

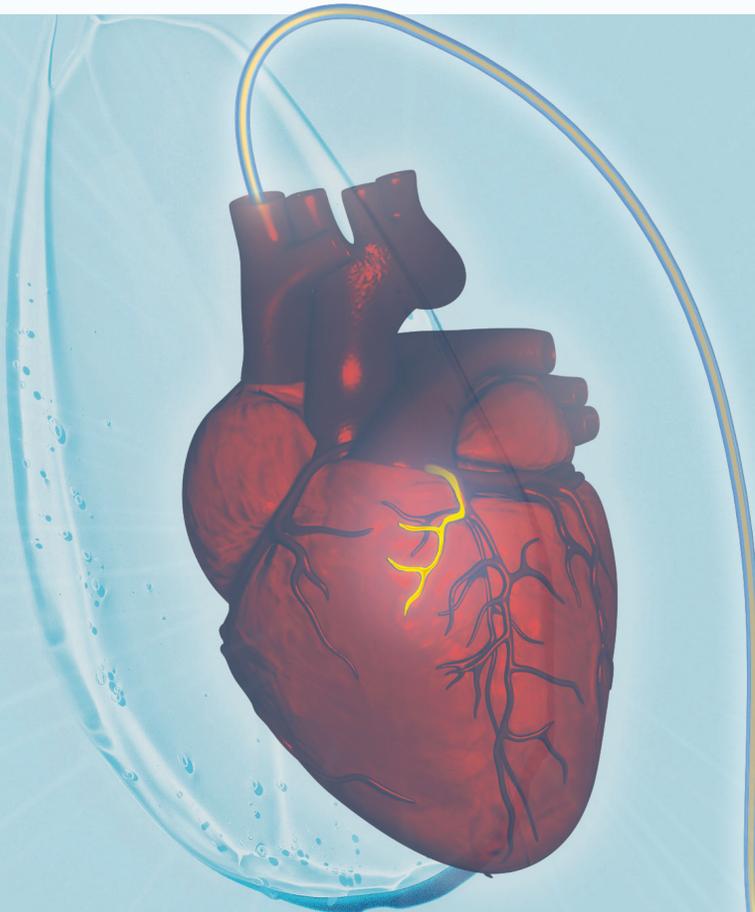


The University of Texas at Austin  
**Biomedical Engineering**  
*Cockrell School of Engineering*

2022-2023

# PULSE

AN ANNUAL PUBLICATION OF THE DEPARTMENT OF BIOMEDICAL ENGINEERING



**HYDROGELS  
& HEART HEALTH**  
**EVOLUTION OF BIOMATERIALS**  
MORE ON PAGE 8

Two Students Receive AHA  
Predoctoral Fellowships  
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Stachowiak Honored for  
Membrane Curvature Research  
Pg 12

## FROM THE CHAIR



**DEAR FRIENDS,** In my first year as chair of the Department of Biomedical Engineering UT Austin, I'm thrilled to witness the development of innovative healthcare technology and nationally recognized translational research across our four research areas.

Our faculty and graduate students continue to advance our strategic vision of improving healthcare delivery and exemplifying the words commonly heard across the UT campus: "What starts here changes the world."

Throughout this past year, we have seen faculty elected as Fellows of the American Association for the Advancement of Sciences (AAAS) and the American Chemical Society Division of Polymeric Materials: Science and Engineering (ACS PMSE), a recipient of the Biomaterials Global Impact Awards, esteemed recognition from the Biophysical Society, and recognition for lifelong dedication to mentorship.

Two of our faculty members were promoted to full professors, and several researchers received major funding awards for further discovery in the fields of membrane biophysics, brain-machine interface, optogenetics, and hydrogels.

We attract undergraduate students that graduate in the top 5 percent of their class and our state-of-the-art labs provide them with unique, functional learning experiences. This year we had an undergraduate student named an NIH scholar, one of only 15 students nationwide chosen as part of the Undergraduate Scholarship Program.

Our graduate students and postdoctoral researchers received awards and support from the American Heart Association, National Science Foundation, National Cancer Institute, and the African-American Advancement Group. Many undergraduate students blossomed in their biomedical engineering careers at employers such as Biosense Webster, Medtronic, Merck, and GE Healthcare.

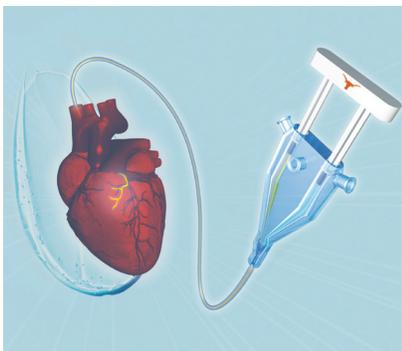
In this issue, I am pleased to share with you an overview of our department that outlines why we are a part of the seventh-best engineering school in the country with a biomedical engineering department ranked among the top three in the state of Texas.

A handwritten signature in black ink that reads "Tyrone Porter".

**TYRONE M. PORTER**

Chair, Department of Biomedical Engineering  
Donald J. Douglass Centennial Professorship in Engineering

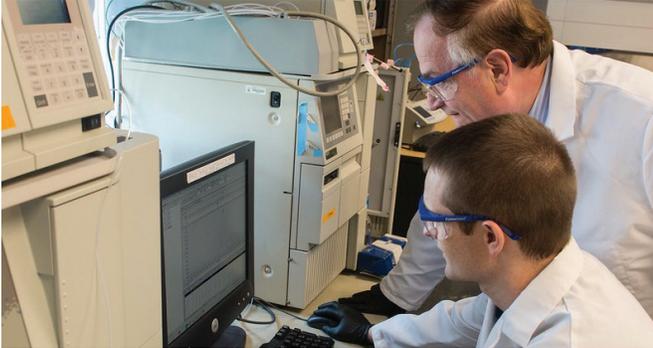
## ON THE COVER



Hydrogels injected into a heart using a divided catheter reveal a new, potential treatment to prevent fatal heart arrhythmias through the creation of a conductive and flexible plastic wire.

