cancer
José N. Onuchic	*Rice University*	Complex Structural Organization Governing the Function of Genome and Large Protein Assemblies
Kim Orth	*The University of Texas Southwestern Medical Center*	Co-Component Receptors: The GPCR Equivalent for Bacteria
Oleg V. Ozerov	*Texas A&M University*	Early-Metal Hydrogenation of Arenes: Potential New Approach to Chiral Phosphines
Guido Pagano	*Rice University*	Trapped-Ion Simulation of Electron Transfer in Molecules
Zachariah A. Page	*The University of Texas at Austin*	Orthogonal Light Driven Radical- And Base-Catalysis Towards Bioinspired Polymers
Jeremy C. Palmer	*University of Houston*	Glass Polyamorphism in Tetrahedral Substances: Toward Discovery of New Amorphous States
Sapun H. Parekh	*The University of Texas at Austin*	Lipid Droplets as Flexible Substrates for Disordered Protein Self-Assembly and Fibrillation
Matthew W. Parker	*The University of Texas Southwestern Medical Center*	The Role of Sequence Composition in Disordered Domain Phase Separation
Matteo Pasquali	*Rice University*	Physical Chemistry of Nanotube and Graphene Fluids

PRINCIPAL INVESTIGATOR	INSTITUTION	TITLE OF RESEARCH
Emily Pentzer	*Texas A&M University*	Rigid Rod Polymers via Group Transfer Polymerization
George N. Phillips, Jr. and Anastasios Kyrillidis	*Rice University*	Machine Learning Solutions to the Crystallographic Phase Problem
Margaret A. Phillips	*The University of Texas Southwestern Medical Center*	Identification and Characterization of Plasmodium Proteasome Inhibitors
David C. Powers	*Texas A&M University*	Development and Application of Dimensionally Expanded Open-Metal-Site Catalysts
B. V. Venkataram Prasad	*Baylor College of Medicine*	X-ray Crystallographic Studies on Viruses and Viral Proteins
Han Pu	*Rice University*	Neural Networks and Quantum Many-Body Systems
Tian Qin	*The University of Texas Southwestern Medical Center*	Uncanonical Functionalization of Bicyclic Heterocycles
Emily L. Que	*The University of Texas at Austin*	Dual Nanoparticle Conjugate Magnetic Resonance Imaging Agents: Design Principles and Applications
Doran I.G.B. Raccah	*The University of Texas at Austin*	Mesoscale Consequence of Quantum Dynamics in Molecular Materials
Arun Radhakrishnan	*The University of Texas Southwestern Medical Center*	Molecular Mechanisms of Cholesterol Sensors in Human Cells
Abelardo Ramirez-Hernandez	*The University of Texas at San Antonio*	Molecular Bottlebrushes at Liquid-Liquid Interfaces: Surface Rheology and Structure
Rebecca J. Rapf	*Trinity University*	The Role of the Interface: Systematic Studies of Reactivity in Complex Aqueous Environments
Joseph M. Ready	*The University of Texas Southwestern Medical Center*	Multi-Component Couplings Involving Alkenyl Boronates
Michael L. Reese	*The University of Texas Southwestern Medical Center*	Interrogating the Function of a Parasite-Specific Ubiquitin-Like System
Tiffany A. Reese	*The University of Texas Southwestern Medical Center*	Investigation of the Membrane Disruption Capacity of a Viral Death-Inducing Protein
Hang Ren	*The University of Texas at Austin*	Single-Entity Electrocatalysis at Structurally Well-Defined Nanoparticles
Pengyu Ren	*The University of Texas at Austin*	Molecular Mechanism of Dopamine Transporter from Atomistic Simulations Using Advanced Electrostatics
Hans Renata	*Rice University*	Chemoenzymatic Approaches to Multisubstituted Piperidines via Divergent Enzymatic C–H Hydroxylations
Joaquin Resasco	*The University of Texas at Austin*	Understanding and Controlling Structural Dynamics in Electrocatalysis
Jeffrey D. Rimer	*University of Houston*	Unique Role of Tautomers as Molecular Modifiers of Crystallization
Jose RizoRey	*The University of Texas Southwestern Medical Center*	NMR and Cryo-EM Methods to Study Protein Complexes on Lipid Bilayers
Sean T. Roberts	*The University of Texas at Austin*	Designing Supramolecular Assemblies for Photon Splitting
Megan L. Robertson	*University of Houston*	Sustainable Block Polymer Properties and Self-Assembly Modulated by Ionic Interactions
Liela A. Romero	*Baylor University*	New Chemical Reactions Enabled by Oxophilic Transition Metal Catalysts
Filippo Romiti	*The University of Texas at Dallas*	Novel Strategies for the Total Synthesis of Complex Bioactive Natural Products

