University of North Carolina at Chapel Hill

# unc research stories

research.unc.edu | Issue 1

## A Message from the Vice Chancellor for Research

This edition of *UNC Research Stories* magazine, formerly known as *Endeavors*, marks the 40th year this publication has covered the breadth and depth of research activity at Carolina. What started as an immersive print publication has grown into a strategic opportunity to showcase our beloved institution as a leading global research powerhouse.

Research at the University of North Carolina at Chapel Hill is a cornerstone of our state's economy. To date, our research has spun out 286 North Carolina-based businesses, which have created over 8,800 job across the state. These businesses generate $17.6 billion in annual revenue.

We're also improving lives across the world. Our researchers are developing game-changing innovations and solutions in drug delivery, infectious and chronic diseases, artificial intelligence, the environment, and more. And they are providing opportunities to train the next generation of problem-solvers.

As outlined in the Research Roadmap (page 6), the Office of the Vice Chancellor for Research is accelerating research growth and opportunity, harnessing the power of our research enterprise to drive innovation, and transforming the research ecosystem to be nimble, efficient, and of greater societal benefit. Through campus-wide partnerships, we ensure our research benefits North Carolina and the world.

With the Roadmap, my office will further propel UNC-Chapel Hill to the forefront of research, scholarship, and discovery. We are empowering researchers with strategic support, funding, and guidance to tackle global challenges. And we are focusing efforts to maximize our impact with a renewed focus on applications so we can better transform scientific discoveries into tangible impact.

I invite you to explore these pages to discover some of the inspiring work happening at Carolina. As we continue to advance our research enterprise, I also invite you to remain engaged. You can learn how to stay informed about our progress, partnerships, and initiatives on page 4. Your continued interest is invaluable as we strive to shape a brighter future through research.

Penny Gordon-Larsen
*Vice Chancellor for Research*

# Facts & Figures

**Research at UNC-Chapel Hill has doubled over the past 15 years,** firmly establishing Carolina as one of America's top-ranked research universities.

**12th** — in the nation for research volume & expenditures

**$1.36B** — in research activity annually

**11th** — in the U.S. for federal research

**$827M** — in federal sponsored funding

**+11,000** — North Carolinians employed by UNC-Chapel Hill research

**+280** — N.C. businesses spun out from UNC-Chapel Hill research

**Learn more about UNC Research at research.unc.edu/about**

UNC | RESEARCH

The University of North Carolina at Chapel Hill





## Letter from the Editor

# *Endeavors* is now *UNC Research Stories*

When I joined the UNC Office of Research Communications in 2015, my former coworker had a framed message on her desk that read: "Print's not dead." She received the piece from an assistant editor who left the office when the print edition of *Endeavors* was eliminated in 2012 due to state budget cuts.

The magazine lived on in a digital format until 2019, when our graphic designer Corina Prassos and I successfully schemed to bring it back into print. Since then, we've grown our distribution from just 2,000 copies to nearly 40,000.

Thanks to a partnership with the *Carolina Alumni Review*, the print magazine now goes to lifetime members of the General Alumni Association, members of our university's governing boards, representatives of our state legislature and congressional delegation, and program managers with our largest federal sponsors like the National Institutes of Health and the National Science Foundation.

As we celebrate the magazine's 40th anniversary, we believe it's time for another change: retire the *Endeavors* name for *UNC Research Stories*.

UNC Research is a thriving community of investigators who are continuously innovating, discovering, and uncovering. We tell their stories. To keep up with the progress and change they have made across four decades and dozens of disciplines, we are updating our name to reflect the research enterprise they have created.

The variety and quality of content will remain the same, and the name will more accurately reflect where our content comes from, tying it directly to the brand that has always been responsible for *Endeavors*. When you see *UNC Research Stories*, there is no doubt that it is a product of Carolina.

While changes are afoot, one thing is clearer than ever: Print's not dead. It's alive — and thriving.

Warmly,

Alyssa LaFaro
*Editor*

For more stories about research at Carolina and to keep up to date with future projects, follow **@UNCResearch** on Instagram, LinkedIn, Spotify, and YouTube.

## In this Issue

### COVER STORY

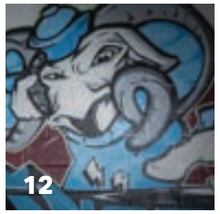


### FEATURES

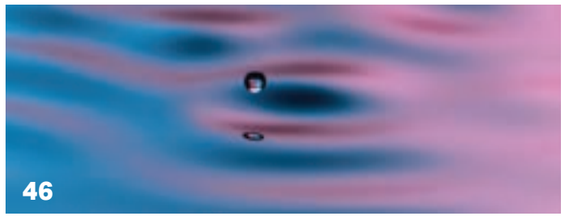


### SERIES









### SCIENCE SNAPSHOTS



# Research Roadmap

ACCELERATE INNOVATE TRANSFORM

**The Research Roadmap** is a bold, actionable plan that will drive even greater research impact and solidify our position as a global research leader.

The Research Roadmap, spearheaded by the Office of the Vice Chancellor for Research, is a strategic plan designed to elevate our existing research excellence. It charts the course to a dynamic research ecosystem that fosters breakthroughs guided by three core principles: accelerate, innovate, and transform.

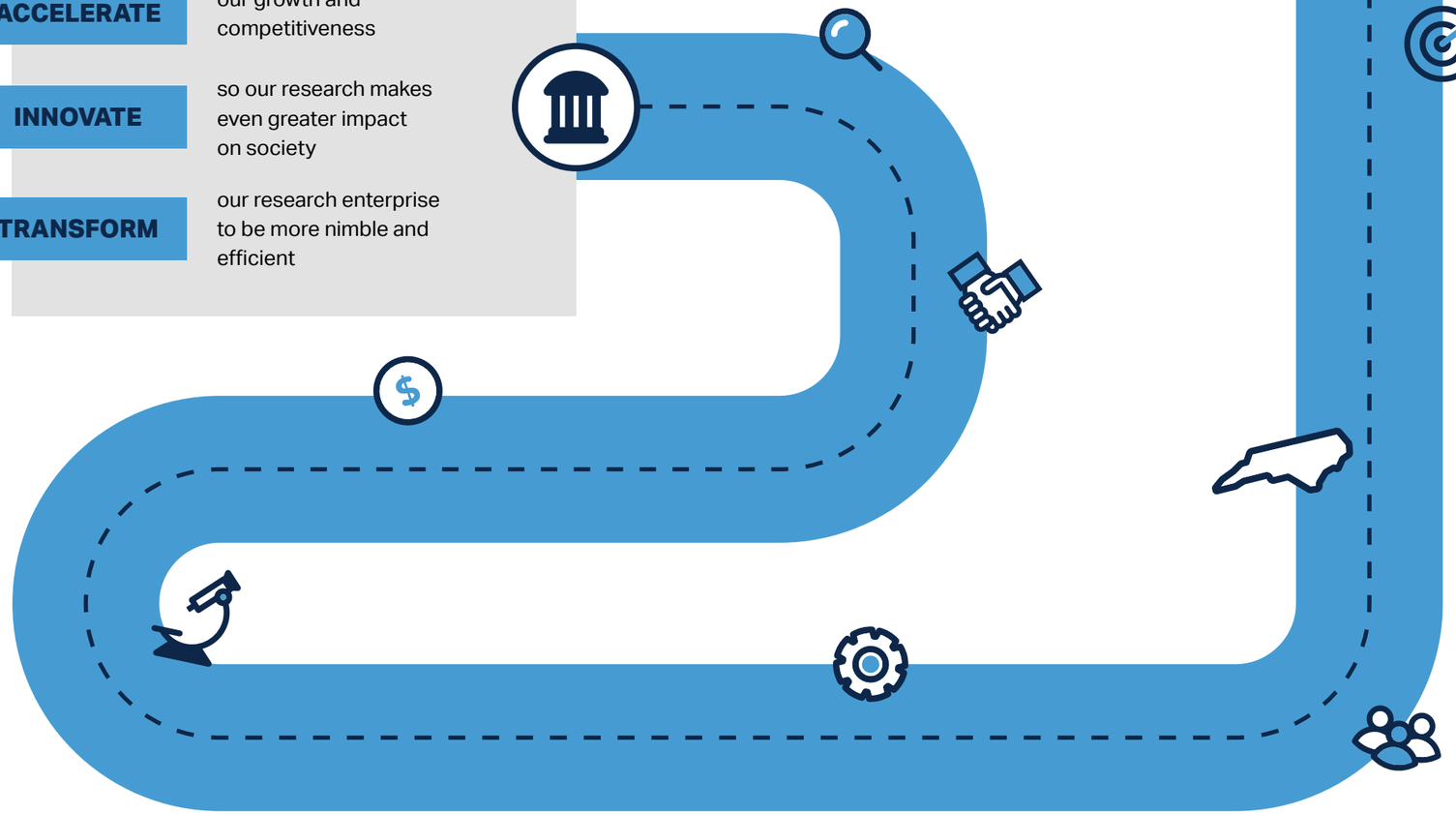
With the Research Roadmap, we aim to accelerate our research growth by capitalizing on our strengths and investing in emerging areas of discovery. By harnessing the power of our world-class research, we will drive innovation. And we will transform our research enterprise to be more agile, efficient, and impactful, with greater returns on investment, improving the well-being of our state, nation, and world.

