All the people in the Texas Science community enrich campus life here with their own experiences, ideas and perspectives. This academic year, several University of Texas at Austin science students donned GoPro cameras to help chronicle life on the Forty Acres from their distinctive vantage point. At the annual Gone to Natural Sciences welcome event, camera-wearing students were among those who wrote down their interpretations of a three-word phrase found on stickers and placards throughout campus: You belong here.

Catch a glimpse of their take at: txsci.net/utpov.
A digest of the people and groundbreaking discoveries that make the College of Natural Sciences at The University of Texas at Austin one of the most creative and interesting places on Earth.

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Dear Friends,

The University of Texas at Austin’s College of Natural Sciences celebrates its 50th anniversary this year, so I have been reflecting on what a half-century means in science.

On the one hand, our scientific leaders explore far more distant vistas, whether learning about life’s origins or the beginnings of the universe itself. At such scales, a few decades amount to no more than a wisp of time.

Yet in 50 years, science has delivered astonishing transformations, from curing disease and improving lives to simply lifting up the human spirit by unveiling more of nature’s brilliance. A half-century ago, when NASA launched Apollo 11 with the help of UT Austin-trained mathematicians and scientists, the Apollo Guidance Computer assisted with safely taking humans to the moon and back. State of the art for its time, the computer contained more than 10,000 transistors. With you right now might be a smartphone containing almost 10 billion – or roughly a million times as many.

Science and mathematics help define every epoch. In our cover story and throughout this edition of The Texas Scientist, you will find various meditations on this theme. See what’s changing – from ocean cleanup to calculus class to vaccine development – and how the evolving story of Texas Science is set to unfold.

Paul M. Goldbart
Dean and R.E. Boyer Chair
See how scientists are solving enduring problems using innovative tools or approaches.
In physics, a hot area of research is studying what happens when ultrathin materials get stacked at a slight angle (see “Twisted Physics,” page 14). Professor of physics Xiaoqin Elaine Li researches the resulting optical properties and works to control light emission, a single photon at a time. Such an innovation holds promise for making quantum information devices smaller, more efficient and more secure. While it may take years for these applications to be realized, Li believes work now with these materials will pave the way for breakthroughs to come.

“Investigating new quantum materials can transform the way we live,” she said.
CRACKING THE CODE

Freshman calculus and organic chemistry are the kinds of courses that can send shudders up the spines of many undergraduates. Both classes are where students take some of their earliest intensive, college-level mathematics and science. Now a pair of distinguished teaching professors at The University of Texas at Austin are among those using research to ensure students’ experiences in early courses like these create a solid foundation on which to build future success in STEM.

Uri Treisman, a professor of mathematics and director of the Charles A. Dana Center, and David Laude, professor of chemistry, have developed effective formulas that weave rigor and support into UT students’ experiences. Their efforts are helping more students start strong, with strategies steeped in educational research and celebrated in a 2019 book, *The Years that Matter Most: How College Makes or Breaks Us*. So what’s in the formula?

Offer a reality check: Many students worry about not belonging in college. Faculty now help new undergraduates understand how common that concern is, plus the ways that university staff and faculty are here to help. All UT students receive targeted lessons in how early classroom difficulties tend to be temporary and how, with the frustration, comes eventual growth.

Keep the tough content intact: A key way Treisman and Laude show respect for their students is setting a high bar. Challenging students keeps them motivated, while preparing them for the future in these disciplines. Students learn they can be leaders, right from the start.

Create meaningful supports: Treisman and Laude have developed a suite of tactics to help students succeed, from study groups to keeping close tabs on students as individuals, and checking in with them regularly. All Natural Sciences first-year students are matched with small, learning communities. Many experience real-world learning, too, in programs like the Freshman Research Initiative and the Inventors Program.

Go online to hear more on what it takes for success in college: txsci.net/utsuccess
HOW TO DESIGN A NEW VACCINE

Historically, scientists have made vaccines by crippling a disease-causing virus, for example with heat or chemicals. When this dead or weakened version of the virus is injected into a person, the immune system learns to recognize it and produce antibodies that prevent the virus from spreading. But what happens when the virus makes itself hard to recognize? A virus called RSV (for respiratory syncytial virus) that is most dangerous in childhood provides a good test case. Scientists like UT Austin’s Jason McLellan are pioneering a radical new way to make vaccines to tame RSV, currently the world’s second-leading viral killer in infants.

