Annual Report 2020

ADVANCING CHEMISTRY.
IMPROVING LIFE.

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Robert A. Welch

For 66 years
The Welch Foundation has led the way in supporting basic chemical research.

The Welch Foundation is a legacy to the world from Robert Alonzo Welch, a self-made man with a strong sense of responsibility to humankind, an enthusiastic respect for chemistry and a deep love for the state of Texas.

Born in South Carolina to a prominent family that fell on hard economic times, Mr. Welch came to Houston as a youth and later made his fortune in oil and minerals. Over the course of his career and life, he became convinced of the importance of chemistry for the betterment of the world.

Scientists, geologists and petroleum engineers were among his close friends and associates as were the civic and business leaders of the day. From these associations and his own study, Mr. Welch determined that the pursuit of chemistry and chemical research held great potential for vast good and would continue to have a valuable impact on business, industry, global leadership and the human condition.

Mr. Welch gave serious thought to the disposition of his estate. His decisions reflected his belief in science and the role it would play in the future. In his will, Mr. Welch stated: "I have long been impressed with the great possibilities for the betterment of mankind that lay in the field of research in the domain of chemistry."

With his death in 1952, Mr. Welch left a generous portion of his estate to his employees and their families. The balance began what is now The Welch Foundation.

Message from the Chair

CARIN M. BARTH
Chair and Director

There is an old Chinese saying: May you live in interesting times. "Interesting" is certainly one word for 2020 – and into 2021. The pandemic upended so many lives in so many ways. Our heartfelt condolences to those of you who have experienced illness or personal loss during the ongoing pandemic.

At The Welch Foundation, with the guidance of scientists and medical professionals, we quickly moved to a completely remote and virtual working environment, including our Board of Directors and Scientific Advisory Board meetings. We regretfully postponed the 2020 research conference to 2021 and canceled the annual 2020 Welch Award gala.

I would like to commend our staff who rose heroically to the challenge without missing a beat. In fact, we found remote work so effective, we are planning a combination of at-home and office work, hopefully starting fall 2021. At the same time, I know we all will be glad to reconnect in person as it becomes safer to do so with the spectacular success of the vaccine in containing COVID-19.

What really stands out for me, however, has been the amazing response of our scientific community here in Texas to this global challenge. Starting on page 12, you can read just a few of the stories of Welch-supported scientists who turned on a dime, pivoting from their own research projects to help in the response effort. What is the coronavirus, how does it infect hosts, how do we treat it, how can we protect people against it, how can we create vaccines to stop it?

While I have long been convinced that basic research in science is absolutely crucial to our world, this pandemic has brought it home to many in a very tangible manner. There is no way we would have been able to unravel the mysteries of this disease, much less create these incredibly effective vaccines, so quickly if not by building on decades of work.

I hope a silver lining to come from this terrible period is that both policy makers and the public in general develop a real appreciation for the value of the work researchers in fundamental science do – and, more importantly, are willing to provide funding to support those efforts, even when there is no obvious, direct benefit from new knowledge.

As we move towards a more normal life here in the U.S., I know many of our researchers are still in the throes of the fight to contain the pandemic. I trust that their expertise and dedication will help save even more lives. Thanks to all of you in our Texas scientific community, not only for COVID-related work, but for the work you do every day to advance chemistry and improve lives.

2020 Highlights

At fiscal year end 2020, The Welch Foundation's endowment stood at $750 million, with the amount invested in chemistry totaling more than $1 billion in actual-dollar support over the Foundation's 66 years.

That investment grew substantially in 2020 with the largest grant in Welch history, $100 million committed to establish The Welch Institute for Advanced Materials at Rice University. This strategic partnership will combine fundamental chemistry and materials science with the latest in machine learning and artificial intelligence to accelerate the discovery, design and manufacture of the next generation of materials. Applications will span new energy systems, sustainable water, space systems, telecommunications, manufacturing, transportation, security and more.

In January, the Foundation named Vincent S. Tagliabracci of The University of Texas Southwestern Medical Center as the 2020 "rising star" recipient of the Norman Hackerman Award in Chemical Research. He discovered that pseudokinases, or "zombie" enzymes, previously thought inert, are actually active and work through different kinds of chemistry to govern the spread of deadly bacteria. His work is expected to have implications for treating disease, including cancer and neurodegenerative disorders.

Steven L. McKnight of The University of Texas Southwestern Medical Center was named the 2020 recipient of the Robert A. Welch Award in Chemistry for his contributions that identified the regulatory regions of eukaryotic genes, gene-specific transcription factors and the role of low complexity sequences in proteins that form functional and reversible aggregates in phase-separated hydrogels. With the 2020 Welch Award gala canceled, Dr. McKnight will be recognized at the 2021 event.

The annual research conference, "Frontiers of Brain Science and Medicine," under the leadership of Scientific Advisory Board member Xiaowei Zhuang of Harvard University, was postponed until 2021.

Two new members were named to the Scientific Advisory Board: Geoffrey W. Coates of Cornell University, effective July 1, 2020, and Kevan M. Shokat from the University of California, San Francisco, effective January 1, 2021. Catherine J. Murphy, University of Illinois at Urbana-Champaign, was named SAB vice chair.

Loan Kieu joined Foundation staff as senior accountant and has since been promoted to assistant controller.

The Welch Institute
Advanced Materials
Rice University

The Welch Foundation's investment in chemistry has totaled more than **$1 billion** in actual-dollar support since its inception.

The Welch Foundation: Fulfilling Our Founder's Vision

Created from an endowment by Texas oilman and philanthropist Robert Alonzo Welch, The Welch Foundation is one of the nation's largest private funding sources for fundamental chemical research at universities, colleges and other educational institutions in Texas. Since its founding in 1954, the Foundation has supported chemistry in Texas through research grants and a variety of other programs.

Following the dictates of Mr. Welch's will, the Foundation remains true to its mission of supporting fundamental scientific exploration that ultimately helps improve our world. The Foundation's endeavors are guided by a Board of Directors, Scientific Advisory Board and professional staff all committed to building a robust scientific community in Texas that advances basic knowledge.

The Board of Directors serves as stewards of The Welch Foundation, overseeing its financial health, operational direction and support for chemistry.

Welch Foundation Board of Directors and Officers

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The Scientific Advisory Board advises the Board of Directors on scientific issues related to the Foundation's mission. The board is composed of renowned leaders in chemistry and the related sciences who evaluate proposals for research grants, review and recommend finalists for the Welch and Hackerman Awards, and help oversee the other Foundation programs to promote chemistry in Texas. Each year, one member presides over the annual Conference on Chemical Research.

Foundation Staff

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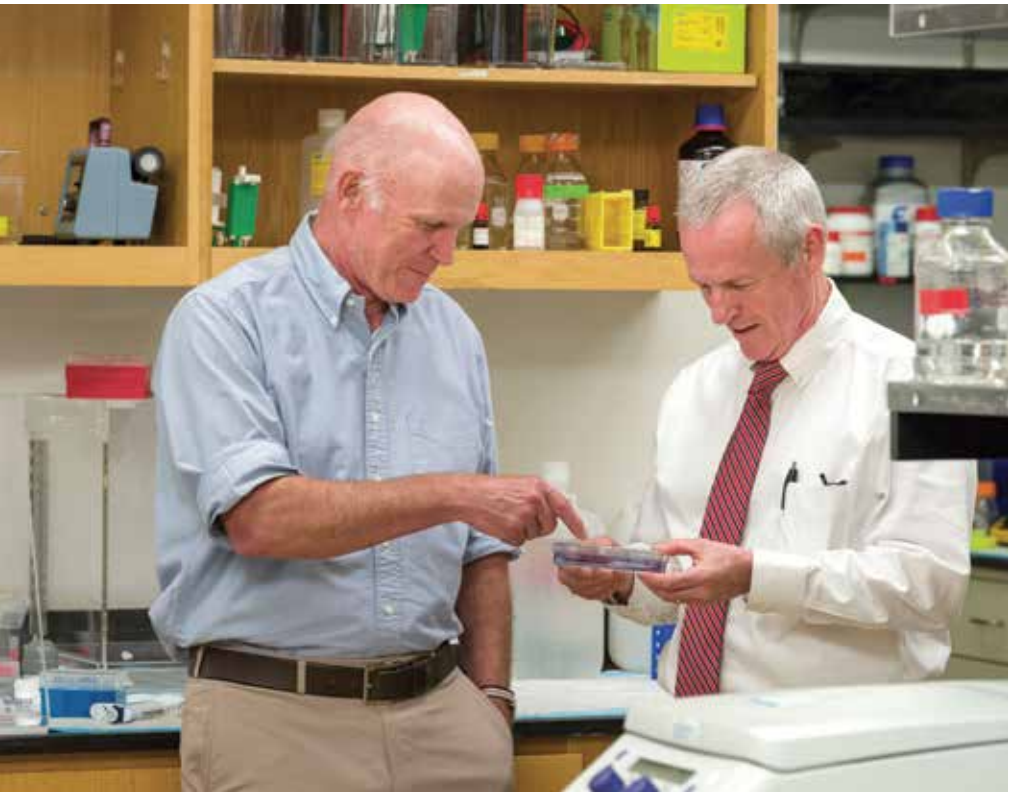
SHERRY WHITE
Senior Accountant

Led by President Adam Kuspa, the staff oversees and implements the day-to-day operations of the Foundation.

Welch Award: McKnight Unravels Secrets of Gene Regulation



Steve McKnight and colleague David Russell, now vice provost and dean of research at UT Southwestern, collaborated on a key breakthrough in our understanding of gene expression.

The $500,000 Welch Award celebrates outstanding achievement by scientists whose research has significantly improved lives.

The 2020 Welch Award in Chemistry honored Steven L. McKnight, Distinguished Chair in Basic Biomedical Research at The University of Texas Southwestern Medical Center, who has devoted his career to experimental studies of gene regulation. His significant discoveries include identifying the regulatory regions of eukaryotic genes, gene-specific transcription factors, and the role of low complexity sequences in proteins that form functional and reversible aggregates in phase-separated hydrogels.

"Dr. McKnight's lifelong work is nothing short of creative and brilliant, and very much in line with the mission of The Welch Foundation, to improve the lives of others through the advancement of chemical research," said Carin M. Barth, The Welch Foundation Board of Directors chair. "Not only has he made revolutionary advances in chemistry and biology, but he is also well-known for his collaborative leadership in the scientific community."

Dr. McKnight's first significant breakthrough discovery came in the 1980s while studying the transcription factor C/EBP. He found that part of the protein folds into a three-

dimensional shape, which he termed a "leucine zipper." This structure and the surrounding science helped underpin our current understanding of gene regulation.

During this research, he also explored another part of the protein that behaved in an atypical manner. This unusual area of the transcription factor could not fold as it was composed of only a few types of amino acids, rather than the 20 amino acids normally required for proteins to adopt a stable structural fold. Subsequent studies by many other scientists discovered that these "gibberish-like" low sequence complexity domains make up as much as 20 percent of our cellular proteins, but no one succeeded in decoding their function.

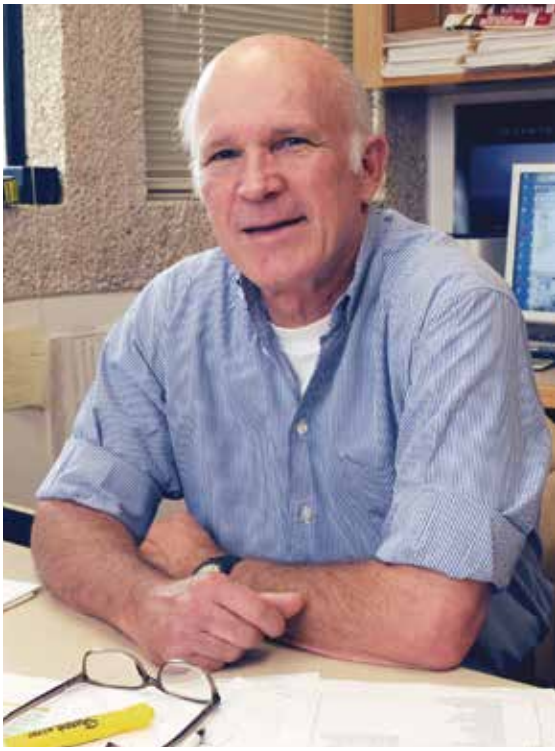
Three decades later, Dr. McKnight stumbled over an unexpected discovery that shed new light on the mystery. His team found that protein domains of low sequence complexity can transition out of aqueous solution to form a gel. This phenomenon of "phase transition" was unusual and opened the door to a new field in cell biology. Importantly, the phenomenon of phase transition offered him a tangible way to perform mechanistic studies on low complexity domains.

Eventually he was able to demonstrate that low complexity domains function in highly dynamic sub-cellular organelles, including small regions within the cell nucleus where gene expression takes place. Instead of folding up and remaining structurally ordered like normal proteins, low complexity domains combine with one another to form transient, reversibly ordered structures that control how dynamic areas of cells can morphologically appear and disappear according to the cell's physiological state.

Dr. McKnight's recent work has identified how human mutations in low complexity domains can cause their transient structures to become more stable than normal – antithetical to traditional mutations that almost always interfere with the stability of proteins' folded state. Many mutations found in low complexity domains can cause neurodegenerative diseases, including amyotrophic lateral sclerosis (ALS).

"We do science for the fun of it," Dr. McKnight said. "You never know what you will discover; we just get in there and dig. Perhaps the most wonderful thing about science is that truth ultimately prevails."

"Steve McKnight has done creative and breakthrough science for decades," said Peter B. Dervan, The Welch Foundation's Scientific Advisory Board chair. "Throughout his 45-year career, he has used molecular, biochemical and biophysical methods to study regulatory pathways. These findings provided the initial conceptual framework for understanding how combinatorial models of DNA regulatory proteins generate the complex patterns of gene expression required for growth and development.



Dr. McKnight helped build a diverse biochemistry department at UT Southwestern that has become one of the nation's research leaders.

Welch President Adam Kuspa (left) and Chair Carin Barth with the 2020 Welch Award recipient, Steve McKnight.

In the most recent phase of his career, McKnight traced the molecular basis of the self-association of many proteins to phase separate without membranes as a means of controlling dynamic aspects of cell organization."

Beyond his own research, Dr. McKnight is credited for creating a strong biochemistry department at UT Southwestern, recruiting talented chemists to work closely with biologists to tackle complex research challenges.

"We decided to go back to our roots and double down on the genuine disciplines of chemistry and biochemistry, building a department filled with hard-core scientists," he said. "The Welch Foundation bet on us to the tune of tens of millions of dollars in grant funding over my two decades as biochemistry chairman. We could not have succeeded without their generous and stable financial support."

Born and raised in El Paso, Texas, Dr. McKnight earned biology degrees at the Universities of Texas and Virginia, followed by postdoctoral studies under Donald Brown at the Carnegie Institution of Washington. He was appointed as a Howard Hughes Medical Institute investigator in 1988. He co-founded a biotechnology company where he worked from 1991 through 1995 before joining UT Southwestern.

He is a member of the National Academy of Sciences, the National Academy of Medicine and the American Academy of Arts and Sciences, and has served as President of the American Society of Biochemistry and Molecular Biology. Among his awards are the Eli Lily Award of the American Society for Microbiology; the National Academy of Sciences' Monsanto Award; the Newcomb-Cleveland Award of the American Society for the Advancement of Science; the National Institute of Health Pioneer Award; and the Wiley Prize in Biomedical Sciences.

Dr. McKnight received the $500,000 Welch Award in a small, private ceremony in 2020 and will be further honored at the 2021 Welch Award gala.

Hackerman Award: 'Rising Star' Brings Pseudokinases to Life

Biochemist Vincent J. Tagliabracci has opened a rich new field of research working with kinases, a type of enzyme, discovering new chemical functions for kinase domains previously considered inactive. This breakthrough earned The University of Texas Southwestern Medical Center researcher the 2020 Norman Hackerman Award in Chemical Research.