PRINCIPAL INVESTIGATOR	INSTITUTION	TITLE OF RESEARCH
Daniel Romo	*Baylor University*	Novel Strategies for Beta-Lactone Synthesis and Annulation to Impact Basic Cell Biology
Michael J. Rose	*The University of Texas at Austin*	Elucidating Design Principles for Semiconductor | Molecule Electronic Coupling
Michael K. Rosen	*The University of Texas Southwestern Medical Center*	Size-Scaling of Biomolecular Condensate Activity
Daniel M. Rosenbaum	*The University of Texas Southwestern Medical Center*	High-Resolution Cryo-EM of Membrane-Embedded Drugs Binding to GPCRs
Tomče Runčevski	*Southern Methodist University*	Exploring the Organic Mineralogy of Titan, Saturn's Moon
David H. Russell	*Texas A&M University*	Native Mass Spectrometry and Thermodynamics Studies of Protein-Ligand and Protein-Protein Interactions
Benjamin R. Sabari	*The University of Texas Southwestern Medical Center*	Transcriptional Condensates During Cell State Transitions
Lorena Saelices Gomez	*The University of Texas Southwestern Medical Center*	Cryo-Electron Microscopy Study of the Conformational Switch of Monomeric Tau That Drives Its Amyloid Aggregation
Amaresh Sahu	*The University of Texas at Austin*	Theory of Electric-Field-Induced Phase Transitions and Rafts in Lipid Membranes
Devleena Samanta	*The University of Texas at Austin*	Chemical Sensing in Living Cells via Target-Responsive, Activatable, Cell-permeable Enzyme Reporters (TRACERs)
Gabriel Sanoja	*The University of Texas at Austin*	Leveraging Non-Covalent Bonds and Mechanochemistry to Advance the Manufacturing of Soft and Tough 3-D Materials
Livia Schiavinato Eberlin	*Baylor College of Medicine*	Understanding Molecular Extraction and Ionization Mechanisms in Solvent-Based Ambient Ionization Mass Spectrometry
John W. Schoggins	*The University of Texas Southwestern Medical Center*	Protein-RNA Interactions Underlying a Virus-Host Genetics Arms Race
Marlan O. Scully	*Texas A&M University*	Quantum Coherence and Entanglement in Chemical, Physical, and Biological Sciences
Irina I. Serysheva	*The University of Texas Health Science Center at Houston*	Cryo-EM Analysis of Ion Channels in a Lipid Membrane
Bryan F. Shaw	*Baylor University*	The Cysteine-Sulfinate "Gas Pedal" and Asparagyl-Carboxy "Brake" in ALS-Linked SOD1 Heterodimerization
Jason Shearer	*Trinity University*	Leveraging Ligand Noninnocence in Cobalt-Based Electrocatalytic Oxidations
James Shee	*Rice University*	Demystifying Strong Correlation in Chemistry—What It Is, Where to Find It, and Algorithms to Quantitatively Describe It
Matthew T. Sheldon	*Texas A&M University*	Nanophotonic Platforms for Polaritonic Chemistry
Benjamin D. Sherman	*Texas Christian University*	Monolithic Tandem Photoelectrodes for Solar Driven Organic Conversions or Water Oxidation Coupled to Hydrogen Formation
Chih-Kang Shih	*The University of Texas at Austin*	Moiré Quasicrystals–A New Frontier for 2D Electronic Materials
Michael Shiloh	*The University of Texas Southwestern Medical Center*	Structure Activity Relationship and Functional Analysis of Mycobacterial Phenolic Glycolipid in Airway Neuron Activation