## THE VISION

**ACCELERATE** our growth and competitiveness

**INNOVATE** so our research makes even greater impact on society

**TRANSFORM** our research enterprise to be more nimble and efficient



## STRATEGIC PRIORITIES

### Enhance Research Assets

- Build, improve, and maintain state-of-the-art research facilities, equipment, data, and technologies to enable success.

### Promote Growth & Opportunity

- Identify and invest in strategic opportunities, leverage existing research strengths, and foster collaboration to discover new knowledge and address strategic challenges.

### Maximize Value & Impact

- Increase the impact of UNC-Chapel Hill research and communicate its value.

## OPERATIONAL IMPERATIVES

### Support and grow a talented research workforce

- Support and grow a talented workforce that ensures UNC-Chapel Hill continues to excel in research that serves N.C. and the world.

### Facilitate efficient research support and compliance

- Foster an environment that facilitates efficient research processes and promotes integrity, objectivity, and quality of research outputs.

**For the latest updates on the Research Roadmap, visit *research.unc.edu/roadmap***

# Everywhere Chemical Exposure

Story & photos by Megan Mendenhall | March 25, 2024

Plastics are disrupting our health and day-to-day lives. Nanoplastics have been found in bottles of drinking water. Per- and polyfluoroalkyl substances (PFAS) are in our cookware and clothing. And phthalates are in nearly everything.

Some premature births have been linked to phthalates — one of the many reasons why Stephanie Engel has spent the past 20 years studying the effects of these chemicals on babies and children.

Phthalates, sometimes known as "everywhere chemicals," are used to make plastics more durable. They are found in a wide range of consumer goods, including personal care products, vinyl flooring, and some medical tubing. They're also added to food packaging and shopping bags to make them more flexible.

"Phthalates can migrate out of whatever they're in," Engel says. "From a container of lotion or your shampoo or cosmetics, it can absorb into your skin. You can ingest it from water bottles. Or it could be in food with plastic wrap around it. All routes lead to phthalate exposure."

Engel, a professor in the UNC Gillings School of Global Public Health, began studying the effects of phthalate exposure on children's neurodevelopment in the early 2000s. Her research has found an association between exposure in the womb and clinically diagnosed ADHD.

Now, she and Carolina neuroimaging scientist Weili Lin are leading a study that uses magnetic resonance imaging (MRI) to scan children's brains. They hope to gain a better understanding of how phthalate exposure in early life affects brain growth and development, continuing a line of inquiry Engel started two decades ago to learn what these chemicals are doing to our most vulnerable populations.

**Phthalates:** a series of chemical substances that increase the flexibility of plastics.

## Pesticides to phthalates

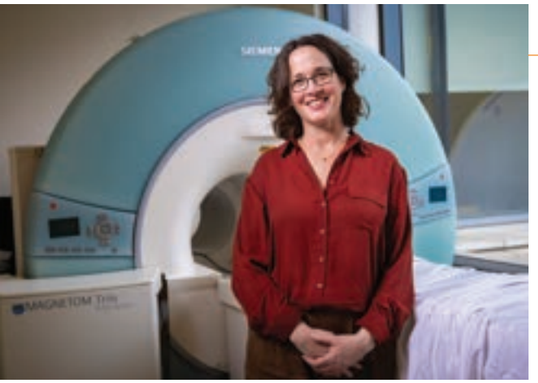
In 2003, after graduating from UNC-Chapel Hill with a PhD in epidemiology, Engel moved to New York City for a postdoctoral position at the Mount Sinai Medical Center, where she eventually became a faculty member.

While there, she worked with colleagues in the Children's Environmental Health Center on a project examining how the effects of low-level exposure to some insecticides used within New York City public housing communities might affect brain development in children.

During this same time, the Centers for Disease Control and Prevention released their National Human Biomonitoring Report on about 200 high-production-volume chemicals and their exposure concentrations to the U.S. public.

This report showed that women of reproductive age and people of color had the highest exposure to some phthalates across all of the subpopulations examined — but little was known about their health impacts in humans. Some research did suggest that DEHP, a specific phthalate, was carcinogenic in animals, and it was associated with reproductive toxicity in rats.

**Listen along on Spotify at UNC Research Stories**



Stephanie Engel poses with a mock scanner, which simulates a real MRI experience, in the Biomedical Research Imaging Center at UNC-Chapel Hill.

Scientists suspected that certain phthalates might be interfering with hormones that regulate the reproductive system, which would explain abnormalities found in the reproductive tracts of male rats exposed to these chemicals. Called endocrine disruptors, these chemicals may interfere with other hormones as well.

"Hormones play an important role in brain development," Engel says. "And we started asking: If there was significant exposure, and that exposure was interfering with hormones that are critical for brain development, was it possible that there might be an association between prenatal phthalate concentrations and some of the developmental end-points that we had been measuring in our children for the last eight years?"

With these new questions in mind, Engel and her colleagues measured prenatal phthalate exposure by testing urine samples collected from mothers during their pregnancy. Then, they compared this information with assessments of the children's behavior.

"I think we were the first study to examine associations between prenatal exposure to phthalates and effects immediately after birth on neonatal orientation, motor development, and quality of alertness — and also on ADHD-like behaviors in children between 4 and 8 years," she says.

## A link to ADHD

While Engel's work with the Mount Sinai study established a possible link between prenatal phthalate exposures and ADHD-like behaviors in children, the cohort was relatively small and behavioral assessments of the children were solely based on parental reports.

"We were really interested in the idea that these behaviors looked a lot like ADHD, but we didn't have a clinical assessment of the children," Engel explains.

To learn more, she needed a larger cohort. After some searching, she found the Norwegian Mother, Father, and Child Cohort Study (MoBa), comprised of a large population of people in Norway who enrolled between 1998 and 2008.

