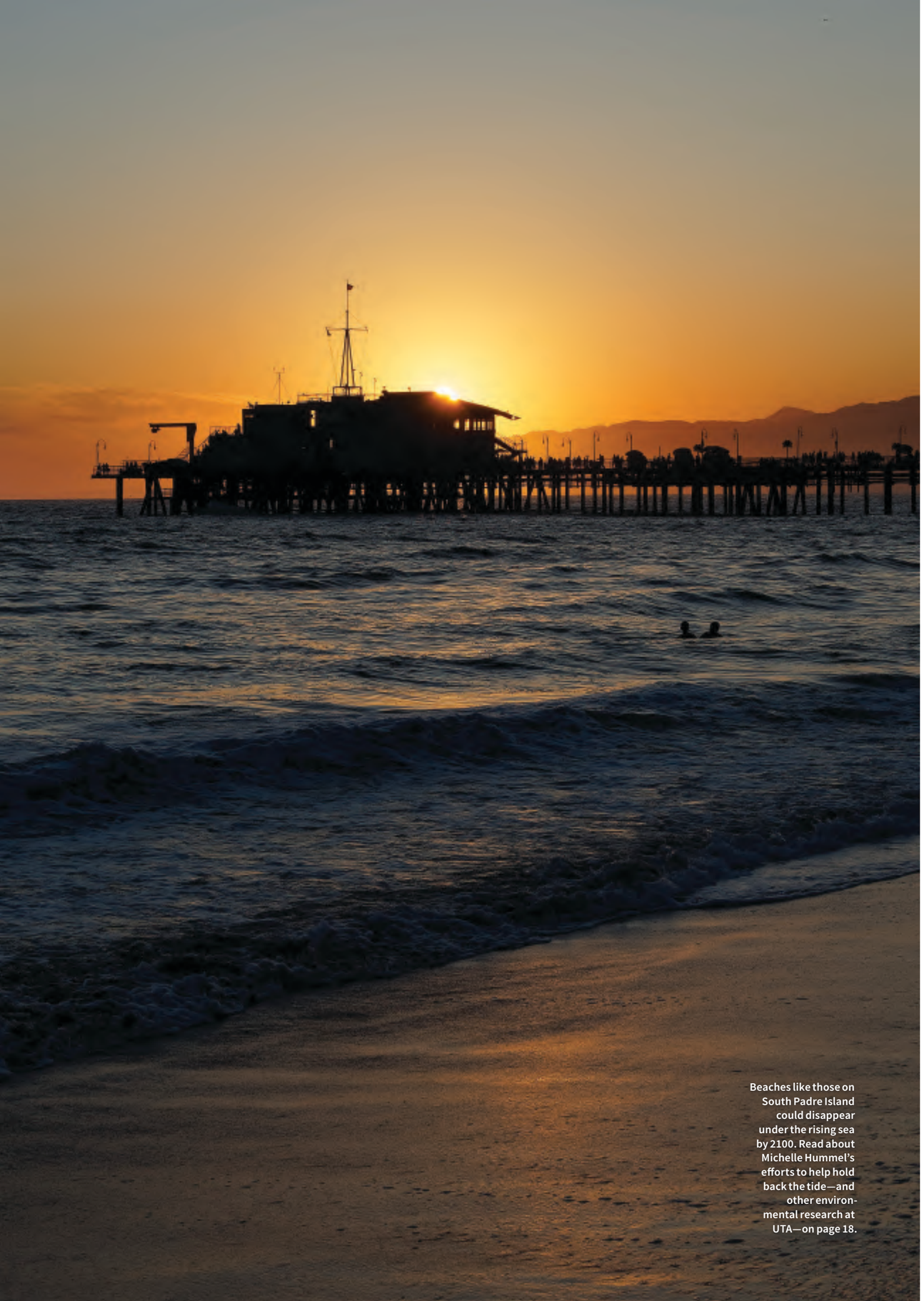
Inquiry

Is Seeing Believing?

UTA researchers investigate the link between perception and reality.

THE UNIVERSITY OF TEXAS AT ARLINGTON

RESEARCH 2021



Beaches like those on South Padre Island could disappear under the rising sea by 2100. Read about Michelle Hummel's efforts to help hold back the tide—and other environmental research at UTA—on page 18.

Inquiry

2021

VP Dispatch

A Year of Challenges

UTA research responds to the pandemic, leadership changes

The year 2020 was one of great challenges and of great accomplishments. The challenges were clear—the once-in-a-century pandemic of a novel disease, a long overdue reckoning with racial justice, and changes in the senior leadership of UTA.

But the year 2020 was also one of innovations. Researchers at UTA pivoted to investigate the origins of the SARS-CoV-2 virus and novel technologies for its detection, protection, and treatment. We repurposed part of the North Texas Genome Center to support a COVID-19 testing facility for students, where murals of masked students now memorialize this historic experience.

As this research proceeded under guidelines to protect health and safety, we continued to rise in stature. For the second consecutive year, we exceeded the metrics required for designation as a National Research University by the state of Texas. Upon confirmation of this achievement, UTA will receive additional funding to invest in research, innovation, and economic development.

The year 2021 has begun with a strong trajectory, and trends in research funding and productivity promise another record-breaking year for UTA. More important, we have new directions. The building under construction for the School of Social Work and the Smart Hospital will support approaches to health care that consider the whole patient and their community. In renewing the University's strategic plan, a fifth research theme—Cultural Understanding and Social Transformations—was added to catalyze work on equity and inclusion as unprecedented changes in society continue. We also launched the new Center for Entrepreneurship and Economic Innovation, which connects students and faculty with the regional ecosystem for economic development. The center will foster a vibrant atmosphere for those who drive to innovate, commercialize new technologies, and pioneer new companies that will impact our North Texas communities and the global economy for decades into the future.

UTA has long been a university on the rise, with growing national and global visibility—a trajectory that last year's trials have not interrupted.

Go Mavericks,

James P. Grover
Interim Vice President for Research

Inquiry

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Leading Edge

Holistic Health Care

UT Arlington broke ground this spring on a new research and teaching facility aimed at enabling a more holistic approach to human wellness. The building, set to open in late 2022, will house both the College of Nursing and Health Innovation's modernized Smart Hospital and the School of Social Work. By pairing the two academic units, UTA aims to foster interdisciplinary learning and research and encourage students to think outside of their skillsets by considering the whole patient in their treatment and assessments.

Texas Tier One

In 2009, Texas established the National Research University Fund to provide universities with a pathway to become nationally competitive, or "Tier One." Over the years, UTA worked diligently to achieve and maintain all the benchmarks needed to receive this designation, and is now set to become just the fourth emerging research university to qualify.

"Tier One will open countless doors for UTA's future," says Interim Vice President for Research James Grover.

New Research Pillar

Last year brought much change to the University. The global pandemic shifted the way we conduct education and research, while the widespread movement for racial justice prompted administrators to establish a new office directly focused on issues related to diversity, equity, and inclusion.

Appropriately, UTA's research focus is expanding to include this important issue. In its renewed *Strategic Plan 2025*, the University added a fifth research theme—Cultural Understanding and Social Transformations. Along with established themes, this new pillar will guide UTA's research enterprise for the next four years as we continue to provide bold solutions with a global impact.

ILLUSTRATION BY LARA TOMLIN

Health and the Human Condition

A century ago, the average American lived about 55 years. Today, we are likely to make 80. Unrelenting scientific curiosity and exploration have made this dramatic increase possible and led to life-saving breakthroughs in the diagnosis and treatment of diseases and other ailments. But progress that improves our quality of life extends beyond the physical realm. Examination of the arts and humanities helps us understand the nature of the human condition and the cultural and social fabric that characterizes our existence and contributes to our well-being.

QUICK HITS

Juhyun Lee, bioengineering assistant professor, is developing an imaging technique and a special electrocardiogram for zebrafish to determine why they are able to regenerate their heart tissue after cardiac arrest.

A research team led by **Kate Hyun**, assistant professor of civil engineering, is developing a study to help older adults lead more active lifestyles. Co-principal investigators are **Kathy Lee**, **Angela Liegey-Dougall**, **Christoph Csallner**, **Xiangli Gu**, and **Steve Mattingly**.

Physics Associate Professor **Mingwu Jin** is leading a study to improve the accuracy of stress tests to better diagnose heart disease. His project is funded by the National Institutes of Health's National Heart, Lung, and Blood Institute.

ASSISTANT PROFESSOR KYRAH BROWN

HEALTH CHECK

Improving outcomes for Black women

Researchers in the Maternal and Child Health Equity Lab are investigating social and health system factors that disproportionately impact the health and birth outcomes of Black women.

"Persistent racial and social inequities in maternal and child health remain a significant public health issue," says public health Assistant Professor Kyrah Brown, who leads the lab. "These inequities are driven largely by conditions in which women are born, grow, live, work, and age. Importantly, these conditions are created by structural forces such as systemic racism that manifest as policies and practices in social and health institutions. Black women in particular tend to experience higher rates of preventable chronic health conditions across the lifecourse, maternal health complications, and adverse birth outcomes compared to other racial groups."

She and her team are using a combination of community-based participatory methods, secondary data analysis, and evaluation science to look at the individual-, community-, and systems-level factors that shape women's health and birth outcomes. The goal is to understand how those complex interactions can be addressed to reduce racial disparities.

NETWORKING

Detecting Alzheimer's disease earlier

Computer Science and Engineering Assistant Professor Won Hwa Kim is bringing an unusual set of tools to aid in the search for early signs of Alzheimer's disease: novel machine learning algorithms.

In previous studies, researchers employed brain images to find which regions of the brain might be related to Alzheimer's. Using a grant from the National Science Foundation, Dr. Kim will instead develop a novel deep learning technique that uses algorithms that mimic the structure and function of neural networks in the brain.

"With the network, we'll be able to see which relationships among brain regions in the brain network are related to Alzheimer's," Kim says. "Instead of studying the entire brain, we'll be able to focus on specific areas to slow and treat the disease's progression."

"Deep learning is a powerful tool that has not been explored in this context before," says Hong Jiang, chair of the Computer Science and Engineering Department. "Dr. Kim's research has great potential to unlock mysteries within the brain that could lead to earlier detection and treatment of Alzheimer's."

ILLUSTRATION BY HARRY CAMPBELL

ANEMIA ANSWER

"This work has ramifications on so much of our medical lives. I'm sure it will provide a baseline for protein analysis in the future."

Detecting iron-carrying proteins

Doctors treating patients with anemia may soon gain a valuable tool. Bioengineering Associate Professor George Alexandrakis is collaborating with Southern Methodist University's MinJun Kim to use nanotechnology to detect defective iron-carrying proteins in blood.

"One key in this research is that a very small amount of blood is needed," Dr. Alexandrakis says. "The protein carries iron, and it can be trapped by our nanosensor. It's then stretched or heated at the single molecule level so we can probe how it refolds again once left alone. The way it refolds or misfolds gives us a way to see if it is defective or not."

The nanosensor also has the potential to find proteins defective due to cancer or other illnesses. Alexandrakis, Dr. Kim, and Associate Vice President for Research Jon Weidanz recently received an additional grant to apply the technology to the personalization of cancer immunotherapy.

"This work has ramifications on so much of our medical lives," says Bioengineering Department Chair Michael Cho. "I'm sure it will provide a baseline for protein analysis in the future."