**More on page 8**

# AIMBE MENTORING AWARD TO PEPPAS



The American Institute for Medical and Biological Engineering (AIMBE) awarded UT Austin biomedical engineering professor Nicholas Peppas the Professional Impact Award for Mentoring during its annual meeting.

AIMBE leaders recognized Peppas for his impact on the field through outstanding mentoring of students and early-career faculty.

Peppas is an internationally-known educator, mentor and research leader in the fields of biomaterials, controlled release, and bionanotechnology. Recognized as the father of hydrogel chemistry and physics, Peppas pioneered molecular design and 3D cross-linked network preparation that swell in water or biological fluids to become hydrogels.

Peppas has educated more than 5,000 undergraduate and graduate students. His educational and research accomplishments and seminal contributions to the biomaterials field have been honored by seven honorary doctorates, four honorary professorships, and more than 170 international awards, including the highest recognitions from the National Academy of Engineering (Founders Award), the National Academy of Medicine (Adam Yarmolinsky Award), the American Institute of Chemical Engineers (the William H. Walker Award, the Institute Lecture), the Society for Biomaterials, and more.

*While his impact and legacy on the field are stellar due to his own outstanding research and educational achievements, the impact is further magnified through the successes of his students, his academic "grandchildren," the rest of his academic family tree, and his numerous other mentees. ■*

# FACULTY UPDATES

Our faculty are gaining recognition for their innovative research and contributions to the field.

## NICHOLAS PEPPAS

received the 2022 Biomaterials Global Impact Award during the Annual Conference of the European Society of Biomaterials.



## Professors NANSHU LU and NICHOLAS PEPPAS

made Clarivate's 2022 Highly Cited Researchers list. They are among 31 global research scientists and social scientists from UT Austin who have demonstrated exceptional influence in their fields.



The Council of the American Association for the Advancement of Science (AAAS) elected professor of biomedical engineering **PENGYU REN** as a 2022 AAAS Fellow.



## JAMES TUNNELL,

whose research focuses on biomedical optical spectroscopy, and **JEANNE STACHOWIAK**, an expert in biological membranes and biophysics, were promoted to the rank of full professor.



CELEBRATING OUR FIRST ACADEMY OF

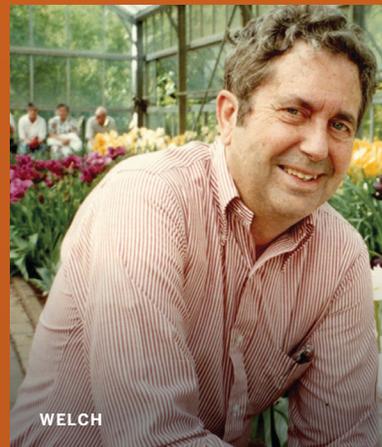
# DISTINGUISHED BIOMEDICAL ENGINEERS

*This historic occasion recognizes Texas Engineers who made a considerable contribution to the field of biomedical engineering and UT Austin.*



#### CONSIDER GIVING

In order to ensure that the Academy of Distinguished Biomedical Engineers is self-sustaining, the department relies on charitable contributions from the community and our alumni. Please consider sponsoring the academy so that we may continue to honor and recognize the important contributions of our exceptional engineers in the years to come.



### CHRIS CONDIT

#### Senior Product Manager at Saluda Medical

Chris Condit is a dedicated philanthropist and biomedical entrepreneur. With no undergraduate degrees in biomedical engineering at the time, Condit majored in electrical engineering with an emphasis on biomedical. He is a recipient of the Outstanding Young Engineering Graduate award from the Cockrell School. Condit developed patented intellectual property with UT Austin professor Tom Milner and his startup CardioSpectra. Partly inspired by his own battle surviving Hodgkin's lymphoma as a child, Condit founded Texas 4000 — an annual charity bike ride to support cancer research.

### KENNETH DILLER

#### Professor, Department of Biomedical Engineering at The University of Texas at Austin

Ken Diller has been an engineering professor at UT Austin since 1973. He is the founding chair of the Department of Biomedical Engineering, and he was chair of the Walker Department of Mechanical Engineering — administrative appointments that spanned a 19-year period. He is an internationally recognized authority in heat and temperature-related processes in living tissues and their design applications for therapeutic devices. Students describe Ken as someone who genuinely cares about every person he teaches and one of the most interesting people they have ever met.

### CASEY FOX

#### Chief Executive Officer and Chief Technical Officer Metric Medical Devices, Inc.

Casey Fox is a pioneer in research focusing on bone healing and osteoporosis. He has several global patents and FDA clearances to market the orthopedic products stemming from his inventions. A recipient of the Distinguished Engineering Graduate award from Cockrell, Fox has held administrative and faculty positions over the last 30 years at UT Austin and academic institutions nationwide.

### CHRISTINE SCHMIDT

#### University of Florida J. Crayton Pruitt Family Department of Biomedical Engineering Chair

Christine Schmidt was a professor of both biomedical engineering and chemical engineering at UT Austin. She was one of the most highly

cited researchers in her field for two years and the inaugural recipient of the Chairmen's Distinguished Life Sciences Award for achievements in neural engineering. Schmidt is known for her impactful research contributions that promote diversity in the engineering workforce.

### AZITA SHARIF

#### Founder and Chief Executive Officer of DSI- Precision Medicine Biobanking & BINDS (Bio-Informatics Network for Discovery Science)

Azita Sharif is a biotechnology entrepreneur with strong cross-functional expertise in engineering and medicine. She summarizes her goal as: "To positively impact human and public health using engineering with focus on analytical preventive medicine." Her company, DSI, provides technology services beneficial to both the organ transplant and biobanking sectors. The academy selected Sharif for her dedication to shine a light on the importance of food safety and transparency to prevent cancer and other chronic illnesses.