Go online to hear our interview with McLellan, who published work in the journal *Science* about this research: txsci.net/fightingrsv

**SCIENCE IN MOTION**

**STEP-BY-STEP**

1. Some people’s immune systems successfully fight RSV, a shape-shifting virus, so harvest a set of naturally produced antibodies from a person with the immunity.

2. Use a special, high-resolution tool, like cryogenic electron microscopy, to watch the virus and antibodies at work and see precisely where antibodies stick to the virus.

3. Design a molecule with the same shape and composition of the section of the virus that antibodies stick to.

4. Now test it. If when you inject the vaccine antigen into uninfected people, it results in the production of protective antibodies, you have done it: created a working vaccine in a whole new way.

Scientists like UT Austin’s Jason McLellan are pioneering a radical new way to make vaccines to tame RSV, currently the world’s second-leading viral killer in infants.
Parenting is a hard, important job that comes with no instruction manual. Parents rely on family, friends and the internet for advice on raising children, but a robust body of science on parenting also can help – particularly regarding discipline, says expert Elizabeth Gershoff, the Amy Johnson McLaughlin Centennial Professor in UT Austin’s Department of Human Development and Family Sciences.

Gershoff has conducted two decades of research on the effects of physically punishing children. Her findings include that the more children are spanked, the more likely they are to become aggressive, engage in anti-social behavior and experience mental-health and cognitive difficulties. Gershoff later helped both the American Academy of Pediatrics and the American Psychological Association implement policies stating that physical punishment is harmful and that their members should help parents learn other methods of discipline. Additionally, she co-edited a 2019 book summarizing evidence-based ways to reduce parents’ use of physical punishment.

Nearly 60 countries have banned all physical punishment of children, and many consulted Gershoff’s research in the process. Invited by a number of countries’ governments to speak about her research, Gershoff also submitted policy briefs for countries that later implemented universal bans on physical punishment, including Scotland and Wales. Her research also brought change in the U.S., where physical punishment in public schools remains legal in Texas and 18 other states. The U.S. Department of Education cited her work in its call to end school corporal punishment, and three states since banned using physical punishment in schools on children with disabilities.

Gershoff continues to work on this topic, noting, “It is incredibly gratifying when parents or schools or countries decide to forgo physical punishment on the basis of the scientific evidence.”
CORWIN ZIGLER
Associate Professor in the Department of Statistics and Data Sciences, also appointed in Women’s Health at the Dell Medical School. Interviewed by Larissa Herold.

What brought you to UT Austin from the Harvard School of Public Health? UT is at a very exciting time when it comes to joining statistics, data science, quantitative research and the health sciences. It’s a strong university, and the opportunity of the new Dell Medical School is unique.

"A lot of my work is there in the impacts from the interconnectedness of people and environments."

One of your research projects looks at how changes in air pollution regulations impact people’s health. How do the statistical methods you’ve developed shed light on questions like this? I’m interested in causal inference. This means measuring and drawing a conclusion about the downstream causal interaction when some action is taken, whether it’s treatment by a doctor, a policy or a public health intervention. And when we do something, can we track the effects of the action? In the real world, effects can be difficult to track and isolate. For example, we can’t do an experiment where we give some people more air pollution and others less to see how their health outcomes differ. So causal inference in a nutshell is a way to re-create experimental conditions out of the hand we’ve been dealt in observational data.

How does your area of research inform real-world outcomes? In an ideal world, we produce some amount of evidence as scientists and then that evidence is used to form a policy decision. In Dell Med, that would mean we come up with a method and then somebody high up in the health care system orients patient care to incorporate it into practice on a large scale. There are higher-level policies and practices that, if we can get them right, can have a lot of impact.

The Faculty Member

The idea here is that people don’t exist in isolation; they’re connected in some way. For example, we might be connected by a social network or by breathing air from the same power plant. Those types of interconnections make the statistics much more complicated. A lot of biostatistics evolved in the context of a medical clinical trial, but when we start to think about a public health intervention, a clinical trial doesn’t work any more because of the interferences from those connections. So a lot of my work is there in the impacts from the interconnectedness of people and environments.