STABILITY

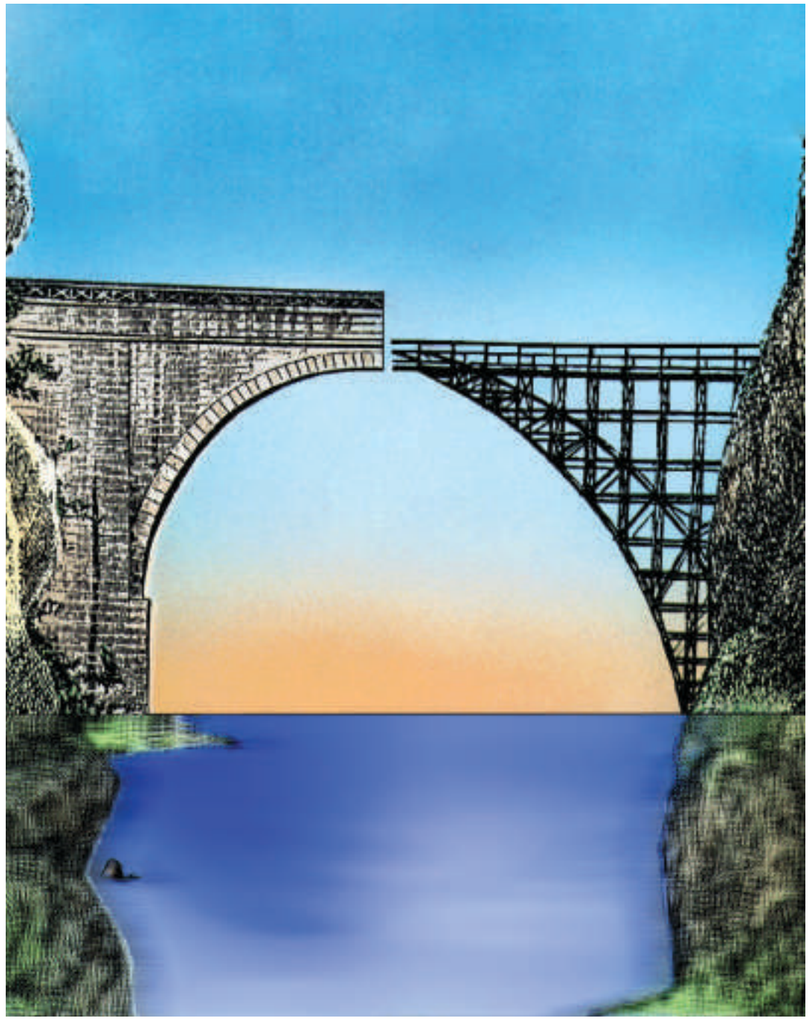
Evaluating bridges more effectively

Civil engineering Professor Nur Yazdani is working with the Texas Department of Transportation (TxDOT) on a new approach for assessing the actual strength and remaining life of bridges, determining bridge ratings, and prioritizing whether they should be strengthened or replaced as needed.

His method combines nondestructive evaluation (NDE) techniques—including ground-penetrating radar, thermal imaging, impact echo, and ultrasonic tomography—computer modeling, and full-scale load testing. One benefit of this approach is that it does not require roads to be closed for long periods of time.

"We have the equipment, manpower, and know-how to perform NDE, modeling, and load testing, and we can use all of that data to determine the true condition of the bridge," Dr. Yazdani says. "We can also test repair options on the computer and provide cost-benefit information that will allow TxDOT to make the best decisions."

"Dr. Yazdani's adroitness in NDE research has brought a new dimension in health evaluation of our nation's infrastructure," says Ali Abolmaali, chair of the Civil Engineering Department.



INSECURE

"Economic abuse is not just about someone taking your cash."

Economic abuse and hardship

One in four women and nearly one in 10 men experience intimate partner violence (IPV) during their lifetime, according to the Centers for Disease Control and Prevention. In an effort to broaden our understanding of the topic, social work Assistant Professor Rachel Voth Schrag, alumna Kristen E. Ravi, and doctoral student Sarah R. Robinson published a study on the link between one form of IPV—economic abuse—and economic hardship.

"Economic abuse is not just about someone taking your cash," explains Dr. Voth Schrag. "It may also involve withholding things that make someone feel economically secure. That can include preventing or limiting work or school hours, damaging credit history, or making unilateral decisions."

The study, published in the *Journal of Family Violence*, found that behaviors related to economic abuse are linked to employment and housing instability, increased use of public assistance, greater material hardship, and other negative consequences. The researchers determined that developing effective strategies to address these economic consequences is central to disrupting cycles of victimization.

ASSISTANT PROFESSOR WARDA ASHRAF

CONCRETE IDEAS

Recreating ancient technology today

Assistant Professor Warda Ashraf hopes to unlock the secrets of the ancient world with her newest project. With funding from the Defense Advanced Research Projects Agency's Young Faculty Award, the civil engineer will explore how civilizations thousands of years ago built structures, roads, and other buildings that still endure today and whether their construction materials can be re-created synthetically in a laboratory.

"Most structures in the United States are designed to last around 50 to 100 years," Dr. Ashraf says. "There are several building structures in European countries that are 2,000 years old and still performing well. Why are they so much better than the current building materials?"

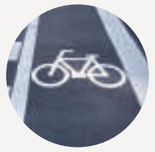
Previous research shows that certain combinations of volcanic ash and seawater were used in the composition of ancient structures in Rome, Greece, and other sites.

"The goal of this project is to mimic this ancient technology to produce highly durable and resilient construction material," Ashraf says. "We will use ingredients that are easily available in the U.S. to achieve similar performance."

Sustainable Communities

Developing more sustainable communities is vital to strengthening our economy, enhancing everyday life, and providing a foundation for lasting prosperity. Opportunities abound to make urban regions more livable, including reducing pollution, preserving ecosystems, and offering a variety of transportation and housing choices. Today's communities demand better building design, land-use planning, and improved infrastructure. They also broaden horizons and enlighten minds through cultural, recreational, and educational programs.

QUICK HITS



Assistant Professor of Research **Katie Kam**, Professor **Steve Mattingly**, and Assistant Professors **Kate Hyun** and **Taylor Li** are investigating the effectiveness of implementing green pavement markings to denote where bicyclists share the road with motorists.

Ali Abolmaali, chair of the Civil Engineering Department, is working with the city of Lubbock to inspect, analyze, and report on the remaining service life of 3.5 miles of pressure pipe that carries water to users.

Sahadat Hossain, professor and director of the Solid Waste Institute for Sustainability, is studying the use of recycled plastic pins to repair deep-seated failures on embankments and the areas around highway bridges.

ILLUSTRATION BY CATHY HULL

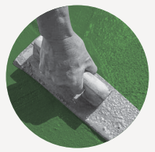
Global Environmental Impact

As concerned citizens of the global community, we must recognize and live within environmental limits. Future generations will survive only if we maintain the delicate balance of our planet through thoughtful stewardship of its natural resources. With the world's population exceeding 7.5 billion, the need to conserve these essential elements is increasingly critical. Becoming more environmentally efficient helps us better manage our shrinking water supply, clean the air we breathe, reduce our carbon footprint, and protect our biodiversity.

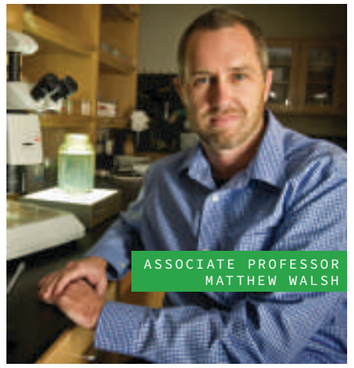
QUICK HITS

Biology doctoral students **Jose Maldonado** and **T.J. Firneno**—both part of Associate Professor **Matt Fujita**'s lab—published two new genomic studies that could aid in conservation efforts for two North American lizard species and a Central American toad.

Associate Professor **Kathleen Smits** is developing a gas-sensing protocol to help industry and regulators monitor underground natural gas leaks in real time.



Civil engineering Assistant Professor **Warda Ashraf**, chemistry Associate Professor **Frank Foss**, and materials science and engineering Assistant Professor **Erika La Plante** are developing new concrete materials that leave more environmentally friendly footprints.



ASSOCIATE PROFESSOR MATTHEW WALSH

ZOMBIE FLEAS

Tracking nuclear effects over time

By resurrecting water fleas from preserved eggs, one UT Arlington researcher hopes to uncover the evolutionary effects of nuclear testing.

Matthew Walsh, an associate professor of biology, traveled to Utah last summer to collect sediment cores containing the preserved eggs of *Daphnia*, a type of water flea, from lakes in the fallout zone of nuclear testing conducted during the 1950s. Each layer of the sediment core represents a distinct time period and contains a generation of water flea eggs that sunk to the lake floor. Dr. Walsh will hatch eggs from before, during, and after nuclear testing took place and measure the water fleas' viability and traits.

"We have no real experimental sense of the long-term evolutionary impacts of nuclear testing, only the common belief of nuclear-induced mutation," Walsh says. "This process allows us to look at nuclear genetic impacts across decades, study their effects in real time, and provide new insights into whether any nuclear-induced mutations degrade over time."

His research is supported by a $200,000 EAGER grant from the National Science Foundation.

DIGESTION

Converting food waste to fuel

For Professor Melanie Sattler, food waste is more than just garbage—it's power.

For Professor Melanie Sattler, food waste is more than just garbage—it's power. The environmental engineer is helping the North Central Texas Council of Governments (NCTCOG) determine how much more energy can be generated by diverting food waste from landfills to anaerobic food digesters.

"Twenty-two percent of our waste stream is food waste," Dr. Sattler says. "It breaks down in landfills and produces methane, which can be used for alternative energy. But often the active part of the landfill doesn't have a cover for two years and a lot of the gas escapes. The alternative to capture more of the gas is to use an anaerobic digester."

There are currently eight wastewater treatment plants with digesters in North Texas. Sending food waste to these or new digesters would produce a better yield of biogas production.

"The North Central Texas Food Waste to Fuel Feasibility Study will be a step forward in assessing local opportunities to divert food waste from landfills to preserve landfill capacity, increase renewable energy production, and reduce vehicle emissions," says NCTCOG Executive Director Mike Eastland.

ENERGY STABILITY

Smart grid supply and demand

As Texas moves toward a "smart grid" energy delivery system, companies are rushing to find the best ways to balance supply and demand.

Enter Shouyi Wang. The associate professor of industrial engineering is using a National Science Foundation grant to do just that.

Electricity is a commodity for which generation and load must be constantly balanced in real time for system reliability and power quality. In addition to traditional generation-side management, load participation is critical for future sustainable smart grid development.

Dr. Wang and his team—which includes Professors Wei-Jen Lee, Victoria Chen, and Jay Rosenberger—will develop machine-learning models that predict real-time market prices and manage large-scale participation of residential demand-response programs. The goal is to create a dynamic decision analytics and optimization framework that enables a highly efficient, real-time energy management system for future smart energy markets.

"From a consumer standpoint, greater efficiency for the energy markets translates to greater savings on energy costs for everyone," Wang says.

PHOTOGRAPH BY THE VOORHES

CANCER CARE

Refining lung cancer treatments

Researchers from UTA and UT Southwestern (UTSW) Medical Center are teaming up to develop a biopsy image analysis system that will help pinpoint care for lung cancer patients.

Junzhou Huang, associate professor of computer science and engineering, and UTSW's Guanghua Xiao received a Cancer Prevention and Research Institute of Texas grant to use machine-learning algorithms and computational biology to refine lung cancer treatments.

Dr. Huang will develop algorithms for predicting clinical outcomes using automated pathological image analyses.

"These developed algorithms will integrate pathological images with molecular profiling data from patients for a comprehensive prediction model that will lead to tailored treatments for individuals," Huang says. "Our ultimate goal is to customize patient treatment."

Hong Jiang, chair of the Department of Computer Science and Engineering, believes Huang's work is an integral part of UTA's research portfolio.

"Lung cancer is a leading cause of death in the U.S. and the world," he says. "Better prediction methods can lead to better patient care, more specific care."

POINTED

To do so, he will use topological data analysis, a new field of applied mathematics.

Better data for robots

Using a new field of applied mathematics, a UT Arlington computer scientist hopes to enhance the perception capabilities of robots.

Assistant Professor William Beksi is investigating how to effectively process 3D point cloud data captured from low-cost sensors, which robots could then use to facilitate intelligent tasks in complex scenarios. To do so, he will use topological data analysis, a new field of applied mathematics that provides tools for extracting topological features from data. The main tool, persistent homology, will allow him to study features such as connected components, holes, and voids at multiple scales.