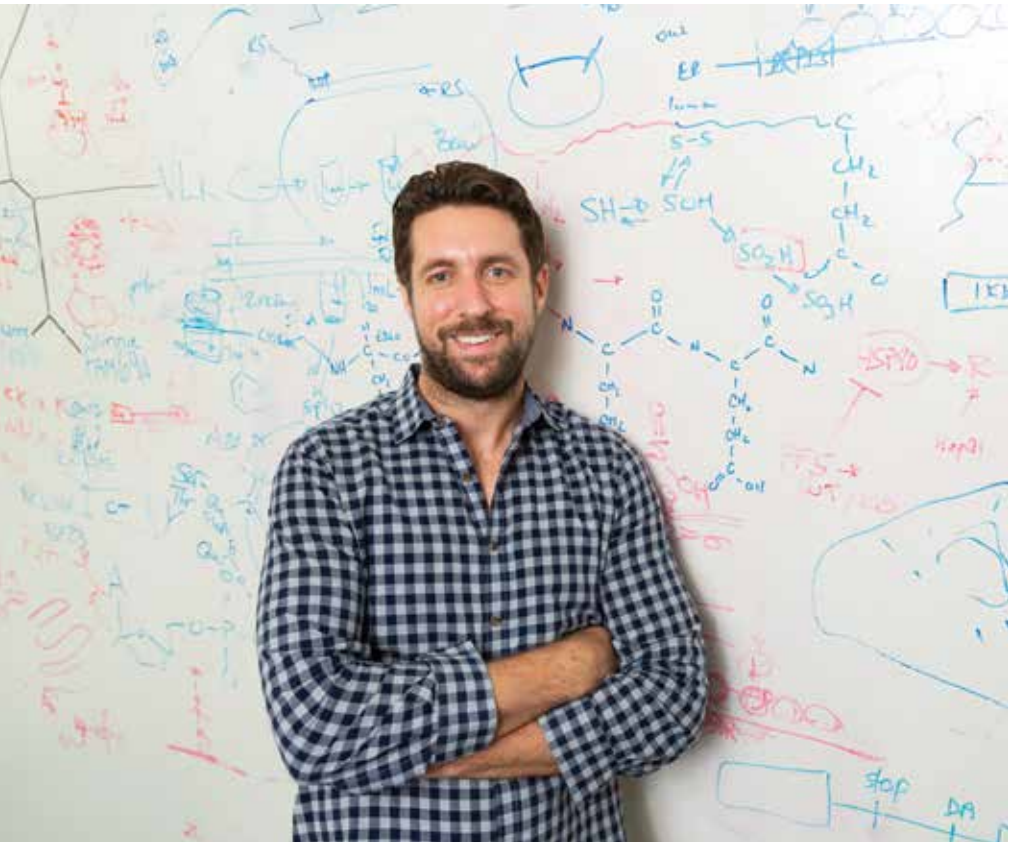
Termed pseudokinases, or "zombies" or "orphans," scientists knew these kinases existed. However, since they don't perform the function of typical protein kinases – catalyzing phosphorylation, a process critical in cell signaling – they were considered dead. Dr. Tagliabracci has shown that two of these pseudokinases, at least, actually use a different type of chemistry to perform important biological functions.

"We are proud to recognize Dr. Tagliabracci for his extraordinary accomplishments," said Carin M. Barth, Welch board chair. "He has hit an exciting and rewarding area of research, and we look forward to following and benefiting from his successes and discoveries in the years to come."

Welch Foundation Chair Carin Barth congratulates Vinnie Tagliabracci at a luncheon celebrating his receipt of the 2020 Hackerman Award.

Named in honor of Welch's long-time chair of its 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.

Using creative methods, tools and techniques, Dr. Tagliabracci and his team have been able to demonstrate that chemistry is happening in these kinases – just not the reaction scientists expected to see. And with more than 50 of these enzymes in humans – and perhaps millions in nature – this area of research will grow exponentially. Pseudokinases participate in a broad range of pathological and physiological processes, ranging from metabolism to bacterial pathogenesis and tissue development. Understanding their function holds enormous potential benefits for human health and for solving challenges in agriculture and other areas.



The Welch Foundation honored Vinnie Tagliabracci for his discovery of new chemistry performed by a type of enzyme long considered inert.

Dr. Tagliabracci's first breakthrough, working with postdoctoral fellow and now UT Southwestern faculty member Anju Sreelanka, showed how one pseudokinase performs AMPylation, which involves attaching an adenosine monophosphate (AMP) molecule onto a protein. This reaction is important for managing oxidative stress in cells, which can cause cancer. Later work in his lab discovered another "dead" kinase actually carries out glutamylation, the transfer of the amino acid glutamate to a protein – a process bacteria use to spread Legionnaires' disease.

Most recently, his team found an unusual pseudokinase in plants. The HopBF1 family of bacterial effectors inactivates the essential chaperone activity of HSP90 to fool the plant's immune system, allowing the bacteria to survive and grow. Eventually, the bacteria can cause significant crop losses, so understanding this activity can help in the development of new methods to fight the disease.

His work with pseudokinases was spurred by his signature discovery as a postdoctoral fellow at University of California San Diego. There he detailed the workings of a family of protein kinases that phosphorylate secreted proteins – a process that had resisted scientists attempts to understand it for 130 years.

"Vincent Tagliabracci is an inventive scientist who is very deserving of this honor," said Peter B. Dervan, the

Foundation's Scientific Advisory Board chair. "His creative work has uncovered atypical kinase domains with unexpected activities important in biology."

Dr. Tagliabracci focuses his lab on high-risk projects, using bioinformatics to search for protein kinases that seem to lack the key catalytic sequences of typical kinases but otherwise fit the family profile. A dedicated teacher and mentor, his goal is to encourage his students to help push back scientific frontiers and experience the excitement of discovering something never seen before.

"I call it curiosity-driven research that is perhaps more high risk than traditional science," Dr. Tagliabracci said. "We work on very basic mechanisms of cell signaling and different disease mechanisms – fundamental problems that don't always have an obvious path to a translational aspect. At the same time, we're keeping in mind the ultimate goal of helping patients, realizing that most of today's drugs started from very basic chemical and biomedical research. It's discovering the unknown and the excitement that you get when you finally figure something out that really gets me going."

A Canadian, Dr. Tagliabracci did his undergraduate work in chemistry and biology at the University of Indianapolis before earning a Ph.D. in biochemistry and microbiology at the Indiana University School of Medicine. He joined the faculty at UT Southwestern as a Michael L. Rosenberg Scholar in Medical Research in 2015. He is the recipient of the Esther L. Kinsley dissertation award from Indiana University, the NIH Director's New Innovator Award, a Cancer Prevention Research Institute of Texas (CPRIT) recruitment of first-time, tenure-track faculty member award and was named a Searle Scholar in 2018.

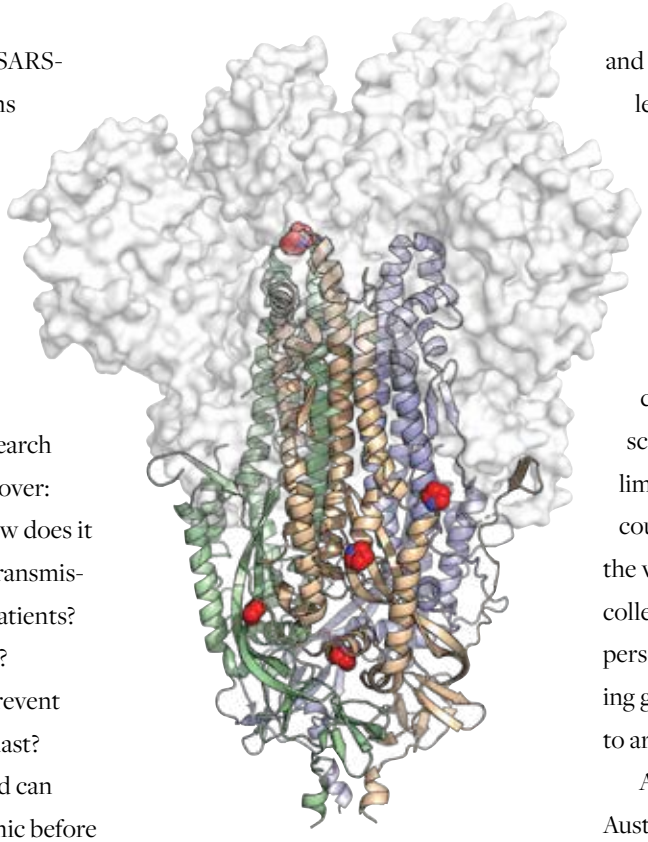
Vinnie Tagliabracci shares the importance of Welch Foundation's early support for his research while accepting the 2020 Hackerman Award.

COVID-19: Welch-Supported Scientists Help Fight the Pandemic

When the novel coronavirus, SARS-CoV-2, started raising concerns in global health circles in early 2020, Welch-supported researchers were among the many scientists worldwide who swung into action.

Using their understanding of science and well-honed research skills, scientists set out to discover: How does this virus work? How does it spread and how can we stop transmission? How can we best treat patients? What are its long-term effects? Can we develop vaccines to prevent it? How long does protection last? What about viral variants? And can we anticipate the next pandemic before it starts?

The following stories capture the efforts of just a few of the Welch-supported scientists who put their chemical expertise to work to find answers in a race against time. Their insights have contributed to the global battle against a disease that cost close to two million lives in 2020 alone, with the virus continuing to surge into 2021. The pandemic underscored for the world how research to help unravel nature's secrets can make a life-saving difference. The research approaches and the new knowledge gained hold lessons for future pandemics.



Developed by a team at UT Austin, the HexaPro spike protein – an advanced version of the one instrumental in many current COVID-19 vaccines – is expected to lead to even more effective vaccines that are also easier to transport and store.

EXPANDING EARLY TESTING

While many scientists pivoted from their pre-pandemic research to take on coronavirus challenges, response from the scientific community was not limited to those whose expertise could be applied directly to fighting the virus. For example, in the early days, colleges across Central Texas donated personal protective equipment, including gowns, face masks and face shields, to area hospitals.

At The University of Texas at Austin, some 40 researchers started a shared Google spreadsheet to catalog more than 100 individual donations of chemical reagents, pipette tips, biosafety cabinets and other supplies for COVID-19 testing. Graduate and undergraduate students volunteered their time and expertise to help expand testing and tracing until the state's infrastructure was able to gear up. To manage spread on campus, Welch principal investigator

Andreas Matouschek led the development of an early-warning testing program at UT Austin.

Andreas Matouschek helped lead the effort to strategically test 5,000 asymptomatic faculty and students each week to identify any emerging hot spots.

PREVENTING VIRAL SPREAD

In those early months, while health experts were struggling to understand the virus and how best to prevent and cure it, figuring out the most effective way to stop its spread with the tools we had was critical.

A Welch-supported study led by **Renyi Zhang**, a Texas A&M University professor, with colleagues from The University of Texas, the University of California San Diego and the California Institute of Technology proved that not wearing a face mask dramatically increases a person's chances of infection by the SARS-CoV-2 virus in three epicenters worldwide. The research, published in *PNAS* (Proceedings of the National Academy of Sciences), was then extended to the most infected U.S. states in another work published in *Science of the Total Environment*.

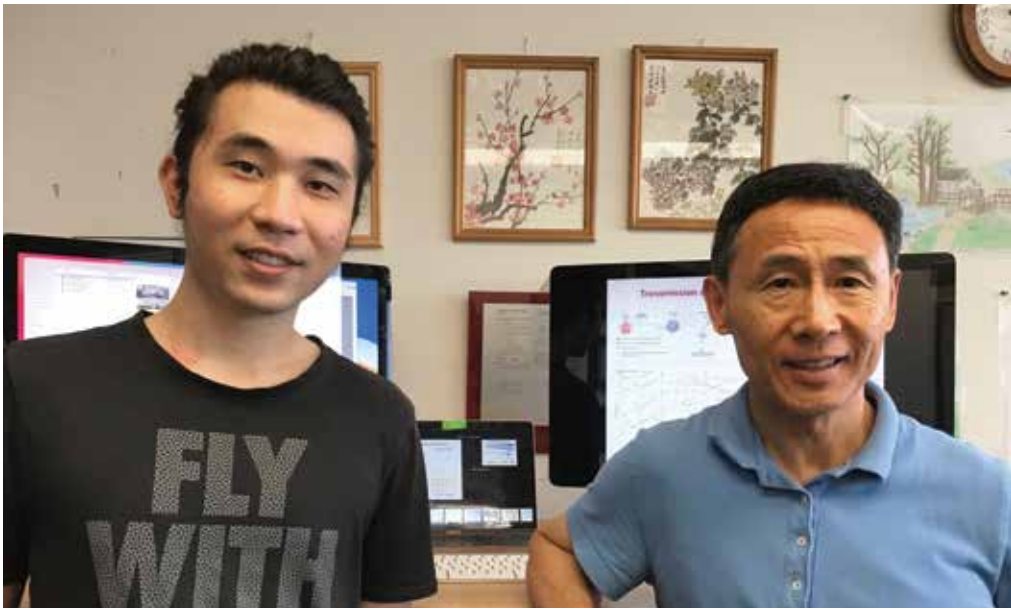
The team examined the chances of a COVID-19 diagnosis and how the SARS-CoV-2 virus is passed from person to person. Comparing trends and mitigation procedures in China, Italy and New York City, the researchers found that using a face mask reduced the number of infections by more than 75,000 in Italy from April 6-May 9, 2020, and by more than 66,000 in New York City from April 17-May 9.

"Our results clearly show that airborne transmission via respiratory aerosols represents the dominant route for the spread of COVID-19," Dr. Zhang said. "By analyzing the pandemic trends using the statistical method, we found that the intervention measures significantly shape the earlier pandemic trends and face covering is mainly responsible for flattening the total infection curve. We conclude that wearing a face mask in public corresponds to the most effective means to prevent inter-human transmission."

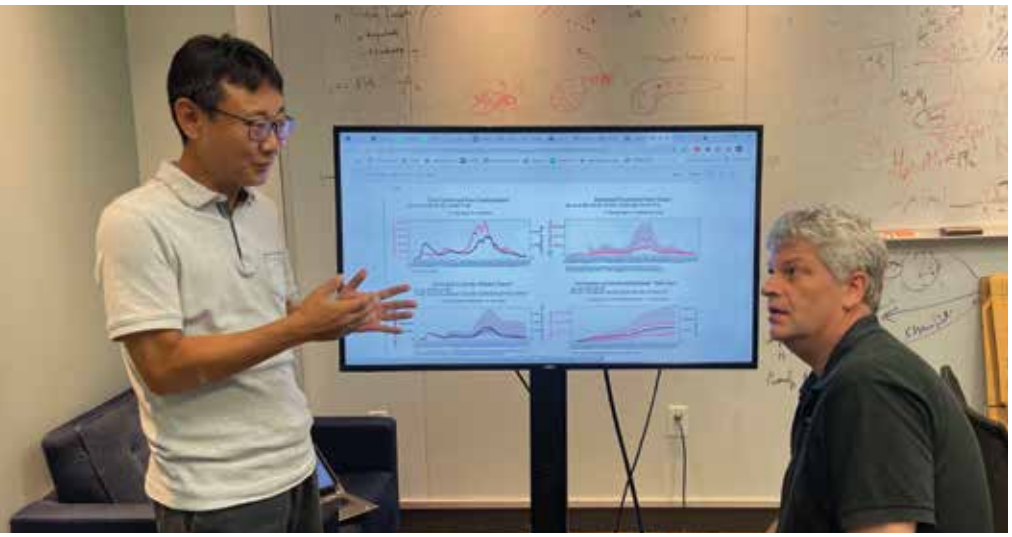
He added that their work also "highlights that sound science is essential in decision-making for the current and future public health pandemics."

TRACKING THE VIRUS

World health experts have long suspected that the incidence of COVID-19 is much higher than reported based on testing alone. To get a more complete picture of the virus' prevalence in the community and help guide public health decisions, researchers at The University of Texas Southwestern



Renyi Zhang (right) and graduate student Yixin Li demonstrated the effectiveness of masks in preventing virus transmission.



UT Southwestern's Jungsik Noh (left) discusses his algorithm to track COVID-19 infections with Gaudenz Danuser.

Medical Center developed a machine-learning algorithm. The tool estimates that the number of COVID-19 cases in the U.S. in the first year of the pandemic was nearly three times that of confirmed cases and that estimated cases in 25 of the 50 hardest-hit countries were five to 20 times greater.

The algorithm uses the number of reported deaths – thought to be more accurate and complete than the number of lab-confirmed cases – as the basis for its calculations. It then assumes an infection fatality rate of 0.66 percent, based on an earlier study of the pandemic in China, and considers other factors such as the average number of days from the onset of symptoms to death or recovery. It also compares its estimate with the number of confirmed cases to calculate a ratio of confirmed-to-estimated infections.

The team found that its algorithm estimates closely corresponded to existing seroprevalence rates in most areas as found in several studies that used blood tests to check for SARS-CoV-2 antibodies.

The study was published in *PLOS One*, with assistant professor Jungsik Noh as lead author and Welch grantee **Gaudenz Danuser**, chair of the Lyda Hill Department of Bioinformatics, as senior author.

WRESTLING THE SPIKE PROTEIN

As the virus spread, access to vaccines became ever-more crucial. Coronavirus expert **Jason McLellan**, a newly appointed Welch chair at UT Austin, dealt a telling early blow against COVID-19, creating the world's first 3D atomic-level map of SARS-CoV-2's spike protein and designing a stabilized version of it. Working in partnership with the National Institutes of Health, his team developed a synthetic spike protein that manufacturers then used to create four of the leading vaccines against COVID-19, including all three approved for emergency use in the United States.