What are some of the challenges you face when looking at health and environment data collected through observations rather than experiments? One of the big challenges is called interference.

At UT Austin’s new Dell Medical School, researchers use data to uncover contributors to health challenges.

Find an extended version of this interview at txsci.net/zigler
DISCRIMINATION’S AFTERMATH

Understanding racial and ethnic differences can start very early. By the age of 5, many children can recognize racial or ethnic groups. By 10, many know discrimination when they see it — including when they themselves are targeted.

Hundreds of studies have tracked how racial and ethnic discrimination affects children’s development, but Aprile Benner, an associate professor of human development and family sciences at The University of Texas at Austin, led a team that reviewed them comprehensively, assessing — across more than 200 peer-reviewed studies of over 90,000 youths — how discrimination affected adolescents’ mental and physical health, behavior choices and academic performance. Benner and the team concluded: “Racial and ethnic discrimination influences all aspects of adolescents’ daily lives and well-being.”

The extent of discrimination’s impact varies, and how parents interact with youths about experiences with discrimination appears to play a role. For example, Benner’s team found Latino students, especially boys, tended to experience poorer outcomes from discrimination compared with African American students. The team theorized that African American families have more conversations with their children to prepare them for the biases that surface too often in daily life.

Benner’s colleague in the department, Fatima Varner, explores the link between parenting and how youths respond to prejudice. African American youths whose parents remain closely involved and engaged after their child experiences a racially discriminatory event do better. “Supportive parenting is linked to a host of positive outcomes for youths – from academic achievement to better social engagement,” Varner said. “Parents have a critical protective role to play against the impact of racial discrimination.”

There is a role for other adults, too. “We need to be asking,” Benner said, “What can we all do to intervene to try to reduce discriminatory treatment?”
A member of Women in Natural Sciences and an alumna of the Freshman Research Initiative, Dattilo used the A.I. called AstroNet-K2 to find planets. She fed it data on known examples, a process known as “supervised learning.” Then AstroNet-K2 found two new examples that fit a similar profile, previously unknown planets outside our solar system, or exoplanets, unlovingly labeled K2-293b and K2-294b. The pair were later confirmed by ground-based telescope observations.

Creating an automatic, unbiased system to identify signals of interest — in this case, a temporary dimming of starlight that occurs when a planet orbits its star — is only the beginning, according to Dattilo, who is now in graduate school.

“There may be unusual planetary systems out there that are interesting but would not be recognized by our model,” she observed. This means the A.I. method, if applied to other data sets or telescopes, “could potentially find highly valuable, previously missed planets.”
Professor Allan MacDonald wondered what would happen if you stacked two atom-thin sheets of a material called graphene on top of each other, but with a slight twist so the atoms in one sheet didn’t perfectly line up with atoms on the other. Using supercomputers at the Texas Advanced Computing Center, he and another researcher modeled the problem of twisted bilayer graphene and found that at a very specific angle electrons in the model behaved in a strange and extraordinary way.

MacDonald, who holds the Sid W. Richardson Foundation Regents Chair in Physics, was surprised to see the atoms suddenly moved more than 100 times more slowly at the 1.1 degree angle. Discovering this “magic angle” effectively launched a new subfield called twistronics.

For decades, scientists have worked to find a material that can transport electricity with perfect efficiency — or superconduct — at something like room temperature. (Current superconductors require closer to absolute-zero temperatures.) Such a discovery would have implications for quantum computing and for efficient sources of electricity. In 2018, scientists demonstrated that bilayer graphene twisted at MacDonald’s magic angle exhibits superconductivity — and at a surprisingly high temperature, too.

Earlier this year, MacDonald won the Wolf Prize, one of the most prestigious prizes in physics. He continues to make discoveries about magic-angle graphene, including research findings that suggest great promise for future advances in electronics and improvements in energy.