Dr. Beksi's research will investigate how the incorporation of topological features can yield unique insight into the structure of point cloud data that is not obtainable from other methods.

"As 3D-sensor technology becomes pervasive in robotics, modern approaches to process and use this data in innovative and meaningful ways have not kept up," he explains. "The idea is to develop new algorithms for processing large-scale 3D point clouds that overcome current limitations and lead to advances in robotic perception."

ASSISTANT PROFESSOR JONATHAN ASAADI

ON TIME

Physicist aims to expand reach of particle detector

Assistant Professor Jonathan Asaadi is one of just 76 scientists nationwide to earn this year's U.S. Department of Energy Early Career Research Award. The prestigious award will support his project to expand the physics reach of the time projection chamber (TPC) by making it capable of detecting previously inaccessible regimes.

The TPC is a particle detector invented by David Nygren—now a Presidential Distinguished Professor of Physics at UTA—that provides a complete, 3D image of large quantities of simultaneous subatomic particle collisions.

Dr. Asaadi is focused on noble element TPCs—noble elements include the least reactive metals and inert gases—which are a popular tool for pursuing the physics associated with neutrino mass, dark matter, and the search for new particles and interactions.

"The objective of this research is to transform the physics reach of these instruments and develop new detection strategies to expand their capabilities to previously inaccessible regimes," he explains.

Data-Driven Discovery

Data fuels important decisions at every level of society. The exponential growth and availability of big data presents numerous challenges and opportunities. It is voluminous, fast, increasingly complex, and comes in a range of formats.

But if managed effectively, big data can deliver powerful benefits. It can result in more accurate analyses in fields ranging from health care to genomics to business informatics to physics. More accurate analyses lead to more confident decision-making. And better decisions can mean greater operational efficiencies, cost reductions, and decreased risk.

QUICK HITS

Computer science Professor **Gautam Das**, Assistant Professor **Won Hwa Kim**, and alumna **Senjuti Basu Roy** are helping make data more usable by increasing the role of humans in the data science pipeline.

Computer science Professor **Sharma Chakravarthy** is investigating ways to develop a process by which data points in multiple graph layers of a large dataset can be connected in a highly scalable way that also allows analysts to look at it in greater depth.

Electrical engineering Professor **Frank Lewis** and Associate Professors **Yan Wan** and **Ali Davoudi** are working to improve control of networked convoys that include autonomous vehicles and those operated by humans.

ILLUSTRATION BY ANDRIY ONUFRIYENKO

Closer Look

The Style
While the mural feels like a single, integrated piece, no two faces are the same and each uses a different artistic style.

The Place
The mural is located in the basement of the Science & Engineering Innovation & Research building, outside the North Texas Genome Center.

Up Next
A second stage is scheduled for the spring semester in conjunction with the mural painting class. Stage one was completed over two months in late 2020.

The Portraits
The mural depicts colorful, 10-foot-tall head-and-shoulder portraits of individuals wearing masks.

The Inspiration
The mural came from a suggestion by the medical director of the North Texas Genome Center, Florence Haseltine, a passionate supporter of the arts. "White walls are meant to put art on," she says. "It makes the place human."

The Experience
The mural is designed to make viewers feel as if they were attending a solo show for each artist as they walk down the corridor.

ON THEIR WAY TO PROCESS COVID-19 TESTS, masked and gowned staffers of UTA's North Texas Genome Center walk past a unique piece of art. A large, colorful mural capturing our unusual moment in history went up late last year, created by faculty and students from the Art and Art History Department.

"This mural gives students ownership of their time here at UT Arlington," says Assistant Professor Yana Payusova. "It was important to come together, as seven artists who have particular styles, and to finish it unified while leaving room for each person to have his or her own individual style be present."

In addition to Payusova, Assistant Professor Carlos Daniel Donjuan, graduate student Hallee Turner, and undergraduate students Leonor Ali, Tiara Francois, Cesar Garay, and Maya Sultana worked on the project.

PERCEPTION REALITY

We make decisions based on our perceptions, but what happens if those perceptions are wrong? UTA researchers are tackling the gulf between reality and appearance—and helping us sort out both in the process. BY AMBER SCOTT

From the moment we open our eyes in the morning, we make decisions—get up or hit snooze? Make the bed or leave it messy? Coffee or juice? And they only accumulate from there: By some estimates, the average adult makes about 35,000 conscious and unconscious decisions every single day. We base these decisions on the information available to us—information that, in today's global knowledge economy, has become staggering in its scope. In fact, one 2011 study found our daily information intake to be about 34 gigabytes, or around 100,000 words. That's a lot of data for our brains to process.

To cope, those brains have become experts at forming quick assessments and perceptions of even very complicated concepts. This is fine—and perhaps beneficial—when we're deciding what to have for breakfast. It's much less so when we're forming opinions on current events or choosing which candidate to vote for.

"Most people have a tendency to want to make up their mind quickly and come to a solution regardless of how much evidence there is for it," says Daniel Levine, professor of psychology. "And often, people's use of information is selective. We sometimes don't use all the information that is given to us, and sometimes, we go well beyond it."

In many ways, this critical but complicated process—of sorting through massive amounts of information, determining the veracity, and deciding what action to take—is exactly what all researchers at The University of Texas at Arlington are working to improve. In their search for greater understanding, our researchers are shaping perception, instilling in students the capacity for interpretation and the ability to find meaning in the world.

Video Games and Violence

Sometimes, researchers' work into perception parallels the national discourse. In late 2019, a gunman in El Paso, Texas, opened fire in a Walmart, killing 22 people. In the wake of the tragedy, citizens sought answers for how this act of violence could happen—and as they have done time and time again since the early 1990s, they zeroed in on a possible instigator: violent video games.

L-R: Kevin Schug found less evidence of groundwater contamination near fracking sites than believed by the local communities; Michael Ward spent decades debunking the idea that video games lead to violence; Chengkai Li developed a tool to help fact-check news and social media in real time.

"We must stop the glorification of violence in our society," then-President Donald Trump commented in remarks at the White House after the El Paso massacre. "This includes the gruesome and grisly video games that are now commonplace."

But according to economics Professor Michael Ward's decades of research, there is no positive link between violent video games and acts of violence—in fact, the opposite may be true.

"The data indicate that when kids are playing more violent video games, they are actually less prone to engage in violent behavior," Dr. Ward says, noting that there are several hypotheses for why this is, including the catharsis of acting out violence in a virtual environment and the simple fact that every hour spent playing a video game is time not spent engaging in real-world violent behavior.

He recently published a study in *Contemporary Economic Policy* that examined data gathered from a nationally representative sample of 15,000 adolescents over an extended period of time. The tracking began in 1995 when the participants were in grades 7-12 and continued all the way into young adulthood, when they were between ages 24 and 32. Across all phases of the study, the data showed that playing video games as an adolescent did not increase, and may instead have decreased, fighting later in life.

"This is my fourth analysis using a fourth methodology and a fourth dataset on actual outcomes that finds no violent effects from video games," Ward says.

Still, despite this growing body of evidence from Ward and other researchers, the idea of video games promoting violence continues to persist. The issue has become even more politicized over the years, with some lawmakers pushing for legislation against these games.

Ward believes this would be a mistake. "It's an easy leap to make, that violent video games should be regulated because they cause acts of violence, especially when you look at the human tendency to try to understand things that are honestly hard to comprehend," he says. "But video game development is among the fastest-evolving forms of human expression ever devised. It would be a shame to unintentionally and needlessly stifle this explosion of creativity with content-based policy interventions."

Fracking and Health

It's easy to understand how perception can shape basic behaviors or simple decisions. More complicated is the idea that perception can shape people's understanding of the physical environment around them—and even their own health. But that's exactly what Kevin Schug and his team at the Collaborative Laboratories for Environmental Analysis and Remediation (CLEAR) Lab have discovered in their investigations into the effects of hydraulic fracturing on groundwater quality.

Hydraulic fracturing, or fracking, is a technique used to extract oil and gas from rock by injecting high-pressure mixtures of water, sand or gravel, and chemicals. Although fracking has been in use since the 1940s, the process underwent a boom in the early 2000s, with natural gas wells in the United States almost doubling from about 276,000 in 2000 to about 510,000 in 2010. In the intervening years, fracking has become a hot-button political issue, with proponents touting it as a safe and clean method of collecting energy and opponents decrying its effects on the environment and human health.

Since 2011, Dr. Schug, UTA's Shimadzu Distinguished Professor of Analytical Chemistry, has been looking into how fracking affects groundwater in Texas and beyond. While he and his fellow researchers have found some contaminants, their studies usually come to the conclusion that when done safely and responsibly, fracking has little to no negative effect on groundwater quality.

For example, one recent study analyzed water samples from 36 private wells in the Barnett, Eagle Ford, Haynesville, and Marcellus Shale regions. Though anecdotal claims of oil- and gas-related contamination had been reported, Schug and his team found that only five samples showed any potential indications of such adulterants.

"We found that the water quality data very rarely aligned with the perceptions that the well owners had of their individual situations," Schug says. "This disconnect between perception and reality is possibly attributed to prevailing negative sentiments toward hydraulic fracturing as well as myriad environmental factors that make point source attribution very challenging."

In another study, he and his collaborators looked at attitudes and perceptions of water quality and individual health status in Frio County, which sits on the Eagle Ford Shale. They analyzed groundwater samples from 19 private wells and surveyed 75 participants about their perceptions of both their groundwater and their health. The majority reported a distrust in the quality of their drinking water, with some attributing that distrust to fracking. Yet the study found no link between water quality and fracking activities. And though most respondents also reported overall good health, those who reported otherwise overestimated their negative health when compared to what was actually documented by their health care providers.

"A lack of communication from the industry is sometimes the culprit. It makes people nervous and skeptical in general," Schug says.

That's a major reason why the CLEAR Lab hosted the second annual Responsible Shale Energy Extraction Conference on UTA's campus in late 2018. The event brought together scientists, engineers, industry professionals, regulators, technology innovators, and concerned citizens to discuss the state of environmental stewardship within the shale energy sector.

"The goal was to show that shale energy extraction and environmental stewardship can be achieved conjointly," Schug says. "As scientists, I think we're all trying to provide the most up-to-date knowledge that we can to help correct the misinformation or misunderstandings."

Fact and Fiction

At a time when "misinformation" and its many synonyms ("fake news," "alternative facts") have become buzzwords, determining what's true can be an overwhelming task. Chengkai Li, professor of computer science and engineering, aims to help truth-seekers with ClaimBuster, a fact-checking tool he has been developing with a team of researchers since 2014.

> "Most people have a tendency to want to make up their mind quickly and come to a solution regardless of how much evidence there is for it."

ClaimBuster monitors live discourse, social media, and news to flag factual claims that are then recommended to fact-checkers for vetting. It also detects matches with a curated repository of fact-checks from professionals. The matched results are delivered instantly to readers and viewers. The tool—developed with Dr. Li's graduate students, communication Associate Professor Mark Tremayne, and researchers at Duke University—was used successfully to fact-check many of the 2016 presidential debates and 2017 Australian Parliament discussions.

"Misinformation and rumors in the news are not new at all," Li says, pointing to the spike of "yellow journalism" in the early 1900s. "But now, with the overabundance of information available to us, people's trust in media is historically low. It's a grand societal challenge, and we don't have a simple solution."

The consequences of this ubiquitous problem are dire, he points out, noting that the way misinformation shapes public perception can damage public health—as when parents choose not to vaccinate their children—and can even threaten national security—as when the integrity of elections is compromised. Providing better, more efficient fact-checking is just one solution to this challenge.

"What we perceive may not always be truth, and fact-checking is about separating perception from the facts," he says. "But this problem can't be solved by tech only. It requires policy, social scientists, and the people themselves."

For now, universities can continue to play a pivotal role in that equation, generating knowledge through rigorous scientific inquiry and disseminating it to students, colleagues, and the public.