MoBa was created to improve understanding of how conditions in early life can influence health in later life. Researchers enrolled over 114,000 pregnant mothers, followed the women and their children from the womb into puberty, and collected questionnaire health data and stored biological samples like urine for future analysis.

"What's really unique about this study is that those pregnancies represented about half of all pregnancies in Norway at the time," Engel explains. "It was really population-based, but also large enough to get a frank clinical diagnosis of ADHD linked with a clinical patient registry."

Because Engel had access to the children's diagnoses and biological samples collected during pregnancy, she could compare exposure concentrations between children with and without an ADHD diagnosis.

"We could do this very elegant, nested case-control study where you select the ADHD cases and a random sample of the cohort," Engel says. "You go back to their stored urine, you measure the phthalate metabolites, and you ask whether the phthalate concentrations were higher among children who ultimately developed ADHD."

She found that children with higher prenatal exposures to certain phthalates had almost three times the odds of being diagnosed with ADHD.

## Brain pictures

By the 2010s, there was mounting evidence across the world that prenatal exposure to phthalates could be problematic for a child's brain development, and that young children were being exposed to certain kinds of phthalates more than adults. But these reports only measured exposure in people as young as 3 years old, and little information was available for infants and toddlers.

Engel was concerned about the impact of high exposure during the first two years of a child's life because of the massive growth and development that takes place in the brain during this time.

In 2016, she was introduced to Weili Lin, who was overseeing the Baby Connectome Project (BCP), which focused on characterizing early brain development during the first five years of life. The study used MRIs — a noninvasive imaging technique used to capture detailed images of soft tissue and organs — to map the development of the human brain from birth through early childhood.

Using these scans, scientists like Lin and his team can identify and analyze gray and white matter within specific regions of the brain during early development. MRI also allows for the assessment of white matter microstructure, providing insights into connectivity patterns crucial for cognitive development. Additionally, it enables scientists to map the maturation processes of functional brain networks.

"These unique features collectively position MRI as a perfect and unique imaging modality in elucidating the complex interplay between brain structure and functional development during early infancy," Lin explains. "It offers invaluable insights into neurodevelopmental trajectories and potential biomarkers for early intervention in disorders."

When Engel learned of the BCP project, she was eager to partner with Lin.

"By taking a picture of the brain at different points during development, we can see how that child's brain compares to other children with higher or lower exposure to phthalates," Engel says. "It's similar to how we monitor growth curves for height and weight in children."

Clinicians commonly use developmental inventories — which often take the form of questionnaires — to determine if children are meeting certain milestones, like smiling or sitting up on their own. They can be useful in identifying behavior that could be symptomatic of some neurodevelopmental delays.

"But inventories are not great about telling us about the mechanisms," she says. "Lots of different problems in your brain can actually result in the same behavioral symptom out in the world."

Using brain scans, Engel could start to piece together how phthalate exposures in early life might change the structural and functional development of the brain.

## Challenging datasets

In 2016, she and Lin collaborated on a pilot study leveraging the ongoing BCP project to collect urine samples from subjects between 2 weeks and 5 years old.

"We'll be able to make that connection between what we're seeing in the brain scans and how it's manifesting out in the world," Engel says.

Engel is still analyzing this information and admits it's one of the trickiest datasets she's ever worked with.

For starters, working with infants and toddlers can be touch-and-go. They need to fall asleep during the MRI session to get a usable scan and often couldn't fall asleep or would wake up in the middle. At other times, Engel's team could get a scan but not a urine sample.

Additionally, the data analysis is very challenging, and it's taken time for Engel and her team to figure out the best approach.

"It's really complicated because what we're trying to look at is not just the relationship of exposure at one point in time with brain development at a single age, but how exposure over time influences the arc of brain development," she explains. "And both things are changing — a child's exposure changes, and their brain changes."

Engel hopes to illuminate the direct effects of phthalates on children's brains and is in the process of sharing early findings with the broader scientific community.

"I do think a picture is worth a thousand words. And the fact that we have pictures of the brain can be very influential from a policy perspective," she says. "I want my research to help inform sensible environmental policy that can protect the development of children's brains."

## Good Vibrations

Story & video by Caroline Bittenbender | January 23, 2024

The Beat Lab provides a welcoming space for digital music experimentation at UNC-Chapel Hill. Music professor Maya Shipman, professionally known as Suzi Analogue, teaches classes about the technique, history, and evolution of beat-making. She and her students study music made by producers and beat-makers across the U.S. and then explore music composition using the lab's high-tech equipment.

**Read the story & watch the video at**
***research.unc.edu/good-vibrations/***

# Let's Get CLINICAL

Story & photos by Alyssa LaFaro | May 20, 2024

All five of Carolina's health schools — the School of Medicine, Eshelman School of Pharmacy, Adams School of Dentistry, Gillings School of Global Public Health, and School of Nursing — are engaged in clinical trials. Increasing clinical trials is a key component of the Research Roadmap (page 6). Researchers from each school are highlighted below, showcasing the diversity and significance of these studies at Carolina.

## Clinical context

Before the 1950s, pediatric acute lymphoblastic leukemia (ALL) — a type of cancer where the bone marrow makes too many immature white blood cells — was universally fatal. Then, a clinical trial run by the National Cancer Institute produced durable remission rates in about a third of the children enrolled.

"This was an unprecedented leap," says David Kram, a UNC-Chapel Hill pediatric neuro-oncologist. "From there, clinical trials were developed by cooperative groups all over the world and in close collaboration — and some competition — with each other."

Today, the cure rate for ALL is over 90%. More than 85% of children with the disease are now enrolled in clinical trials across North America and Europe.

This story is not unique to ALL.

In the early 1980s, the average life expectancy for someone living with AIDS was three years after diagnosis. By 2000, researchers from the National Institutes of Health (NIH) had developed an antiretroviral therapy to prevent people with HIV from developing AIDS and created better testing and interventions to curb the number of children born with the disease.

Thanks to clinical trials, people with the disease can now live a relatively normal life. Same goes for those with hemophilia, hepatitis, and various cancers.

"Clinical trials are at the heart of all medical advances," Kram stresses. "They are the major tool used to explore whether new tests or treatments for a disease work and are safe."

## Phases of progress

Clinical trials involve human participants who take a drug or engage in an intervention to help researchers uncover the success of those treatments.

"People often think about clinical trials when new drugs, surgical treatments, or vaccines are being developed and tested, but many clinical trials are done to evaluate whether social, educational, or behavioral interventions improve health," says Shawn Kneipp, a professor in the UNC School of Nursing.