PRINCIPAL INVESTIGATOR	INSTITUTION	TITLE OF RESEARCH
Qimiao Si	*Rice University*	Theoretical Studies of Electronic Correlations and Dynamics in Carbon-Based and Related Low Dimensional Systems
Donald Siegel	*The University of Texas at Austin*	Chemical Pathways for the Efficient Storage of Thermal Energy
Daniel J. Siegwart	*The University of Texas Southwestern Medical Center*	Elucidating Fundamental Mechanisms Driving Selective Organ Targeting (SORT) Lipid Nanoparticles (LNPs)
Daniel A. Singleton	*Texas A&M University*	Localized Vibrational Promotion of Organic Reactions in Solution
Elizabeth Skellam	*University of North Texas*	Investigating the Scope and Mode of Dimerization Reactions Catalyzed by Fungal Flavin-Dependent Monooxygenases
Kevin Slagle	*Rice University*	Tensor Network Algorithms for Many-Body Quantum Chemistry Dynamics
Myles W. Smith	*The University of Texas Southwestern Medical Center*	Accessing Complexity via Dearomatization of Nitrogen Heteroarenes
Alexei V. Sokolov	*Texas A&M University*	Vibrational Micro-Spectroscopy Enhanced by Molecular Coherence and Plasmonic Nanoantennas
Anju Sreelatha	*The University of Texas Southwestern Medical Center*	Defining the Eukaryotic AMPylome
Allison L. Stelling	*The University of Texas at Dallas*	Development and Application of IR-Based Methods for Detecting A-T Hoogsteen Base Pairs in the Nucleosome
Francois St-Pierre	*Baylor College of Medicine*	Developing Near-Infrared Fluorescent Voltage Sensors with Optimized Photochemistry
Xuewu Sui	*Texas A&M University*	The Mechanism of Membrane-Embedded Catalysis for Bioenergy Storage
Lu O. Sun	*The University of Texas Southwestern Medical Center*	Molecular Mechanisms Underlying Autophagy-Dependent Myelination
Daniel P. Tabor	*Texas A&M University*	Accelerating the Prediction and Analysis of Vibrational and Electronic Spectroscopy
Jeffrey J. Tabor	*Rice University*	Next-Generation Antibiotics: High Throughput Discovery of Inhibitors of Pathogenic Bacterial Two-Component Systems
Vincent S. Tagliabracci	*The University of Texas Southwestern Medical Center*	Novel Protein Kinases and Pseudokinases
Uttam K. Tambar	*The University of Texas Southwestern Medical Center*	Catalyst-Controlled Stereoselective Rearrangements
Yizhi Jane Tao	*Rice University*	Structural Mechanisms of Innate Immunity Suppression by Influenza Viruses
David W. Taylor	*The University of Texas at Austin*	DNA Recognition and Unwinding by Cas9 Variants
Thomas S. Teets	*University of Houston*	Blue-Phosphorescent Platinum Complexes Supported by Strong sigma-Donor Carbenes
Andy A. Thomas	*Texas A&M University*	Exploring New Strategies to Access Remote Synthetic Landscapes
Ross Thyer	*Rice University*	Investigating the Function and Assembly of Synthetic Selenolate-Coordinated Iron-Sulfur Clusters
Stefano Tiziani	*The University of Texas at Austin*	Exploring the Chirality of Enantiomeric Metabolites to Identify New Cancer Metabolic Vulnerabilities