After all, as marketing Assistant Professor Narayanan Janakiraman notes, "There's your perception, my perception, and somewhere between those, the truth. That's why knowledge is power, isn't it? Empowering people with knowledge will not only help them become more prudent decision-makers, it will help build a better society for us all." i

Environmentalists, engineers, and biologists are working to understand and predict the effects of climate change on areas and organisms around the world. BY SARAH BAHARI

PLANET PROTECTION

PHOTOGRAPH BY MAPS4MEDIA

EACH YEAR, thousands of people flock to South Padre Island during Spring Break, seeking a week of sun on its white sands. But by 2100 those same beaches—and many others along the Gulf Coast—could be gone, swallowed by rapidly rising sea levels caused by climate change.

According to a National Park Service report, Padre Island National Seashore may experience a rise in sea level of 2 feet, 3 inches by 2100. And it's not alone—worldwide, sea level has risen about 8 inches since 1880. The Gulf Coast is particularly vulnerable, it seems; a 2019 report from the National Oceanic and Atmospheric Administration found that it recorded the fastest rates of sea-level rise in the U.S.

What, if anything, can coastal communities do to mitigate such devastation? And what of the effects of climate change on plants, animals, and other species worldwide? These questions are at the heart of environmental research being done at The University of Texas at Arlington.

In addition to rising sea levels and flooding, our scientists are studying the dwindling biodiversity in our waterways, the dire consequences of land use and human activity on ecology, and the effect of climate change on regional weather patterns. By examining such threats, UT Arlington's researchers are developing solutions that consider the need for development and economic progress in conjunction with environmental protection and a sustainable future.

"Environmental research is critical, and never more so than today, when there are so many threats to the health and sustainability of the planet," says Morteza G. Khaledi, dean of the College of Science. "Our faculty is addressing vitally important issues, including climate change, energy, clean water, and biodiversity, because having a habitable, healthy planet is something that directly affects every single person."

COASTAL FLOODING
• *California*

Like south Texas, California's coast is already experiencing the early effects of rising sea levels—extensive coastal flooding during storms. This is only projected to worsen as more ice sheets melt.

Civil engineering Assistant Professor Michelle Hummel is studying how natural features and nature-based features, along with artificial structures, can be used to control coastal flooding. The project is a partnership between UTA and the University of Arkansas and is funded by the National Oceanic and Atmospheric Administration.

"We are essentially trying to determine if nature-based approaches can be as effective as engineered approaches," she says. "How can we leverage natural features to solve this problem?"

Nature-based approaches include sand dunes, marshes, and wetlands, which provide secondary benefits like restoring habitats for certain species. Artificial structures are things like seawalls, bulkheads, and levees. The two can also be combined to create structures like a seawall bordered by marsh.

"Coastal communities are waking up and realizing that something needs to change," Dr. Hummel says. "We need to develop and implement creative solutions that will protect our environment, people, and property."

She and her team are developing an integrated modeling framework that includes surface water and groundwater to predict how various approaches would affect the extent and duration of flooding. They will examine two separate coastal areas in California—Santa Monica Bay and Humboldt Bay.

Santa Monica is open to the coast, with high waves and wide, sandy shores. Beyond the beach, the area is highly urban, so as sea levels rise, more infrastructure is at risk. In contrast, Humboldt Bay is in a more rural area and is separated from the ocean by a narrow inlet. Its shoreline is more agricultural and has different natural features and processes that could contribute to flooding or erosion.

By examining the two, the team can compare and contrast the efficacy of different approaches under different conditions. The framework developed could eventually be used to study other coastlines, including Texas' Gulf Coast.

"Many coastal communities want to address flooding caused by rising sea levels but don't know where to begin," Hummel says. "Our framework will give them an invaluable tool they can use to understand which approaches would work best."

Humboldt Bay in northern California is at increased risk of flooding in the coming years.

"Coastal communities are waking up and realizing that something needs to change."

—MICHELLE HUMMEL, ASSISTANT PROFESSOR OF CIVIL ENGINEERING

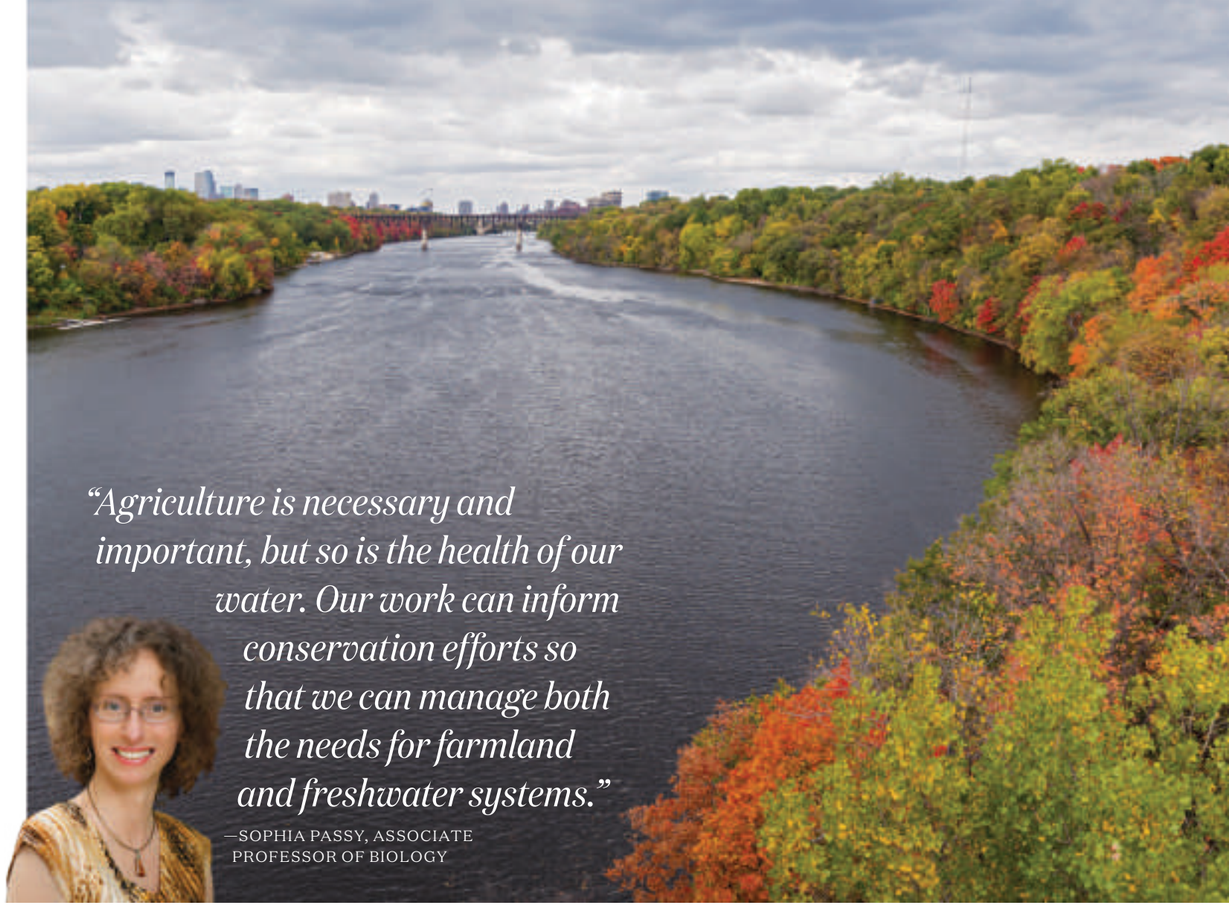
WATER POLLUTION
• *Mississippi River*

Beginning in Minnesota, the Mississippi River rushes south and cuts through the country's heartland to the Gulf of Mexico. The second-longest river in the U.S., it brings drinking water to millions of people, provides a home to thousands of aquatic species, and serves as a touchstone in our nation's culture and history.

But the river is badly polluted. Fertilizers and pesticides from surrounding farms flow into it, carrying nitrogen and phosphorus. Those nutrients fuel algae blooms that reduce oxygen and kill sea life.

"Biodiversity is essential for the health of our ecosystems and their ability to provide vital services to humans, such as clean water and air," says Sophia Passy, associate professor of biology.

She is working with an international team of scientists to examine how agriculture is affecting the biodiversity of freshwater species. They analyzed samples from 1,225 streams near agricultural fields and forests, using national databases of algae, insects, and fish to identify what was found. Results showed that agriculture is indeed causing a loss of biodiversity in algae, insects, and fish at regional to subcontinental scales. For example, areas where streams received large amounts of nitrogen and phosphorus were home to far fewer species compared to predominantly forested regions. This loss resulted in an ecological process called biotic homogenization, where aquatic communities—in this case, those species that were able to thrive in streams near agricultural operations—become similar, limiting their ability to rebound from environmental disturbances.



"Agriculture is necessary and important, but so is the health of our water. Our work can inform conservation efforts so that we can manage both the needs for farmland and freshwater systems."

—SOPHIA PASSY, ASSOCIATE PROFESSOR OF BIOLOGY

The team's work was published in *Global Ecology and Biogeography*, with William Budnick, a doctoral student in Dr. Passy's lab, serving as lead author.

"Agriculture is necessary and important, but so is the health of our water," Passy says. "Our work can inform conservation efforts so that we can manage both the needs for farmland and freshwater systems."

ACID RAIN
• *Adirondack Mountains*

In a separate study, Passy looked into the biological consequences of acid rain on water sources in the Adirondack Mountains. The largest park in the contiguous United States has been severely affected by the weather phenomenon, which is caused by atmospheric pollution.

She and a team of researchers collected algae samples from 200 streams in the Adirondacks with high, low, and variable acidities. (Algae are particularly important because they form the basis of the aquatic food chain.) They found that in streams with high acidity, only the most tolerant species were present; in streams with low acidity, acid-sensitive species were prevalent; and in streams of variable acidity, both acid-tolerant and acid-sensitive species were present.

Though environmental stress like acidification can initially cause a greater regional turnover as sensitive species become less ubiquitous, if it continues, it can result in the eradication of species and the biotic homogenization of regional floras. This in turn can lead to negative consequences for ecosystem functions.

Passy believes acid rain is one of the most serious human disturbances in the northeast United States. As such, she recommends that changes in species turnover be monitored because they can serve as early indicators of ecosystem degradation and future loss of regional biodiversity.

Pollution in the Mississippi River is creating biodiversity problems for the species that inhabit it.

ECOSYSTEM DISRUPTION
• *Texas*

Even the smallest streams of water teem with life—fish, mussels, insects, frogs, lizards. Within these ecological spheres, organisms depend on one another to survive. Any outside disruption can prove disastrous.

One of the more common forms this disruption can take is human activity, such as bridge construction and

other infrastructure projects. That's what civil engineering Assistant Professor Habib Ahmari is hoping to mitigate through his collaboration with the Texas Department of Transportation (TxDOT).

"Anytime a bridge is built, there is an impact," he says. "Land is disturbed. Vegetation is removed. Sediment from the bridge construction sites can enter the streams, which has the potential to change the quality of water and impact the stream ecology."

In Texas, the risks are exceptionally high. The state has nearly 55,000 bridges for public vehicular traffic—the most in the country, according to a 2018 TxDOT report. Dr. Ahmari and his team, which includes civil engineering Associate Professor Xinbao Yu and researchers from Texas A&M University, are developing a model for the agency that predicts the ecological consequences of bridge construction to support more environmentally sound project planning.

The team will conduct a baseline study of the aquatic habitat—including species and population sizes—before construction begins, then follow up throughout the construction process and after it is complete. Much of the focus will be on freshwater mussels, which play a critical role in streams because they filter the water for other species and serve as an important food source for otters, raccoons, muskrats, and some fish. These important bivalves are already imperiled, with 15 species at risk of extinction in Texas, according to Texas Parks and Wildlife.

"If freshwater mussels are killed or forced to migrate from the rivers, the habitat of the ecological system will change dramatically," Ahmari says. "These mussels are very important to the health of our waterways and must be protected."