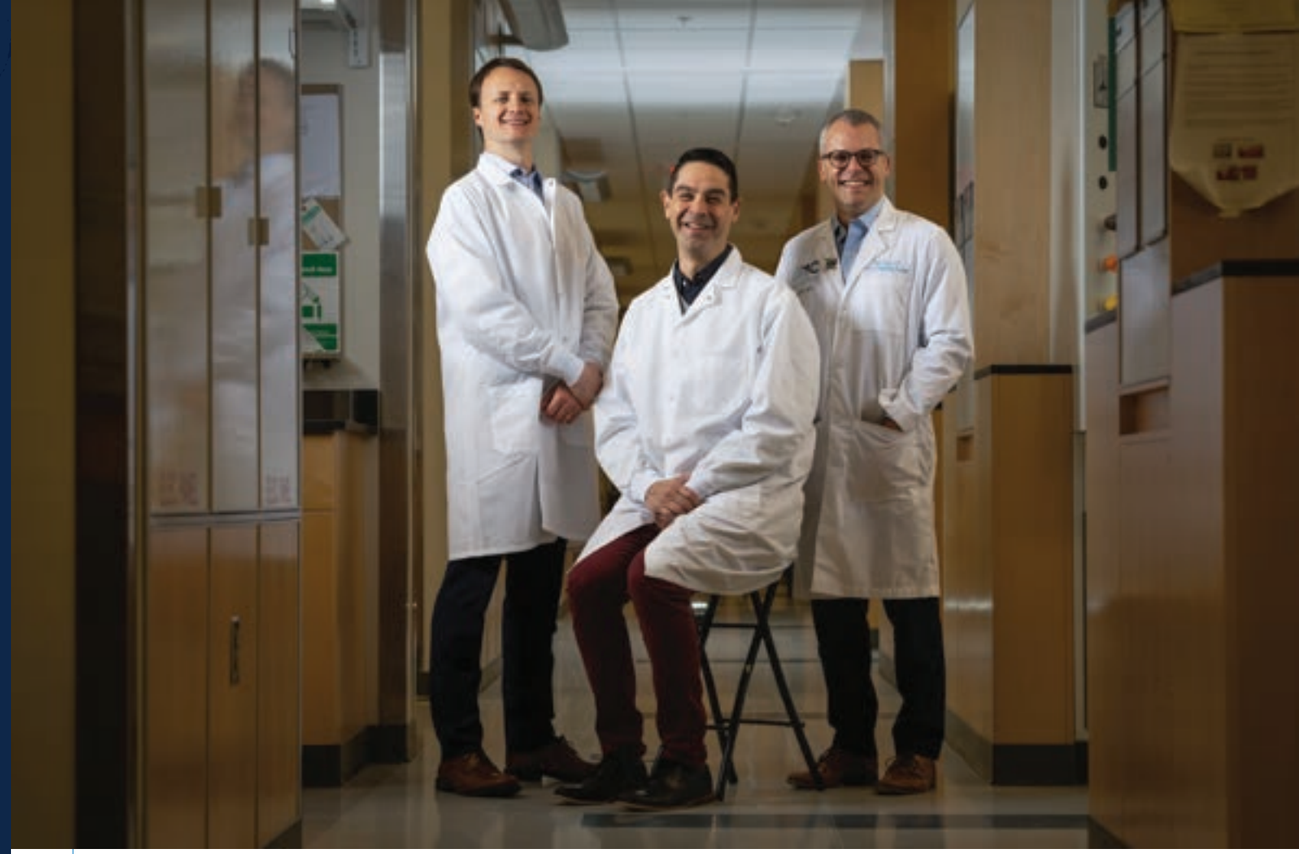
People participate in clinical trials for many reasons. They gain access to new therapies otherwise inaccessible — and, oftentimes, this might be their "last option" for improving their disease. Others enroll to receive additional care and attention from clinical trial staff. And some just hope to move science forward.

That's what research is: incremental steps forward over time. And all research begins with discovery. A question leads to an experimental setup that creates data for the researcher to analyze. Then it moves into the preclinical stage. For a drug, this involves small-scale lab testing to prove effectiveness. Promising treatments move into clinical trials.

The largest public funder of clinical trials in the U.S. is the NIH, which uses four phases to propel a drug forward. Each one incrementally includes more participants as researchers continue to prove a drug's safety and document its side effects. In Phase IV, after reviewing the clinical trial data, the Federal Drug Administration (FDA) can approve the drug and make it available to the general population.

Carolina researchers are involved in various phases of clinical trials. Here's a look at multiple projects, the researchers behind them, and the health needs they are striving to meet.

**To read the full story, visit *research.unc.edu/lets-get-clinical/***



## Developing personalized treatments for brain cancer

*UNC Eshelman School of Pharmacy researchers Andrew Satterlee (left) and Shawn Hingtgen (center) and UNC School of Medicine researcher David Kram (right) are running a clinical trial that tests patients' tumors to develop better, more personalized treatments for cancer in the future.*

### What is your research focus?

We focus on treating cancer. We know that nine out of 10 new cancer drugs that make it to the clinical trial phase fail to benefit patients, and thus fail to gain FDA approval for further use. We believe a key barrier is in the models themselves: When a new cancer drug works in preclinical disease models but fails to work in humans, something must be wrong with the model. Our research focuses on inventing a new and better cancer model.

### Tell us about the clinical trial you're running.

We have developed a model that can test broad types of brain cancer better than any model currently used. For example, instead of using cancer cells that have been grown in plastic dishes, our model uses a patient's own tumor tissue, right after it is removed from the patient's brain. It's tough to keep tumors alive after they are taken out of a person's body, but our model is very good at maintaining and testing the tumor tissue, no matter the tumor type.

To prove that our brain tumor model effectively replicates a patient's tumor, we need to test as many patient-specific tumor samples as possible and compare the behavior and drug responses in the real tumors and in our models. This is precisely what our clinical trial aims to do.

This trial is open at UNC for children and adults with primary central nervous system tumors. After undergoing surgery, their tumor tissue is used for clinical testing. We take what's left to establish a patient-specific brain tumor model in our lab.

We then "treat" the model with various drugs and compare the results to the drugs that have been prescribed to patients by their doctors. We don't inform a patient's treatment plan or use this data to help guide clinical decision-making. That type of intervention will only occur after we see enough positive associations between our model's results and what happens to patients after their doctor-prescribed treatments.

## Making dentistry less stressful and more fun for kids

*UNC Adams School of Dentistry researcher Laura Jacox is running a clinical trial to measure the impact of animal-assisted therapy on anxiety and pain in pediatric dental patients.*

**What is your research focus?**

I work to answer questions to improve clinical care for dental patients. One of my projects evaluates whether animal therapy with dogs can be used to improve children's experiences at the dentist — to help manage fear, anxiety, and pain without medications. Studies have found that kids and adults with high dental anxiety avoid going to the dentist, and as a result, have worse oral health.

When these anxious patients decide to see the dentist, their needs are greater and more emergent — and often require surgery and/or dental extractions. For children with high dental anxiety, they often need medication or more significant anesthesia. Many parents prefer to avoid these medications as they carry some risks and higher costs.

Animal therapy holds promise as a non-medicated approach to care for anxious children at the dentist — and make it a positive experience! We hope that canine therapy can provide a safe, non-medication-based approach for managing dental pain and anxiety, and possibly prevent anxiety development, so patients see their dentists regularly and have better oral and systemic health.