### RICHARD SMALLING

#### Cardiovascular Medicine Professor & Division of Cardiology Director at UT Health Houston

Dr. Richard Smalling specializes in the treatment of valvular heart disease and adult congenital heart disease. Named an America's Top Doctor for the past 15 years, Dr. Smalling received the Distinguished Service Award from the American Heart Association Texas Affiliate. He holds six patents and co-founded Windmill Cardiovascular Systems. Dr. Smalling has dedicated more than 50 years of his life to the advancement of cardiovascular care, technology, and treatment.

### A.J. WELCH

#### UT Austin Department of Biomedical Engineering Professor (1933-2022)

Ashley James (A.J.) Welch was a leading biophotonics researcher with an expertise in biomedical applications for lasers. He served on UT Austin's Biomedical Engineering Committee in the late 60s and early 70s, allowing graduate students to earn degrees in and providing the foundation to establish the Biomedical Engineering Department in 2001. The academy selected Welch for his everlasting legacy of fundamental research and influences that carry on in the lives of students he mentored and colleagues with whom he worked. ■



# BELONG

## AMONG BME PROGRAMS AWARDED COCKRELL DEI SEED GRANTS

The Cockrell School of Engineering kicked off its first-ever diversity, equity, and inclusion (DEI) Seed Grants program this year and awarded four biomedical engineering programs for their efforts.

The DEI Seed Grants program is an initiative under the Cockrell School's new National Science Foundation-funded Center for Equity in Engineering. The initiative supports seed grants ranging between \$3,000 to \$5,000 for projects that aim to promote DEI.

The goal of these staff-student partnerships is to improve the engineering community for all levels of education, research focus areas, and personal backgrounds.

The Biomedical Engineering Learning and Networking Group (BELong) fosters an environment where students and faculty can learn from each other's experiences and be successful, inside and outside of the classroom, according to its founder Brittain Sobey, biomedical engineering academic advising coordinator.

**"BELONG IS HERE TO CONNECT FRESHMEN AND SOPHOMORES WITH SENIOR STUDENT MENTORS, FACULTY, AND STAFF TO PURSUE ACADEMIC SUCCESS AND CULTIVATE AN INCLUSIVE ENGINEERING COMMUNITY WITHIN THE DEPARTMENT OF BIOMEDICAL ENGINEERING," SAID SOBEY.**

Faculty advisor Laura Suggs said her years of experience with other mentoring programs helped her realize the tremendous benefits BELoNG

can offer, and she hopes the program will help students find a BME family and home — an effort that is already paying off.

"In my freshman year, I didn't know many people, and I did not have a good support group," said BELoNG peer advisor Christian Kocian. In my spring semester, I met some of the upperclassmen who made me feel like I belonged in a family in BME and they went out of their way to make me feel like I belonged. That had a huge impact in my life, I performed better in my classes, and the experience made me want to do the same for others. When I first heard about BELoNG, I said to myself 'I want to do this with all of my heart.'" ■

### OTHER BME PROGRAM RECIPIENTS:

- **Emerging Leaders in Engineering Seminar Series**, Mykel Green (postdoc)
- **BME Peer-Led Teaching Assistant Support**, Nikhith Kalkunte (graduate student)
- **Neuroengineering Research and Science Ambassador Experience for Cockrell Undergraduates**, Rodrigo Osuna Orozco (postdoc); Samantha Santacruz (faculty)

For more information: [bit.ly/BELoNG](https://bit.ly/BELoNG)

# BME STUDENTS WIN NSF FUNDING

Eight students in the Department of Biomedical Engineering and several admitted prospective graduate students received 2023 National Science Foundation Graduate Research Fellowship Program (GRFP) awards that will allow them to pursue graduate studies in the field of biomedical engineering.

## OUR CURRENT AWARDEES:



Artman

**BRINKLEY ARTMAN** is a first-year graduate student working with **Evan Wang**.

Nkanasah



Kamatar

**ADVIKA KAMATAR** is a second-year graduate student, working with **Jeanne Stachowiak** and **Sapun Parekh**.



Patel

**ABBEY NKANSAH** is a second-year graduate student, working with **Elizabeth Cosgriff-Hernandez**.



Singer

**RESHMI PATEL** is a first-year graduate student, working with **Tom Yankeelov**. Patel is also an Imaging Science Fellow.

**BREAHNA SINGER** is a first-year graduate student, working with **Stephanie Seidlits**.

Tripathi



**SANI TRIPATHI** is a first-year graduate student, working with **James Tunnell**. Tripathi is also an Imaging Science Fellow.