PRINCIPAL INVESTIGATOR	INSTITUTION	TITLE OF RESEARCH
Erdal Toprak	*The University of Texas Southwestern Medical Center*	Development of a Platelet-Based Electrochemical Assay for Pancreatic Cancer Diagnosis
James M. Tour	*Rice University*	Molecular Jackhammers (MJH) to Open Cell Membranes through Vibronic-Driven Action (VDA)
Thomas M. Truskett	*The University of Texas at Austin*	Statistical Mechanics of Dynamic Covalent Networks
Francis T.F. Tsai	*Baylor College of Medicine*	Structure, Function, and Mechanism of a Novel Envelope Stress-Response System
Kuang-Lei Tsai	*The University of Texas Health Science Center at Houston*	Biochemical and Structural Analysis of the Transcription Mediator Subunit Med13
Benjamin P. Tu	*The University of Texas Southwestern Medical Center*	Translational Adaptations to Sulfur Starvation
Emanuel Tutuc	*The University of Texas at Austin*	Correlated Electrons in Moiré Materials
Adam R. Urbach	*Trinity University*	Affinity-Controlled Release Mediated by Synthetic Receptors
Syed M. Usama	*The University of Texas at San Antonio*	Subtyping Triple Negative Beast Cancer by Multispectral Raman Imaging
Peter G. Vekilov	*University of Houston*	Microscopic Perspective of Amyloid-β Fibrillization
Rafael Verduzco	*Rice University*	New Concepts for Selective Ion Transport in Charged Polymers
Dino Villagran	*The University of Texas at El Paso*	Molecular Based Electrocatalysts for Environmental Remediation
Julea Vlassakis	*Rice University*	Probing Fusion Oncoprotein Glycosylation, Solubility, and Interactions with Single-Cell Resolution
Boyuan Wang	*The University of Texas Southwestern Medical Center*	Mapping Allosteric Regulations by Intermediate Metabolites Using Chemical Proteomics
Haotian Wang	*Rice University*	Understanding the Interfacial Chemistry of Electrochemical CO_2 Reduction Reactions
Huiliang Wang	*The University of Texas at Austin*	Two-Stage Condensation Approach of DNA Plasmids for Enhanced Gene Delivery in Sono-Optogenetics
Jinfan Wang	*The University of Texas Southwestern Medical Center*	Optical Control of Translation with an Engineered Protein Inspired by SARS-CoV-2
Wennie Wang	*The University of Texas at Austin*	*Ab Initio* Elucidation of Structural Heterogeneities in MoS_2 for Photocatalysis
Zhao Wang	*Baylor College of Medicine*	Determining Chemical Interactions Mediating Membrane Complex Formation by Cryo-EM
Lauren J. Webb	*The University of Texas at Austin*	Electrostatic Field-Based Mechanisms of Function in Chemically Complex Lipid Membranes
Julian G. West	*Rice University*	New Fluorination Reactions Using Earth Abundant Elements
Kenneth D. Westover	*The University of Texas Southwestern Medical Center*	Development of JNK2 Selective Inhibitors for Cancer
Dawn M. Wetzel	*The University of Texas Southwestern Medical Center*	Mechanism of an Anti-Trypanosomal Microtubule-Stabilizing Molecule
Angelique W. Whitehurst	*The University of Texas Southwestern Medical Center*	Molecular Mechanisms of a Novel Anti-Cancer Target, Testis Specific Serine Kinase 6
Christian P. Whitman	*The University of Texas at Austin*	Enzymes of the Tomaymycin Biosynthetic Pathway

PRINCIPAL INVESTIGATOR	INSTITUTION	TITLE OF RESEARCH
Jeffrey B. Woodruff	*The University of Texas Southwestern Medical Center*	Molecular Rules Determining Centrosome Composition
Jun Wu	*The University of Texas Southwestern Medical Center*	Dissecting the Novel Function of Tasor in Regulating Mouse Pluripotent Stem Cells
Chuan Xiao	*The University of Texas at El Paso*	Decipher the Biochemistry Folding and Assembly Mysteries of the Most Common Protein Motif Used by Viruses
Han Xiao	*Rice University*	Traceless Protein Labeling using Proximity-Induced Chemistry
Yonglong Xie	*Rice University*	Crafting New Materials Through Stacking Engineering of Atomic Sheets
Shiqing Xu	*Texas A&M University*	Fundamental Studies on Electrochemical Palladium-Catalyzed Directed C-H Functionalization with Nucleophiles
Xin Yan	*Texas A&M University*	Aziridination-Enabled Lipid Modification for Cis- and Trans-Isomer Identification
Ming Yi	*Rice University*	Correlated Topology on Geometrically Frustrated Lattices
Seung-hee Yoo	*The University of Texas Health Science Center at Houston*	Regulatory Role of the Cryptochrome-Fad Axis in Mitochondrial Bioenergetic Oscillation
Guihua Yu	*The University of Texas at Austin*	Probing the Electrocatalytic Properties and Mechanisms of Molecularly-Assembled Two-Dimensional Inorganic Solids
Melissa L. Zastrow	*University of Houston*	Uncovering Metal Homeostasis Mechanisms of Lactobacillaceae Bacteria in the Gut Microbiota
Xing Zeng	*The University of Texas Southwestern Medical Center*	Enzymology and Physiological Significance of the Uncharacterized Cytochrome P450 Protein CYP2B10
Gul H. Zerze	*University of Houston*	Resolving Dynamics of Biomolecular Condensates Via Multiscale Simulations
Xiuren Zhang	*Texas A&M University*	Biochemical Basis of Liquid-Liquid Phase Separation of Dentin Sialophosphoprotein and Its Impact on Mirna Processing Machinery
Xuewu Zhang	*The University of Texas Southwestern Medical Center*	Structure and Regulatory Mechanism of the Death-Associated Protein Kinase 1
Alexey M. Zheltikov	*Texas A&M University*	Multimodal Chemically Selective Optical Imaging and Fiber-Optic Thermometry
Jie Zheng	*The University of Texas at Dallas*	Neurotransmitter-Like Nanoparticles
Yubin Zhou	*Texas A&M University Health Science Center*	Synthetic Biology Tools for Optogenetic Control of Endogenous Proteins and Designer Cells
Hanyu Zhu	*Rice University*	Synthesizing and Probing Chiral Interactions in Atomically Thin Lattices
Xuejun Zhu	*Texas A&M University*	Elucidating Gut Bacterial Enzymes for the Reductive Metabolism of Small Molecules
Brian Zoltowski	*Southern Methodist University*	Chemical Foundations of Magnetosensing in Butterfly Migration