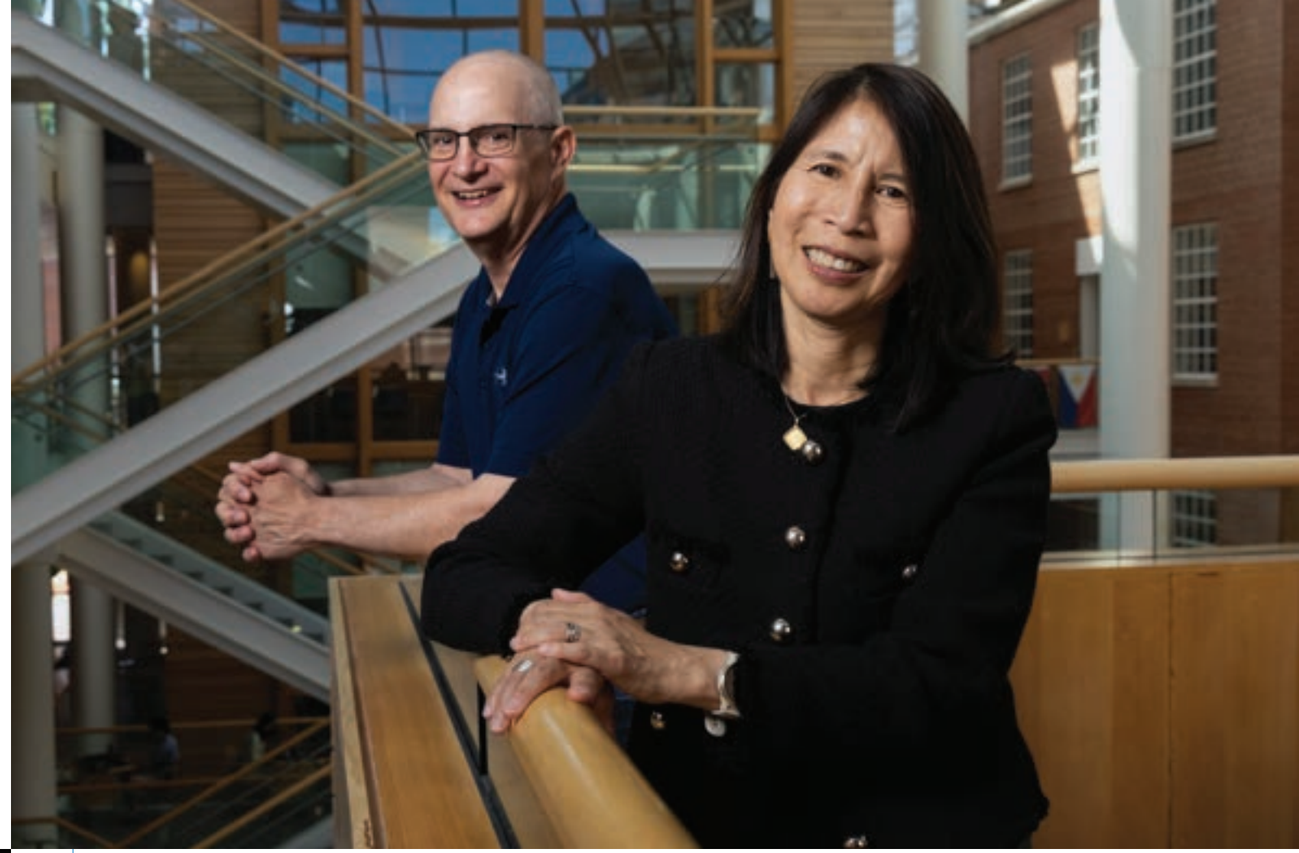
**Tell us about the clinical trial you're running.**

Our trial investigates the effects of animal-assisted therapy on anxiety and pain in pediatric dental patients compared to a control activity. Children receive a no-cost dental exam, a cleaning, and a gift card, along with an anxiety-reducing activity. During the dental visit, the children's heart rate and behavior are recorded, and they answer survey questions and give saliva samples, so we can study their salivary stress hormones, behaviors, and feelings during the appointment.

**Have you made any discoveries thus far?**

Our survey of child dental patients and their caregivers indicated a broad interest in animal therapy, with 75% of participants believing it would make dental experiences more enjoyable and 82% indicating that it would reduce anxiety, with little to no concern regarding safety, cleanliness, or allergies. Nearly half of them would preferentially select an office providing canine therapy.





## Supporting people living with HIV in Vietnam

*UNC Gillings School of Global Public Health researchers Vivian Go and Bill Miller are running multiple clinical trials in Vietnam to prevent HIV spread and support people living with the disease.*

**What is your research focus?**

We do research to prevent people from getting HIV, but also help them get the care they need. We often work with people who use drugs or alcohol, helping them limit their risk of HIV or manage their infection if they already have the disease.

**Tell us about the clinical trials you're running.**

We have five ongoing clinical trials. All of them are happening in Vietnam.

One that's about to end focuses on people who inject drugs and are just starting treatment for HIV. We used short counseling sessions to help them receive the care they need and to take the medicines effectively.

Two trials testing investigational drugs are ongoing. These include evaluating a new drug for preventing tuberculosis and testing a new vaccine for hepatitis B, both in people living with HIV.

And then two new trials are just starting. One tests an intervention that helps people with HIV who drink too much alcohol. We showed previously that this intervention helps these people stay in HIV care and take their medication effectively. Our trial is taking this intervention and scaling it up to 32 clinics in Vietnam. We're testing whether delivering that intervention using experiential learning for clinic staff helps them deliver it to their patients.

The other trial is using a similar intervention for alcohol reduction among men who have sex with men. The goal is to help them take a medicine called PrEP to reduce their HIV risk.

**Have you made any discoveries thus far?**

It's too early in the process for our current trials, but a 2021 study found that long-acting injectable medication to prevent HIV infection was both safe and effective among men who have sex with men and transgender women.

## Reducing food allergies in children

*UNC School of Medicine researcher Edwin Kim is running multiple clinical trials to develop better treatments for people with food allergies.*

**What is your research focus?**

We are studying treatments that can increase how much food a person can tolerate before having an allergic reaction, and if a reaction were to happen, decrease the severity of their symptoms.

**Tell us about the clinical trials you're running.**

We are a site in the OUtMATCH study, which is designed to see if an injectable medication called omalizumab can protect against multiple food allergies, including peanuts and milk. Omalizumab specifically targets the allergic antibodies in a person's immune system, and then removes these antibodies. We hope that it can prevent allergic reactions to these foods or, at the very least, increase how much food a person can tolerate before having a reaction to protect against accidental exposure.

We are also a site for the ALLIANCE study, which tests whether a dissolving tablet that contains a tiny amount of peanut protein can be used for sublingual immunotherapy (SLIT). The idea behind SLIT is to give small exposures of the allergen, in this case 1/75th of a peanut kernel, under the tongue once daily to reprogram the immune system to become less reactive. The amount is just enough to make it safe, but still big enough for your immune system to see and respond to.

A third study is AVX-201, which tests regular exposures to peanuts using peptide immunotherapy, given by injection. Instead of using a whole peanut, which can trigger allergic reactions, the PVX-108 medication is made of small, broken-up parts of the peanut protein called peptides that can hopefully bypass the parts of the immune system that react and go straight to the parts that build tolerance.

## Improving health for jobseekers and workers

*UNC School of Nursing researcher Shawn Kneipp is running a clinical trial to test interventions to reduce chronic disease risks that occur from unemployment, which includes supporting people hired into new jobs.*

**What is your research focus?**

How chronic health conditions affect the ability of people to either become or stay employed, and how employment environments can affect health. For example, how do chronic health conditions like migraine headaches or depression interfere with the ability to find a job or maintain a full-time job?

On the flip side, what kinds of things are available in the work environment that can help people with these chronic health conditions get hired and better manage their health conditions? For example, does having a more supportive supervisor lead to better health and employment outcomes for people?

**Tell us about the clinical trial you're running.**

I am currently running a clinical trial to test a "multilevel intervention" for people who are not employed but looking for work. This means we are testing interventions that target changing factors at more than one level.

In our current trial, one intervention focuses on behavior change to help jobseekers deal with the stress of unemployment, stay healthy, and avoid chronic disease. Another happens in the job they are hired into, where supervisors learn how to better support their new employees. This helps reduce employee stress and encourages healthy behaviors.

**What motivates you to do this work?**

I am a public health nurse and nurse practitioner who has worked with people in clinics, in residential neighborhoods, and in social services departments for many years. I've seen how stressful it is for people when they lose their job and don't have resources to fall back on. Those experiences have led to the research I am doing now.