“The thing that’s energized my work is that nature is always posing new problems,” MacDonald said. “When you ask a new type of question, you don’t know in advance what the answer is or where the adventure will lead.”
WHEN FEAR FLOODS BACK

Since the time of Pavlov and his dogs, scientists have known that frightening memories we thought we had put behind us can sometimes pop up at inconvenient times. UT neuroscientists recently found that a very specific group of cells in the brain are to blame. Michael Drew, a University of Texas at Austin associate professor, identified the neurons that, when activated, suppress scary memories and when inactivated cause those negative memories to resurface. His finding explains both how this process works in the brain and where (not in the amygdala, which dictates other fear memories, but in the hippocampus, the part of the brain involved with other types of recall).

The discovery may prove helpful for health professionals working to make more effective decisions about treating anxiety, phobias and post-traumatic stress disorder. For example, exposure therapy is one of the leading ways to treat these disorders – but it sometimes stops working. To override past fears, the therapy promotes formation of new memories of safety; for example, a person who had a frightening incident with spiders might practice letting a harmless spider crawl on him. But since the same part of the brain is involved, whether creating the new safe memories or bringing up the older, fear-inducing ones, some competition for resources may come into play.

“The new memory does not erase the original fear memory but instead creates a new memory that inhibits or competes with the original fear,” Drew said.

Given the new discovery, mental health professionals may need to rethink the duration and timing of exposure therapy, and pharmaceutical makers now have a new pathway for exploring ways to treat fear-based conditions.

"The new memory does not erase the original fear memory but instead creates a new memory that inhibits or competes with the original fear."
PINEY PARADISE

Biological researchers and students of the life sciences get special access to Texas’ natural splendors at UT Austin’s Stengl Lost Pines Biological Field Station. The nearly 600 acres located east of Austin are reserved exclusively for scientific exploration. The site, home to the country’s western-most grove of loblolly pines, attracts top scientists, including those at the beginning of their careers who participate in UT Austin’s new and prestigious Stengl-Wyer Scholars program.

Find a gallery of field-station photos and details of our new programs in life science made possible by the largest-ever gift to the College of Natural Sciences: cns.utexas.edu/sve
You co-founded a startup based on the research you did at UT Austin with computer science professor Daniel Miranker. What was the technology you developed?

We developed software called Ultrawrap, which basically translates a conventional relational database into something called a knowledge graph. It's easier to combine data from different data sets when they're in graph form than in relational databases. Ultrawrap helps businesses understand their data better.

How did you get started in this research?

A visiting professor at my former college in Colombia gave a lecture on something called the Semantic Web, which was a proposal to organize and tag all the information on the internet so that autonomous agents could find and make sense of it. And I was hooked. It got me thinking about what the next generation of the web might look like, and I definitely wanted to be part of that. I transferred to UT Austin as an undergrad and joined Dan's research team. He suggested that I work on what eventually became Ultrawrap.

How did that research lead you to co-found a startup?

When I finished my bachelor's degree, I told Dan I'd like to work on a Ph.D. with him and start a company based on what we were developing. He said, "You don't need a Ph.D. to start a company." I said, "That's true, but I want to be able to work on a problem that's really hard that's never been solved before – and that's what you do in a Ph.D. program. And I want to make sure that problem is related to industry, because if we solve it, it's going to be a business opportunity." We worked hard and the end result was what we envisioned. Last summer, data.world acquired our company, and I joined as the principal scientist.

What did you learn from doing research with Dr. Miranker?

Number one, I learned to be comfortable in a sea of ambiguity. You start out lost, but eventually, you'll figure out what the problem is that needs to be solved. The second thing is how to communicate the problem to others. You can't solve it unless you can define it. I am a scientist because of Dan. This whole career that I started is thanks to his training and mentorship. He is like another father figure.
In the last half-century, science has served up a bonanza of advances. The periodic table gained 13 more elements—practically a new row. There’s one more state of matter, and one less planet (sorry, Pluto). Even the tree of life received a facelift (hello, Archaea). We crafted the technologies to effectively house the world’s knowledge on a single network, sequence the human genome, clone a sheep and detect gravitational waves. And we are computing now at a rate about a billion times faster than 50 years ago (at least if you’re using UT Austin’s Frontera, the world’s most powerful university supercomputer).

So what will the next 50 years bring? Absent a crystal ball, your best bet would be to ask a scientist. Many faculty across Natural Sciences have ideas about the future that fuel their research. From promising predictions to big ideas, here are six guesses about what comes next.