The resulting model will incorporate various factors, including the type of soil, slope of land, and typical rainfall pattern, to generate a prediction for sediment release. Various measures that reduce sediment release—such as building barriers between the bridge site and stream and applying mulch to the ground—will be incorporated so planners can study multiple scenarios. Throughout construction, Ahmari and his team will also conduct population samples of freshwater mussels and their habitat near the bridge and further downstream to determine the extent of impact.

They believe the tool they are building could eventually be modified to study other species or habitats, with additional states potentially using it to plan for new bridges.

SHIFTING WEATHER PATTERNS
• *Sierra Madre Occidental*

Every summer, the North American Monsoon gathers over the southwestern United States and northern Mexico. Lasting usually until September, the weather pattern fuels rain and thunderstorms across the region, bringing more than half the annual rainfall to the drylands of West Texas; Chihuahua, Mexico; and neighboring states in both countries.

The monsoon hovers over the Sierra Madre Occidental, a mountain range that stretches along the west coast of northern mainland Mexico. Majie Fan, an associate professor of earth and environmental sciences, is studying the mountain range's evolution in an attempt to better understand its role in forming the monsoon.

"The birth and development of the North American Monsoon have received little modern research attention despite the millions of people in the southwestern United States and western Mexico who rely on its rains for agriculture, domestic use, and industry," she says. "Understanding its evolution will give us valuable insight into the entire region's weather patterns."

That's especially important for future water management, as numerical simulations suggest that the timing of monsoon rains will change with global warming. Scientists must understand the processes that caused this shift in the weather pattern if they're going to help the region adapt to the changes it will inevitably cause.

To do so, Dr. Fan and her team are measuring stable isotope compositions—the ratios of different oxygen and hydrogen isotopes—in modern river water and in ancient water archived in hydrated volcanic glass that erupted millions of years ago. The two will be compared to reveal the topographic history and help researchers assess the evolution of the monsoon.

"Data gathered can help scientists develop land and water management processes to better adapt to climate change in coming years," Fan says. "Climate change is likely to affect the timing of monsoon rains, and we should be prepared."

Monsoon season for Copper Canyon and other locations along the Sierra Madre Occidental mountains range may shift as the climate warms.

BIODIVERSITY LOSS
• *Dominican Republic*

When a forest is cut down, which species die? Which survive? Which thrive?

Biology Assistant Professor Luke Frishkoff is exploring these questions by looking at how land use affects biodiversity loss among animals and why some species are able to adapt to climate change.

"When discussing climate change and deforestation, we tend to think of all species as losers," he says. "But roughly 30% of species are actually quite good at coping, and we are working to determine why that is."

Dr. Frishkoff has traveled across Texas, Jamaica, the Dominican Republic, Costa Rica, and Ecuador to examine how various reptiles and amphibians adjust to changes in the land, such a forest being chopped down to clear room for agriculture production.

In one study in northern Dominican Republic, he and his team compared the numbers of Anolis lizards in the highlands—a location with cooler temperatures and higher altitude—with those in the lowlands, an area that tends to be warmer and closer to sea level. Anolis lizards are common tropical lizards that are a model system in ecology and evolutionary biology.

In the Dominican Republic, human land use like deforestation can force species to migrate in order to survive.

The researchers found that at low elevation, deforestation causes Anolis lizard populations to dwindle, with remaining lizards migrating to higher elevations. However, the lizards unique to the region's mountaintops could not survive when forests were removed.

"Essentially, we determined that elevation plays a major role in which species survive when humans modify habitats," Frishkoff explains. "By comparing high and low elevations, we can get a sense of how these biological communities might look in the future."

As the climate warms and human land use changes, it is crucial for scientists to understand and have mechanisms to predict which species will endure. Biodiversity balances the ecosystem, as species need one another to survive.

"Eventually, we want to predict how biological communities across climates and across land uses respond," Frishkoff says. "Policymakers and planners can use this information to make decisions that weigh both the needs of humans and biological communities."

THROUGH THESE AND other projects, UTA is positioning itself to be a leader in environmental research.

"We're tackling this important work by hiring knowledgeable research faculty, dedicating resources and lab space to the work, and, most importantly, training our students to be the next generation of innovative scientists," Dean Khaledi says. "The education and research experiences they receive here will give them the tools and knowledge necessary to lead the charge in reducing the negative impacts of climate change and improving the health of our planet." i

Rapid Response

Across campus, UT Arlington researchers reacted to the COVID-19 pandemic with new ideas, new information, and new hope.

BY DANA JENNINGS

WHEN COVID-19 BEGAN sweeping through the population in 2020, the higher education community faced a daunting challenge: how to continue its important educational and research work in the face of a global pandemic.

For The University of Texas at Arlington, the answer was to become nimble and innovative in adapting its mission for a world where social distancing is fundamental to health. In addition to new course modalities and safety protocols, this meant shifting a portion of the University's $120 million research enterprise to help the global community combat the deadly virus.

From developing faster tests to designing better supply chains to combating dangerous misinformation, UTA's service-oriented researchers answered the call. By the end of July, their collective, urgent efforts had uncovered new insights to aid healthier communities.

Tracing COVID's Roots

Understanding the origins and nature of the COVID-19 virus quickly became a top priority for researchers working to stymie its transmission—especially given how fast misinformation spreads in the digital age.

One of those scientists tackling the issue was Todd Castoe, associate professor of biology. He used his expertise in genomics to join collaborators in studying how the coronavirus jumped to humans and in reconstructing its evolutionary history. Partnering with David Pollock, professor of biochemistry and molecular genetics at the University of Colorado; doctoral student Blair Perry; and an international team of collaborators, Dr. Castoe found that the best current evidence points to horseshoe bats or possibly pangolins—a scaly anteater found in China—as likely ancestor hosts for the virus. This conclusion refutes an earlier study's suggestion that the coronavirus made the leap from

ILLUSTRATION BY RUSSOSKY

dogs to humans.

In the resulting paper for *Molecular Biology and Evolution*, the team emphasized how easy it is for speculative or weakly supported findings to be blown out of proportion. If such tenuous evidence were used to make decisions on managing the crisis, it could result in needed resources and efforts being wasted.

"Considering the ramifications, scientists need to be particularly careful in interpreting findings and avoid rushing to conclusions that are not well-supported by solid evidence," Castoe says. "We need to get this right."

In tandem with the study on host species, he and Perry also joined a study to trace and reconstruct the evolutionary history of the virus. They discovered that the genetic lineage of SARS-CoV-2—the virus that causes COVID-19—has been circulating in bats for decades.

"Understanding the origins of SARS-CoV-2 is a major priority because it may provide evidence for how and why this virus was transferred to humans, and how similar transfers to humans may be prevented in the future," Castoe says.

Exploring Treatment Options

In the early days of the COVID-19 pandemic, two decades-old antimalarial drugs, chloroquine and hydroxychloroquine, were touted as preventive and therapeutic treatments for the virus.

In response, Mauro Toledo Marrelli, associate professor of research, and Marco Brotto, nursing professor and director of the Bone-Muscle Research Center, took to the laboratory to study the actual effectiveness of the drugs. What they uncovered raised red flags for at-risk populations.

While researchers across campus focused on combating COVID-19, others looked for ways to support the community in its hour of need.

"Using chloroquine and hydroxychloroquine as prophylactic or therapeutic alternatives for SARS-CoV-2 infection is, at best, hypothetical, but their side effects are factual," the researchers wrote in a paper for *Revista de Saúde Publica*. "In fact, the drugs could contribute to the exacerbation of musculoskeletal diseases in older adults at risk for developing severe COVID-19."

The team found that there is a shortage of peer-reviewed, rigorous, pre-clinical cell-based, animal-based, and/or randomized clinical studies supporting the effectiveness of the two drugs in treating COVID-19. But there is plenty of evidence supporting the dangers of the drugs' side effects.

"Prescribing these two drugs can trigger problems in certain populations," says Dr. Brotto, who is also the George W. and Hazel M. Jay Endowed Professor and director of UTA's nursing doctorate program. "There is well-documented evidence that these drugs accumulate in cells from several tissues with consequent tissue injury in the liver, retina, skeletal, and cardiac muscle cells. Effects include irreversible cardiac effects, myopathy, and neuropathy."

For the team, the risks outweigh the benefits. This conclusion was echoed in the vocal hesitation of organizations such as the National Institutes of Health, the Centers for Disease Control and Prevention, and the World Health Organization to recommend the drugs for COVID-19 treatment.

"We only want to find the best treatment alternatives for patients based on the foundation of medical ethical treatment for over 2,500 years, 'First, do no harm,'" Brotto says.

New Pathways for Recovery

In addition to grappling with the present reality of COVID-19, UT Arlington researchers also began laying the foundation for efficient testing and treatment options to help the U.S. emerge on the other side of the pandemic.

Seong Jin Koh, professor of materials science and engineering, is using a National Science Foundation (NSF) RAPID grant to develop a $5 device that can deliver COVID-19 testing results on-site in about 10 minutes. The thumb-sized device relies on nanotechnology on a one-centimeter-square silicon chip.

"Our new technology will allow health officials to quickly and easily determine if a person is a COVID-19 carrier," Dr. Koh says. "Because it is portable, the device could be used in airports and other high-volume locations. The chip could be mass-produced by the millions each day and help ease the demand for testing kits."

It also has potential for usefulness beyond the COVID-19 pandemic, as it can easily be adjusted to detect other illnesses. Such a device would be valuable in future outbreaks or for detecting common diseases such as the flu, with the advantage that production could begin on a large scale immediately.

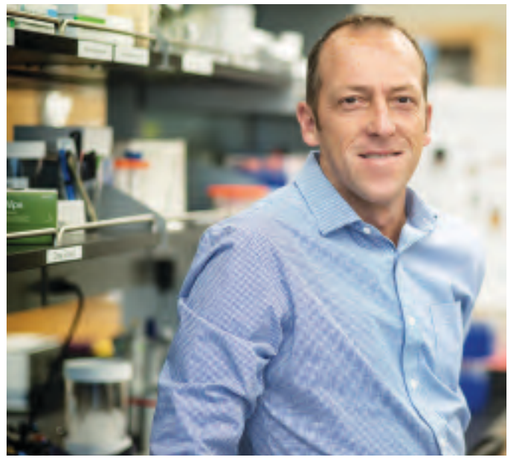
The NSF's investment in UTA continued with Erick Jones, professor of industrial, manufacturing, and systems engineering. He is working with artificial intelligence to develop a rapid-response supply chain designed to quickly deliver COVID-19 medications, once they are available, to vulnerable urban populations in Texas.

A collaboration with the city of Houston, the project has the potential to get needed treatments into the hands of the most critically ill and at-risk populations and prevent hospitals from becoming overwhelmed.

"We've seen that hospital capacity is being strained with elderly people or those with no other health care options," Dr. Jones says. "If we could provide medications to the people who are most at-risk and least likely to easily access them, it will free up capacity for people who need ventilators."

To that end, he is creating a real-time map that would allow the Houston Health Department to supply medication to people who are critically ill first. It would also present a more detailed picture of who is at risk of contracting the disease or who already may have it.

Further, Jones plans to design a process to enable anti-COVID-19 drugs to be delivered to a central point in a neighborhood for pickup. Doctors or social workers could then visit with patients via telemedicine, verify that the medication is correct, and witness the patient take it to ensure that it is being used effectively.



L-R: Todd Castoe is researching COVID-19's origins, Erick Jones is bolstering the medication supply chain, and Seong Jin Koh is developing a rapid, portable test.

Improving Safety

At the UT Arlington Research Institute (UTARI), faculty are working to address a major challenge facing health care workers on the front lines of the pandemic.

Principal Research Scientists Nick Gans and Muthu Wijesundara, Research Scientist Michael Araujo, and biology Associate Professor Michael Roner are exploring the ability of UV light to inactivate viruses and other microorganisms, something that could be used to create a new class of personal protective respirators.