Endowed Chairs

The Welch Foundation endows 53 chairs at 21 institutions.

INSTITUTION	CHAIRHOLDER AND CHAIR NAME
Baylor College of Medicine	Theodore G. Wensel, Welch Chair in Chemistry
Baylor College of Medicine	Thomas F. Westbrook, Welch Chair in Chemistry
Baylor College of Medicine	Damian W. Young, The R. P. Doherty, Jr.-Welch Chair in Science
*Baylor College of Medicine**	The Robert A. Welch Chair in Science
Baylor University	John L. Wood, Welch Chair in Chemistry
Rice University	Lane W. Martin, Welch Chair in Materials Science 1
Rice University	Gustavo E. Scuseria, Welch Chair in Chemistry
Rice University	Peter G. Wolynes, The D. R. Bullard-Welch Chair in Science
*Rice University**	The Charles W. Duncan, Jr.-Welch Chair in Chemistry
*Rice University**	Welch Chair in Materials Science 2
*Rice University**	Welch Chair in Materials Science 3
Texas A&M University	Tadhg P. Begley, Welch Chair in Chemistry
Texas A&M University	James C. Sacchettini, The Roger J. Wolfe-Welch Chair in Science
Texas A&M University	Karen L. Wooley, The W. T. Doherty-Welch Chair in Chemistry
Texas A&M University	Hongcai Zhou, Welch Chair in Chemistry
Texas A&M University Health Science Center	Vytas A. Bankaitis, The E. L. Wehner-Welch Chair in Chemistry
Texas A&M University Health Science Center	Thomas A. Kent, Welch Chair in Chemistry
Texas A&M University Health Science Center	Roderic I. Pettigrew, Welch Chair in Chemistry
Texas Christian University	Eric E. Simanek, Welch Chair in Chemistry
Texas Tech University	Yehia S. Mechref, Welch Chair in Chemistry
Texas Tech University Health Sciences Center	Jannette M. Dufour, Welch Chair in Biochemistry
The University of Texas at Arlington	Daniel W. Armstrong, Welch Distinguished University Chair in Chemistry
The University of Texas at Austin	David Allen, Norbert Dittrich-Welch Chair in Chemical Engineering
The University of Texas at Austin	Eric V. Anslyn, Welch Regents Chair in Chemistry
The University of Texas at Austin	Richard M. Crooks, Welch Chair in Chemistry (Materials Chemistry)
The University of Texas at Austin	Michael J. Krische, Welch Chair in Science
The University of Texas at Austin	Xiaoqin Li, The Jack S. Josey-Welch Chair in Science
The University of Texas at Austin	Yi Lu, The Richard J.V. Johnson-Welch Regents Chair in Chemistry
The University of Texas at Austin	Jason S. McLellan, Welch Chair in Chemistry
The University of Texas at Austin	Jonathan L. Sessler, The R. P. Doherty, Jr.-Welch Regents Chair in Chemistry
The University of Texas at Austin	Devarajan Thirumalai, The Marvin K. Collie-Welch Regents Chair in Chemistry