Our digital series, The Next 50 Years, includes audio stories, messages from scientists and more from UT Austin experts: txsci.net/next50
MANAGING A.I. WILL TAKE A VILLAGE

The expert: Computer science professor Peter Stone chaired the first report of the 100-Year Study on Artificial Intelligence, a multi-institution initiative, and he runs the U.S. division of Sony A.I. He also leads Good Systems, a UT Austin grand challenge initiative seeking to develop best practices for designing and using artificial intelligence, while predicting and mitigating its risks.

The idea: A.I.’s future is up to us. Researchers can use A.I. to bring about highly targeted treatments for diseases; safer, more efficient transportation; and improvements in care for the elderly – while avoiding the doomsday scenarios from film and many futurists’ predictions.

How it would work: The best computer scientists will team up with experts in law, public policy, philosophy, design and communications now so that A.I. technology development happens with their input.

In his words: “We need to identify the principles of a system that’s more likely to be used for good than for harm. These aren’t questions that can be answered just by A.I. researchers.”

DIET WILL GET A PRECISION TUNING

The expert: Molly Bray, a geneticist and chair of the Department of Nutritional Sciences, is working towards a future where each person gets a personalized diet and exercise plan tailored to the individual’s specific genetics, history and lifestyle.

The idea: We’ll prevent or reduce obesity, metabolic disorders and diabetes; lower health care costs; and see people live healthier, more productive lives by finding the preventive approach that works for each individual.

How it would work: Tools that collect a person’s health data, from wearable devices to at-home blood tests, would allow for real-time physiological data-monitoring. Using tools to mine data from your dietary intake, physical activity, mood, blood sugar and biological metabolites, medical professionals would know which one of any of a plethora of effective diets is best matched to you.

In her words: “All diets can work, but the hard part is getting people to stick to them. A plan optimized for you would make you feel great, address your specific disease risks and also help you stick with the program.”
CIRCUITS WILL DRIVE ADDICTION CARE

The expert: Lauren Dobbs is a neuroscientist and assistant professor conducting research in the Waggoner Center for Alcohol and Addiction Research.

The idea: To treat conditions like alcoholism and drug addiction, doctors will prescribe a medication precisely targeted to the specific circuits and molecules in the brain involved with addiction, with some treatments even tailored to an individual’s genetics to reduce side effects and help people with addiction experience effective recovery.

How it would work: Already Dobbs and other neuroscientists are mapping the addicted brain – for example, by studying how the use of combinations of drugs, such as cocaine and heroin, alter the brain, or which genes in brain cells become more active or less active when a drug is abused. Using this information to discover novel medical therapies, or even repurpose existing medicines that work on the same brain circuits and molecules, may be the key to stopping addiction.

In her words: “Addiction takes over a person’s life, all of their reason, their logic and their personality. I want to understand how drugs affect brain circuits to make them completely change, and then, hopefully, by reversing that, give them their lives back.”

WE’LL ALL BE DISCOVERING SPECIES

The expert: Integrative biology professor David Hillis directs UT’s Biodiversity Center, where scientists are mindful that the planet is losing species quickly even while much work remains to learn about the species with us today. In fact, scientists believe only about 20% of Earth’s current species have been identified.

The idea: We will unmask the missing biodiversity – call it the dark biome – and rapidly identify currently unknown bacteria, insects, plants and more that can generate improvements in agriculture, thanks to better managing of soil microbes and pollinators, and new methods for storing climate-warming carbon in plants and the ground.

How it would work: Hillis envisions crowds of citizen scientists armed with inexpensive, portable genetic sequencers, sampling water and soil to help map the diversity of life around them by sharing that information through online databases. Scientists would gain critical information, while the public would more clearly see the value of biodiversity – and that all life, even human life, depends on it.

In his words: “There are undescribed species literally in almost anyone’s backyard, so if the technology were available, a lot of people would want to see how many species they can discover that scientists don’t know about yet.”
CELLS WILL GIVE UP THEIR MYSTERIES

**The expert:** Chemist Carlos Baiz works to fill in the unknowns of what goes on inside any given cell. To help uncover the intricate, riotous dance of billions of molecules snugly packed and performing all the functions of life, his team researches how different kinds of molecules interact in the crowded, messy environment of a cell.