Personal protective equipment (PPE) can filter viral particulates, reducing the wearer's risk of contracting coronavirus. But to maintain effectiveness and safety, medical personnel are meant to use a new mask for each patient—something that, during a heightened outbreak like the COVID-19 pandemic, could translate to five or more respirators an hour.

Keeping up a supply of these masks during the pandemic has proven difficult. The novel approach by the UTARI team could allow respirators to be long-term devices, reduce transmission rates, improve access to respirator masks, and lower overall costs.

Beyond the Lab

While researchers across campus focused on combating COVID-19, others looked for more immediate ways to support the community in its hour of need.

TMAC at UTA received $3.3 million in federal funding to help small- and medium-sized businesses respond to the pandemic as part of funding authorized by the CARES Act and distributed by the Department of Commerce's National Institute of Standards and Technology. Such funding was critical for these entrepreneurs, as the pandemic underscored supply chain weaknesses that have been around for decades.

"Many products are produced by foreign supply chains. When these chains are disrupted, it causes havoc in producing and providing products to U.S. consumers," explains Mark Sessumes, TMAC state executive director. "Health-related products, including equipment, pharma, and PPE, don't just impact American lives, but also our economy, safety, and security."

The North Texas Genome Center (NTGC) focused its attention on bolstering the campus' testing capacity. Thanks to its recent certification under the Clinical Laboratory Improvement Amendments (CLIA), the facility was able to establish on-site COVID-19 test processing to help provide for the repopulation of campus.

"In the years since it was established, the NTGC has earned a highly respected reputation in genome sequencing for biomedical research," says Jon Weidanz, associate vice president for research and director of the NTGC. "After becoming CLIA-certified in January, we were poised to begin human genome sequencing for medical purposes. Then COVID hit, and we jumped into action to be able to serve our community."

Whatever shape the pandemic has taken as it spikes and falls, one thing has proven clear: UT Arlington stands ready to join the global community in creating and supporting new pathways for healing. i

GROWING PAINS

Dallas-Fort Worth is growing at a staggering rate. A group of UTA researchers may hold the solutions to ensuring the Metroplex develops with safety, sustainability, and equity in mind.

BY JENNY GUMBERT

CITIES ARE GROWING—especially in North Texas. According to the U.S. Census Bureau, the Dallas-Fort Worth-Arlington Metroplex grew by 19% between 2010 and 2019, the largest gain in the country. With more than 7.5 million people, DFW is the most populous metropolitan area in Texas and the fourth largest in the U.S. But with that kind of accelerated growth comes problems.

Historically, cities were built alongside sensitive watershed environments like the Trinity River due to the resources they provided, such as drinking water, food, and the transportation of goods. But as these areas grew, the effects of urban development on watersheds often weren't taken into consideration, resulting in increases in serious environmental issues and negative social outcomes.

Researchers from The University of Texas at Arlington's College of Architecture, Planning, and Public Affairs (CAPPA) and Department of Civil Engineering are working to develop solutions that could help DFW and other metroplexes continue their urban growth while protecting the surrounding environments.

"The DFW area is booming significantly and rapidly, and many different places are experiencing some issues due to this development," says Nick Fang, associate professor of civil engineering. "When doing this kind of urban planning, people often have a tendency of overlooking the adverse impacts from the projected development, but we need to respect nature and the watershed."

Exploring Urban Development

Try searching for "watershed urbanism" online and your inquiry will likely come up short—the concept is so new, it's still being defined. Among those helping write this new history are Dr. Fang and Kevin Sloan, a landscape architect and professor

of practice in CAPPA, who are bringing their varied individual expertise to inform and mold the emerging concept.

The general idea is that watersheds and metroplex regions are not isolated phenomena. One should not dominate the other—instead, urban planners should always take into consideration how the natural environment will be affected by development and vice versa. In doing so, we can greatly diminish the negative consequences that often emerge.

Though the idea may seem simplistic—even obvious—few development projects operate with this mindset.

"From the urban planning and architectural standpoint, they want to build something, but, before they do, they need to actually figure out how to respect what's nature-given and what's inside the watersheds," Fang explains. "Then they can design, plan, and build with much better quality and without being worried about future issues caused by human actions today."

"You want to build a systematic view of a watershed corridor for planning purposes, design purposes, flood management, and so forth," Sloan adds. "This is a comprehensive design."

In 2019, the pair worked with Adrian Parr, former dean of CAPPA; Michael Zarestky, former civil engineering associate professor; and Meghna Tare, director of sustainability, to develop "Future Cities, Livable Futures: Watershed Urbanism," a regionwide conference focused on watershed urbanism. Funded by a National Science Foundation grant, the event brought researchers together with entities across the private and public sectors to explore how this emerging concept could be applied to the Trinity River Watershed.

"We wanted to bring all of the different kinds of personnel and experts related to watersheds and urban planning together to get a discussion going," Fang says. "The idea was, 'Let's have a discussion about what is going on in DFW and what is needed for the future.'"

"Watershed urbanism is a topic that is showing great potential for ecology, for hydrology, and on and on. It's going to save the world."

Resilient Watershed Urbanism

Sloan is an expert on rewilding, a concept he describes as designing environments with a very specific calculation in mind for what you want the results to be.

"We're talking about making the hydrology and ecology do the same kind of thing for itself that we make hydrology and ecology do for landscape architecture," he explains. "It's just remapping it all back together so it's one cohesive phenomenon, not landscape over here, civil engineering over there."

In 2019, CAPPA awarded funding for four interdisciplinary research grants focused on water and human settlements. Sloan and Fang are collaborating on one, "Assessing the Value of Resilient Watershed Urbanism," that looks at riparian zones along riverbanks in DFW to investigate ways to use the watershed to accommodate both urban development and rewilded nature.

Fang brings his expertise on hydrology and hydraulic modeling to the team. He has worked on several projects that address flooding in Texas, such as a recent grant from the Texas General Land Office analyzing drainage and proposing recommendations for future flood prevention in nine different southeastern counties.

"When we deal with urban planning, you have to think about how that can blend into the concept to find a common ground," he says. "If you compromise a lot of features in the watershed or do not respect its nature, eventually you're going to have flooding issues. But if you plan well, you can take advantage of the watershed system while still enjoying the amenity."

Now that the researchers have begun to explore real-world applications for watershed urbanism, they have grown excited for its seemingly infinite potential.

"Watershed urbanism is a topic that is showing great promise for ecology, for hydrology, and on and on," Sloan says. "It's going to save the world."

ILLUSTRATION BY EMILY JANE STEINBERG

Nick Fang believes urban developers should respect and utilize watersheds in their designs; Dennis Chiessa is studying the potential sociological consequences of a planned development in north Fort Worth; Karabi Bezboruah is collaborating with universities in India to develop solutions to urban flooding.

North of the Island

Directly north of downtown Fort Worth, an island is forming. Due to the city's rapid population growth and development—both of which are projected to continue into the future—many Fort Worth neighborhoods are at risk of flooding from the Trinity River. An increase in impermeable surfaces like concrete and pavement means more rain is running into the river. The city's 1960s levee system is overstressed.

The proposed solution is to cut a bypass channel that will result in the creation of Panther Island, a project that promises both flood mitigation and a new mixed-use waterfront community. Though it has a seemingly admirable goal, Dennis Chiessa, assistant professor in the School of Architecture, worries the project hasn't taken into consideration how the development will affect all of its surroundings—and how it may actually create new problems.

Instead of the effects of urban development on the surrounding natural environment, Chiessa's concern is for the potential sociological consequences on the majority-Latino community that inhabits Fort Worth's historic North Side neighborhood, located on the other side of the new channel. His research project is funded through one of CAPPA's interdisciplinary grants and includes three other CAPPA faculty: Associate Professor Taner Özdil, Assistant Professor Rod Hissong, and Instructor Nazanin Ghaffari.

"We're looking at the North Side of Fort Worth through the lens of development to understand how the existing community is impacted," explains Chiessa, who grew up on the North Side. "There are obvious concerns about what will happen if 20,000 people come to live and work on Panther Island and what effect that's going to have on the neighborhood, including gentrification and displacement, as well as potential benefits like jobs and increased tax revenues."

The team and its student researchers have been exploring how different sites within the North Side could be transformed to positively reimagine the neighborhood's future once the island is complete. They have shared these ideas with residents to motivate them to get actively involved in advocating for the benefit of their community, with the goal of increasing awareness of the issues surrounding the built environment.

"Understanding how water, the new canal, and development can work together is critical to ensuring this project benefits the larger public," Chiessa says.

Mitigating Urban Flooding

Though their primary focus remains on the DFW Metroplex, some UT Arlington researchers are looking beyond its borders to apply their watershed urbanism research—way beyond. For public affairs and planning Associate Professor Karabi Bezboruah, civil engineering Professor Melanie Sattler, and engineering faculty Arpita Bhatt, the northeast Indian city of Guwahati offers a case study for the problems that can arise when urban development and environmental reality clash.

During monsoon season, the Brahmaputra River flowing through Guwahati regularly rises above its danger level, resulting in frequent flooding of the low-lying areas. The problem is exacerbated by additional factors like rapid population growth, construction in floodplains, deforestation, and a lack of integrated water management policies and effective infrastructure planning.

Drs. Bezboruah, Sattler, and Bhatt are collaborating with Cotton University and Shiv Nader University to identify grassroots strategies for avoiding and mitigating urban flooding's socioeconomic and health impacts. The team will share the resulting water management policies and infrastructure planning practices via training workshops at Cotton University, with government officials, NGO executives, engineers, architects, and real estate developers being invited to attend.

"It's a great opportunity to collaborate with eminent international researchers on the topic of urban flooding and to come up with solutions that will have significant social impact," says Bezboruah. i

Invention Index

Promoting innovation and the commercialization of research

THE MAVPITCH BUSINESS COMPETITION HELPED HELPED STUDENT FRANK RIDOUT EXPAND HIS COOKIE BUSINESS.

Center for Entrepreneurship and Economic Innovation

In 2020, UT Arlington received special appropriation from the Texas Legislature to establish a new Center for Entrepreneurship and Economic Innovation. Led by Associate Vice President for Research Kimberly Mayer, the center's mission is to enable the University to engage more meaningfully with local companies and businesses and to serve as an engine for economic recovery and growth in Arlington and the North Texas region. Among its top priorities are supporting students and faculty throughout the innovation process and developing an incubator that can offer services to fledgling UTA-led businesses.

SolGro

A startup with ties to UTA was recently chosen for two distinguished business accelerators, illustrating the University's commitment to entrepreneurship and research commercialization.

SolGro Inc. was founded by student Tyler Sickels with technology developed by physics Professor Wei Chen. The company created a patented canopy system that embeds nanomaterials into greenhouse glazing to convert wasted sunlight into usable light for increased plant photosynthesis.

SolGro was selected for the early-stage startup accelerator MassChallenge and for the first-ever "agtech" cohort by The Wells Fargo Innovation Incubator.

Recent patents

Yaowu Hao, associate professor of materials science and engineering, along with researchers Xiankai Sun and Sina Moeendarbari, invented a method of performing brachytherapy using radiotherapeutic seeds, or NanoSeeds.

Distinguished Professor of Physics J. Ping Liu synthesized ferromagnetic nanowires with high aspect ratio. The nanowires serve as ideal building blocks for future bonded, consolidated, and thin film magnets with high energy density and high thermal stability.

Distinguished University Professor Krishnan Rajeshwar and Functional Applied Biomaterials Lab Director Yi Shen received a patent for a unique approach to solar energy conversion and storage that uses all-vanadium photo-electrochemical storage cells.

FACULTY NEWS

Highlighting recent faculty awards, appointments, publications, and more

CPRIT award opens path for cancer researcher

With $2 million in support from the Cancer Prevention & Research Institute of Texas (CPRIT), UT Arlington added an emerging leader in cancer biology to its faculty and fortified its cancer research enterprise.

Piya Ghose, assistant professor of biology, came to UTA in 2020 with an established portfolio of investigations into programmed cell death, which has major implications for cancer treatment.