One of the most rewarding things is when study participants share how helpful an intervention was. When one of my earlier trials finished around 2010, I held discussion groups to talk about what they experienced. The best feeling in the world was when most of the people in the group were actually eager to participate in whatever study we were doing next. There is no better reward than that.

# Nick Eakes

Over the last 15 years, Nick Eakes has worked for UNC-Chapel Hill in a variety of roles, most recently as a science education specialist at Morehead Planetarium and Science Center. He coordinates Morehead's outreach efforts including the mobile planetarium and skywatching programs.

**Q: What brought you to Carolina?**

**NE:** I grew up here. I graduated from East Chapel Hill High School in 2008 and UNC-Chapel Hill in 2012 with a BA in psychology. I began my time at Morehead Planetarium as a high school volunteer, teaching LEGO engineering camps for elementary age children in the summers leading up to college. My interest in astronomy and love for the planetarium grew from there.

**Read the full interview at**
***research.unc.edu/rooted-nick-eakes/***

Photo by Megan Mendenhall

**Rooted**

**Rooted recognizes long-standing members of the UNC-Chapel Hill community who have aided in the advancement of research by staying at Carolina. They are crucial to the UNC Research enterprise, experts in their fields, and loyal Tar Heels.**

Patricia Gensel holds a hammer and chisel on a giant slab. Yellow markers signify where she's already used these tools to reveal the ancient plant fossil embedded in the rock.

# Adventures in Ancient Plants

Story & photos by Alyssa LaFaro | June 18, 2024

Upon first glance, the fourth floor of Wilson Hall on UNC-Chapel Hill's campus is no different from the rest of the biology department building: fluorescent lighting, white tile floors, ancient wooden desks in professors' offices.

But then Patricia Gensel leads me to a door at the end of the hallway. She buzzes with excitement as she slides the key into the lock. After a particularly satisfying "click," the door opens — and her world unfolds. Floor-to-ceiling drawers filled with specimens. Rolling carts covered in rocks. And on a table in the center, a giant slab that most people can't get their arms around.

"I don't go in for small," Gensel says with a laugh. "At one point I had about 4,000 specimens, but I donated a lot to museums in the U.S. and Canada. Now, I'd guess I have closer to 2,000."

She directs my attention back to the giant rock. Upon closer inspection, an outline of what looks like some type of fern is embedded in its top.

"This is foliage. An early seed plant, most likely," she says.

Gensel is a paleobotanist. She studies plants from the Devonian and Lower Carboniferous periods, which date back 327-400 million years — pre-dating dinosaurs. This timeframe marks the beginning of plants that lived on land, produced seeds, grew root systems, and developed wood, ultimately forming into trees.

"These are small, simple plants," she explains. "Some of them lacked roots. Many of them lacked leaves. They mostly had a stem and a reproductive structure called the sporangium."

Since joining the Carolina biology faculty in 1975, Gensel has drastically improved our understanding of these flora, uncovering new taxa — or classifications — of plants, approximating the number of species that existed, and rigorously documenting their evolution. To study them, she's collected fossils found in rocks all over the world, from the Canadian arctic to Beijing to Australia, and has published this work in nearly 90 papers and a book.

She's like Indiana Jones — but for plants.

Studying the history of plant life is key to understanding the planet's development over time. They inform the biodiversity of the area they grew in and the animals that lived alongside them. Their various structures and lifecycles reflect Earth's warming and cooling patterns — and can even indicate future pathways of our ever-changing climate.

"Plants give us oxygen, and without them, we wouldn't be able to survive," she says. "Plus, we all have an interest in knowing where we come from — and this is where we come from on a big scale."

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## Snakes, spores, and schools

Gensel's passion for plants stems from her childhood near Buffalo, New York, where she grew up tromping through her grandfather's farm, mesmerized by the different organisms she was often surrounded by.

"He had a wooded area in the back of his farm, and in the spring, we would go and look at the wildflowers," she recalls. "Also, my grandmother was interested in natural history. She was active in Audubon, and we'd look for birds together. It goes back a long way."

This love for the natural world followed Gensel into her teens, and she spent her last two summers before college participating in summer science programs that included field trips to places like the Buffalo Museum of Science and the Adirondacks.

"I remember when this guy came in to talk to us about snakes — and brought one with him," Gensel shares, chuckling. "It was great. I still love snakes and try to encourage people not to kill them when they see them."

Majoring in biology was an easy choice for Gensel. About halfway through her undergraduate degree at Hope College in Holland, Michigan, she attended a lecture on fossil spores. And when she approached the professor to ask a few questions, he offered her a job in his lab.

"I think I always had an interest in plants, but this crystallized it," she says.

Paleobotany was a way for Gensel to merge multiple interests. It requires foundational knowledge in both botany

and geology, but also involves working at excavation sites, unearthing fossils with the same techniques archaeologists use to uncover artifacts.

While awaiting acceptance to graduate school, Gensel continued to work in the lab until her mentor introduced her to a palynologist — a person who studies fossil spores and pollen — who was looking for an assistant to aid him in his research on Devonian spores in London.

"I think it took me about two minutes to say yes," Gensel says.

After a year, she realized she preferred studying whole plants versus spores and traveled back across the pond to work on master's and PhD degrees at the University of Connecticut (UConn).

**"Many of my students haven't been exposed to this history, and they often tell me I open their mind to other ways of thinking. I think it broadens their thinking about what we can learn from the past."**

**- Patricia Gensel**

## A pioneering paleobotanist

After graduating from UConn in 1972, Gensel stayed on as a postdoctoral researcher for a few years before landing a faculty position in the botany department at UNC-Chapel Hill in 1975. She and Ann Matthysse, also still at Carolina, were the first two female professors ever hired by the department.

Gensel continued to study plants from the Devonian period — a timeframe that had gaps in paleobotany literature. This meant Gensel had plenty of opportunity for discovery.

"This is a world where no flowering plants existed," she says. "It's a world where plants first became established in the land and diversified."

To understand ancient plants, botanists must study how modern ones are constructed and function. Then, they trace those properties back in the timeline, searching for when they first appear and what caused their development. It's incredibly challenging, Gensel admits, because these plants look drastically different from what we know today.

The first known land plants, called *Cooksonia*, were small and mossy with branches leading to tiny knobs. They lacked root structures, leaves, and wood — characteristics that wouldn't show up until the Devonian period. Gensel was one of the first researchers to pinpoint when these traits appeared.

"I was fascinated by how many of these 400-million-year-old plants had features present in living ones," Gensel shares. "At that time, they looked very different, but they still were doing some very similar things and were surprisingly more sophisticated than people thought when I first started out in this field."

As Gensel added more and more data to the existing literature on Devonian plants, she began expanding her research into the next period in geologic history: the Lower Carboniferous — or "Lower Carb" as Gensel calls it — about 327-359 million years ago. On average, scientists know less about this time because there are fewer places in the world where terrestrial sediment can be found. Two are on the East Coast: Virginia and New Brunswick, Canada.

Recently, Gensel has spent much time in New Brunswick alongside two colleagues who discovered one of the most intact fossilized trees from the Lower Carb to date. Contained in a rock about the size of a Mini Cooper, the tree they found has been preserved 3-dimensionally, which helped them reconstruct a model of what it would have looked like in its original form.

With its tall skinny trunk and almost equally long spindly leaves, the tree looks like something out of "The Lorax." So, of course, the research team is affectionately calling it the "Dr. Seuss tree."

"This tree is special because it doesn't match any existing models we have of trees from this period," Gensel explains. "It's motivating me to further study the Lower Carb, comparing the different environments where the fossils can be found across Nova Scotia, Virginia, and Europe."