Zinga

**KETSIA ZINGA** is a second-year graduate student, working with **Jeanne Stachowiak** and **Pengyu Ren**.

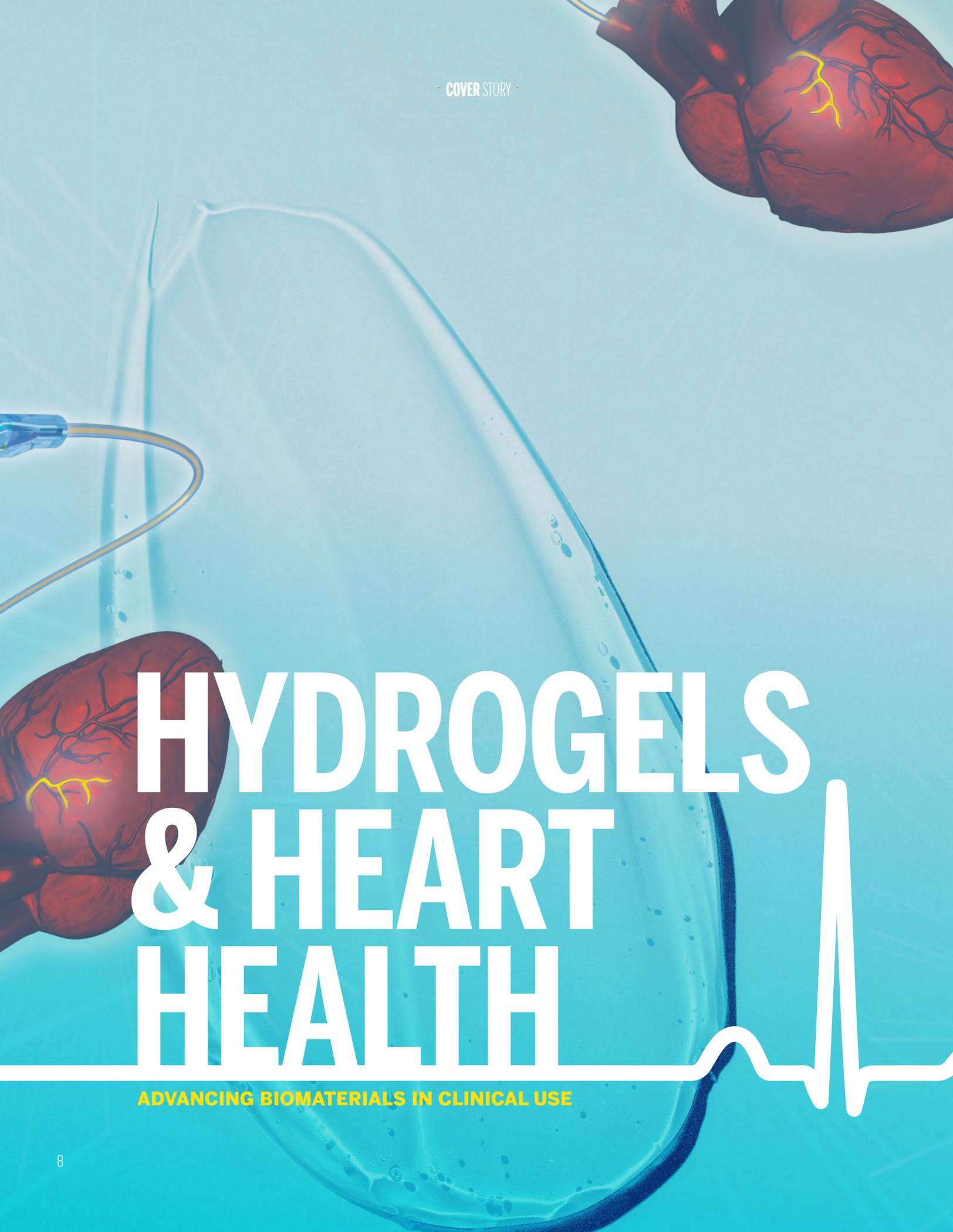
One current biomedical engineering undergraduate student and one alumnus also received awards. **Aditi Merchant** is a senior within the department, and **Jordyn Wyse** received their Bachelor of Science in biomedical engineering from UT Austin in 2021.

Four prospective graduate students are among the awardees. And, senior undergraduate **Aislinn Hurley** received honorable mention.

The GRFP aims to ensure the quality, vitality, and diversity of the scientific and engineering workforce of the United States. The GRFP seeks to broaden participation in science and engineering of underrepresented groups, including women, minorities, persons with disabilities, and veterans.

**THE FIVE-YEAR FELLOWSHIP PROVIDES THREE YEARS OF FINANCIAL SUPPORT INCLUSIVE OF AN ANNUAL STIPEND OF \$37,000. ■**

COVER STORY



# HYDROGELS & HEART HEALTH

ADVANCING BIOMATERIALS IN CLINICAL USE



**A personal connection to the leading cause of death worldwide, combined with a quest for research results to move from the bookshelf into the doctor's office, resulted in a unique partnership and innovative cardiovascular treatment concept.**

Every year, one in three deaths globally is attributed to cardiovascular disease.

A collaboration between biomedical engineering professor **Elizabeth Cosgriff-Hernández** and **Dr. Mehdi Razavi** of the Texas Heart Institute is showing promise in preventing fatal heart arrhythmias — one of the leading causes of cardiac arrest.

Current treatment options for heart arrhythmias include medications and a procedure known as ablation therapy. Dr. Razavi came to Cosgriff-Hernández with the idea of finding a solution to the problem—*a matter that hits home for her.*



**“I HAVE A FAMILY MEMBER WHO HAD A FAILED ABLATION PROCEDURE,” COSGRIFF-HERNÁNDEZ SAID.**

Partnerships between health care providers and engineers are crucial for academic research to translate into clinical use. The transformative work by Cosgriff-Hernández operates exactly at this interface, bringing novel engineering solutions to address critical medical challenges.

“The research-clinician partnership allows engineers to understand the translational challenges early in the design process,” said Cosgriff-Hernández.

Her collaboration with Dr. Razavi focuses on innovative methods for preventing fatal heart arrhythmias. Currently, many patients are treated through implantation of a defibrillator, which shocks the heart muscle back into normal rhythm with a painful, powerful electrical pulse. Since people never know when the shock will occur, many end up living with chronic anxiety and depression.

Their work is garnering national attention after Cosgriff-Hernández and Dr. Razavi received a \$2.37 million grant from the National Heart, Lung, and Blood Institute.