David Allen

Lane W. Martin

Yehia S. Mechref

Thomas F. Westbrook

INSTITUTION	CHAIRHOLDER AND CHAIR NAME
*The University of Texas at Austin**	The Norman Hackerman-Welch Regents Chair in Chemistry
The University of Texas at Dallas	Ray H. Baughman, Welch Chair in Chemistry
The University of Texas at Dallas	Rudi Fasan, The Robert A. Welch Chair in Chemistry
The University of Texas at Dallas	Vladimir Gevorgyan, Welch Chair in Chemistry
*The University of Texas at El Paso**	Welch Chair in Chemistry
The University of Texas at San Antonio	Oleg V. Larionov, Welch Chair in Chemistry
The University of Texas at San Antonio	Kirk S. Schanze, Welch Distinguished University Chair in Chemistry
The University of Texas Health Science Center at Houston	Zhiqiang An, Welch Distinguished University Chair in Chemistry
The University of Texas Health Science Center at Houston	John L. Spudich, Welch Chair in Chemistry
The University of Texas Health Science Center at San Antonio	Charles P. France, Welch Distinguished University Chair in Chemistry
The University of Texas Health Science Center at San Antonio	Patrick M. Sung, Welch Distinguished University Chair in Chemistry
The University of Texas MD Anderson Cancer Center	John A. Tainer, Welch Chair in Chemistry
The University of Texas MD Anderson Cancer Center	David J. Tweardy, Welch Chair in Chemistry
The University of Texas Medical Branch	B. Montgomery Pettitt, Welch Distinguished University Chair in Chemistry
The University of Texas Medical Branch	Michael P. Sheetz, Welch Distinguished University Chair in Chemistry
The University of Texas Southwestern Medical Center	J. Russell Falck, Welch Chair in Chemistry
The University of Texas Southwestern Medical Center	Eric N. Olson, Welch Chair in Science
University of Houston	Olafs Daugulis, Welch Chair in Chemistry
University of Houston	Jan-Åke Gustafsson, Welch Chair in Chemistry
University of Houston	Allan J. Jacobson, Welch Chair in Science
University of North Texas	Shengqian Ma, Welch Chair in Chemistry
University of North Texas Health Science Center	Laszlo Prokai, Welch Chair in Biochemistry

**Chair not filled*

Departmental Research Grants

The Welch Foundation funds **43** institutions, **243** faculty and **589** trainees.

INSTITUTION	PARTICIPATING FACULTY	CHEMICAL RESEARCH TRAINEES
Abilene Christian University (Abilene)	8	10
Angelo State University (San Angelo)	7	12
Austin College (Sherman)	7	14
East Texas A&M University (Commerce)	6	22
East Texas Baptist University (Marshall)	4	3
Hardin-Simmons University (Abilene)	2	3
Houston Christian University (Houston)	1	7
Huston-Tillotson University (Austin	1	1
Jarvis Christian College (Hawkins)	3	5
Lamar University (Beaumont)	11	23
LeTourneau University (Longview)	4	18
Lubbock Christian University (Lubbock)	5	12
McMurry University (Abilene)	3	6
Midwestern State University (Wichita Falls)	5	16
Our Lady of the Lake University (San Antonio)	3	3
Prairie View A&M University (Prairie View)	7	21
St. Edward's University (Austin)	3	12
St. Mary's University (San Antonio)	3	8
Sam Houston State University (Huntsville)	12	13
Schreiner University (Kerrville)	3	7
Southwestern University (Georgetown)	4	16
Stephen F. Austin State University (Nacogdoches)	11	54
Sul Ross State University (Alpine)	1	3
Tarleton State University (Stephenville)	6	12
Texas A&M International University (Laredo)	8	8
Texas A&M University-Corpus Christi (Corpus Christi)	10	19
Texas A&M University-Kingsville (Kingsville)	9	26
Texas A&M University-Texarkana (Texarkana)	2	4
Texas Lutheran University (Seguin)	4	10
Texas Wesleyan University (Fort Worth)	3	10

INSTITUTION	PARTICIPATING FACULTY	CHEMICAL RESEARCH TRAINEES
Texas Woman's University (Denton)	9	40
The University of Texas at Tyler (Tyler)	8	28
The University of Texas of the Permian Basin (Odessa)	4	18
The University of Texas Rio Grande Valley (Edinburg)	18	12
Trinity University (San Antonio)	9	15
University of Dallas (Irving)	3	15
University of Houston-Clear Lake (Houston)	5	13
University of Houston-Downtown (Houston)	9	22
University of Mary Hardin-Baylor (Belton)	2	3
University of St. Thomas (Houston)	6	17
University of the Incarnate Word (San Antonio)	7	15
Wayland Baptist University (Plainview)	2	4
West Texas A&M University (Canyon)	5	9
Total	**243**	**589**

Postdoctoral Fellows Grants

The Welch Foundation funds 4 investigators at 4 institutions.