Within weeks, **Ilya Finkelstein**, who would become the 2021 Hackerman Awardee, and **Jennifer Maynard**, a Welch principal investigator, teamed with Dr. McLellan to

UT Austin researchers are continuing work on the spike protein so critical in SARS-CoV-2 vaccine development. Jason McLellan (above) is collaborating with Ilya Finkelstein and Jennifer Maynard (at right).

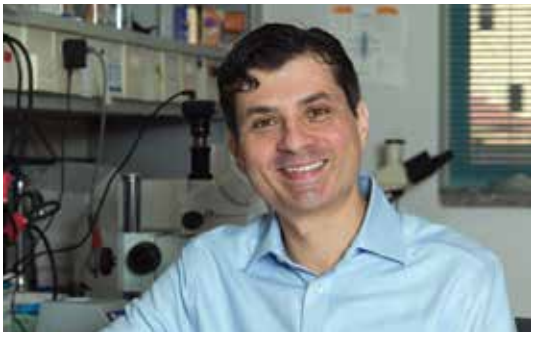
develop an advanced version of the spike protein for use in newer vaccines. The improved version, when expressed in cells, produces up to 10 times more of the protein.

"Depending on the type of vaccine, this improved version of the protein could reduce the size of each dose or speed up vaccine production," said Dr. McLellan, associate professor in the Department of Molecular Biosciences. "Either way, it could mean more patients have access to vaccines faster."

Dubbed HexaPro, the new protein is also more stable than the team's earlier version of the spike protein, which should make it easier to store and transport. It also keeps its shape even under heat stress, during storage at room temperature and through multiple freeze-thaws.

Jeremiah Gassensmith (left) and Gabriele Meloni have developed an approach that may make vaccines to prevent COVID-19 easier to store and transport.

Dr. Finkelstein's lab also is focused on anticipating and mitigating viral variants that may evade vaccine-elicited immunity and works closely with Houston Methodist to track how SARS-CoV-2 variants are spreading in Texas.



MAKING VACCINE DISTRIBUTION EASIER

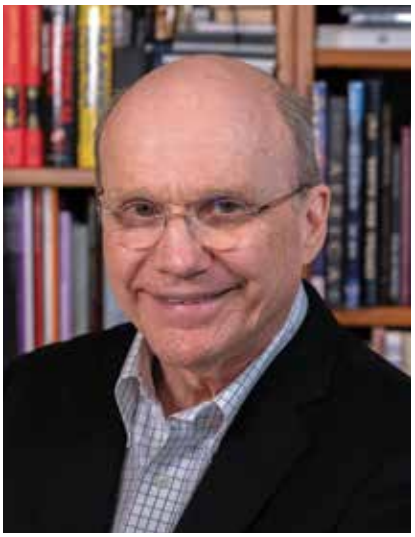
Jeremiah Gassensmith and **Gabriele Meloni**, both Welch principal investigators, have taken on the challenge of deploying messenger RNA vaccines, such as those produced by Pfizer/BioNTech and Moderna, which currently must be distributed and kept at subfreezing temperatures.

The vaccines use lipid nanoparticles – basically spheres of fat molecules – to protect and deliver the mRNA that generates a vaccine recipient's immune response to the SARS-CoV-2 virus.

In proof-of-concept experiments, The University of Texas at Dallas team has demonstrated an inexpensive technique that generates crystalline exoskeletons around delicate liposomes and other lipid nanoparticles and stabilizes them at room temperature for up to two months.

This could solve a key distribution challenge, especially in parts of the world without the infrastructure to keep these vaccines and other lipid-based drug formulations cold.

"Although we did not include in this work the specific lipid nanoparticles used in current COVID-19 vaccines, our findings are a step toward stabilizing a lipid nanoparticle in a way that's never been done before, so far as we know," Dr. Gassensmith said.



David Taylor (left) and Kenneth Johnson, UT Austin, have detailed the mechanism by which the anti-viral drug remdesivir slows down SARS-CoV-2's replication and spread – information that could lead to more effective drugs.

TREATING COVID-19 INFECTIONS

Investigating potential treatments for COVID-19 also is a top priority.

A UT Austin study explored remdesivir, the only antiviral drug currently approved in the U.S. In work published in *iScience* and in *Molecular Cell*, scientists identified a critical mechanism the drug uses to stall the machinery of the coronavirus that drives replication and spread. This more detailed understanding will allow drug companies to develop new and improved antivirals with the goal of creating more potent drugs that require smaller doses with less side effects and provide quicker relief. These insights could also be vital in helping fight new mutations of the virus.

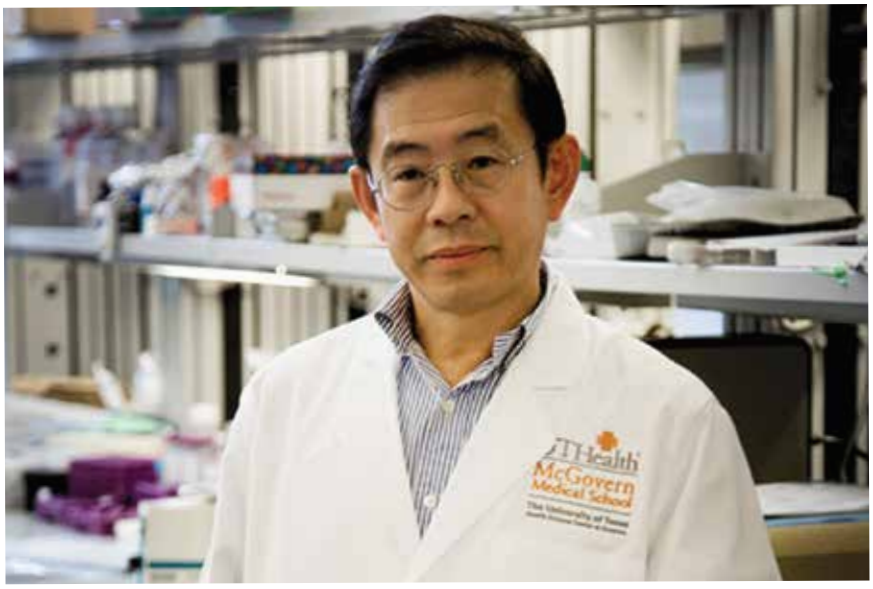
The work was directed by **Kenneth Johnson** and **David Taylor**, both Welch grant recipients, with funding provided in part by The Welch Foundation.

Meanwhile, researchers at The University of Texas Health Science Center at Houston, The University of Texas Medical Branch, the University of Houston, and IGM Biosciences have discovered a potential new antibody therapy for COVID-19. The work was published in *Nature*.

Immunoglobulin M (IgM) antibodies protect mucosal surfaces and are the body's "first responders" in fighting infection. The team engineered an IgM antibody, named IGM-6268, that can be administered intranasally. Preclinical research has shown it potently neutralizes the original SARS-CoV-2 as well as a number of variants, including those first detected in the U.K., South Africa and Brazil (alpha, gamma and beta).

Highly effective for both prophylaxis and treatment in mouse models, IGM-6268 is now being developed by IGM Biosciences as a potential therapy for COVID-19. If validated in clinical trials, IGM-6268 could provide a kind of chemical mask for anyone exposed to SARS-CoV-2 and as an extra line of defense for people who might not be fully protected by vaccines. Because IgM molecules are relatively stable, it might be feasible to formulate them into a nasal spray sold in pharmacies and kept on hand for emergency use.

"Synergizing the strengths of multiple institutions from academia



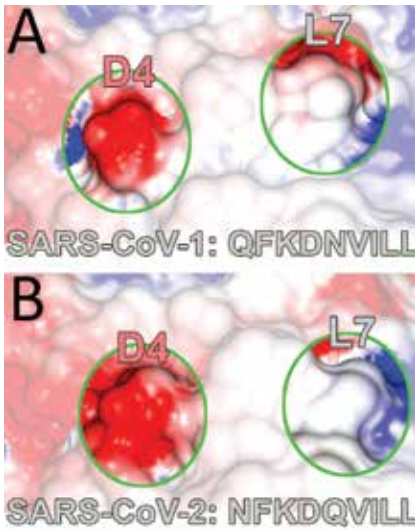
Zhiqiang An of UT Health, working with colleagues at other area institutions, developed a new antibody to be administered nasally to fight the virus.

and industry is the key to the rapid translation from ideas to therapeutic candidates," said **Zhiqiang An**, one of the lead researchers and the Robert A. Welch Distinguished University Chair in Chemistry at McGovern Medical School at UTHealth. "We are very excited about IGM-6268's potential."

Another effort by scientists at **Rice University** and **The University of Texas MD Anderson Cancer Center** has discovered that a particular peptide drawn from the SARS-CoV-2 virus has an unexpected but significant influence on how it stably binds to a receptor that is central to the immune system's ability to attack disease cells.

The study, published in *PNAS* (Proceedings of the National Academy of Sciences), shows at atomic resolution the binding but also, for the first time, the unbinding mechanisms that underlie a key component of the immune system. This better understanding of the mechanism could lead to advancements in immunotherapy to boost the body's ability to fight disease.

In addition to COVID-19, this work could have important applications in cancer and other diseases.



Welch helped fund research that could improve immunotherapy treatment.

COVID-19: A Case Study in How Basic Research Saves Lives

"While Welch Foundation funding is typically directed toward specific projects, our fundamental precept from the Foundation's earliest days has been to give researchers the freedom to pursue the inquiries they consider most important – often exploring new and risky ideas.

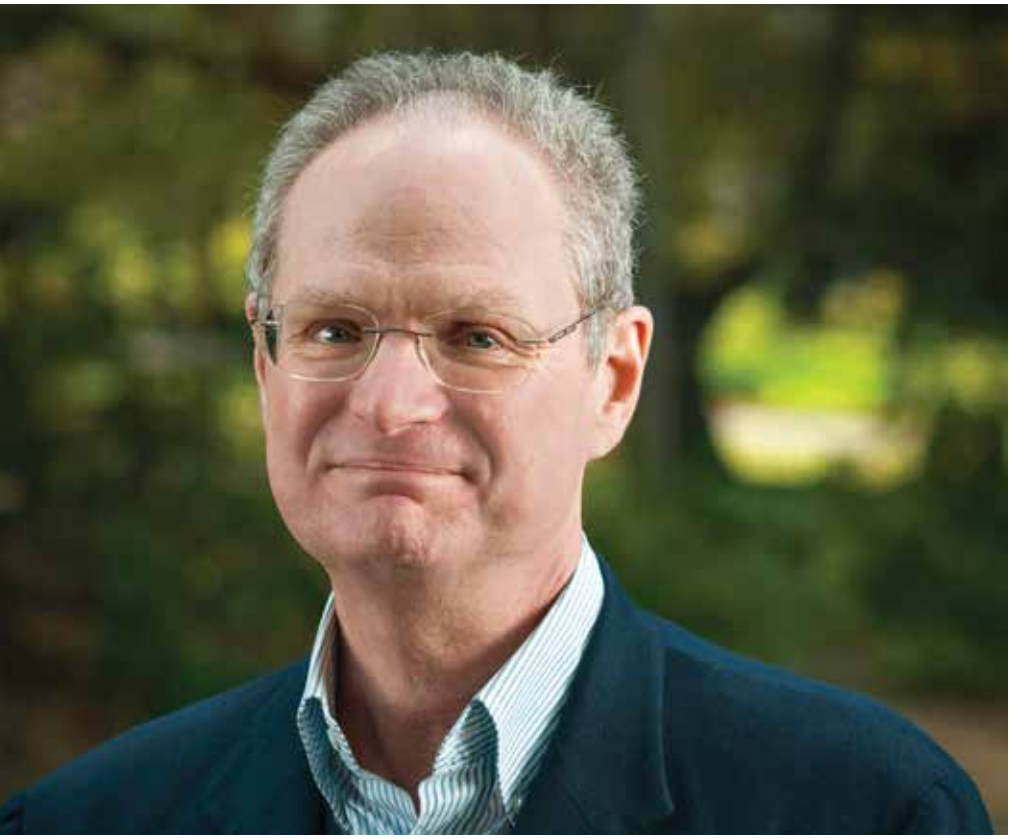
When the pandemic hit, many of our researchers chose to redirect the resources in their laboratories toward solving aspects of the problem. For example, if you study how viruses replicate, you might already have a toolbox of small molecule potential therapeutics to interrupt the replication process of that class of viruses.

Back when SARS was a problem and spreading around the world, Dr. Peter Hotez and his group at Baylor College of Medicine and Texas Children's Hospital were developing a SARS vaccine and had identified potential vaccine candidates. But they had to put them in the freezer because of lack of funding. It's fairly typical that when an emergency subsides, the funding agencies move on to other priorities.

ADAM KUSPA
President

Our current situation is a perfect example of how consistent funding for basic research, like that provided by Welch, really needs to be supported in a significant and consistent way. The scientific community's ability to create and then build upon an extensive database of fundamental chemical and biological research and resources is crucial. By creating a robust knowledge infrastructure, society is better prepared to respond quickly and effectively to emerging global challenges."

Programs: Spurring Research, Educational Initiatives Across Texas



Paul Alivisatos was named chair of The Welch Institute's Scientific Advisory Board. The institute's mission is to accelerate the discovery, design and manufacture of next-generation materials by combining fundamental chemistry and materials science.

"The challenges of a global pandemic underscore the critical importance of scientific research to society," said Welch Foundation President Adam Kuspa. "Advances in chemistry not only improve lives – they also can save them. I am so proud of how scientists across the world, and particularly here in Texas, were able to move quickly and decisively to probe the mysteries of the virus and develop effective vaccines. Of course, this was only possible by building on years of previous research. COVID makes a compelling – if tragic – argument for why all of us should celebrate and support the work of basic science researchers. It also shines a spotlight on the importance of the work of funding agencies like The Welch Foundation that invest in the dedicated men and women working to understand our world."

THE WELCH INSTITUTE FOR ADVANCED MATERIALS

In August 2020, The Welch Foundation committed $100 million to Rice University in the largest grant in its history to establish The Welch Institute for Advanced Materials, a sweeping strategic partnership focused on advanced materials research.

The Welch Institute
Advanced Materials
Rice University

Located on the Rice campus, The Welch Institute will combine fundamental chemistry and materials science with the latest in machine learning and artificial intelligence to accelerate the discovery, design and manufacture of the next generation of materials with applications to new energy systems, sustainable water, space systems, telecommunications, manufacturing, transportation, security and more. The Welch Institute is the first such effort to launch with the goals, scientific strategy, scientific team, and facilities and equipment all focused on driving the design of advanced materials.

The Institute's goal is to attract top researchers from around the world to collaborate with Rice University's internationally renowned faculty and scientific resources, making the Institute a center of intellectual discovery, innovation and transformation in advanced materials. The Institute is governed by an independent board of directors, led by Chair James T. Hackett, and will be advised by a scientific advisory board, chaired by Armand Paul Alivisatos, University of California, Berkeley, and a 2019 Welch Award recipient.

Jim Hackett was named chair of the Board of Directors for The Welch Institute.

"This partnership of The Welch Foundation and Rice University is a wonderful development and promises to do so much to advance the fields of materials research and innovation with great potential to open new areas of discovery that benefit humanity," said Dr. Alivisatos. "I look forward to working closely with the Foundation and the Rice community in these early stages, as we work together to recruit a world-class team."

RESEARCH GRANTS

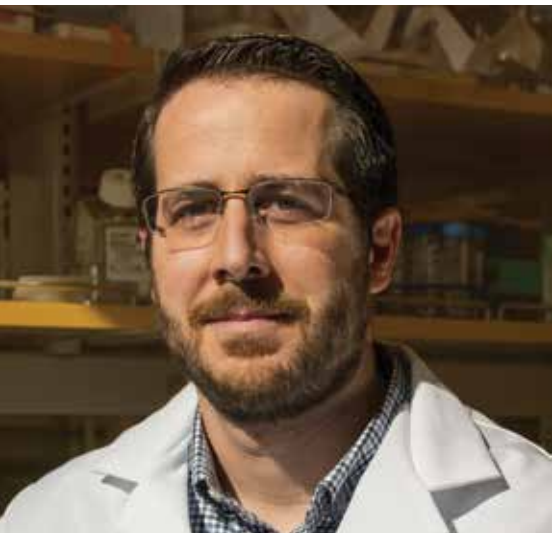
The Welch Foundation awarded $25.6 million through its research grant program in fiscal year 2020. Support included funding 31 new proposals and renewing 51 projects (82 total) at 17 Texas institutions. Overall, Welch supports 374 principal investigators. From its inception in 1954 through August 31, 2020, the Foundation has contributed more than $1 billion to chemical research.