**The idea:** The cell’s inner secrets will be revealed thanks to a highly advanced simulation that allows scientists to see in exquisite detail how cancer or other disorders work, how drugs designed for treatment affect a cell’s functioning and how life unfolds at its most basic level.

**How it would work:** An “atomistic computer model” that accurately simulates a cell’s workings over time, atom by atom, would take information like what Baiz is collecting today and match it to the power of truly advanced supercomputers, allowing the entire life of a cell to be simulated in minutes.

**In his words:** “Imagine a 3D movie so to speak of how each atom is interacting with each other atom as the cell grows and reproduces. If there’s a certain life process that you don’t understand, you can rewind, play it again, and then see how the molecules interact together and piece together all the different parts.”

WE’LL FIND LIFE IN THE UNIVERSE

**The experts:** Assistant professor of astronomy Caroline Morley, senior research scientist Michael Endl and others seek to learn about planets outside our solar system. They are able to use technology found only at UT’s McDonald Observatory, a Habitable Zone Planet Finder made to find and study Earth-sized planets orbiting red dwarf stars far away.

**The idea:** Since our galaxy alone hosts an estimated 5 billion stars with planets in the so-called “habitable zone,” and since more of these planets are being discovered all the time, the tally of known living worlds will jump from one (Earth) to double that...or more.

**How it would work:** Researchers will soon use NASA’s James Webb Space Telescope and enormous ground-based telescopes, like the Giant Magellan Telescope that UT Austin is helping to build, to measure chemicals in the atmospheres of exoplanets to detect the presence of life.

**In their words:** “I’d be surprised if we weren’t reading headlines that people have found compelling evidence that there’s life on planets around nearby stars.”
UT philanthropist
Casey Stengl

UT-trained chemist
Ray Wilson

UT-trained surgeon
Hector Garcia

former UT chemist
Marye Anne Fox

search engine inventor
Alan Emtage

UT mathematician
Karen Uhlenbeck

astronomer
Vera Rubin

UT-trained mathematician
Vivienne Malone-Mayes

programming pioneer
Grace Hopper

carbon researcher
Mildred Dresselhaus

blood bank inventor
Charles Drew

UT-trained chemist
Ray Wilson

UT-trained surgeon
Hector Garcia

programming pioneer
Grace Hopper
WORLD CHANGERS

Scientists and mathematicians make breakthroughs that change the world. At worldchangers.cns.utexas.edu, we are celebrating trail-blazing STEM leaders, who happen to be women and/or from communities of color, both from within our University of Texas community and beyond it. Log on to learn about incredible steps forward made possible by people like search engine inventor Alan Emtage and UT professor emeritus Karen Uhlenbeck, the first woman to win mathematics’ highest honor, the Abel Prize. You can also download free digital displays or posters for your home, office or classroom.
What drew you to major in nutrition and Plan II?
I've always had a penchant for writing, and I wanted to have a significant part of my education in the liberal arts arena, but I also am very science-minded, and I was interested in human health, public health and preventative health care. I found nutrition through that passion. I care a lot about helping people with their relationship with food and trying to manage health with food because everyone eats. I think it's a great impact point to help people live a better life, and it also is so interdisciplinary because it intersects with things like the economy and the environment.

What is your role in the newly relaunched UT Nutrition Institute?
I started with UTNI in August, and I've been helping with coordinating content production for the online blogging platform. We're building it from the ground up, making nutrition information easily consumable for different audiences: health professionals, entrepreneurs, lifelong learners and members of the community, whether they cook, parent or simply want to improve their health.

What has been your most valuable experience at UT thus far?
I would say the opportunity to get to write my own show [a play called “terms&CONDITIONS”], direct it and put it on for the community here, because I got to synthesize a lot of my different interests. I feel like that was a pretty pivotal moment in my undergraduate career.

What is the play you wrote and directed about?
It is a story about a girl who's struggling a lot with mental health issues. The play follows her throughout trying to learn more about herself. It explores a lot of different themes, like family dynamics, the relationship she has with food and being seen. I wrote it because I couldn’t find a play I wanted to direct that was exactly what I wanted to do. It felt like a story that I just needed to write.