## An ending and a beginning

Gensel is one of just two botanists left at Carolina. During her 49-year career here, she watched the botany department dissolve into the biology department and the field shrink as biology students began to pursue more traditional fields of study like medicine and environmental science.

As she nears retirement in Spring 2025, she worries what will happen to her specialty as the years go on — especially since teaching, for her, has always been a place to share that passion and inspire the next generation of scientists to consider the field.

"Many of my students haven't been exposed to this history, and they often tell me I open their mind to other ways of thinking," Gensel says proudly. "I think it broadens their thinking about what we can learn from the past."

For years, Gensel has brought classes to roadside outcrops in Pulaski, Virginia, for fossil hunting. She teaches them about different kinds of rock, how and where to search for fossils, and how to remove them intact.

"For students, this really makes fossils become real," she says. "It's an incredibly valuable experience."

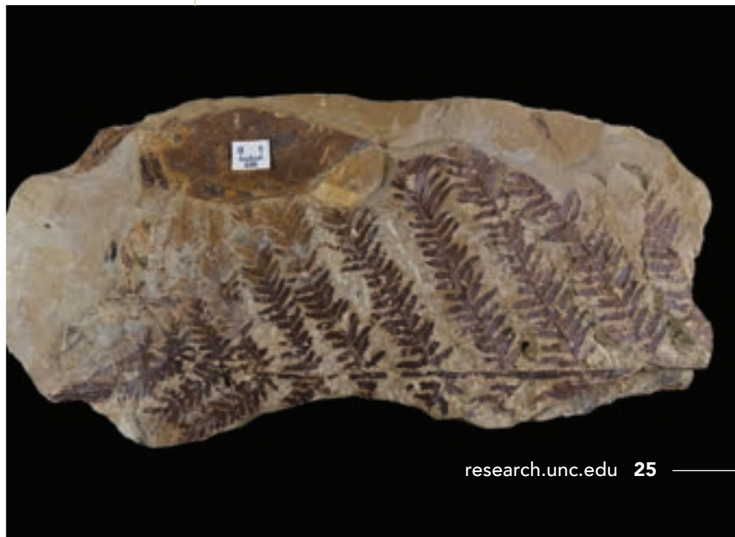
While retirement is in many ways an ending for Gensel, it's also a beginning. Her time normally spent teaching will be fully devoted to her remaining research projects, of which she has many.

"I still find it exciting to work with these plant puzzles," she says. "They're some of the biggest and hardest puzzles out there."

These are the stems and sporangia of an Early Devonian plant called *Psilophyton*, found in northern New Brunswick, Canada.

A new genus of Lower Carboniferous foliage, likely the leaves of an early seed plant.

Gensel has a few fossils outside of her typical timeframe. This rock shows a Triassic fern called *Clathropteris*.



## All the Light We Cannot See

Story & video by Megan Mendenhall | January 18, 2024

The UNC Outer Banks Field Site on Roanoke Island hosts a small group of undergraduate students each fall semester to expose them to coastal science and environmental policy research. In 2023, they studied how artificial light at night affects wildlife and shared their results with community members to stimulate discussions on protecting the people and ecosystems of the Outer Banks.

**Read the story & watch the video at**
***research.unc.edu/all-the-light-we-cannot-see/***

# An Unexpected Colleague

Story by Alyssa LaFaro, photos by Megan Mendenhall,
& photo illustration by Corina Prassos | February 23, 2024

Optimists believe AI will be powerful enough to run the world one day. It will create safer driving conditions, automate some jobs, and even conduct life-saving medical procedures. It will change humankind for the better, improving our systems and helping us live longer, healthier lives.

Pessimists think AI will expand beyond our control and eventually take over humanity. It will be a Sci-Fi movie made real. Think "The Matrix," "I, Robot," or "Wall-E."

But for Mohammad Jarrahi, a self-described realist, neither of these scenarios plays out. He sits somewhere in the middle, finding balance in what AI can really achieve in practice.

"Both scenarios are overhyped perspectives," he shares. "Emotional intelligence is our capability — and technology cannot understand emotional intelligence the way we can. Creativity and critical thinking are still ours. AI can remove the drudgery — the mundane, repetitive tasks that aren't a source of human learning."

As a professor in the UNC School of Information and Library Science, Jarrahi studies human-AI symbiosis. Just like in biology, it is the concept of two different species complementing one another and aiding survival. In this case, the two species are real and artificial.

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"It is not competition or cooperation — it's both," he says. "It's coopetition. We need to collaborate with the AI and be mindful that it is not our friend. If we can move past the fear and the hype, we can figure out how AI can realistically help us."

## A sociotechnical surgeon

Jarrahi grew up in the 1990s, during the rise of the web. He began programming in high school and even helped the school get its report cards online. Shortly after enrolling in college in 2000, the dotcom bubble burst and a slew of internet companies failed. Jarrahi was fascinated by it all.

"My father was an IT manager, and he influenced me to go beyond programming and technological aspects to learn about the management of information systems

**"It is not competition or cooperation — it's both. It's coopetition. We need to collaborate with the AI and be mindful that it is not our friend. If we can move past the fear and the hype, we can figure out how AI can realistically help us."**

**- Mohammad Jarrahi**

**“AI is a very powerful horse that you must first tame, but you can hop on it now and go very fast. It’s a process of taming and taking advantage of the horse. The minute you don’t pay attention, the horse will bring you down.”**

**- Mohammad Jarrahi**

rather than developing them,” he shares. “A strong understanding of both the social context of an organization and the technology is what creates positive outcomes.”

Jarrahi went on to pursue a master’s in analysis, design, and management of information systems from the London School of Economics and a PhD in information science and technology from Syracuse University.

Now, Jarrahi studies how information systems — technologies that inform our life and work — play a role in shaping relationships, culture, organizational structure, and team dynamics in the workplace. He wants to understand how AI is changing these spaces and what that means for the future of work.

Jarrahi’s research in this space is largely influenced by the “sociotechnical tradition.” To explain what this is, he says to imagine a patient who needs an artificial heart transplant. Bioengineers develop the new heart and have the most knowledge about how it works. But they don’t know how to install it — that’s where the surgeon comes in.

“I tell my students, ‘You are the surgeon.’ That’s the sociotechnical researcher,” he says. “You need to understand the technology — the heart — and how to transplant that technology into a bigger organic system.”

## Human versus AI

Jarrahi’s research unpacks why AI systems should be designed to strengthen human contributions in the workplace — not replace them.

“AI is a very powerful horse that you must first tame, but you can hop on it now and go very fast,” he says. “It’s a process of taming and taking advantage of the horse. The minute you don’t pay attention, the horse will bring you down.”

Inspired by J.C.R. Licklider, a psychologist and computer scientist who coined the term “man-computer symbiosis” in 1960, Jarrahi brings the concept into the 21st century and creates his own version: human-AI symbiosis.

He points to a recent study using images of lymph nodes to detect cancer as an example. A strict AI approach for processing the images led to a 7.5% error rate, while pathologists’ examination had a 3.5% error rate. But when the AI and human doctors combined their efforts, that number was reduced to 0.5%.

One of Jarrahi’s most-cited papers to date is “Artificial intelligence and the future of work: Human-AI symbiosis in organizational decision making,” published in the academic journal *Business Horizons*, which awarded it best article of 2018. In it, he defines two types of workplace decision-making: analytical and intuitive. The former involves collecting and analyzing information with reason and logic, tasks that AI technology excels at. Intuitive decision-making requires imagination, creativity, and gut instinct — intrinsically human characteristics.