"To be recognized among a cohort of numerous strong, young scientists is an honor, and it is motivating to look at the CPRIT scholars who have come before me," Dr. Ghose says. "This award has opened up my world and is allowing me to pursue big, ambitious questions from the jump. It, along with the supportive and connected nature of UTA, really allows me to hit the ground running."

She is currently studying a special form of programmed cell death called compartmentalized cell elimination, in which different parts of a cell degenerate in different ways. She believes this could lead to a greater understanding of how tumors behave throughout the body.

> ***"This award has opened up my world and is allowing me to pursue big, ambitious questions from the jump."***

"I'm excited to discover what this concept can teach us in how we approach cancer," Ghose says. "Through the CPRIT proposal, I got the chance to think about how I identify as a scientist and how I can utilize my interests to have an impact that will benefit the world. I feel at home at UTA and in what I'm doing. The years of effort are proving to be worth it."

ILLUSTRATION BY LARA TOMLIN

Awards

Two University of Texas at Arlington faculty members—**Stephanie Rasmussen**, associate professor of accounting in the College of Business, and **Ericka Robinson-Freeman**, associate professor in practice in the School of Social Work—have earned the UT System Board of Regents Outstanding Teaching Award.

Dereje Agonafer, Presidential Distinguished Professor and the Jenkins Garrett Professor in the Department of Mechanical and Aerospace Engineering, received the Howard University 2020 Alumni Award for Distinguished Postgraduate Achievement.

The Construction Management Association of America chose **Sharareh "Sherri" Kermanshachi**, assistant professor of civil engineering, as the Mark Hasso Educator of the Year.

History Associate Professor **Cristina Salinas** received the 2020 National Association for Chicana and Chicano Studies Book Award for *Managed Migrations: Growers, Farmworkers, and Border Enforcement in the 20th Century*, which exam-

UTA's first Jefferson Science Fellow

Business Professor **Edmund Prater** is the first person from UT Arlington to be appointed a Jefferson Science Fellow by the National Academy of Sciences.

The fellowship program is designed to help the U.S. government leverage the expertise of academic scientists, engineers, and physicians. It requires one year of service in the State Department or the U.S. Agency for International Development on-site in Washington, D.C., and overseas.

"I'm one of the few people in my family to have not served in the military. I want to serve," says Dr. Prater, who also is executive director of the Veterans Business Outreach Center. "I believe in service, and I believe I owe this country my service. This was an opportunity for me to do that."

His expertise is multidimensional, but focuses on global supply chains, logistics operations, and entrepreneurship. In addition to his doctorate in business, Prater earned three engineering degrees from the Georgia Institute of Technology and has owned businesses in the United States and Russia.

In his nomination letter, Interim President Teik C. Lim wrote that Prater is "a distinguished scholar, tireless leader, and role model for our youth, and he is most deserving of this opportunity."

ines connections between the agricultural industry and border enforcement in the Rio Grande Valley.

Karabi Bezboruah won the 2020 United States Distance Learning Association International Excellence in Teaching/Training Award. She is an associate professor in the College of Architecture, Planning, and Public Affairs.

Management Assistant Professor **Alison Hall Birch** received the Academy of Management Review's Best Paper Award for 2020.

The Texas Society of Architects honored **Kathryn Holliday**, professor and founding director of the David Dillon Center for Texas Architecture, with its award for Excellence in the Promotion of Architecture through the Media in Honor of John G. Flowers; and **Bradley Bell**, associate professor and director of the School of Architecture, with its Outstanding Educational Contributions in Honor of Edward J. Romieniec.

Presidential Distinguished Professor and the Jenkins Garrett Professor in the Department of Mechanical and Aerospace Engineering **Dereje Agonafer** was honored with a Lifetime Achievement Award by the SEMI-THERM Educational Foundation Thermal Hall of Fame.

Publications

A new multisite study led by UTA and published in *Nature Communications Biology* details a series of biomarkers in the blood that could lead to better diagnoses and treatments for osteoporosis. The UTA team comprises **Zhiying Wang**, **Liangqiao Bian**, **Chenglin Mo**, **Maciej Kukula**, **Daniel W. Armstrong**, and **Marco Brotto.**

Physics Professor **Wei Chen** co-authored four studies related to his work with nanomaterials. Two were published in *Applied Material Interfaces*, while the others were published in *Coordination Chemistry Reviews* and *Nature Signal Transduction and Targeted Therapy*.

Sriram Villupuram, associate professor in the College of Business, determined that curb appeal in residential housing could account for up to 7% of a home's value when sold. His study was published in the *Journal of Real Estate Finance and Economics*.

In his new book, *Getting Signed: Record Contracts, Musicians, and Power in Society*, sociology Associate Professor **David Arditi** explores how the dream of receiving a record contract can obscure a culture of exploitation in the music industry.

Jennifer Zhang, professor in the College of Business' Department of Information Systems and Operations Management, published a paper in *ScholarSpace* that estimates the value of images in predicting the success of crowdfunding projects.

A recently published study led by **Ariane Froidevaux**, assistant professor of management, says that student debt may hurt graduates' chances of securing full-time employment. The paper appeared in the *Journal of Applied Psychology*.

A UTA study of transit-oriented developments across Dallas-Fort Worth identifies the most important factors that can increase housing values near those sites. **Ard Anjomani**, professor in the College of Architecture, Planning, and Public Affairs, and recent alumnus **Saad AlQuhtani** published the study in the *Journal of Transport Geography*.

Evan Mistur, assistant professor in the College of Architecture, Planning, and Public Affairs, published an article in the *Journal of Chinese Political Science* suggesting that nationalistic governments around the globe are more likely to copy other nationalistic governments in responding to the COVID-19 pandemic.

Grants

Sahadat Hossain, director of UTA's Solid Waste Institute for Sustainability, and **Warda Ashraf**, assistant professor of civil engineering, are combining their two areas of expertise—recycling and asphalt/concrete, respectively—to lead a feasibility study on building plastic roads, funded by the Texas Department of Transportation.

UTA and the city of Coppell are collaborating on robotic inspections of sewer pipelines and material testing of their core samples to predict their service life. **Ali Abolmaali**, professor and chair of the Civil Engineering Department, is leading the $895,100 project. Faculty Research Associates **Arash Emami Saleh** and **Maziar Mahdavi** are co-principal investigators.

Social work Associate Professor **Anne Nordberg** and civil engineering Professor **Steve Mattingly** are developing a comprehensive vision of what the Texas transportation system should look like in 25 years. The two-year project is funded by the Texas Department of Transportation.

David Wetz, a professor of electrical engineering, received a three-year, $799,000 grant from the Naval Surface Warfare Center–Dahlgren Division to study the high-voltage dielectric insulation properties of epoxy and additively manufactured materials.

In collaboration with researchers from Iowa State University, **Caroline Krejci**, industrial engineering assistant professor, is helping develop a framework to analyze food, energy, and water systems in the greater Des Moines, Iowa, area. The project is funded by a $2.5 million grant from the National Science Foundation.

Social work Assistant Professor **Kathy Lee** earned a grant from the Alzheimer's Association International Research Grant Program to study the best ways to communicate with caregivers of East Asian Americans diagnosed with memory disorders.

Computer science Assistant Professor **Ming Li** received a five-year grant from the National Science Foundation's Faculty Early Career Development program to develop a framework for wireless carriers and internet providers to incorporate data obtained through context-aware sensing.

Nur Yazdani, a professor of civil engineering, received funding from the National Oceanic and Atmospheric Administration to develop a web-based tool that will help stakeholders properly design home slab elevations to protect homes and possessions against flood waters in future storms.

Appointments

The National Academy of Inventors selected **David Hunn**, adjunct professor of mechanical and aerospace engineering, as a fellow. Four UTA faculty members were also named senior members of the institute: **Pranesh Aswath**, interim provost and vice president for academic affairs; **Wei Chen**, professor of physics; **Haiying Huang**, professor of mechanical engineering; and **Robert L. Woods**, professor of mechanical engineering.

The Advisory Council on Underwater Archaeology elected **Ashley Lemke**, assistant professor of anthropology, as chair of the international advisory body.

Ashfaq Adnan, associate professor in the Mechanical and Aerospace Engineering Department, was named a fellow of the American Society of Mechanical Engineers.

The Atlantic Council named **Brian Whitmore**, adjunct assistant professor in the Charles T. McDowell Center for Global Studies, as a non-resident senior fellow.

The Royal Aeronautical Society elected mechanical and aerospace engineering Professors **Kamesh Subbarao** and **Luca Maddalena** as fellows.

Jim Williams, civil engineering professor, was re-elected president of Chi Epsilon, the national civil engineering honor society.

The Institute of Industrial and Systems Engineers named **Erick C. Jones**, the George and Elizabeth Pickett Endowed Professor and associate dean for graduate affairs in the College of Engineering, as a fellow.

The American Association for the Advancement of Science selected **Qinhong Hu** as a fellow.

The Optical Society named electrical engineering Professor **Weidong Zhou** as a fellow.

European Academy of Sciences, Engineering Division, elected **Maria Konsta-Gdoutos** as one of eight new fellows for 2020. She is a civil engineering professor and associate director of the Center for Advanced Construction Materials.

Ali Abolmaali, professor and chair of civil engineering, was named a fellow of the American Society of Civil Engineers.

ILLUSTRATION BY LARA TOMLIN

Early Insight

Supporting research experiences at the undergraduate level

Helping cancer patients

Alyssa Tijerina, a nursing and psychology junior, received an internship in 2020 with the Texas Center for Proton Therapy, which uses an advanced form of radiation that employs protons to destroy cancer cells while minimizing damage to the surrounding tissue.

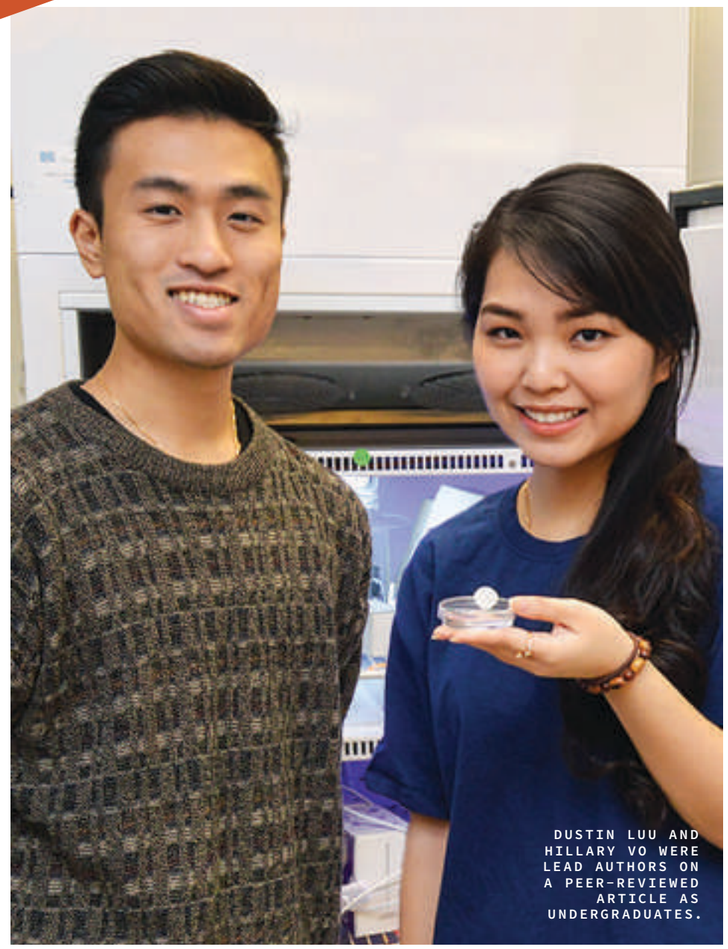
"I offered Alyssa the opportunity to develop this new internship because I believe her multifaceted interests, both in nursing and psychology, would be a great fit for what we do at the center," says Gary Barlow, the center's administrative director.

Research teams and medical experts at the center work with patients through in-depth studies and cutting-edge trials to address challenges and identify ways to better treat, diagnose, and prevent cancer.