Do you have any advice for new students?
I would say try anything and everything that seems interesting, because there's really something for everybody. Finding a smaller community to engage with in a campus of this size is critical because people are really great resources in terms of helping to find what you really like. You can find your passions and your soul.
Beautiful images from University of Texas at Austin labs
Semiconductors used in electronic devices perform well when the crystallinity of the thin film is just right. UT Austin chemistry graduate student Calla McCulley varies the conditions used to deposit thin films of promising semiconducting materials called perovskites. Perovskites are cheap and easy to produce, creating efficiencies in things like solar panels that weren’t possible when only silicon crystals were available. Here, two types of crystalline structures (amorphous needles and polycrystalline grains) come together to highlight how structural variations give an insight into semiconductor performance when implemented in various electrical applications at the Microelectronics Research Center at UT’s J.J. Pickle Research Campus.
MU-JIE LU
Doctoral candidate in cell and molecular biology in the lab of Professor Lulu Cambronne.
Interviewed by Esther Robards-Forbes.

What drew you to study life sciences?
I chose biology because we know so much about the nature of science, though we don't really understand how everything works, even in our own bodies. When we go deeper, into organs and cells, there are more questions. How does a stem cell know what type of cell to become? How do they work together to make a whole body? I want to understand on a molecular level the real basic original mechanics and how genes drive a phenotype or a disease, because if we can understand what is happening at a basic level, treatments and cures are possible. I really want my research to have some applications and to help people live longer, healthier lives.

Why did you want to study metabolic diseases specifically?
Because everybody needs glucose and fatty acid to provide the energy cells need to survive, but recently we discovered that they're not just a source of energy; they also change the cell behavior. Understanding how cells coordinate nutrient utilization, gene expression and cellular behaviors is important. When these go wrong, it can lead to diseases. Our lab's insights could lead to new treatments.

I hear you like to hike. What's been your favorite hike? And where do you want to go next?
Enchanted Rock is my favorite. I've never hiked to the top of a giant dome before, and it gave me a gorgeous 360° view from the top. I also like the dome's reflection on the Moss Lake surface. Next, I want to go to Big Bend.

What has your experience as an international student been like at UT?
Because I come from a very different cultural background, when I got here, a few things surprised me. There are so many social events here, and people like to socialize a lot. I'm trying to learn how to build connections with other people. This is a good opportunity to make some new friends or meet some new scientists from the other labs. I get nervous sometimes, like many international students. I'm glad that everyone is so friendly and kind.

What type of career do you want to have?
Good professors and mentors have taught me how to be a good scientist. I would like to have my own lab, do my own research and teach to pass this knowledge and spirit to someone else. Maybe I can motivate my own students to become involved in science and research, and we can help a lot of people.
AFTER THE SPILL

By Christine Sinatra.
Texas’ Gulf Coast has experienced the aftermath of the “worst oil spill in history”– twice. Forty years ago, a rig called Ixtoc I exploded off the coast of Campeche, Mexico, and the spill held that ignominious title until 2010.

That’s when the disastrous BP oil spill, Deepwater Horizon, eclipsed it.

Ed Buskey, a UT Austin professor who holds the Bass Regents Chair in Marine Science, has seen the lasting impact of oil spills on coastal communities. He also is part of the research community at the University of Texas Marine Science Institute working to ameliorate the damage from these events by studying the impact of oil in marine ecosystems and exploring ways to address or prevent extensive damage after the next spill.

This year brings the 10th anniversary of Deepwater Horizon, so we sat down to hear from the scientists and research staff on the front lines. Together, they are leading efforts from Texas to ensure that the world is better prepared when the next crisis strikes.

**Know the Enemy**

Buskey leads a multi-institution research consortium that explores how oil breaks up in ocean waters, as well as what tiny organisms at the base of the food chain are doing when oil and cleanup dispersants enter the water. The group’s efforts are helping to improve the models the U.S. Coast Guard and the National Oceanic and Atmospheric Administration can use to guide decisions in the midst of a crisis.

“When an oil spill is happening, everything is chaotic. Every morning you have to get up and decide: What should we do now?” Buskey said. “No matter what, it’s going to be a terrible impact on the environment, so the goal is to minimize the damage as much as possible based on the best information.”