POSTDOCTORAL FELLOW	INSTITUTION	TITLE OF RESEARCH
Brad Ganoe	*Rice University*	Spin Projection for Strong Correlation: A Quantum Monte Carlo Approach
Kayla Goforth	*Texas A&M University*	Shedding Light on the Mechanisms Underlying Animal Magnetoreception
Heidi Pak	*The University of Texas Southwestern Medical Center*	Role of Feeding Entrainment in Mediating Health and Lifespan
Ziyi Zhang	*The University of Texas at Austin*	Tunable Dynamic Covalent Bonding for Programmable Assembly of Colloidal Nanocrystal Gels

Departmental Equipment Grants

The Foundation's **$2 million+** in grants to **29** institutions spurred **$850,000+** in cost sharing.

INSTITUTION	WELCH AMOUNT	COST SHARE
Abilene Christian University (Abilene)	$ 75,000.00	$ 54,837.50
Angelo State University (San Angelo)	$ 75,000.00	$ 15,354.11
East Texas A&M University (Commerce)	$ 75,000.00	$ 4,830.00
East Texas Baptist University (Mashall)	$ 75,000.00	$ 1,525.00
Hardin-Simmons University (Abilene)	$ 75,000.00	$ 24,203.00
Huston-Tillotson University (Austin)	$ 75,000.00	$ 10,000.00
Jarvis Christian College (Hawkins)	$ 75,000.00	$ —
Lubbock Christian University (Lubbock)	$ 75,000.00	$ 57,041.19
McMurry University (Abilene)	$ 75,000.00	$ 25,000.00
Midwestern State University (Wichita Falls)	$ 75,000.00	$ 21,239.37
St. Mary's University (San Antonio)	$ 75,000.00	$ 9,970.03
Southwestern University (Georgetown)	$ 75,000.00	$ —
Sul Ross State University (Alpine)	$ 75,000.00	$ 8,136.50
Tarleton State University (Stephenville)	$ 75,000.00	$ 66,347.55
Texas A&M International University (Laredo)	$ 75,000.00	$ 74,463.94
Texas A&M University–Kingsville (Kingsville)	$ 75,000.00	$ 3,236.37
Texas A&M University–Texarkana (Texarkana)	$ 75,000.00	$ 24,421.00
Texas Wesleyan University (Fort Worth)	$ 75,000.00	$ —
The University of Texas at Tyler (Tyler)	$ 75,000.00	$ 75,000.00
The University of Texas of the Permian Basin (Odessa)	$ 75,000.00	$ 75,000.00
Trinity University (San Antonio)	$ 75,000.00	$ 75,000.00
University of Dallas (Irving)	$ 75,000.00	$ 22,430.00
University of Houston–Clear Lake (Houston)	$ 75,000.00	$ —
University of Houston–Downtown (Houston)	$ 75,000.00	$ 46,984.00
University of Mary Hardin-Baylor (Belton)	$ 75,000.00	$ —
University of St. Thomas (Houston)	$ 75,000.00	$ 76,486.21
University of the Incarnate Word (San Antonio)	$ 75,000.00	$ 25,909.75
Wayland Baptist University (Plainview)	$ 75,000.00	$ 75,000.00
West Texas A&M University (Canyon)	$ 75,000.00	$ —
Total	$ 2,175,000	$ 872,415.52

Catalyst for Discovery Program Grants

The Welch Foundation funds 28 investigators at 4 institutions.