Senior wins important position

Exercise science senior Matthew Fiedler earned a position as a research course assistant at the renowned Marine Biological Laboratory. He will assist with the instruction of a physiology advanced research training course at the lab for seven weeks this summer. Highly adept in imaging techniques, Fiedler will help professors in the classroom and with hands-on microscopy lessons.

"This is an exciting honor and an outcome I didn't expect," he says. "I'll have the chance to work with new varieties of species samples while building my skills in teaching technical research concepts."



DUSTIN LUU AND HILLARY VO WERE LEAD AUTHORS ON A PEER-REVIEWED ARTICLE AS UNDERGRADUATES.

Exceeding Expectations

During their final year at UT Arlington, biology students Dustin Luu and Hillary Vo achieved something few undergraduates have: lead authorship of a peer-reviewed, published article. Called "An Efficient Method for Hatching Diapausing Embryos of *Daphnia pulex* Species Complex (Crustacea, Anomopoda)," the paper details a new, efficient method for hatching embryos that have stopped development but remain viable for an extended period of time. It was published in the *Journal of Experimental Zoology Part A: Ecological and Integrative Physiology*.

"For undergraduates who juggle a busy schedule of classes and other extracurricular activities, publishing peer-reviewed articles as lead authors is a tremendous achievement," says Assistant Professor Sen Xu, who served as the corresponding author.

The State of

RESEARCH

at

THE UNIVERSITY OF TEXAS AT ARLINGTON

THE STATE OF RESEARCH

UT ARLINGTON is a research university that inspires bold solutions with global impact. In 2019, it launched an update to its *Strategic Plan 2025* that is focused on a framework of six fundamental guiding aspirations, including one dedicated to Research and Creative Works.

The goals of this aspiration are to

- Serve as the model 21st-century research university for the state of Texas and around the world
- Increase student participation in research and experiential learning
- Enhance faculty and staff recognition nationally and internationally
- Improve reputation and rankings in teaching, research, and creative activities
- Grow and develop impactful research centers, partnerships, and scholarly collaborations
- Strengthen the culture of innovation across campus

To that end, the University has expanded its research pillars to include Cultural Understanding and Social Transformations, along with Health and the Human Condition, Sustainable Communities, Global Environmental Impact, and Data-Driven Discovery. Together, these important topics will help guide the work of our faculty and students over the next five years as they conduct innovative research aimed at improving the quality of life for all.

BY THE NUMBERS

19 fellows in the National Academy of Inventors, the most in Texas and tied for the 5th-most of all universities

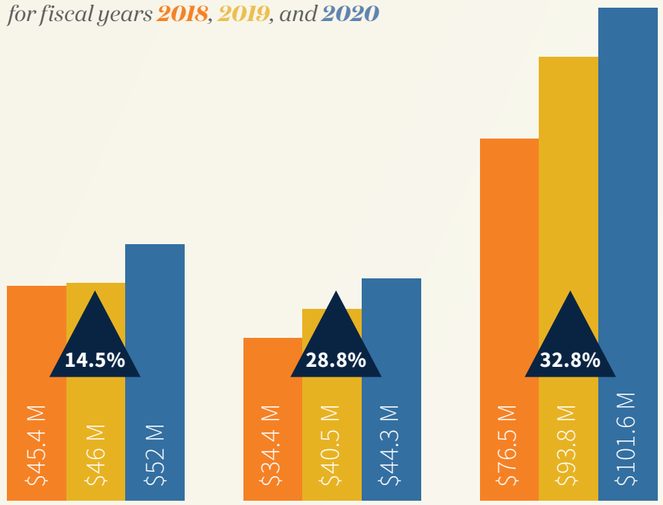
4 out of the 38 National Academy of Inventors' class of 2020 Senior Members come from UTA, the most of any university in the nation

228 Ph.D.s were conferred in the 2019-20 academic year, a growth rate of 78% over the past decade

13 graduate programs were named "Best Graduate Schools" in *U.S. News & World Report*'s 2021 rankings

RESTRICTED AND FEDERAL RESEARCH EXPENDITURES

for fiscal years 2018, 2019, and 2020



RESTRICTED RESEARCH EXPENDITURES *as defined by the THECB*

FEDERAL RESEARCH EXPENDITURES *as defined by the THECB*

AMOUNT OF AWARDS

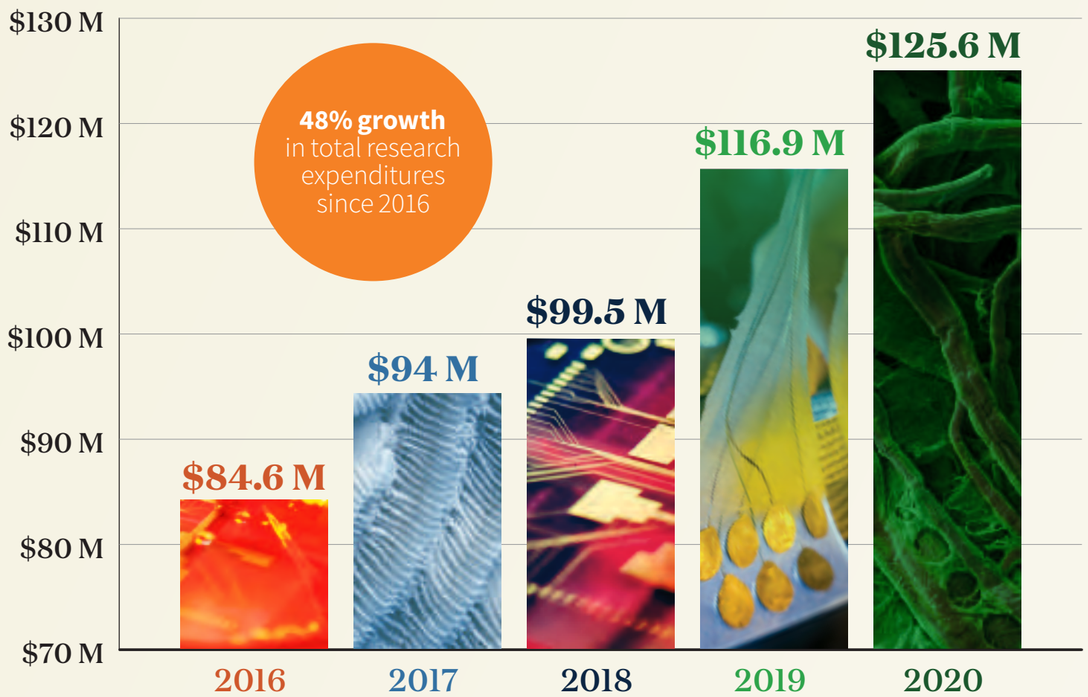
TEXAS TIER ONE MILESTONES

UTA has successfully achieved and maintained the following criteria required to qualify for National Research University Fund (NRUF) support and Texas Tier One status:

- At least **$45 million** in restricted research expenditures
- At least **200 Ph.D.s** awarded annually, something UTA has achieved for five consecutive years
- **High-quality faculty**; UTA currently has seven members of the National Academies of Science, Engineering, and Medicine
- Membership in the **Phi Kappa Phi Honor Society**
- Designation as an **emerging research university** in the Coordinating Board's accountability system
- A freshman class with **high academic achievement**, a criterion for which UTA consistently ranks the highest among universities in the running for NRUF designation

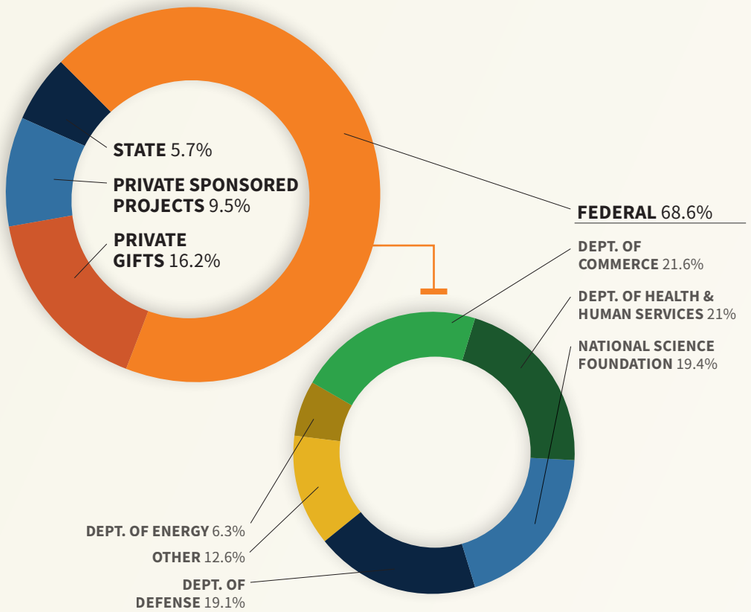
UTA TOTAL RESEARCH EXPENDITURES

by fiscal year, as reported in the THECB RD Expenditure Survey



EXTERNAL RESEARCH EXPENDITURES BY SOURCE

for fiscal year 2020



Showcase

Previewing a new work by UTA faculty

The Imagery of Revolution

In his new book, *Language and Metaphors of the Russian Revolution: Sow the Wind, Reap the Storm*, Associate Professor of Russian **Lonny Harrison** examines metaphors for revolution in the storm, flood, and harvest imagery in Russian literary works.

In this excerpt, Dr. Harrison discusses how weather and storm imagery in Boris Pasternak's Nobel Prize-winning novel *Doctor Zhivago* runs counter to currents of revolutionary ideology in Soviet life.

PASTERNAK'S NOVEL, LIKE his poetry, centers on the ecstatic beauty and creative power of life. Emotional states are mirrored in the weather and environment, or vice versa. The Revolution is welcomed by Yuri Zhivago, who views it with awe, like the spontaneity of weather—an unleashing of elemental force (*stikhinost'*), for better or worse, creative or destructive, but always profound in its impact. Unlike the trope as it appears in canonical Soviet literature, where elemental force or spontaneity are tempered by class consciousness, the most essential part of life for Zhivago is the living, breathing consciousness that springs from inner vitality [...]

The preponderance of weather imagery in *Doctor Zhivago* is more than a reflection of the protagonists' inner emotional life. Zhivago is awed and inspired by its power, but he must struggle against it to survive. The flood is the beautiful, perennial force of life associated with the heroine Lara Antipova. But the storm of revolution is relentless, destructive, and inhumanly cruel; it transforms people into pitiless ideologues. [...] An exasperated Yuri Andreevich concludes that men who are not free are prone to idealizing their bondage—but he keeps it to himself in order not to hurt his friends' feelings.

Decades earlier, Pasternak had poetically illustrated how Lenin gave agency to the storm. Impressed with his striking charisma and oratorical skill, Pasternak wrote a poem depicting his memory of the Bolshevik leader at the Ninth Party Congress in July 1921. Lenin enters "Like the compressed sphere of a storm/Flying smokeless into the room." His speech pierced the poet's neck with sparks "Like the rush of globe lightning"; his words were "of engine oil"; and Lenin himself is likened to a "rapier thrust." Later in a draft excerpt from the 1950s, Pasternak would call him the "voice of the great Russian storm," who "allowed the ocean to rage," while "the hurricane passed over with his blessing." Similarly, in *Doctor Zhivago*, Yuri places the likes of Lenin in a special category, observing that wars and revolutions are like history's yeast, produced by fanatical men of genius. But it wasn't the military genius alone who transformed the world. Referencing *War and Peace*, he doesn't think Tolstoy spelled out the limitations of the great man theory of history quite enough. Revolutions might be made by fanatical men of action, but the spirit that inspired them is worshipped long after. Zhivago longed nostalgically for earlier days, when the revolution had seemed like a god unto itself, a particular sort of madness for that point in time only, but not a confirmation of any political theory or Party. Such were the events of 1905 and the first weeks after February 1917, depicted in the novel as part and parcel of the organic whole encompassing the weather and environment, flowing social movement, and the private lives of individuals. i

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