Existing models guide experts on the best way to keep oil out of sensitive habitats and away from coasts – whether through mechanical oil removal, chemical dispersants, fire or some other approach. The models rely on having the right data about weather, ocean currents and things like the types of bacteria living in the water (some microbes consume compounds in oil, something Buskey’s colleague Brett Baker has researched). Other important considerations, Buskey says, are the physics driving the motion of oil under various conditions; the amount of water residing in drops of oil found in a plume deep under the sea; and the ways oil interacts with tiny organisms such as plankton.

“The worst possible thing that can happen is that oil comes ashore and affects sensitive habitats,” Buskey said. “We’ve been trying to provide better information to inform a model like this so that first responders can make the best possible decisions.”

"The worst possible thing that can happen is that oil comes ashore and affects sensitive habitats."

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Sunlight illuminated the Deepwater Horizon oil spill off the Mississippi Delta on May 24, 2010.
Worse than It Looks
Immediately after an oil spill like Deepwater Horizon, news outlets broadcast images of masses of dead fish washing ashore and fishing industry workers who were temporarily unable to work. But marine scientist Andrew Esbaugh is researching the longer-term impacts of oil spills on fish and those whose livelihood or diet relies on them.

Esbaugh, an associate professor, is researching with a team how oil affects specific fish in the Gulf of Mexico that are critical for both U.S. fisheries and the Gulf ecosystem. It turns out even small amounts of oil, too little to kill a fish like red drum even in its larval stage, can harm fish over the long run.

Oil weakens the red drums’ cardiovascular systems, harming their development and causing delays that leave them more vulnerable to predators and less able to catch their own prey. Even neurological problems can follow, leading the fish to take potentially deadly risks.

“The analogy we use is fish act like they’re drunk,” Esbaugh said. “They become less social. They’re more likely to move away from their group and become bold, leaving a protected habitat for an unknown habitat where they are alone.”

In a nutshell, oil doesn’t have to kill animals immediately to keep them from performing as they usually would to stay alive or grow old enough to reproduce.

Tending to Animals
The worst-case scenario is when oil reaches the sensitive marshes and beaches where birds and turtles nest – and, unfortunately, the Gulf Coast has witnessed this scenario more than once. Rescuing the living animals coated in oil requires certified staff and a special recovery facility. Luckily, UT’s Marine Science Institute and its National Estuarine Research Reserve happen to house such an animal-rescue operation.

UT Austin’s animal rescue and rehabilitation facilities support conservation and recovery of compromised local wildlife after an oil spill and otherwise. The facility is known as the Amos Rehabilitation Keep, or ARK, named for its legendary founder, oceanographer Tony Amos. Amos arrived at the Marine Science Institute just prior to the Ixtoc disaster. He began the ARK after seeing birds and sea turtles covered in oil from that spill. The program expanded in the decades to follow, rescuing coastal animals also harmed by fishing lines, cold winter temperatures and other dangers. Today, about 100 local volunteers have joined the cause.

The ARK now takes in an average of 1,500 animals annually: seabirds, raptors and turtles, oiled or otherwise put in harm’s way. Although Amos died in 2017, the ARK team continues his legacy of rescuing animals; within only weeks of his death, in fact, ARK volunteers were working with staff to find oiled birds or turtles and help them recover.

“From what Tony started initially, it’s really grown, and I think that’s good both for the community here and for us at the university,” said reserve director Jace Tunnell. “At the University of Texas Marine Science Institute, we’re saving these animals. That connects with people.”

To learn more about the research and community offerings at UT’s Marine Science Institute, visit utmsi.utexas.edu.
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Alumna Dr. Lorraine “Casey” Stengl, who left a remarkable legacy through her transformative endowment to support UT Austin’s ecology and evolutionary biology research and education programs at the Stengl Lost Pines Biological Station (see gallery, page 16) and beyond.

Austin philanthropist David Booth, who committed a significant gift to help Texas Science build the Giant Magellan Telescope in Chile, which may well lead to the first detection of life beyond our planet (see page 23).

Alumna Mary Anderson Abell, whose loyal giving to the Marine Science Institute supports its vital work, from community outreach to research to education, on Texas’ Gulf Coast (see article, page 32).

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