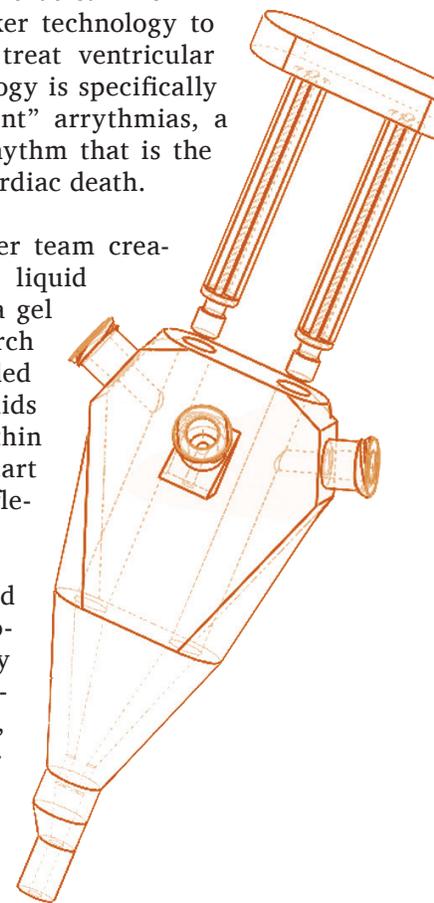
Hydrogels are common in everyday products. They are used to produce hygiene products due to their ability to absorb and retain a large amount of moisture. In the food industry, hydrogels can

be applied to ensure packaging has antimicrobial activity, absorbs moisture released from foods and extends storage time.

Cosgriff-Hernández and her team are using an existing proof-of-concept involving injectable hydrogel electrodes to develop a combined material and delivery system that can work in conjunction with pacemaker technology to expand its capability to treat ventricular arrhythmias. This technology is specifically targeted towards “reentrant” arrhythmias, a type of abnormal heart rhythm that is the leading cause of sudden cardiac death.

Cosgriff-Hernández and her team created a formulation of two liquid components that become a gel when mixed. The research team is working on a divided catheter that keeps the liquids separate until they join within the blood vessel of the heart to form a conductive and flexible plastic wire.

By transforming these blood vessels into flexible electrodes, this new technology can restore conduction pathways through the heart, even across regions of scarring, and prevent fatal arrhythmias.



While the results are promising, its use in humans is still far off.

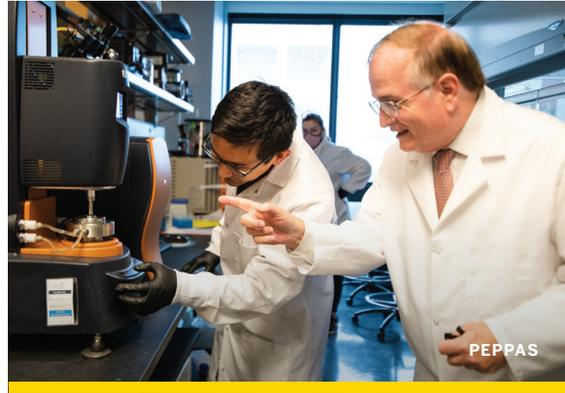
## HYDROGELS: POTENTIAL FOR BIOMEDICAL ENGINEERING & BEYOND

Hydrogels are quickly capturing an increased amount of attention in recent years for their applications in biomedical engineering, mechanical engineering, chemical engineering, and additional fields.

Their flexibility, high water absorption and retention, strong biocompatibility, and other characteristics draw attention of engineers.

Specific to biomedical engineering, hydrogels are used as biocompatible materials and in controlled-release devices, especially in controlled delivery of drugs, peptides, and proteins, as well as the development of novel biomaterials. In addition, hydrogels have strong biocompatibility and biodegradability. They are widely used in other biomedical fields, including drug delivery and release, medical dressing, gum tissue regeneration, and bone repair.

Experts consider hydrogels to be one of the most promising medical materials in the future. Biomedical engineering professor **Nicholas Peppas** is widely recognized as a pioneer of hydrogel chemistry and physics. He created the molecular design and



preparation of 3D cross-linked networks, which in turn swell in water or biological fluids and become hydrogels. This work led to a series of novel, controlled-release systems — a series of pH-sensitive devices for drug delivery.

In 2020, team of chemical engineers at UT Austin developed a new way to produce medicines and chemicals on demand and preserve them using portable “biofactories” embedded in hydrogels. The approach could help people in remote villages or on military missions, where the absence of pharmacies, doctor’s offices or even basic refrigeration makes it hard to access critical medicines, daily use chemicals and other small-molecule compounds. ■



## WHAT THE FUTURE HOLDS FOR HYDROGELS

Due to necessity and desire to minimize the frequency of antiquated open surgeries, hydrogels have emerged as a powerful material for biomedical engineering and beyond. From noninvasive and targeted release of drugs to regenerative care and wound healing, hydrogels are set to play an increasingly larger role in improving healthcare delivery.

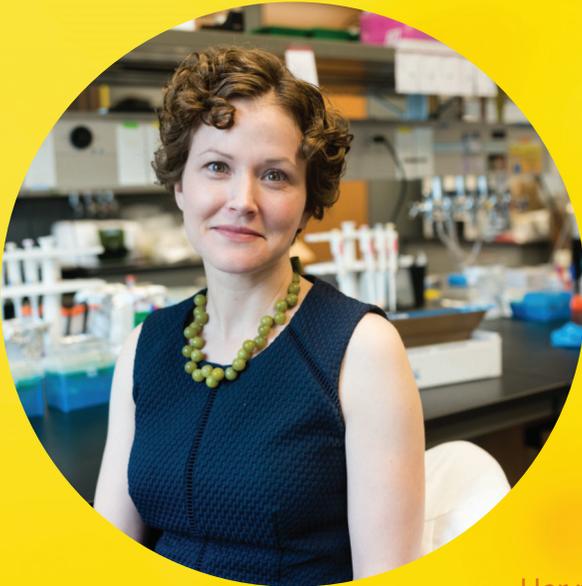
# MEMBRANE



UNDERSTANDING THE ROLE OF

# CURVATURE

ON CELLULAR LIFE



BIOMEDICAL ENGINEERING ASSOCIATE  
PROFESSOR JEANNE STACHOWIAK  
RECEIVED THE 2023 MICHAEL AND  
KATE BÁRÁNY AWARD FOR HER  
PARADIGM-SHIFTING DISCOVERY  
IN THE FIELD OF MEMBRANE  
BIOPHYSICS.