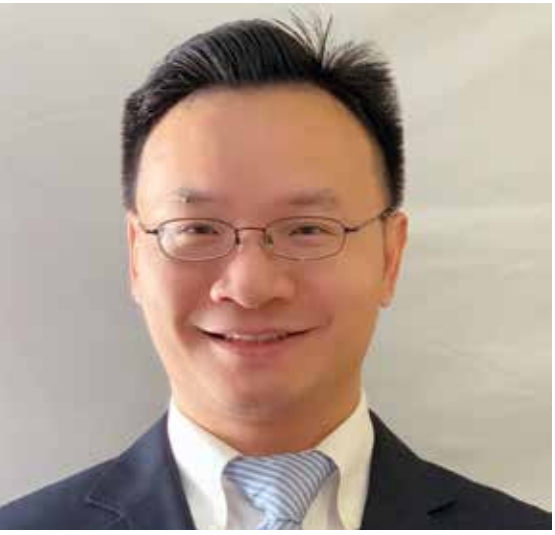
Each research grant provides a minimum of $80,000 annually for three years and may be renewed based on the proposal submitted by the principal investigator. The grant supports research in chemistry by a full-time faculty member with tenure or on tenure track at institutions of higher education in Texas.

A list of principal investigators receiving Welch Foundation grants during its 2020 fiscal year, September 1, 2019, to August 31, 2020, begins on page 30. The listing includes researchers' institutions and the titles of their research projects. The work of two of these principal investigators is highlighted starting on page 21.

DEPARTMENTAL RESEARCH GRANTS

Small- and medium-size colleges and universities across the state play an important role in educating students in





Jason McLellan, UT Austin (top), and Shengqian Ma, University of North Texas, were named to Welch chairs.

the sciences in general and chemistry in particular. However, limited resources can challenge these institutions to provide the same level of educational experience as can be found at larger universities. Therefore, for much of its history, The Welch Foundation has provided funding to many of these schools with the goal of helping build and strengthen their chemistry programs and provide opportunities to more students to take part in hands-on research.

In 2020, 39 Texas colleges and universities received Welch support, with four additional schools approved for the program starting in June 2021: East Texas Baptist University in Marshall, Sul Ross State University in Alpine, Texas A&M International University in Laredo and Texas A&M University-Texarkana.

Departmental grants allow the schools to offer research opportunities to students, support faculty work and enhance chemistry programs. The departments typically use Welch funding to provide scholarships or stipends for undergraduates and graduates, purchase laboratory supplies and equipment, and underwrite student travel to participate in scientific conferences.

The Welch Foundation
supports
basic research
in chemistry each year
through a range of programs.

Welch regularly hears from these smaller institutions that funding research in chemistry makes it possible to inspire students. The experience promotes a sense of discovery and passion for scientific inquiry – enthusiasm and excitement that is difficult to create through book learning alone. For many students, this is their first opportunity to conduct research themselves and they later go on to seek advanced degrees and careers in science and medicine.

Descriptions of how two colleges in Welch's departmental grant program, Lubbock Christian University and Texas Woman's University, have leveraged those funds to enhance their educational missions can be found in the foundation grants section starting on page 23.

WELCH CHAIRS

The Welch Foundation endows 48 chairs at 21 Texas universities. This support is designed to recruit and retain talented chemical researchers and teachers to Texas universities as well as strengthen the quality of higher education programs across the state. The Foundation provides ongoing research funding for chairholders, helping support graduate and postdoctoral students working with the professors.

In 2020, two scientists were named to Welch Chairs in Chemistry: Jason S. McLellan at The University of Texas at Austin and Shengqian Ma at the University of North Texas.

Foundation Grants: Welch Funding Supports New Scientific Advances

SKYE FORTIER
Principal Investigator
The University of Texas at El Paso

A synthetic inorganic chemist, Skye Fortier calls himself a "molecule maker." He and his research group focus on molecules with metals in them, ranging from titanium to uranium, creating elaborate molecular architectures designed to elicit a particular property of the metal. One key interest is understanding the orbital character and electronic properties of the metals within the molecules and how they relate to reactivity.

"Research in my laboratory is largely driven by fundamental scientific and chemical curiosity in the basic sciences – particularly in the area of molecular inorganic chemistry," he said. "We focus on trying to 'push the envelope' by examining the chemistry of metals in unusually low oxidation states and in unusual coordination environments."

From this work, Dr. Fortier's team has made new discoveries such as using earth-abundant titanium for the mimicry of precious metals in C-H activation chemistry and hydrogenation catalysis. His group also has shown that titanium can be used to remediate sulfur-containing molecules in petroleum feedstocks. Other research interests include designing ligands to stabilize highly reactive iron-nitride and cobalt-nitride bonds, with implications for understanding nitrogen fixation and transfer chemistry. His group also studies lanthanide and actinide elements.

Dr. Fortier, while having interest in a number of elements, does have a particular fondness for uranium.

Skye Fortier focuses on synthesizing molecules containing metals with distinct electronic properties for potential practical applications.

"Uranium exists at the last frontier of the periodic table – there is so much we don't know about it," he said. Although uranium is radioactive, its long half-life makes it easy to work with.

He notes that while uranium chemistry has become more popular, it still suffers from the stigma of association with nuclear weapons and nuclear waste. However, a deeper understanding of the element will have important practical applications, such as developing new methods for improved waste handling. Dr. Fortier is hoping to create new molecular systems with uranium to access unique chemistry.

"Welch funds research at the cutting edge of scientific discovery," Dr. Fortier said. "The actinide elements, such as uranium, have a set of orbitals totally unique from any other element in the periodic table, and these orbital combinations should allow for unique chemistry. We are currently exploring new approaches to take advantage of these distinct electronic properties."

A native Texan, Dr. Fortier grew up in El Paso and earned his undergraduate degree at UTEP before leaving for a Ph.D. at the University of California, Santa Barbara and postdoctoral work at Indiana University.

"Eventually, it seemed like the stars aligned to draw me back to Texas," he said. "The possibility of receiving research support from The Welch Foundation was a deciding factor in coming back home. It's a very special and important foundation that Texas is privileged to have, and its approach to funding is instrumental in supporting the chemistry I want to do."

VLADIMIR GEVORGYAN

Robert A. Welch Distinguished Chair in Chemistry
The University of Texas at Dallas

Vlad Gevorgyan's path to Texas started in Russia and featured stops along the way in Latvia, Italy, Japan and Chicago. Here, he has cross appointments at The University of Texas at Dallas and UT Southwestern Medical Center. His charge: Create connections between the two schools by fostering collaborations among a broad range of scientists, including synthetic chemists and biologists, to advance new knowledge.

"I have two homes," he laughed. "Although my second home at UTSW is now virtual due to the pandemic."

At UT Dallas he is developing a center of excellence for reaction discovery and high-throughput synthesis. The "big idea," he says, is to create new synthetic methodology to easily convert widely available compounds into the building blocks for new materials and new treatments for disease.

"Basically, we focus on synthetic organic methodology research, looking for new ways to put molecules together

Vlad Gevorgyan has developed a new type of photocatalyst with palladium that both harvests light and then uses it to catalyze reactions.

for new purposes – from synthesizing medicines to designing new materials," Dr. Gevorgyan said. "We look to discover and develop fundamentally interesting catalytic methodologies for broad synthetic applications."

His research focuses on developing and understanding new chemical processes from which to create more powerful, more selective and more environmentally safe tools to be used in a variety of fields. The next step is to apply these new methods and strategies.

"We want to simplify the synthesis of compounds to create environmentally benign reactions and minimize or eliminate waste byproducts," he said.

One key interest is performing transition metal catalysis with visible light – an important new area of research – with the goal of creating durable and inexpensive transformations. Using visible light, he was able to redirect the well-established two-electron chemistry of palladium into the realm of one-electron chemistry.

Dr. Gevorgyan calls palladium a "double duty" catalyst as it both harvests light and then uses it to catalyze reactions. This new type of photocatalyst improves on the traditional approach, which requires the addition of a transition metal catalyst to spur reactions.

Other work involves improving biomedical imaging, specifically PET scans, a technique in which small amounts of a molecule containing a radioactive atom are used to locate a target protein with precision. The goal is to develop new and more efficient ways to synthesize and diversify radioactive labels used in the process and to give them interchangeable parts.

This project is an example of the cross-collaboration Dr. Gevorgyan is working to foster and he is proud the project has landed Monica Rivas, one of his Welch-supported graduate students, a coveted National Institutes of Health predoctoral fellowship.

"The initial formulation of new approaches for rapid, selective carbon-carbon bond-forming reactions will be performed here in the UT Dallas Department of Chemistry and Biochemistry," he explained. "Once developed, this 'cold chemistry' will be used in the synthesis of new 'hot' PET imaging agents, possessing short-lived fluorine-18 and carbon-11 isotopes, in collaboration with UTSW researchers at the cyclotron facility of the Advanced Imaging Research Center.

"Welch's very generous support allows us to invest in high-risk, high-reward endeavors in their early stages," Dr. Gevorgyan added. "I still get a thrill from the excitement of discovery and find it especially rewarding to see the students in my lab bring those discoveries to life. The Welch chair was an 'anchor' in the offer that convinced me to move to Texas."

JULIE MARSHALL

Departmental Grant
Lubbock Christian University

When Julie Marshall joined the faculty at Lubbock Christian University 20 years ago, her charge was to build undergraduate research at the small private school.

"My first challenge was to find funding," she said, "and The Welch Foundation has walked alongside us in that journey. Welch is the lifeblood of our program."

Today, Lubbock Christian incorporates research into its chemistry and biochemistry degree plans, either through an internship or by working with a professor on a project.

"As we don't have graduate students, this opportunity gives undergraduates extensive hands-on experience and exposure to critical thinking," she said. "It also gives them a real competitive advantage in the job market or when applying to graduate school."

Dr. Marshall herself has worked with about 50 undergraduates over the years. "The mentoring opportunity creates a different relationship with the student. It is a closer bond – more of a partnership – and we develop long-lasting ties."

Students typically shadow a professor for up to a year as sophomores. They are then ready to begin a research project in the summer session as juniors before finishing up the following spring with a presentation of their work.

At any given time, five to 10 students are participating, with nine taking part in 2020.

With the pandemic posing new challenges, Dr. Marshall said the university has had to innovate.

"With COVID, we had less expenses as we weren't traveling and had to shut some projects down," she explained. "We redirected those funds to create the Welch Academy to give younger students laboratory experience and the chance to learn skills that will be useful later for their research projects."

The academy will launch in fall 2021.

After shutting down the campus in spring 2020, Lubbock Christian reopened in the fall semester with a mix of virtual and face-to-face classes.

A Lubbock Christian graduate herself, Dr. Marshall earned a masters and a Ph.D. at Texas Tech before returning to her alma mater. Much of her research involves peanut production, both peanut allergens and the chemistry of peanut oil. One current project involves setting up a CRISPR system for peanuts and looking for opportunities to finetune the peanut's fatty acid composition to provide environmental and health benefits.

"Many people don't realize that peanuts are a huge crop in the Texas Panhandle – we are one of the nation's top peanut-producing states," she said.

Other students are working with faculty on water quality projects, including exploring antibiotic resistance of bacteria in wastewater treatment and another involving nearby water resources. Still others are tackling projects in natural products chemistry.

"It has been an interesting year," Dr. Marshall said. "From having to conduct virtual poster sessions last spring to innovating to ensure we deliver a rich science education in these challenging conditions, our professors and our students have really come through. We are deeply appreciative of Welch support through the process."

A Lubbock Christian Welch Scholar makes notes on the results of her latest experiment.

RICHARD D. SHEARDY

Departmental Grant
Texas Woman's University

Texas Woman's University aims to get chemistry students involved in research as early as their freshman year. The school offers Bachelor of Science degrees in chemistry, environmental chemistry and biochemistry, as well as a master's in chemistry.

"We pursue a philosophy of social engagement here at TWU," said Richard Sheardy, department chair. "In chemistry, that means connecting research with real-world problems. This brings science to life for our students."

One current initiative in progress is to create a department-wide undergraduate research project on microplastics in the environment. The program would range from collecting samples, analyzing them for plastics and, ultimately, exploring the health implications.

"This will expose students to real field work and applying the techniques we teach them, such as the theory and practice of GC-mass spec (gas chromatography-mass spectrometry)," Dr. Sheardy said.

In another project, students in the environmental chemistry track are analyzing water used in hydraulic fracturing (or fracking) in various stages of the remediation process to evaluate treatment effectiveness.

TWU is a regional hub for Science Education for New Civic Engagements and Responsibilities, or SENCER, an initiative of the National Center for Science & Civic Engagement focusing on empowering faculty and improving STEM teaching and learning by making connections to civic issues. The university is also working with the National Science Foundation on a planning grant to recruit and retain indigenous students into STEM programs and to incorporate indigenous knowledge into mainstream science.

"We have a great faculty and students," Dr. Sheardy added. "Welch support means we don't have to rely on state-allocated funds for a robust research program – a real bonus," he said.

Welch funding provides support for equipment and supplies, travel to conferences and stipends for students. After COVID shut down the campus in March 2020, TWU was able to move to a hybrid model with online classes and 50 percent capacity in labs.

The chemistry department recently moved into a new building with open space to build collaborative efforts across research labs and stocked with up-to-date instrumentation. Dr. Sheardy is especially proud of a new 20-foot-high sculpture from artist Roger Berry, funded by an alumnus donation, that graces the new building.

"From one angle, it looks like the infinity sign," he said. "It was the inspiration for our department t-shirts: 'Chemistry-Environmental Chemistry-Biochemistry, Infinite Possibilities.'"

TWU environmental chemistry students collect air samples as part of a hands-on research project.

PATRICK SUNG

Robert A. Welch Distinguished Chair in Chemistry
The University of Texas Health Science Center at San Antonio

Patrick Sung's quest is to understand the processes by which cells repair DNA damage and then build on this knowledge to prevent and treat the cancers that can develop when such repairs fail.

Dr. Sung strives to understand the functions of DNA repair genes and to reconstitute DNA repair reactions with purified enzymes. His goal is to elucidate the mechanism of DNA double-strand break repair, a process that is crucial for maintaining genome stability.

There are two major, mechanistically distinct pathways to eliminate DNA breaks: homologous recombination that requires an intact homologous duplex that is highly similar to the broken segment of DNA to direct the process, and non-homologous DNA end joining, which simply rejoins the ends of the broken DNA molecule. Dr. Sung's research has provided mechanistic insights into the homology-directed repair pathway in both yeast and humans, focusing on the roles of the breast and ovarian tumor suppressors BRCA1 and BRCA2 in the process.

"This is fascinating work," Dr. Sung said. "Once we understand protein action, we will be able to explain why cells become transformed and cancerous when DNA repair fails. While there are

hundreds of BRCA1 and BRCA2 mutations, our experience allows us to zoom in on those we believe are the most deleterious and define their impact on the efficiency of DNA repair."

The Sung laboratory has been able to prompt BRCA1 and BRCA2 genes to make their proteins using a unique insect cell culture system. Analysis has shown that loss of DNA repair capacity is the key factor in a BRCA mutation leading to cancer. During cell division, the BRCA proteins enable cells to use the most accurate repair pathway. Without this help, cells become reliant on non-homologous DNA end joining and other less accurate repair pathways, allowing the introduction of genetic mutations in DNA, chromosome rearrangements, genomic instability and, ultimately, cancer.

His team is developing chemical compounds to shut down the residual DNA repair capacity of cancer cells. The next step will be to evaluate potential efficacy of the most promising compounds using animal models and then work with medicinal chemists to make versions that are longer lasting in the body.

"Finally," Dr. Sung added, "we hope to take the best candidates to clinical trials. It is a very long process, but the end result is so worthwhile."

Dr. Sung began his faculty career at The University of Texas Medical Branch in Galveston before moving to UT Health San Antonio and then to Yale University in 2003. There, he began looking at DNA repair as a clinical problem. Dr. Sung returned to San Antonio in 2019 where he holds a Welch chair. Today he is a leading expert in BRCA1 and BRCA2 cancer biology and was recently awarded a National Cancer Institute Outstanding Investigator Award, a $6.5 million grant to continue this work.

"I am so happy to be back in San Antonio," Dr. Sung said. "The value of Welch's generous funding for basic scientific work is hard to overstate. My wife and I love Texas and, with the support from the state and the emphasis on higher education, it is so easy to do impactful work here."

Patrick Sung is working to understand DNA repair processes and, ultimately, to create drugs to shut down this capacity in cancer cells.

GUIHUA YU

Principal Investigator
The University of Texas at Austin

Guihua Yu's research goal is to leverage nanotechnology to address issues in energy and water. His highly interdisciplinary team draws from chemistry, physics, materials science and engineering to develop a fundamental understanding of new materials with designed nano-architectures and then applies technological solutions at the energy-water nexus.