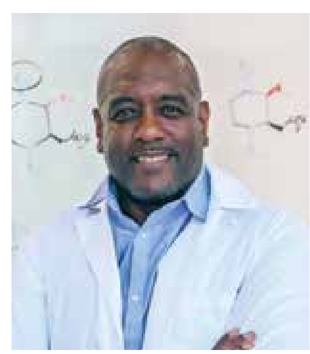
PROGRAM DIRECTOR	CO-INVESTIGATORS	INSTITUTION	TITLE OF RESEARCH
Yi Lu	Thomas R. Cundari Andrew D. Ellington Kami L. Hull Michael J. Rose	*The University of Texas at Austin*	Artificial Dinitrogen Transferases: Leveraging Bio-Inspired Nitrogen Fixation to Directly Transfer N_2 into Organic Molecules
Deepak Nijhawan	Jef K. De Brabander Tian Qin Joseph M. Ready	*The University of Texas Southwestern Medical Center*	A Platform for the Rapid Discovery of Novel Small Molecules for Chemical Biology
Jeffrey D. Rimer	Alamgir Karim T. Randall Lee Jeremy C. Palmer Peter G. Vekilov	*University of Houston*	Welch Center for Advanced Bioactive Materials Crystallization
Megan L. Robertson	Brad Carrow Olafs Daugulis Alamgir Karim Ramanan Krishnamoorti	*University of Houston*	Enabling Polyolefin Circularity via Chemical Functionalization, Compatibilization, and Upcycling
Michael K. Rosen	Qian Cong Matthew W. Parker Benjamin R. Sabari Jeffrey B. Woodruff	*The University of Texas Southwestern Medical Center*	Biochemical Specificity and Function of Biomolecular Condensates
Damian W. Young	Martin M. Matzuk Zhi Tan Mingxing Teng	*Baylor College of Medicine*	Innovation in DNA-Encoded Chemistry Technology to Enable More Effective Ligand Discovery

Robertson: Courtesy of University of Houston

Yi Lu

Megan L. Robertson

Michael K. Rosen



Damian W. Young

Welch eXperimental (WelchX) Collaboration Pilot Grants

The Welch Foundation funds 23 investigators at 14 institutions.

PRINCIPAL INVESTIGATORS	INSTITUTIONS	TITLE OF RESEARCH
Ilya J. Finkelstein Zhao Wang	*The University of Texas at Austin* *Baylor College of Medicine*	Mapping Sub-Cellular Genotype-Phenotype Relationships with Correlated Spatial Sequencing and Electron Cryo-Tomography
Kami L. Hull Megan L. Robertson	*The University of Texas at Austin* *University of Houston*	Chemical Recycling of Polystyrene to Value-Added Polymers and Chemicals
Anna Konovalova Tian Qin	*The University of Texas Health Science Center at Houston* *The University of Texas Southwestern Medical Center*	Cost-Effective Tool for Bacterial Reverse Vaccinology
Caleb D. Martin Anindita Das	*Baylor University* *Southern Methodist University*	Embedding Lewis Superacids into Covalent Organic Frameworks: Recyclable Heterogeneous Metal-Free Catalysts
Stanton F. McHardy Jonathan T. Sczepanski	*The University of Texas at San Antonio* *Texas A&M University*	Development Of PROTACs with Programable Oligonucleotide-Based Linkers
Michael J. Rose Ananda S. Amarasekara Aditya D. Mohite	*The University of Texas at Austin* *Prairie View A&M University* *Rice University*	Detection and Extraction of Hot Carrier Dynamics in Silicon using Ultrafast Electron and Rational Surface Functionalization
Ron Smaldone David C. Powers	*The University of Texas at Dallas* *Texas A&M University*	Printing Therapeutics: Architecting Tandem Catalysts for Fine-Chemical Synthesis
Zachary J. Tonzetich Anthony F. Cozzolino	*The University of Texas at San Antonio* *Texas Tech University*	Soft Lewis Acid Directed Reductive C-C Bond Formation for the Generation of Platform Chemicals from CO_2
Joshua Tropp Benjamin K. Keitz Melissa L. Zastrow	*Texas Tech University* *The University of Texas at Austin* *University of Houston*	Unraveling the Role of Iron in the Gut Microbiome using Iron-Selective Organic Electrochemical Transistors
Lauren J. Webb Sheena D'Arcy Hao Yan	*The University of Texas at Austin* *The University of Texas at Dallas* *University of North Texas*	Molecular Mechanisms of Life in the Deep Sea: Understanding Protein-Lipid Structures and Dynamics at High Pressure

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