Her research details how cells control the shape and content of their membranes.

Membrane curvature is critical to many cellular processes, including the internalization of signaling receptors and key nutrient transportation. The bottom line is if a cellular membrane is damaged or not functioning properly, the cell will die.

“Membrane curvature is required for the life of every cell. It also provides a mechanism for pathogens, such as viruses, as well as nutrients and drugs to enter cells. Therefore, understanding the fundamental mechanisms responsible for membrane curvature is critical to the understanding of all diseases,” said Stachowiak.

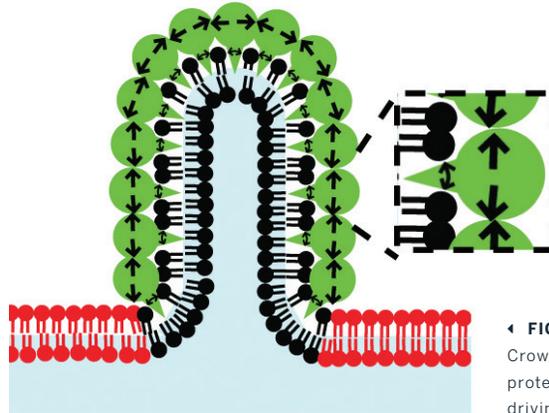
## WHAT THE NEW RESEARCH SHOWS:

The prevailing view is structured protein motifs such as amphipathic helices, or crescent-shaped BAR domains, are the drivers of membrane curvature.

For the most part, scientists ignore disordered proteins in the context of membrane bending because they lack a defined structure. Stachowiak and her team demonstrated that these disordered domains are more efficient at driving curvature than traditional domains due to the amount of space they occupy.

Stachowiak's research demonstrates that proteins can induce membrane curvature solely through a surface-crowding mechanism. More importantly, the results show membrane-bound protein domains induce membrane curvature without hydrophobic insertion.

When proteins bind to the surface of the membrane, the area that each protein can explore decreases



◀ **FIGURE 1**

Crowding among membrane bound proteins generate steric pressure, driving the membrane to bend.

as the density of proteins on the surface grows. This causes pressure that simultaneously increases with the membrane protein coverage.

At sufficiently high coverage, the pressure can overcome the energetic cost of membrane bending which increases the area where proteins diffuse. Stachowiak's research predicts that a 20% to 50% range of protein coverage on tubulated membranes is sufficient to drive the formation of highly curved membrane structures through protein-protein crowding. The data suggests proteins with high membrane affinity have the

greatest capacity for curvature generation.

Stachowiak emphasized the group effort that is involved with academic advancements and discoveries.

**Understanding the fundamental mechanisms responsible for membrane curvature is critical to the understanding of all diseases.**

**"NOTHING SIGNIFICANT HAPPENS IN SCIENCE WITHOUT A TEAM. I AM GRATEFUL TO THE TEAM I WORKED WITH WHEN WE FIRST DISCOVERED THE PROTEIN CROWDING MECHANISM: EVA SCHMID, CARL HAYDEN, DARRYL SASAKI, AND DAN FLETCHER," STACHOWIAK SAID. " I AM ALSO GRATEFUL TO ALL MY WONDERFUL LAB MEMBERS WHO HAVE HELPED ME BUILD ON THAT FINDING OVER THE PAST DECADE. FINALLY, I AM GRATEFUL TO MY HUSBAND, TIM, WHO HAS PARTNERED WITH ME TO RAISE OUR FAMILY WHILE WE BOTH PURSUED OUR PASSIONS AT WORK."**



◀ **STACHOWIAK'S TEAM**

Back row (left to right): Susovan Sarkar, Sadhana Gollapudi, Yohan Lee, Brandon Malady, Feng Yuan, Grant Ashby, Ketsia Zinga, Caleb Walker, Arjun Sangani, Carl Hayden, Advika Kamatar.

Front row: Kristin Graham, Jeanne Stachowiak and her two children.



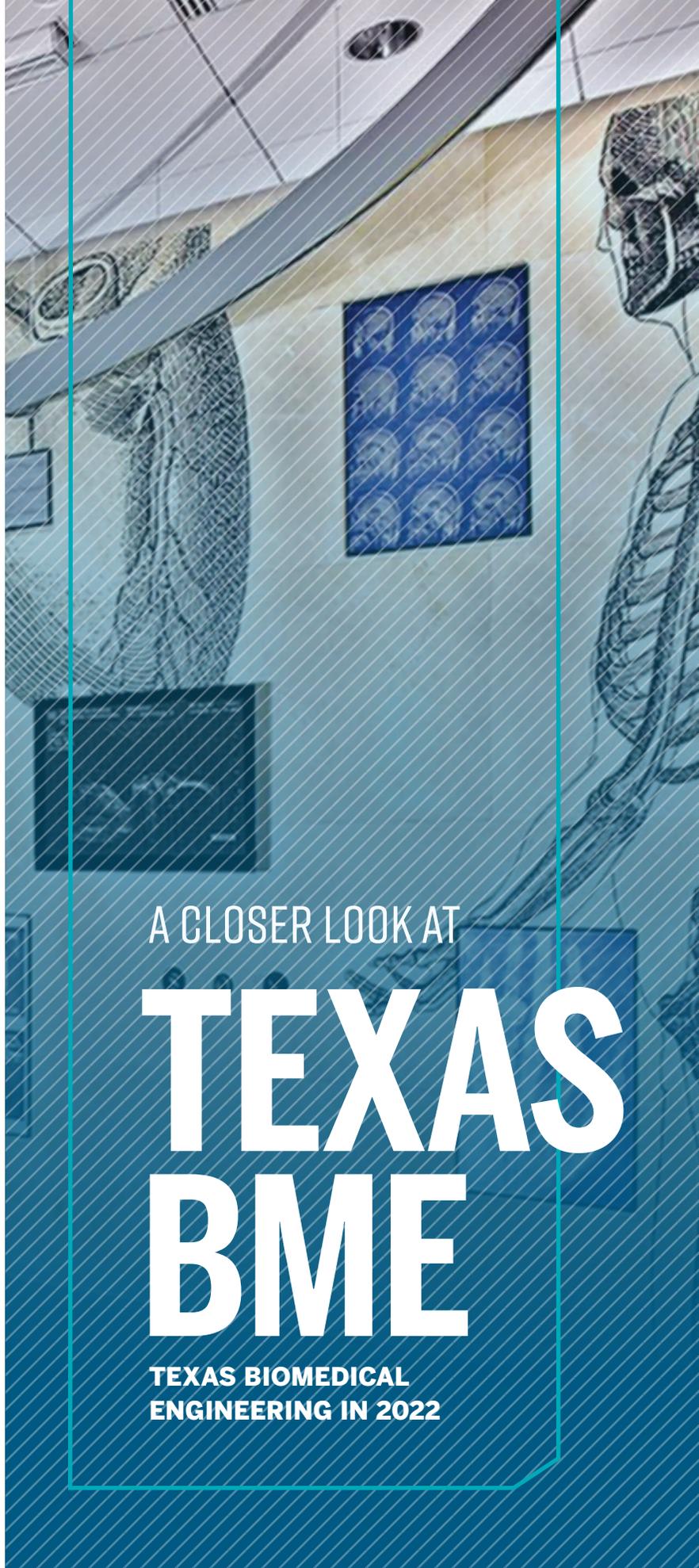
#### THE AWARD:

The Biophysical Society honored Stachowiak at their 67th annual meeting in San Diego, in February. The Society's president, Gail Robertson of the University of Wisconsin-Madison, said Stachowiak established herself as a leader in the area of membrane shaping and the organization is excited to follow her career and future achievements.

For Stachowiak, it is the interest in her work that matters most.

"I am honored that my colleagues find my lab's work to be important and interesting. That means more to me than any award ever could," she said.

*The Michael and Kate Bárány Award for Young Investigators recognizes outstanding contributions to biophysics by a person who has not achieved the rank of full professor at the time of nomination. In recognition of the endowment gift from Michael and Kate Bárány, the award was renamed in 1998. ■*



# A CLOSER LOOK AT TEXAS BME

TEXAS BIOMEDICAL  
ENGINEERING IN 2022

A CLOSER LOOK AT

# TEXAS BME

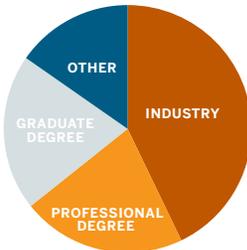
IN 2022

## STUDENTS

### UNDERGRADUATE

- 552** enrolled undergraduate students
- 1442** average SAT score of admitted students
- 54%** secure internships
- 79%** work in research groups or labs
- 32%** participate in study abroad programs
- 132** degrees awarded in 2022

### AFTER GRADUATION



- \$97,410** average starting salary
- 42%** pursue jobs in industry
- 21%** pursue professional degrees
- 20%** pursue graduate degrees
- 16%** other

OUR B.S. GRADUATES ARE ACCEPTED TO TOP SCHOOLS, INCLUDING

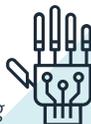
- Georgia Tech
- MIT
- Rice
- UC Berkley
- UC San Diego
- Johns Hopkins
- Washington University
- Duke
- Cornell

### GRADUATE

- 9** enrolled Master's students
- 121** enrolled Ph.D. students
- 3.63** average GPA of admitted students
- 8** National Science Foundation fellows
- 19** Master's degrees awarded in 2022
- 17** Doctoral degrees awarded in 2022
- 49** (or 40%) have major university or external fellowships

**100%**

of Ph. D. students receive full funding



### STUDENT NEWS

Graduate student **Andrea (Didi) Gardner** awarded an NIH F31 Pre-doctoral Fellowship.



Gardner



Kuo

Graduate students **Nikhith Kalkune** and **Yu-An Kuo** awarded University Graduate Continuing Fellowship.



Kalkune

Graduate student **Ketsia Zinga** named an AAAG Scholar.

Undergraduate student **Sophia Ty** named a NIH scholar, one of only 15 students chosen as UGSP Scholars.

Undergraduate student **Aislinn Hurley** received a 2022 Optics and Photonics Education Scholarship.



Zinga



Ty



Hurley

## ALUMNI

**2,183**

biomedical engineering alumni around the world



OUR GRADUATES FIND POSITIONS AT TOP COMPANIES, INCLUDING:

- Biosense Webster
- Capital One
- Epic
- GE Healthcare
- Medtronic
- Merck
- Proctor & Gamble
- Stryker

## FACILITIES

### Biomedical Engineering Bldg

- 106,000 square feet
- LEED Silver certification
- Opened doors in 2008

### Engineering Education & Research Ctr

- 430,000 square feet
- Multidisciplinary research lab
- Opened doors in 2017



\$17.5M

in total expenses on sponsored funds in 2022

## FACULTY

### TENURE/TENURE-TRACK FACULTY

- 24 core faculty
- 20 endowed faculty positions
- 33 affiliated faculty around the world

### HONORS AND AWARDS

- 7 National Science Foundation CAREER Award recipients
- 17 American Institute for Medical and Biological Engineering fellows
- 5 American Association for the Advancement of Science fellows
- 3 National Academy of Inventors fellows
- 2 National Academy of Engineering members
- 2 National Academy of Medicine members
- 2 American Academy of Arts and Sciences members

## RESEARCH

### RESEARCH AREAS

- Biomedical imaging and instrumentation
- Cellular and biomolecular engineering
- Computational biomedical engineering
- Molecular, cellular and tissue biomechanics

### RESEARCH CENTERS

- James T. Willerson Center for Cardiovascular Modeling and Simulation
- Center for Computational Oncology
- Center for Emerging Imaging Technologies
- Institute for Biomaterials, Drug Delivery and Regenerative Medicine

### PAPERS AND PATENTS

- 350 research papers and publications in 2021-22
- 5 patents issued in 2021-22

### OUR FUNDING SOURCES INCLUDE:

- National Science Foundation
- National Institutes of Health
- U.S. Department of Defense
- University Fellowships
- Diversity Fellowships

### RESEARCH ON THE RISE



Rausch

Assistant professor **Manuel Rausch** received a **\$3.9 million R01 grant** from the National Institutes of Health to lead a study of the heart's tricuspid valve to better understand functional tricuspid valve regurgitation.