Dr. Yu's work is broadly centered on rational design and synthesis of functional nanomaterials, fundamental understanding of their chemical and physical properties, and development of large-scale assembly and integration strategies for applications in energy, environmental and sustainable technologies.

"We work from the bottom up using nanoscience to create novel structures to make new materials with useful properties," Dr. Yu said.

His team is experimenting with novel organic nanomaterials for solar water purification and harvesting, including solar seawater desalination and atmospheric water harvesting.

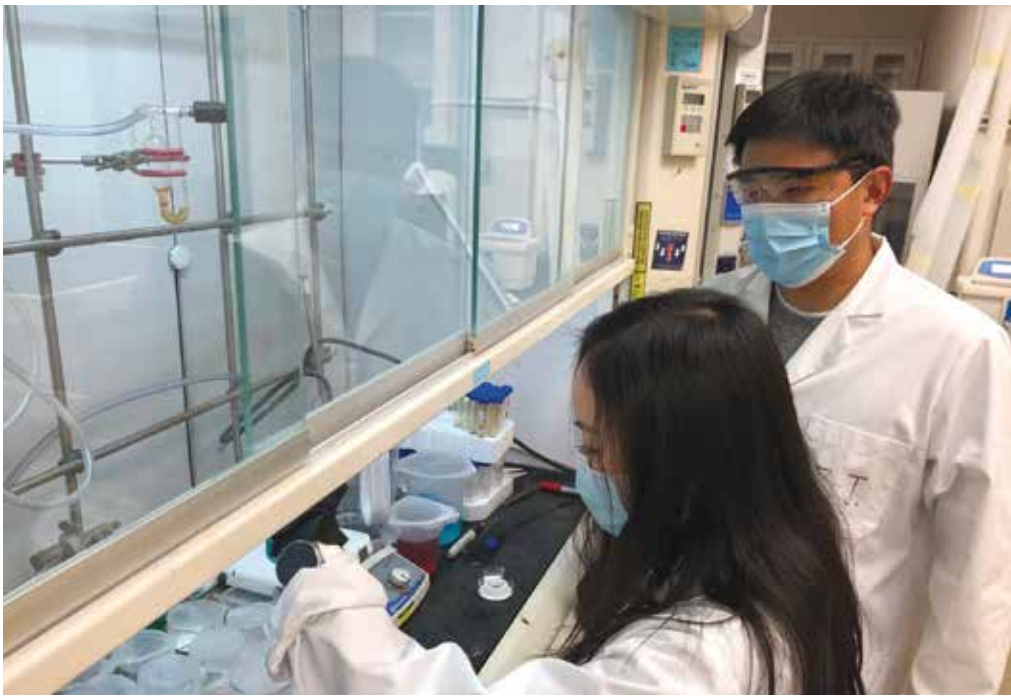
In one breakthrough, Dr. Yu has developed a cost-effective, compact technology that uses gel-polymer hybrid materials for solar-powered water purification. With hydrophilic (attraction to water) qualities and semiconducting (solar-adsorbing) properties, the hydrogels – a network of polymer chains – can produce clean, safe drinking water from any source, removing salt and other contaminants. The nanostructured gels work off ambient sunlight and can produce significantly higher volumes of water than traditional approaches.

In another application, Dr. Yu's lab has created self-watering soil with hydrogels that pull water from air to irrigate plants.

Other research, supported by Dr. Yu's Welch grant, is aimed at discovering new phenomena and improving fundamental understanding of energy storage mechanisms for future-generation batteries. His lab works with metal sulfides and oxides – inorganic solids – to create self-assembled materials, taking a cue from how nature works. This involves creating superstructures by interlaying very thin sheets of storage materials in a manner that controls the interactions between them to significantly improve energy performance.

Using this approach, his team has created a battery that combines the benefits of both solid-state and liquid batteries, without many of the drawbacks inherent in these systems. The battery uses metallic electrodes that can remain liquefied at a temperature of 20 degrees Celsius (68 degrees Fahrenheit), the lowest operating temperature ever recorded for a liquid-metal battery and a significant improvement over current liquid-metal batteries that require 240 degrees Celsius. Dr. Yu's batteries are less expensive, charge faster, hold charge longer, are more environmentally friendly and can be scaled to power small handheld devices or entire energy networks.

The battery works with a sodium-potassium alloy anode and a gallium-based alloy cathode. The team is exploring other materials, including widely available options, to create a version with even lower melting points. In another advance, Dr. Yu's lab recently discovered the new mechanisms of nanoscaled transitional metal particles useful for creating even faster-charging batteries.



Guihua Yu (right) consults with a student. His lab focuses on designing functional nanomaterials to solve problems in water and energy.

"We are very excited by this development," he said. "Exploring the unknowns so often leads to new technology. And this is a key benefit of Welch support. It allows us to explore risky or ambitious goals. It is so different from other grants in that it is long-term, as long as you work hard to continue pushing science forward, so you can keep tackling and exploring the unknown over time."

Statements of Financial Position

AS OF AUGUST 31, 2020 AND 2019

	2020	2019
ASSETS		
CASH AND CASH EQUIVALENTS	$ 16,596,249	$ 2,467,935
INVESTMENTS	730,818,871	703,185,799
RECEIVABLES:		
Investment transactions	772,809	385,062
Interest and dividends	46,734	204,281
Other	594,560	788,975
Total receivables	1,414,103	1,378,318
OTHER ASSETS	1,578,935	1,022,718
TOTAL	$ 750,408,158	$ 708,054,770
LIABILITIES AND NET ASSETS		
LIABILITIES:		
Unpaid grants	$ 111,269,748	$ 23,375,886
Current and deferred federal excise tax payable	1,813,784	1,499,273
Accounts payable and other	227,569	182,339
Total liabilities	113,311,101	25,057,498
NET ASSETS	637,097,057	682,997,272
TOTAL	$ 750,408,158	$ 708,054,770

Statements of Activities

AS OF AUGUST 31, 2020 AND 2019

	2020	2019
REVENUES, INCOME, AND GAINS (LOSSES):		
Interest and dividends	$ 3,170,731	$ 3,809,825
Oil and gas royalties and other	2,233,323	2,787,970
Net realized gains on sales of investments	34,026,148	63,335,646
Unrealized appreciation (depreciation) of investments	43,334,312	(47,113,066)
Unrealized appreciation of other assets	17,958	35,343
Investment management expenses	(3,421,203)	(3,447,071)
Federal excise tax provision	(334,443)	(759,224)
Total net investment income and gains	79,026,826	18,649,423
EXPENSES:		
Grants approved, net	119,729,246	34,032,149
Grants administration	3,342,084	2,644,317
General and administrative	1,541,200	1,513,549
Total expenses	124,612,530	38,190,015
DEFERRED FEDERAL EXCISE TAX (PROVISION) BENEFIT ON UNREALIZED CAPITAL GAINS	(314,511)	1,221,911
CHANGE IN NET ASSETS	(45,900,215)	(18,318,681)
NET ASSETS, beginning of year	682,997,272	701,315,953
NET ASSETS, end of year	$ 637,097,057	$ 682,997,272

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

Principal Investigators

The Welch Foundation supported 374 active research grants at 25 institutions in 2020.

PRINCIPAL INVESTIGATOR	INSTITUTION	TITLE OF RESEARCH
Girish S. Agarwal	*Texas A&M University*	Correlated Superresolution Microscopy with Tailored Deep-Subwavelength Illumination via Nano and Plasmonic Structures
Jung-Mo Ahn	*The University of Texas at Dallas*	Tailoring Small Molecules to Mimic Protein Helical Surfaces
Esra Akbay	*The University of Texas Southwestern Medical Center*	Targeting Arginase Enzyme Activity to Restore Arginine for T Cell Function in the Tumor Microenvironment
Hal S. Alper	*The University of Texas at Austin*	Biochemical Evaluation of Furan-Fatty Acid Biosynthesis and Production
Neal M. Alto	*The University of Texas Southwestern Medical Center*	Post-Translational Modification of Host Enzymes by Bacterial Effector Proteins
Oliviero Andreussi	*University of North Texas*	Modeling Solvation-Driven Rare-Events: From Drug Design to Protein Folding
Xiao-chen Bai	*The University of Texas Southwestern Medical Center*	Molecular Mechanisms of Epidermal Growth Factor Receptor, Insulin Receptor and RET Receptor Activation from High-Resolution Cryo-EM Analysis
Carlos R. Baiz	*The University of Texas at Austin*	Studies in Biophysical Chemistry: Applications of Ultrafast Infrared Spectroscopy
Kenneth J. Balkus, Jr.	*The University of Texas at Dallas*	Zeolite Encapsulated Metal Complexes
Zachary T. Ball	*Rice University*	New Strategies for Catalytic Bond Formations
Laura A. Banaszynski	*The University of Texas Southwestern Medical Center*	Chromatin-Based Mechanisms of Gene Activation
Sarbajit Banerjee	*Texas A&M University*	Developing Design Rules and a Synthetic Toolbox for Accessing Metastable Solids
Jiming Bao	*University of Houston*	Correlating Photocatalytic and Photoelectrochemical Activity of Cobalt Oxides with Dynamics of Photo-Excited Electrons and Holes
David P. Barondeau	*Texas A&M University*	Elucidating Control Mechanisms for the Synthesis of Sulfur-Containing Biomolecules
Jeffrey E. Barrick	*The University of Texas at Austin*	Chemical Specificity of DNA Uptake by Naturally Competent Bacteria
Bonnie Bartel	*Rice University*	Novel Peroxisomal Processes in Plants
Doran I.G. Bennett	*Southern Methodist University*	Mesoscale Quantum Dynamics in New Semiconductor Materials
Matthew R. Bennett	*Rice University*	The Role of Protein/DNA Interactions in the Kinetics of Biochemical Networks
David E. Bergbreiter	*Texas A&M University*	Multiphase Multicomponent Systems for Synthesis and Catalysis

PRINCIPAL INVESTIGATOR	INSTITUTION	TITLE OF RESEARCH
Ricardo A. Bernal	*The University of Texas at El Paso*	High Resolution Cryo-EM Reconstructions of the Heat Shock Protein 60 and its Conformational Intermediates
Eric R. Bittner	*University of Houston*	Theoretical Models of Charge-Separation in Molecular Donor/Acceptor Systems
Paul Blount	*The University of Texas Southwestern Medical Center*	Determining Protein-Lipid and Protein-Protein Interactions for a Channel Involved in Mechanosensing
Joan F. Brennecke	*The University of Texas at Austin*	Molecular Design of Ionic Liquids for Liquid Separations: Combined Modeling and Experimentation
Robert Brenner	*The University of Texas Health Science Center at San Antonio*	Shedding Light on Endoplasmic and Sarcoplasmic Reticulum Voltage Changes During Calcium Signaling
Jakoah Brgoch	*University of Houston*	Synthesis of Gold Compounds with Unusual Oxidation States and Metalloaromaticity
Jennifer S. Brodbelt	*The University of Texas at Austin*	Characterization of Ion Conformations by Ultraviolet Photodissociation
Maurice Brookhart	*University of Houston*	Pd(II)- and Ni(II)-Catalyzed Olefin Polymerizations and Copolymerizations
Shawn C. Burgess	*The University of Texas Southwestern Medical Center*	Dysregulation of Intermediary Metabolism During Disease
Can Cenik	*The University of Texas at Austin*	Transcriptome-Wide Measurement of Translation Using a Novel On-Chip Isotachophoresis Approach
Maria Chahrour	*The University of Texas Southwestern Medical Center*	Forward Genomics to Identify Social Communication Genes
Walter G. Chapman	*Rice University*	Structure and Properties of Complex Fluids in the Bulk and Interfacial Regions
James Chappell	*Rice University*	Activating Total Synthesis of Natural Products in Diverse Bacterial Species
James R. Chelikowsky	*The University of Texas at Austin*	Simulating Direct Images of the Covalent Bond from Atomic Force Microscopy
Banglin Chen	*The University of Texas at San Antonio*	Porous Mixed-Metal-Organic Frameworks for Recognition of Small Gas Molecules
Tai-Yen Chen	*University of Houston*	Interplay of Redox Status and Cu Homeostasis in Live Neurons at the Single-Molecule Level
Zheng Chen	*The University of Texas Health Science Center at Houston*	Identification of Endogenous ROR Ligands as Modulators of Aging Clock and Physiology
Zhijian J. Chen	*The University of Texas Southwestern Medical Center*	Regulation of Innate Immunity by Liquid-Liquid Phase Separation
Jae-Hyun Cho	*Texas A&M University*	Biophysical Bases of Evading Host Innate Immune Responses by Pandemic and Seasonal Influenza Viruses
Yuh Min Chook	*The University of Texas Southwestern Medical Center*	Mechanisms of Importin 8-Mediated Nuclear Import
Cecilia Clementi	*Rice University*	Mapping the Free Energy Landscape of Proteins by Combining Theory and Experiment
Melanie H. Cobb	*The University of Texas Southwestern Medical Center*	Regulatory and Catalytic Properties of MAP Kinase Cascades
Jeffery L. Coffer	*Texas Christian University*	Well-Defined Silicon Nanotubes for Targeted Loading, Release, and Therapeutically-Relevant Activity
James J. Collins III	*The University of Texas Southwestern Medical Center*	Characterization of an Essential Parasite Kinase

PRINCIPAL INVESTIGATOR	INSTITUTION	TITLE OF RESEARCH
Robert J. Comito	*University of Houston*	Main Group Catalysts for Advanced and Sustainable Polymers
Maralice Conacci-Sorrell	*The University of Texas Southwestern Medical Center*	Non-Canonical Functions of Myc in Protein Acetylation and Chemoresistance
Jacinta C. Conrad	*University of Houston*	Dynamics in Attractive Nanoparticle Supercooled Liquids and Glasses
Nicholas K. Conrad	*The University of Texas Southwestern Medical Center*	Biochemical Analysis of a Novel S-adenosylmethionine Sensor
Lydia M. Contreras	*The University of Texas at Austin*	*In vivo* Structural Characterization of Catalytic and Regulatory RNAs
Christina B. Cooley	*Trinity University*	Fluorogenic Reversible Addition-Fragmentation Chain-Transfer Polymerization for Biomolecular Detection
David R. Corey	*The University of Texas Southwestern Medical Center*	Recognition of Cellular Nucleic Acids by Synthetic Oligomers
Luis G. Cuello	*Texas Tech University Health Sciences Center*	Crystallographic and Functional Studies on the Novel Role of Water Molecules in K+ Channel C-Type Inactivation Gating
Thomas R. Cundary and Mary E. Anderson	*University of North Texas*	Hydridic Activation of Methane
Gregory Cuny	*University of Houston*	Synthesis of Conformational Restricted Natural Products
Jenee D. Cyran	*Baylor University*	Elucidating Sunlight Driven Chemical Processes at Aqueous Interfaces
Pengcheng Dai	*Rice University*	Transport, Magnetic, and Neutron Scattering Studies of Quantum Materials
Kevin N. Dalby	*The University of Texas at Austin*	Inhibiting a Mechanosensor for Cancer Therapy
Weiwei Dang	*Baylor College of Medicine*	Regulation of Telomere Function Through Lysine Methylation in Telomere Shelterin Complex
Gaudenz Danuser	*The University of Texas Southwestern Medical Center*	Probing Oncogenic Functions of Vimentin Filaments by Small Molecule Screens
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*	Dinitrosyls and Dithiolenes as Electron Buffering Ligands and Sites for Uptake of O_2, Alkenes, and CO_2
Bryan W. Davies	*The University of Texas at Austin*	Defining the Physicochemical Space of Antimicrobial Nanobodies
Jef K. De Brabander	*The University of Texas Southwestern Medical Center*	Synthesis and Chemical Biology of Bioactive Small Molecules
Michael W. Deem	*Rice University*	Design of Novel Organic Structure Directing Agents for Zeolites
Nicole J. De Nisco	*The University of Texas at Dallas*	Glycosaminoglycan Utilization and Metabolism by the Microbiota of the Urogenital Tract
H. V. Rasika Dias	*The University of Texas at Arlington*	Metal Complexes of Highly Fluorinated Ligands
Loi H. Do	*University of Houston*	Molecular Engineering of the Second Coordination Sphere for Controlled Olefin Polymerization Catalysis

PRINCIPAL INVESTIGATOR	INSTITUTION	TITLE OF RESEARCH
Sheel Dodani	*The University of Texas at Dallas*	Exploring the Negative (X-) Side of Biology: Molecular and Protein-Based Technologies for Imaging Cellular Chloride
Ivan D'Orso	*The University of Texas Southwestern Medical Center*	Cooperative Assembly of HIV Transcription Elongation Complexes
Konstantin Doubrovinski	*The University of Texas Southwestern Medical Center*	Molecular Basis of Tissue Material Properties in the Early Drosophila Embryo
Peter Douglas	*The University of Texas Southwestern Medical Center*	Stress-Mediated Actin Phosphorylation in Endocytosis and Intestinal Barrier Function
Michael C. Downer	*The University of Texas at Austin*	Femtosecond Optical Probes of Nano-Interface Chemistry
Michael P. Doyle	*The University of Texas at San Antonio*	Challenging Selective Chemical Reactions
Kim R. Dunbar	*Texas A&M University*	Engendering Strong Magnetic Coupling and Anisotropy in Transition Metal and Lanthanide Metal Complexes
F. Barry Dunning	*Rice University*	Studies Involving Molecules in High Rydberg States
Ron Elber	*The University of Texas at Austin*	Rafts and Biological Membranes
Andrew D. Ellington	*The University of Texas at Austin*	A Neural Network for Polymerase Engineering
Donglei L. Fan	*The University of Texas at Austin*	Innovative Mechanism for the Synthesis of 3-D Nanosuperstructures by Electrochemical Reactions
Lei Fang	*Texas A&M University*	Centripetal Aza-Circulene and Aza-Helicenes
Walter L. Fast	*The University of Texas at Austin*	Chemical Probes of Biological Catalysts
Shervin Fatehi	*The University of Texas Rio Grande Valley*	Stochastic Methods for Highly Accurate Quantum Chemistry Extended to Nonadiabatic Molecular Dynamics
Carol Ann Fierke	*Texas A&M University*	Using Photochemistry and Proximity-Driven Covalent Complex Formation to Identify Enzyme-Substrate Pairs in Live Cells
Michael Findlater	*Texas Tech University*	Base-Metal Catalyzed Transformations
Ilya J. Finkelstein	*The University of Texas at Austin*	Massively Parallel Peptide Interaction Mapping on a Repurposed Next-Generation DNA Sequencer
Skye Fortier	*The University of Texas at El Paso*	New Vistas in Early Actinide Chemistry
Frank W. Foss, Jr.	*The University of Texas at Arlington*	Ion Binding, Mobility, and Single Molecule Fluorescence Sensing at Molecularly Designed Gas-Solid Interfaces
Matthew S. Foster	*Rice University*	Quantum Criticality and Coherence in Topological and Strongly Correlated Matter: Random Curvature and (Artificial) 2D Quantum Gravity
Doug E. Franz	*The University of Texas at San Antonio*	New Catalytic Methods Towards the Synthesis of Allenes
Kendra K. Frederick	*The University of Texas Southwestern Medical Center*	In-Vivo Structural Biology for Protein-Folding Diseases
Benny D. Freeman	*The University of Texas at Austin*	Synthesis and Characterization of Water and Ion Transport in Novel Ion Exchange Membrane Polymers
Jonathan R. Friedman	*The University of Texas Southwestern Medical Center*	Mechanisms of Mitochondrial Inner Membrane Organization
François P. Gabbaï	*Texas A&M University*	Tuning the Electrophilic Properties of Group 10 Metal Complexes Using Non-Innocent Antimony Z-Ligands
Matthieu G. Gagnon	*The University of Texas Medical Branch*	Structural Studies of the Chemical Interactions During Non-Canonical Reading of the Genetic Code

PRINCIPAL INVESTIGATOR	INSTITUTION	TITLE OF RESEARCH
Elyssia S. Gallagher	*Baylor University*	Examining the Effects of Metal Ions on Carbohydrate Structure During In-Electrospray H/D Exchange: A Fundamental Study
Venkat Ganesan	*The University of Texas at Austin*	Fundamental Studies of Self-Assembly in Mixtures of Organic and Inorganic Molecules
Xue Gao	*Rice University*	The Next Generation of Ribosomal Natural Products from Microbiome
Yang Gao	*Rice University*	Investigating the Catalytic Mechanisms of Mg^{2+}-Dependent Enzymes with Time-Resolved Crystallography
Isaac Garcia-Bosch	*Southern Methodist University*	C-H Bond Functionalization Promoted by Cu Complexes Bearing Tridentate Redox-Active Ligands with Tunable H-Bonds
Jeremiah J. Gassensmith	*The University of Texas at Dallas*	Detection of Trace ROS Metabolites with Unnatural RNAs
Haibo Ge	*Texas Tech University*	Catalytic Functionalization of Unsaturated Hydrocarbons
Feliciano Giustino	*The University of Texas at Austin*	Designer Perovskites for Light Harvesting and Light Emission
John A. Gladysz	*Texas A&M University*	Werner Complexes as "Organocatalysts"
Margaret E. Glasner	*Texas A&M University*	Role of Underground Metabolism in the Evolution of New Metabolic Pathways
Vishal M. Gohil	*Texas A&M University*	Phospholipid-Protein Interactions in Mitochondrial Bioenergetics
Elizabeth J. Goldsmith	*The University of Texas Southwestern Medical Center*	Abiotic Stress Modulation of ASK1 Activity by Autophosphorylation
John B. Goodenough	*The University of Texas at Austin*	Influence of Counter Cation in Mixed-Metal Oxides
Nick V. Grishin	*The University of Texas Southwestern Medical Center*	Chemistry of Speciation
Qing Gu	*The University of Texas at Dallas*	Super-Resolution Chemical Imaging Microscopy with Perovskite Gain-Assisted Hyperbolic Metamaterials
Jason H. Hafner	*Rice University*	Surface Enhanced Spectroscopy for Biomembrane Structure
Naomi J. Halas	*Rice University*	Synthesis, Photophysical and Photocatalytic Properties of Complex Nanoparticles
P. Shiv Halasyamani	*University of Houston*	New Ultraviolet and Deep-Ultraviolet Nonlinear Optical Materials – Synthesis, Crystal Growth, Characterization and Structure-Property Relationships
Michael B. Hall	*Texas A&M University*	Computational Chemistry on Transition Metal Systems
Jeffrey D. Hartgerink	*Rice University*	Synthesis of Nanostructured Organic Materials via Self-Assembly
Kaden Hazzard	*Rice University*	Ultracold Molecules for Synthetic Chemistry, Chemical Kinetics, and New Phases of Matter
Adam Heller	*The University of Texas at Austin*	Titanium Dioxide Crystals in the Type 2 Diabetic Pancreas and in the Diseased Brain
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*	Dissecting Mechanisms of Spatially Regulated Lipid Droplet Biogenesis at Inter-Organelle Sites

PRINCIPAL INVESTIGATOR	INSTITUTION	TITLE OF RESEARCH
Ryan E. Hibbs	*The University of Texas Southwestern Medical Center*	Structural Principles of Inhibitory Neurotransmitter Receptor Modulation
Lea Hildebrandt Ruiz	*The University of Texas at Austin*	Effects of Chlorine Atoms on Tropospheric Oxidation Chemistry
Christian B. Hilty	*Texas A&M University*	Mechanisms of Graphene Based Single Site Catalysts Determined by Hyperpolarized NMR
Gary Chung Hon	*The University of Texas Southwestern Medical Center*	Epigenetic Control of Non-Coding Gene Regulation
Lora V. Hooper	*The University of Texas Southwestern Medical Center*	Biochemical and Structural Basis for Vitamin A Transport During Infection
Bo Hu	*The University of Texas Health Science Center at Houston*	High-Resolution Structure Determination of Molecular Machines *in situ* by Cryo Electron Tomography
Todd W. Hudnall	*Texas State University*	Diborylcarbenes: A Decades Old Search for Unprecedented Electrophilic Carbenes
Randall G. Hulet	*Rice University*	Quantum Effects in Soliton Molecules
Kami L. Hull	*The University of Texas at Austin*	Development of Stereoselective Three Component Carboamination Reactions
Simon M. Humphrey	*The University of Texas at Austin*	New Directions in Coordination Polymer Chemistry: Materials Based on Heavier p-Block Donors for Enhanced Magnetism and Catalysis
Gyeong S. Hwang	*The University of Texas at Austin*	First-Principles Investigation of the Structure, Chemistry and Function of Carbon-Based Nanomaterials
Oleg A. Igoshin	*Rice University*	Speed-Accuracy-Dissipation Trade-Offs in Non-Equilibrium Biochemical Information Processing
Tatyana I. Igumenova	*Texas A&M University*	Sequestration Without Isomerixation: A Novel Mode of AGC Kinase Regulation by Pin1
Dmitri N. Ivanov	*The University of Texas Health Science Center at San Antonio*	Deciphering the Role of dNTP Metabolism in Antiviral Immunity, DNA Repair and Cell Cycle Control
Brent L. Iverson	*The University of Texas at Austin*	A New Family of Reporting Molecules
Andrea Isella	*Rice University*	Investigating the Origin of the Chemistry of Planets
Brent L. Iverson	*The University of Texas at Austin*	Dynamic Supramolecular Solids
Khuloud Jaqaman	*The University of Texas Southwestern Medical Center*	*In situ* Measurement of Inter-Receptor Interaction Kinetics on the Cell Surface
Makkuni Jayaram	*The University of Texas at Austin*	Chemical and Mechanistic Characterization of Complex Active Sites for Phosphoryl Transfer in Nucleic Acids
Jenna Jewell	*The University of Texas Southwestern Medical Center*	Deciphering the Glutamine Signaling Pathway to mTORC1
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 Study of Hh Signaling at the Primary Cilium
Ning Jiang	*The University of Texas at Austin*	A High-Throughput Single-Cell Method to Link Antigen Specificity to T Cell Receptor Sequences
Youxing Jiang	*The University of Texas Southwestern Medical Center*	Structural and Functional Studies of Organellar Cation Channels

PRINCIPAL INVESTIGATOR	INSTITUTION	TITLE OF RESEARCH
Lukasz A. Joachimiak	*The University of Texas Southwestern Medical Center*	Role of Local Structure in Modulating Assembly of Intrinsically Disordered Proteins
Kenneth A. Johnson	*The University of Texas at Austin*	Dynamics of Structural Changes Governing DNA and RNA Replication
Keith P. Johnston	*The University of Texas at Austin*	Controlled Assembly of Inorganic and Organic Nanoparticle Clusters
Matthew Jones	*Rice University*	Dimensionally- and Toplogically-Constrained Nanoparticle Assembly
Richard A. Jones	*The University of Texas at Austin*	Molecular Precursors for New Functional Materials
Karl M. Kadish	*University of Houston*	Electrochemistry and Spectroelectrochemistry of Compounds with Multiple Redox Centers
Adrian T. Keatinge-Clay	*The University of Texas at Austin*	Engineering the Macrolactin Polyketide Assembly Line
Ben Keitz	*The University of Texas at Austin*	Peptide Directed Synthesis of Metal-Organic Frameworks
Thomas C. Killian	*Rice University*	Pump-Probe Spectroscopy of Rydberg-Macromolecule Decay Pathways
Nayun Kim	*The University of Texas Health Science Center at Houston*	Locus-Specific Quantitation of Uracil Associated with Unscheduled DNA Synthesis
Natasha Kirienko	*Rice University*	Structural Determinants of Pyoverdine Chemical Function
Steven A. Kliewer	*The University of Texas Southwestern Medical Center*	Regulation of the Type 2 Diabetes Drug Target PPARγ by Sumoylation
Che Ming Ko	*Texas A&M University*	Theoretical Studies of Heavy Ion Collisions
Jennifer J. Kohler	*The University of Texas Southwestern Medical Center*	Discovering the Glycoconjugate Receptors of Pertussis Toxin
Michael Kolodrubetz	*The University of Texas at Dallas*	Computational Path Integral Approaches to Non-Equilibrium Quantum Systems
Anatoly B. Kolomeisky	*Rice University*	Dynamic Selectivity as a New Concept for Understanding Molecular Transport in Channels
Junichiro Kono	*Rice University*	Optical, Infrared and Terahertz Spectroscopy of Low-Dimensional Materials
Genevieve Konopka	*The University of Texas Southwestern Medical Center*	Chemical Regulation of Human Brain Cell Type Specification
Anna Konovalova	*The University of Texas Health Science Center at Houston*	Mechanism of Signal Transduction Across the Bacterial Cell Envelope
Brian A. Korgel	*The University of Texas at Austin*	Nanocrystal Assemblies
László Kürti	*Rice University*	New Paradigms in Heterocyclic Chemistry
Jaan Laane	*Texas A&M University*	Molecular Structures and Vibrational Potential Energy Surfaces in Ground and Excited Electronic States
Helen C. Lai	*The University of Texas Southwestern Medical Center*	Molecular Interactions of the Prdm12 Transcription Factor Implicated in Painlessness
Keji Lai	*The University of Texas at Austin*	Imaging Chemical Processes in 2D Materials Under Controlled Environment
Alan M. Lambowitz	*The University of Texas at Austin*	Bacterial Reverse Transcriptases: Characterization and Biotechnological Applications

PRINCIPAL INVESTIGATOR	INSTITUTION	TITLE OF RESEARCH
Christy F. Landes	*Rice University*	A Mechanistic Description of Chromatography Separations from a Single Molecule Perspective
Oleg V. Larionov	*The University of Texas at San Antonio*	New Strategies for Efficient and Selective Functionalization of Complex Carbocycles and Heterocycles
Michael Latham	*Texas Tech University*	Uncovering Allosteric Coupling in a DNA Damage Repair Complex with Methyl-Based NMR Spectroscopy
Howard (Ho Wai) Lee	*Baylor University*	Chemical Sensing with Enhanced Raman and Coherent Anti-Stoke Raman Spectroscopy on Epsilon-Near-Zero Metasurfaces
T. Randall Lee	*University of Houston*	Functionalized Xanthates, Dithiocarboxylates, and Dithiocarbamates for Coating Surfaces and Nanoparticles
Guigen Li	*Texas Tech University*	Chiral GAP Catalysts for Asymmetric Reactions
Pingwei Li	*Texas A&M University*	The Structural Basis of RNA Synthesis by Zika Virus
Wei Li	*Rice University*	Exotic Collective Phenomena in Nuclear Chemistry at a Trillion Degrees
Wenbo Li	*The University of Texas Health Science Center at Houston*	Elucidating the Role of m6A Methylation on Enhancer RNAs
Xiaochun Li	*The University of Texas Southwestern Medical Center*	Structure and Function of Sterol-Sensing Domains in Membrane Proteins
Xiaoqin (Elaine) Li	*The University of Texas at Austin*	Charge and Energy Transfer Dynamics in Layered Photocatalysts
David S. Libich	*The University of Texas Health Science Center at San Antonio*	The Structural Biology of EWSR1 and EWS-FLI1 in Biomolecular Condensates
Erez Lieberman Aiden	*Baylor College of Medicine*	Switching DNA Loops on-and-off via dCas9 Blockade of CTCF-Binding Sites
Milo M. Lin	*The University of Texas Southwestern Medical Center*	Accelerating Thermodynamic Sampling to Predict the Toxic Oligomer Structure of Abeta42 in Alzheimer's Disease
Paul A. Lindahl	*Texas A&M University*	Low-Molecular-Mass Zinc, Copper, and Heme Trafficking-Complexes in Biological Cells
Brian M. Lindley	*Baylor University*	The Development of Diborylamide Ligand Platforms for Electrochemical CO_2 Reduction
Stephan Link	*Rice University*	A Single Particle Approach to Plasmon Photochemistry
Alexander R. Lippert	*Southern Methodist University*	Single Molecule Localization Lithography
Glen Liszczak	*The University of Texas Southwestern Medical Center*	Regulation and Function of DNA Damage-Induced Chromatin ADP-Ribosylation
Hung-wen Liu	*The University of Texas at Austin*	Mechanistic Studies of Novel Enzymes
Wenshe Liu	*Texas A&M University*	Novel Chemical Biology Methods for the Synthesis of Ubiquitin and Ubiquitin-Like Protein Conjugation Systems
Xin Liu	*The University of Texas Southwestern Medical Center*	Chromatin Targeting of Polycomb Repressive Complexes
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*	Understanding and Designing Two-Dimensional Electrocatalysts Through Grand-Canonical Quantum-Mechanical Simulations