Assistant professor **Huiliang (Evan) Wang** received a new **five-year R35 grant** from the National Institutes of Health to explore and address challenges in the field of optogenetics.



Wang



Brock

Professor **Amy Brock** received **U01 grant** from the National Cancer Institute to integrate big data into cancer treatment.

Professor **Janet Zoldan** received a **NIH R01 grant** to study the use of hydrogels for peripheral artery disease treatment. ■



Zoldan



# AHA FELLOWSHIPS

**TWO BIOMEDICAL ENGINEERING  
GRADUATE STUDENTS RECEIVED  
THE PRESTIGIOUS AMERICAN HEART  
ASSOCIATION (AHA) PREDOCTORAL  
FELLOWSHIP AWARD.**

***Andrew Robinson** is a fourth-year graduate student in **Elizabeth Cosgriff-Hernández** Lab and **Natalie Simonian** is a third-year graduate student, working in the **Michael Sacks**, Willerson Center for Cardiovascular Modeling and Simulation.*

*The purpose of the fellowship is to enhance the training of promising students in pre-doctoral or clinical health professional degree training programs and recognize students who intend careers as scientists, physician-scientists or other clinician-scientists, or related careers aimed at improving global health and wellbeing, according to the AHA.*



**ROBINSON'S RESEARCH:**

Robinson's research focuses on the development of electrospun materials for cardiovascular applications, specifically the development of synthetic vascular grafts and heart valves with improved mechanical properties.

His proposal for the American Heart Association predoctoral fellowship is titled "Model-directed Fabrication of a Durable Synthetic Heart Valve," with a goal of designing and optimizing a polymer-based synthetic replacement valve.

Current clinically used bioprosthetic replacement heart valves have a high rate of failure within 10-15 years due to limited durability. Unfortunately, these biological-based materials have seen little advancement in durability over the last few decades leading to the desire for a synthetic heart valve.

Polymeric valves enable a large design space to develop the next generation of heart valves. However, current fabrication methods of polymeric materials often result in isotropic materials — meaning the valve has the same mechanical properties in all directions.

This can cause a potential problem considering the native heart valve has a highly anisotropic structure. Previous modeling work by collaborators in the Sacks Lab demonstrated that even small changes toward a native fiber structure significantly improves the function and may lead to enhanced durability of the valve.

Utilizing the electrospinning procedures that Robinson refined over the last few years, he can fabricate materials with curvilinearly aligned fibers, where fibers are aligned in an arc, like the colors of a rainbow, and wavy fibers over a wide range.

Utilizing computational simulations in collaboration with the Sacks Lab, Robinson can rapidly produce a wide range of fiber structures to study.

The combination of advanced material fabrication and computational simulation provides a promising route to rapidly identify fiber structures that optimize the durability of the heart valve.

**"BEYOND BEING A TENACIOUS AND BRILLIANT RESEARCHER, ANDREW IS ALWAYS WILLING TO HELP FELLOW LAB MEMBERS AND HAS WORKED TO BUILD A MORE DIVERSE AND INCLUSIVE ENGINEERING COMMUNITY HERE AT UT," SAID COSGRIFF-HERNANDEZ.**

**SIMONIAN'S RESEARCH:**

Simonian's research focuses on patient-specific, image-based models of the mitral valve to predict surgical outcomes and optimize treatment planning.

The mitral valve is the largest of four valves in the heart, and ensures the correct direction of blood flow in the left side of the heart. Sometimes, the valve can no longer close properly and blood leaks backwards, a condition known as Mitral Regurgitation. One method to fix a leaky

valve is to surgically implant a ring around the edge of the valve.

Unfortunately, this method is unsuccessful in approximately 33% of patients.

Another treatment option is the MitraClip procedure which closes the valve by pinning the leaflets together with a clip. The procedure is a safe option even for patients who cannot handle surgery. However, this procedure also does not work well for everyone and improved testing to find the most beneficial method is essential.

Her proposal for the American Heart Association predoctoral fellowship is titled "In-Vivo Patient-Specific Optimization of MitraClip Repair in Mitral Regurgitation," and it focuses on developing computer models of a patient's heart to predict the effectiveness of the MitraClip procedure.

Utilizing clinical images of a patient's heart, Simonian creates a 3D computer model to simulate its movement before and after surgery. Examining differences in size, shape, and behavior between valves that function well after treatment can tell researchers more about how the disease damages the valve and how the clip impacts the valve.

The overall goal is to provide physicians with improved, patient-specific knowledge about the efficacy of each treatment option for patients with leaky mitral valves. ■



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## DESIGNING DEVICES WITH DILLER

**Professor Kenneth Diller** is an internationally recognized authority in heat and temperature related processes in living tissues and how they may be applied in the design of therapeutic devices. This includes the thermal treatment of injured soft tissues, safe and effective induction of therapeutic hypothermia, as well as treatments for burn injuries.

Diller has been an engineering professor at UT Austin since 1973. He is the founding chair of the Department of Biomedical Engineering, and previously served as chair of the Walker Department of Mechanical Engineering. These administrative appointments spanned a 19-year period.



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