PRINCIPAL INVESTIGATOR	INSTITUTION	TITLE OF RESEARCH
Jun Lou	*Rice University*	Atomic Layer Enabled Novel Electrochemical Devices for Energy and Biosensing Applications
Carl J. Lovely	*The University of Texas at Arlington*	New Methods for the Total Synthesis of Aminoimidazole-Containing Marine Alkaloids
Vassiliy Lubchenko	*University of Houston*	Bonding and Structural Degeneracy in Incommensurate Phases and Quasicrystals
Lloyd L. Lumata	*The University of Texas at Dallas*	Non-Invasive and Ultrasensitive Detection of Altered Biochemistry in Brain Cancer Using Hyperpolarized 13C Magnetic Resonance
Weibo Luo	*The University of Texas Southwestern Medical Center*	Novel Role of Ubiquitination in Hypoxia-Inducible Factor 1 Transcriptional Activity
Xuelian Luo	*The University of Texas Southwestern Medical Center*	Chemical Inhibition of the Hippo TEAD-YAP Transcription Factors for Cancer Therapy
Nathaniel A. Lynd	*The University of Texas at Austin*	Functional Epoxide Photopolymerization: Fundamentals and Materials Synthesis
Jianpeng Ma	*Baylor College of Medicine*	Exploring the Chemical Forces Stabilizing Human Polycomb Repressive Complex 2
Allan H. MacDonald	*The University of Texas at Austin*	Spintronics in Two-Dimensional Magnetic Materials
Frederick M. MacDonnell	*The University of Texas at Arlington*	Photothermochemical Liquid Hydrocarbon Synthesis from Water and Carbon Dioxide
Ram Madabhushi	*The University of Texas Southwestern Medical Center*	Elaborating the Roles of DNA Breaks in Stimulus-Dependent Gene Transcription in Neurons
Corina Maeder	*Trinity University*	Implication of an Uncharacterized Protein Auto-Cleavage in Spliceosome Assembly Regulation
Dmitrii E. Makarov	*The University of Texas at Austin*	New Methods for Predicting the Kinetics of Complex Molecular Rearrangements
David J. Mangelsdorf	*The University of Texas Southwestern Medical Center*	Characterization of the DAF-12 Signaling Pathway in Parasitic Nematodes
Filippo Mangolini	*The University of Texas at Austin*	Encapsulation of Lubricious Ionic Liquids within Polymer Nanoshells
Arumugam Manthiram	*The University of Texas at Austin*	Synthesis and Properties of Transition Metal Oxides with Unusual Valence States
Amanda B. Marciel	*Rice University*	Synthesis of Polyampholytes via Protein Engineering to Decode Complex Solution Behavior
Edward M. Marcotte	*The University of Texas at Austin*	A Mass-Spectrometry-Based Reference Map of Core Plant Protein Complexes
Caleb D. Martin	*Baylor University*	Heavy Element-Boron Systems: From Unusual Bonding to New Synthetic Tools
Stephen F. Martin	*The University of Texas at Austin*	Synthesis of Biologically Relevant Molecules
Elisabeth D. Martinez	*The University of Texas Southwestern Medical Center*	Development of Epigenetic Inhibitors to Prevent Acquired Drug-Resistance in Malaria
Andreas Matouschek	*The University of Texas at Austin*	Structure and Function of a Nano-Scale Biological Machine
Jeremy A. May	*University of Houston*	Novel Synthetic Methods in Organic Chemistry Derived from Highly Reactive Intermediates

PRINCIPAL INVESTIGATOR	INSTITUTION	TITLE OF RESEARCH
Jennifer A. Maynard	*The University of Texas at Austin*	Control of Protein Folding Quality: Portable Sequence Determinants of Antibody Stability
David G. McFadden	*The University of Texas Southwestern Medical Center*	Mechanism of Action of Neuroendocrine-Selective Cancer Toxins
Jason S. McLellan	*The University of Texas at Austin*	Structural Basis of Host-Pathogen Interactions
Julian Meeks	*The University of Texas Southwestern Medical Center*	Identifying New Mammalian Bile Acid Receptors
Gabriele Meloni	*The University of Texas at Dallas*	Transition Metal Selectivity and Translocation in Transmembrane Ion Pumps
Joshua T. Mendell	*The University of Texas Southwestern Medical Center*	Biochemical and Structural Analysis of the NORAD-PUMILIO Ribonucleoprotein Complex
Quentin Michaudel	*Texas A&M University*	C-C Cross Couplings Enabled by SuFEx Click Chemistry
Ognjen Š. Miljanić	*University of Houston*	Robust Porosity in Molecular Crystals
Delia J. Milliron	*The University of Texas at Austin*	Plasmonic Transparent Conducting Oxide Nanocrystals: Dopant Chemistry and Heterogeneity
Ping Mu	*The University of Texas Southwestern Medical Center*	Small Molecule Inhibitors Targeting Lineage Plasticity and Neuroendocrine Differentiation in Advanced Prostate Cancer
Charles B. Mullins	*The University of Texas at Austin*	Nano-Structured Materials for Chemistry
Siegfried M. Musser	*Texas A&M University Health Science Center*	Physicochemical Properties of FUS Droplets: *In vitro* Models of Liquid-Like Membrane-Less Compartments in Cells
Yunsun Nam	*The University of Texas Southwestern Medical Center*	Structure and Function of microRNA Precursors
Douglas Natelson	*Rice University*	Novel Single- and Few-Molecule Vibrational Spectroscopy and Photochemistry
Andriy Nevidomskyy	*Rice University*	Exotic Phases of Matter in Quantum Spin Ice and Other Frustrated Magnets
Kyriacos C. Nicolaou	*Rice University*	Total Synthesis of Bioactive Natural and Designed Molecules
Deepak Nijhawan	*The University of Texas Southwestern Medical Center*	Target Identification of Compounds that Target Colorectal Cancer Cells with APC Mutations
Michael Nippe	*Texas A&M University*	Novel Dinuclear Transition Metal Complexes for Small Molecule Activation and Conversion
Qian Niu	*The University of Texas at Austin*	Properties and Their Inter-Couplings in 2D Materials
Peter J.A. Nordlander	*Rice University*	Plasmon Enhanced Chemistry
Adam D. Norris	*Southern Methodist University*	New Chemosensory Isoform of a Canonical Mechanosensory Protein
Simon W. North	*Texas A&M University*	Fundamental Imaging Studies of Chemical Reactivity
Kathryn A. O'Donnell	*The University of Texas Southwestern Medical Center*	Regulation of PD-L1 by the Heme Biosynthesis Pathway
Mohammad A. Omary	*University of North Texas*	Dawn Rise Upon New Chemical Bonds Amidst Ground- and Excited-State Bonding Assortments in Luminescent Molecules/Excitons/Polarons
José Onuchic	*Rice University*	The Energy Landscape for Folding and Function of Molecular Motors and Chromatin
Robert C. Orchard II	*The University of Texas Southwestern Medical Center*	Defining the Molecular Mechanisms of Viral Inhibition by TRIM Restriction Factors

PRINCIPAL INVESTIGATOR	INSTITUTION	TITLE OF RESEARCH
Kim Orth	*The University of Texas Southwestern Medical Center*	Biochemical Structures of the Two States of VopQ: Soluble and Membrane-Bound Channel
Oleg V. Ozerov	*Texas A&M University*	Rational Design of Cobalt Catalysts for Coupling Reactions
Zachariah A. Page	*The University of Texas at Austin*	Photochemistry as a Tool to Generate Complex Soft Matter
Jeremy C. Palmer	*University of Houston*	Metastable Liquid-Liquid Phase Transitions and Glass Polymorphism in Tetrahedral Fluids
Sapun H. Parekh	*The University of Texas at Austin*	Imaging *in situ* Lipid Droplet Chemical Heterogeneity in Macrophage Inflammation with Vibrational Microscopy
Jae Mo Park	*The University of Texas Southwestern Medical Center*	Development of Hyperpolarized Probes for Imaging Neurotransmitter Synthesis
Matteo Pasquali	*Rice University*	Physical Chemistry of Nanorods and Nanoplates
Margaret A. Phillips	*The University of Texas Southwestern Medical Center*	Purine Salvage Pathways as Potential Drug Targets in Trypanosomatid Parasites
Lionel W. Poirier	*Texas Tech University*	New Methodologies for Accurate Quantum Calculations of the Dynamics of Atomic Nuclei
David C. Powers	*Texas A&M University*	Synthesis of, and Small-Molecule Activation with, Open-Metal-Site Molecular Clusters
Jai Prakash	*Texas A&M University-Corpus Christi*	Bio-Inspired Multinuclear Manganese Complexes as Water Oxidation Catalysts for Hydrogen Production
B. V. Venkataram Prasad	*Baylor College of Medicine*	X-ray Crystallographic Studies on Viruses and Viral Proteins
Han Pu	*Rice University*	Machine Learning in Quantum Physics and Quantum Chemistry
Tian Qin	*The University of Texas Southwestern Medical Center*	Leveraging the Reactivity of Sulfur in Reaction Development
Emily L. Que	*The University of Texas at Austin*	Chemical Probes for Interrogating Metalloenzyme Activity in Cells and *in vivo*
Arun Radhakrishnan	*The University of Texas Southwestern Medical Center*	Molecular Mechanisms of Cholesterol Sensors in Human Cells
Mark G. Raizen	*The University of Texas at Austin*	Imaging of Surface Chemistry with Neutral Atoms
Frank M. Raushel	*Texas A&M University*	Elucidation of Enzyme Reaction Mechanisms
Joseph M. Ready	*The University of Texas Southwestern Medical Center*	New Directions in Asymmetric Synthesis
Michael Reese	*The University of Texas Southwestern Medical Center*	Unraveling the Non-Canonical Activation Mechanism of Toxoplasma Kinases
Linda E. Reichl	*The University of Texas at Austin*	Quasibound States and Decay Processes in Nanometer Scale Quantum Systems and Fluids
Pengyu Ren	*The University of Texas at Austin*	Multiscale Modeling of RNA 3D Structure and Folding
Peter M. Rentzepis	*Texas A&M University*	Ultrafast Time and Space Structural Dynamics in Solids. Efficient, Remote Detection and Inactivation of Pathogens
Luke M. Rice	*The University of Texas Southwestern Medical Center*	Biochemical and Structural Analysis of TOG Domains in Microtubule Regulation
Michael G. Richmond	*University of North Texas*	Synthesis and Reactivity Studies of Polynuclear Clusters
Jeffrey D. Rimer	*University of Houston*	Physicochemical Factors Governing Molecular Modification of Calcium Oxalate Crystallization

PRINCIPAL INVESTIGATOR	INSTITUTION	TITLE OF RESEARCH
Jose RizoRey	*The University of Texas Southwestern Medical Center*	NMR Methods to Study Membrane Proteins in Lipid Bilayers
Sean T. Roberts	*The University of Texas at Austin*	Repackaging Electronic Energy with Molecular Semiconductors
Jacob T. Robinson	*Rice University*	Molecular Mechanisms for Magnetically Sensitive Ion Channels
Debora F. Rodrigues	*University of Houston*	Plant-Based Antibiotic Nanocarriers Investigation in the Simultaneous Reduction of Pathogen Mutation Rates and Intestinal Infections in Humans
Daniel Romo	*Baylor University*	Novel Strategies for β-Lactone Synthesis and Annulation to Impact Basic Cell Biology
Michael J. Rose	*The University of Texas at Austin*	Earth Abundant Elements for Energy Related Energy Conversions
Michael K. Rosen	*The University of Texas Southwestern Medical Center*	2D Phase Separated Protein Polymers: Interactions with Actin Filaments
Daniel M. Rosenbaum	*The University of Texas Southwestern Medical Center*	Capturing the Active Conformations of CNS GPCRs with Nanobodies
Peter Rossky	*Rice University*	Understanding Conjugated Polymer Aggregation and Optoelectronic Properties via Multiscale Simulation
Tomce Runcevski	*Southern Methodist University*	Exploring the Organic Mineralogy of Titan, Saturn's Moon
Rick Russell	*The University of Texas at Austin*	Quantitative Tests of Modularity in a Helicase Protein that Resolves Misfolded RNAs
Livia Schiavinato Eberlin	*The University of Texas at Austin*	Understanding and Optimizing Molecular Extraction and Ionization Mechanisms in Solvent Based Ambient Ionization Mass Spectrometry
Sandra L. Schmid	*The University of Texas Southwestern Medical Center*	Structure and Function of the Clathrin Terminal Domain: An Endocytic Hub
John W. Schoggins	*The University of Texas Southwestern Medical Center*	Biochemical Characterization of a Novel Antiviral RNA Binding Protein
Hans A. Schuessler	*Texas A&M University*	Optical Studies of Atomic and Molecular Systems with Femtosecond, XUV and IR Laser Radiation
Marlan O. Scully	*Texas A&M University*	Experimental and Theoretical Research into Quantum Chemistry and Quantum Optics
Jonathan T. Sczepanski	*Texas A&M University*	Synthesis and Applications of DNA-Encoded Libraries of Mirror-Image RNA
Joachim Seemann	*The University of Texas Southwestern Medical Center*	Biochemical and Structural Analysis of Golgi-Based Spindle Assembly Activities
Irina I. Serysheva	*The University of Texas Health Science Center at Houston*	Cryo-EM Analysis of Ion Channels in a Lipid Membrane
Libo Shan	*Texas A&M University*	Biochemical and Regulatory Constraints of Immune Sensors
Bryan F. Shaw	*Baylor University*	The Dark Side of "Wild Type" Cu, Zn SOD1 in Motor Neuron Disease: Metal Snatcher or Prion Template?
Jason B. Shear	*The University of Texas at Austin*	Development of Micro-3D-Printed Optical Fiber Probes for Remote Characterization of Complex Bio-Environments
Matthew Sheldon	*Texas A&M University*	Defining Chemical Reaction Pathways via Resonant Thermal Substrates

PRINCIPAL INVESTIGATOR	INSTITUTION	TITLE OF RESEARCH
Benjamin D. Sherman	*Texas Christian University*	Monolithic Tandem Photoelectrodes for Solar Driven Organic Conversions or Water Oxidation Coupled to Hydrogen Formation
A. Dean Sherry	*The University of Texas at Dallas*	Shift Reagents for MRI Detection of Specific Metabolites
Chih-Kang Shih	*The University of Texas at Austin*	Controlling Interlayer Electronic Interactions in Transition Metal Dichalcognide Hetero-Bilayers
Michael Shiloh	*The University of Texas Southwestern Medical Center*	Activation of Nociceptive Neurons by a Mycobacterial Bioactive Lipid
Qimiao Si	*Rice University*	Theoretical Studies of Electronic Correlations and Dynamics in Carbon-Based and Related Low Dimensional Systems
Matthew H. Sieber	*The University of Texas Southwestern Medical Center*	Examination of the Mitochondrial Mechanisms that Drive Quiescence and the Re-Initiation of Growth
Daniel J. Siegwart	*The University of Texas Southwestern Medical Center*	Design and Synthesis of Activatable pH-Responsive Water Soluble Dyes for Biomedical Imaging
Myles W. Smith	*The University of Texas Southwestern Medical Center*	Enantioselective Diketone Desymmetrization for the Synthesis of Chiral Heterocycles
Alexei V. Sokolov	*Texas A&M University*	Ultrafast Coherent Molecular Spectroscopy with Spatially and Temporally Shaped Electromagnetic Fields
Dong Hee Son	*Texas A&M University*	Mn-Doped Cesium Lead Halide Perovskites as the New Magnetically-Doped Quantum Dots
Anju Sreelatha	*The University of Texas Southwestern Medical Center*	AMPulation of Manganese Superoxide Dismutase by Selenoprotein O
Jeanne C. Stachowiak	*The University of Texas at Austin*	Protein Liquid Droplets as Dynamic Supramolecular Catalysts for *in situ* Self-Assembly in Cells
Mihaela C. Stefan	*The University of Texas at Dallas*	Functionalized Polycaprolactones for Delivery of Anticancer Drugs
Francois St-Pierre	*Baylor College of Medicine*	Developing an Expanded Color Palette of Fluorescent Voltage Sensors with Optimized Photochemistry
WuPei Su	*University of Houston*	Direct Phasing in Macromolecular Crystallography
Ruhma Syeda	*The University of Texas Southwestern Medical Center*	Probing the Mechanism of SWELL Response to Osmotic Stress and Ionic Strength
Jerzy O. Szablowski	*Rice University*	Engineering a New Class of Site-Specific Therapeutics for Brain Disorders
Daniel P. Tabor	*Texas A&M University*	Mapping the Structure and Formation of Aerosols Through Theoretical Spectroscopy and Multiscale Simulation
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*	Stereoselective Transformations of Alkynes
Yizhi Jane Tao	*Rice University*	Structure and Function of the Influenza A Virus Ribonucleoprotein Complex
David Taylor	*The University of Texas at Austin*	Chemical Insights into Substrate Cleavage by CRISPR-Cascade
Thomas S. Teets	*University of Houston*	New Synthetic Strategies for Cyclometalated Iridium Complexes

PRINCIPAL INVESTIGATOR	INSTITUTION	TITLE OF RESEARCH
Jonathan R. Terman	*The University of Texas Southwestern Medical Center*	Chemistry and Enzymology of MICAL Family Oxidoreductases
Randolph P. Thummel	*University of Houston*	Cyclotetrapyridines and Related 6-5 Chelators
ChinSen Ting	*University of Houston*	Superconductivity in Doped Fe(Se,Te) and Other Correlated Electron Materials
Frank K. Tittel	*Rice University*	Investigation of Quartz Enhanced Spectroscopy (QEPAS) to Trace Gas Detection via Autonomous Networked Drones
Zachary J. Tonzetich	*The University of Texas at San Antonio*	Earth-Abundant Transition Metal Catalysts Supported by Pincer Ligands
James M. Tour	*Rice University*	Molecular Machines Open Cell Membranes and Kill Cancer Cells with Visible Light
Eszter Trufan	*University of Houston-Downtown*	Synthesis and Characterization of New Ball-Type Phthalocyanines
Thomas M. Truskett	*The University of Texas at Austin*	Liquids Near Interfaces: Single-Molecule and Collective Dynamics
Francis T.F. Tsai	*Baylor College of Medicine*	Structural and Mechanistic Studies of NTP-Dependent Stress Proteins
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*	Metabolic Functions of Autophagy
Emanuel Tutuc	*The University of Texas at Austin*	Correlated Electrons in Controlled Moire Patterns of Two-Dimensional Materials
Adam R. Urbach	*Trinity University*	Supramolecular Studies of Intrinsically Disordered Polypeptides
Rafael Verduzco	*Rice University*	Charge Transport in Conjugated Ladderphanes and Network-Stabilized Conjugated Polymers
Eric J. Wagner	*The University of Texas Medical Branch*	Biochemical and Structural Investigation of Integrator
Yihong Wan	*The University of Texas Southwestern Medical Center*	Novel Biochemical Mechanisms for Maternal Milk Regulation of Offspring Traits
Fei Wang	*The University of Texas Southwestern Medical Center*	Mechanistic Dissection of a Novel Meiotic Exit Regulation by Autophagy
Haotian Wang	*Rice University*	Isolated Transition Metal Single Atomic Sites for Selective CO_2 Reduction
Meng C. Wang	*Baylor College of Medicine*	Chemical Imaging of Glutathione Spatiotemporal Dynamics During Aging
Qinghua Wang	*Baylor College of Medicine*	Chemical Mechanisms of Human Adaptation of Influenza Virus
Weiwei Wang	*The University of Texas Southwestern Medical Center*	Molecular Mechanism and Functional Significance of the Mammalian Heteromeric Glycine Receptor and its Interaction with Scaffolding Protein Gephyrin
Yingfei Wang	*The University of Texas Southwestern Medical Center*	Biochemical Characterization of PAAN
Yuhong Wang	*University of Houston*	The Kinetics and Conformational Changes During the Peptidyl Transferase Reaction in Single Ribosomes

PRINCIPAL INVESTIGATOR	INSTITUTION	TITLE OF RESEARCH
Zhao Wang	*Baylor College of Medicine*	Determining Chemical Interactions Mediating Biological Complex Formation by Cryo-EM
Aryeh Warmflash	*Rice University*	Embryonic Patterning as a Reaction-Diffusion System
Coran Watanabe	*Texas A&M University*	Streptomyces sahachiroi: A Rich Treasure Trove of Unique Biosynthetic Reactions
Benjamin P. Weaver	*The University of Texas Southwestern Medical Center*	Regulation of Non-Canonical Caspase Functions by Distinct Protein Complexes
Lauren J. Webb	*The University of Texas at Austin*	Do Electrostatic Fields at the Ras-Effector Interface Direct Normal Versus Pathological Function?
Geoff Wehmeyer	*Rice University*	Probing Anharmonic Atomic Bonding Using Thermal Phonon Mean Free Path Spectroscopy
R. Bruce Weisman	*Rice University*	Optical Properties and Processes of Carbon Nanotubes
Alexander H. Weiss	*The University of Texas at Arlington*	New Method for the Chemical Characterization of the Internal Surfaces of Porous Materials
Kenneth D. Westover	*The University of Texas Southwestern Medical Center*	Covalent Targeting of SRC Kinase
Christian P. Whitman	*The University of Texas at Austin*	Structure Function Relationships in Enzymes
C. Grant Willson	*The University of Texas at Austin*	Programmed Self-Assembly of Nanostructures
Lon J. Wilson	*Rice University*	Carbon Nanotube Capsules for Advanced Theranostic Applications
Sebastian E. Winter	*The University of Texas Southwestern Medical Center*	Respiration-Driven Changes in the Gut Microbiome During Inflammation
Jeffrey B. Woodruff	*The University of Texas Southwestern Medical Center*	Molecular Rules Determining Centrosome Composition
Jiang Wu	*The University of Texas Southwestern Medical Center*	Tumor Suppression Function of Brg1/SMARCA4 is Disrupted by DCLK1-Mediated Phosphorylation
Han Xiao	*Rice University*	Genetic Incorporation of Fluorogenic Amino Acids
Chong Xie	*The University of Texas at Austin*	Probing the *in vivo* Chemistry in the Behaving Brain
Jian Xu	*The University of Texas Southwestern Medical Center*	*In Situ* Analysis of the Structure-Function of Transcriptional Enhancers
Boris I. Yakobson	*Rice University*	Science of Nearly-1D Materials: From Nanotubes to Nanowires
Ding-Shyue Yang	*University of Houston*	Ultrafast Electron Crystallography and Femtosecond Spectroscopy of Structural Transformation Dynamics in Transition Metal Systems
Jin Ye	*The University of Texas Southwestern Medical Center*	Chemical Reactions Controlling Ferroptosis
Hsin-Chih Yeh	*The University of Texas at Austin*	NanoCluster Beacons for Highly Specific DNA Methylation Detection
Sherry J. Yennello	*Texas A&M University*	Investigating the Equation-of-State for a Two-Component Nuclear System
Ming Yi	*Rice University*	Tuning Complex Quantum Phases One Parameter at a Time

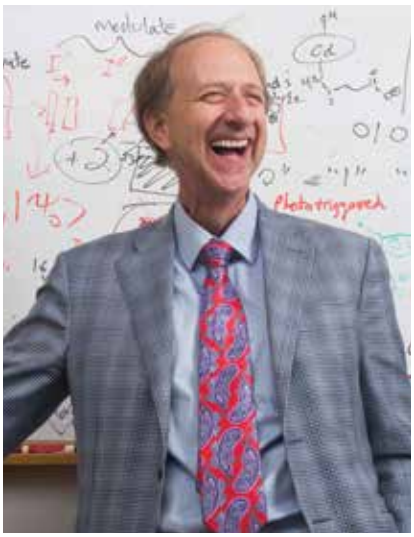
PRINCIPAL INVESTIGATOR	INSTITUTION	TITLE OF RESEARCH
Seung-hee Yoo	*The University of Texas Health Science Center at Houston*	A FAD-Driven Biochemical Oscillation Governing CRYPTOCHROME Turnover
Guihua Yu	*The University of Texas at Austin*	Probing the Charge Storage Mechanisms of Molecularly-Assembled Two-Dimensional Inorganic Solids
Hongtao Yu	*The University of Texas Southwestern Medical Center*	Biochemical and Structural Analysis of Cohesion and Its Regulators
Yonghao Yu	*The University of Texas Southwestern Medical Center*	Mass Spectrometric Analysis of the Cross-Talk Between Protein ADP-Ribosylation and Phosphorylation
Anvar A. Zakhidov	*The University of Texas at Dallas*	Photochemistry of Nanoimprinted Hybrid Perovskites for Photovoltaics
Melissa L. Zastrow	*University of Houston*	Cofactor-Based Fluorescent Proteins as Platforms for New Zinc Ion Sensors
Chun-Li Zhang	*The University of Texas Southwestern Medical Center*	Chemical Regulation of Human Motor Neurons
Junjie Zhang	*Texas A&M University*	Functions of Unique Structures in Mycobacterium Tuberculosis Translation
Renyi Zhang	*Texas A&M University*	Chemical Kinetics and Mechanism of Hydrocarbon Oxidation Reactions
Xiuren Zhang	*Texas A&M University*	Biochemical Basis of SWI/SNF ATPase in Remodeling RNA Complexes
Xuewu Zhang	*The University of Texas Southwestern Medical Center*	Structural and Functional Analyses of the BCCIPβ/RPL23 Complex
Yan Jessie Zhang	*The University of Texas at Austin*	Visualization of the Incorporation of Molecular Oxygen in Endoperoxide Bond Formation Using Time-Resolved X-ray Crystallography
John C.-G. Zhao	*The University of Texas at San Antonio*	Expeditious Modification of Organocatalyst Structures for Improved Stereoselectivities
Alexey M. Zheltikov	*Texas A&M University*	Multimodal Chemically Selective Optical Imaging and Fiber-Optic Thermometry
Jie Zheng	*The University of Texas at Dallas*	Unravelling Charge Selectivity in the Glomerular Filtration of Ultrasmall Engineered Nanoparticles at the Chemical Level
Yubin Zhou	*Texas A&M University Health Science Center*	Chemical Biology Toolkit for Remote Control of 3D Genome Architecture

Endowed Chairs

The Welch Foundation endows 48 chairs at 21 institutions.

INSTITUTION	CHAIRHOLDER AND CHAIR NAME
Baylor College of Medicine	David D. Moore, The R. P. Doherty, Jr.-Welch Chair in Science
Baylor College of Medicine	Theodore G. Wensel, Welch Chair in Chemistry
Baylor College of Medicine	Thomas Westbrook, Welch Chair in Chemistry
Baylor University	John L. Wood, Welch Chair in Chemistry
Rice University	Gustavo E. Scuseria, Welch Chair in Chemistry
Rice University	Peter Wolynes, The D. R. Bullard-Welch Chair in Science
*Rice University**	The Charles W. Duncan, Jr.-Welch Chair in Chemistry
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 Joe 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**	Welch Chair in Chemistry
Texas Tech University Health Sciences Center	Vadivel Ganapathy, Welch Chair in Biochemistry
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
The University of Texas at Arlington	Daniel W. Armstrong, Welch Distinguished University Chair in Chemistry
The University of Texas at Austin	Eric V. Anslyn, Welch Regents Chair in Chemistry
The University of Texas at Austin	Allen J. Bard, The Norman Hackerman-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	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

**Chair not filled*



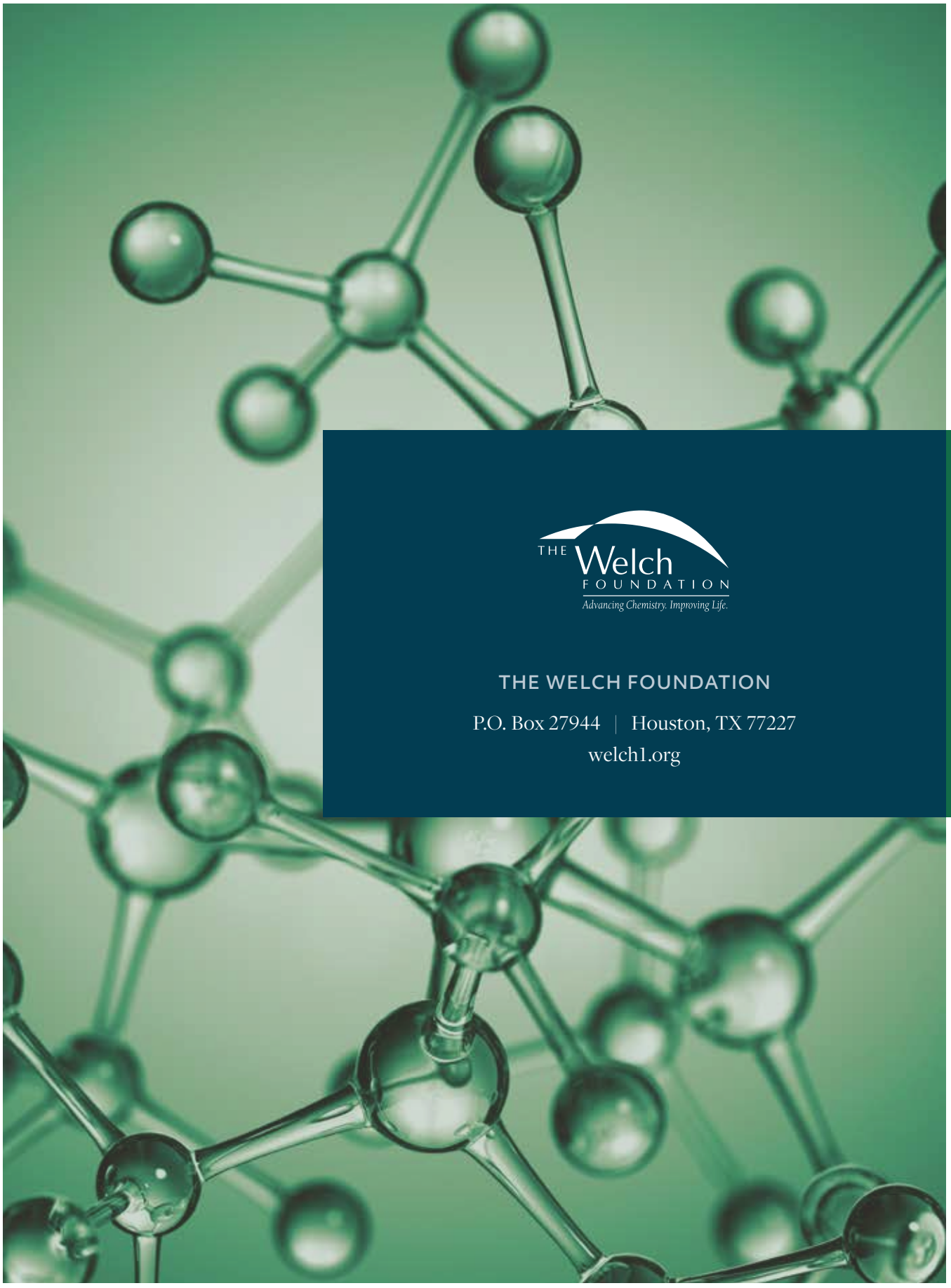
Roderic I. Pettigrew | Jonathan L. Sessler | Theodore G. Wensel (right)

INSTITUTION	CHAIRHOLDER AND CHAIR NAME
The University of Texas at Austin	Steven Weinberg, The Jack S. Josey-Welch Chair in Science
*The University of Texas at Austin**	The Richard J.V. Johnson-Welch Regents Chair in Chemistry
*The University of Texas at Austin**	Norbert Dittrich-Welch Chair in Chemical Engineering
The University of Texas at Dallas	Ray H. Baughman, Welch Chair in Chemistry
The University of Texas at Dallas	Vladimir Gevorgyan, Welch Chair in Chemistry
The University of Texas at El Paso	Luis Echegoyen, Welch Chair in Chemistry
The University of Texas at San Antonio	Kirk S. Schanze, Welch Distinguished University Chair in Chemistry
*The University of Texas at San Antonio**	Welch 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 M. D. Anderson Cancer Center	Andrew Futreal, Welch Chair in Chemistry
The University of Texas M. D. Anderson Cancer Center	John A. Tainer, 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

Departmental Grants

The Welch Foundation funds 39 institutions and 481 trainees.

INSTITUTION	PARTICIPATING FACULTY	CHEMICAL RESEARCH TRAINEES
Abilene Christian University (Abilene)	6	12
Angelo State University (San Angelo)	6	1
Austin College (Sherman)	6	7
Hardin-Simmons University (Abilene)	2	3
Houston Baptist University (Houston)	2	5
Huston-Tillotson University (Austin)	1	5
Jarvis Christian College (Hawkins)	3	7
Lamar University (Beaumont)	11	33
LeTourneau University (Longview)	2	3
Lubbock Christian University (Lubbock)	4	9
McMurry University (Abilene)	2	8
Midwestern State University (Wichita Falls)	5	9
Our Lady of the Lake University (San Antonio)	2	2
Prairie View A&M University (Prairie View)	11	8
St. Edward's University (Austin)	4	8
St. Mary's University (San Antonio)	4	7
Sam Houston State University (Huntsville)	12	20
Schreiner University (Kerrville)	2	4
Southwestern University (Georgetown)	7	14
Stephen F. Austin State University (Nacogdoches)	12	24
Tarleton State University (Stephenville)	7	13
Texas A&M University-Commerce (Commerce)	6	10
Texas A&M University-Corpus Christi (Corpus Christi)	10	5
Texas A&M University-Kingsville (Kingsville)	11	29
Texas Lutheran University (Seguin)	3	6
Texas Wesleyan University (Fort Worth)	3	9
Texas Woman's University (Denton)	7	37
Trinity University (San Antonio)	9	10
University of Dallas (Irving)	2	4
University of Houston-Clear Lake (Houston)	7	5
University of Houston-Downtown (Houston)	10	25
University of Mary Hardin-Baylor (Belton)	3	9
University of St. Thomas (Houston)	5	24
The University of Texas at Tyler (Tyler)	14	25
The University of Texas of the Permian Basin (Odessa)	5	22
The University of Texas Rio Grande Valley (Edinburg)	19	35
University of the Incarnate Word (San Antonio)	3	12
Wayland Baptist University (Plainview)	2	3
West Texas A&M University (Canyon)	5	9



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