Then, he describes three big challenges organizations face and the human and AI traits required to solve them: uncertainty, complexity, and equivocality.

*Uncertainty* is when a decision presents many alternatives and unforeseen outcomes.

Imagine a company looking at two possible corporate investors. One is a startup that can’t offer a lot of money up front but will ultimately allow more freedom to pursue new ideas. The other is an established corporation that will pay more, but they have specific guidelines for what they want to achieve in the next three years.

AI can assess these investors using data from each to weigh their pros and cons. It will pick the most logical option on paper. The company’s owners will be more subjective and will try to get to know the people they’d be working with and think critically about how those relationships will affect their goals. The combination of both methods will lead to a better outcome than just one.

*Complexity* refers to complicated situations with a lot of variables. AI will always be able to process heavier data loads than humans can handle. But humans can choose where to look for and gather that data from, informing what feeds the AI.

Lastly, *equivocality* involves decisions among multiple parties who can’t agree on a plan of action. When this happens, humans can negotiate, build consensus, and rally support. AI can analyze those sentiments and provide diverse interpretations.

“Although AI capabilities help humans overcome complexity through the machines’ superior analytical approach, the role of human decisionmakers and their intuition in dealing with uncertainty, and especially equivocality of decision-making, remains unquestionable,” Jarrahi writes.

## AI’s future in the workplace

In addition to writing perspectives, Jarrahi is conducting a qualitative study on how generative AI systems are transforming jobs for knowledge workers — people who use their expertise and critical thinking to solve problems, develop products and services, or create strategies. He wants to uncover how knowledge workers engage with the technology.

Study participants created digital diaries about how they’re using ChatGPT at work, along with the bottlenecks, pain points, and opportunities it creates. After analyzing these responses, Jarrahi and his team conduct follow-up interviews to learn more.

So far, he’s discovered that a lot of workers are using it for proofreading, ideation, and basic information synthesis — but they have to continuously verify the results.

“Lawyers are using it. Programmers are using it to write some basic code,” he says. “The idea is you need a knowledge worker to use that piece of advice, text, or code to embed it into a bigger organizational process. It’s a powerful toolkit that can do magic, but that magic is not self-driving.”

Jarrahi himself uses ChatGPT in his own writing to organize his ideas into a more cohesive text with good structure and flow. But he stresses the need to proofread what the AI produces because sometimes it deletes important points or adds nonsense.

“These technologies are not going to replace us,” he says. “They are going to reinvent our work — and we have to reinvent ourselves.”


## Just the Facts

Story by Abigail Keller & photo by Megan Mendenhall | May 24, 2024

After helping create a fact-checking service in South Korea, Heesoo Jang continues to improve trust between readers and the media at Carolina. As a PhD student within the UNC Hussman School of Journalism and Media, she researches how AI systems and digital platforms impact society, journalism, and democracy.

**Read the story at**
***research.unc.edu/just-the-facts/***

# First came love then came science

Story by Carleigh Gabryel | February 13, 2024


Bulik and Sullivan met in 1978 at the University of Notre Dame. Bulik was a figure skater and Sullivan ran cross country and track. The duo attended graduate programs at different universities in the San Francisco Bay Area and got married in Bulik's hometown of Pittsburgh in 1986. (photos courtesy of Cynthia Bulik and Patrick Sullivan)

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In 1978, Cynthia "Cindy" Bulik navigated a crowded University of Notre Dame dorm room, looking for a way to ditch a party she was dragged to by her roommate. It was the first-year's second day on campus, and this was not her kind of scene. But Bulik's sentiment shifted when she noticed a young man.

"This guy came running into the room totally sweaty, didn't really interact with anyone, and splashed water on his face," says Bulik, now the Distinguished Professor of Eating Disorders within the UNC School of Medicine (SOM). "I remember thinking that he was cute. And then I talked to him, and he was smart too."

Patrick Sullivan, the Yeargan Distinguished Professor of Psychiatry and Genetics within SOM, also remembers that night well. The sophomore was finishing up a run when he returned to a party thrown by his roommates.

"I was totally taken by Cindy from the very start," Sullivan says. "I remember telling someone I had this feeling that she and I would be together long-term. And I was right."

Bulik and Sullivan are established researchers who have made groundbreaking progress in the field of eating disorders and genetics both separately and together. They have created a family and community that allows their love for science and each other to thrive.

## A transformative semester

It wasn't long after their serendipitous dorm party encounter that Bulik and Sullivan were an item. For Bulik, it was the first of many fateful encounters Bulik had that semester at Notre Dame. The second happened in a lecture hall, during an intro to psychology course she tried to drop.

"I wanted to be a diplomat and study international relations, not psychology," Bulik says. "But my first class with John Cacioppo, who went on to create the field of social neuroscience, was a moment in my life when everything just clicked."

Within a week of that class, Bulik was in Cacioppo's office discussing projects that she could get involved in. Her path to psychology was set.

Several weeks later, her life course was altered again — this time at a football game.

"I was in the student section and these guys grabbed me from behind, lifted me up, and passed me over their heads to other people in the stands. I was scared to death," Bulik says. "And then they dropped me. It broke my back."

The injury impaired Bulik's ability to move, and she went home to Pittsburgh to be with her parents for the rest of that semester. She continued her studies from afar, along with her relationship with Sullivan, whose care and support continued to strengthen their bond.

In the spring, Bulik returned to Notre Dame to pick up where she left off, all while learning to cope with the new limitations caused by her spine injury.

## Travel and training

As the duo neared the end of their undergraduate studies, Sullivan was unsure of his next steps.

"I tried to write my personal statement for medical school and couldn't get past the first sentence," he says. "I took that as a sign that I needed to figure some things out, so I took time off and traveled across Europe."

Meanwhile, Bulik went back to Pittsburgh to be a research associate in the department of psychiatry at the University of Pittsburgh School of Medicine. She dove into projects on sleep and depression and was introduced to the study of eating disorders.

"I shadowed the attending psychiatrist on the eating disorders unit," Bulik says. "A lot of the patients were around my age and had severe anorexia nervosa, and it just hit me."

Bulik was a figure skater and had been around eating disorders for most of her life but wasn't able to identify them as such. No one had discussed that this was a health issue. It was an experience that defined the course of her career.

She made plans to pursue a clinical psychology graduate program at the University of California, Berkeley (UC-Berkeley). But before starting school, she joined Sullivan — who had been keeping in touch with postcards and the occasional, and expensive, long-distance phone call — on the tail end of his travels.

"Travel has always been important to us," Bulik says. "In the beginning, I knew that even though we were very different people, our values have always aligned, and I think travel and adventure are two of those."

And those travels gave Sullivan the direction he'd been searching for.

"I wrote my personal statement for medical school while standing up on a bus in northern Greece," he says. "At that point, it was simple because I knew exactly what I wanted to do and why."

And he knew where, too — California with Bulik.

## Forging a joint path

In 1983, the dynamic duo started attending graduate programs at different universities in the San Francisco Bay Area. Bulik created her own course of studies in the emerging field of eating disorders at UC Berkeley, and Sullivan attended the UCSF School of Medicine, where his interest in psychiatry grew.


**"I was totally taken by Cindy from the very start. I remember telling someone I had this feeling that she and I would be together long-term. And I was right."**
**- Patrick Sullivan**

Then in 1986, in the middle of their graduate programs, they got married.

"It became blindingly obvious that we were deeply compatible, and marriage was the clear next step," Sullivan says.

The couple finished their graduate programs in 1988, and launched careers that would take them across the country and world, all while growing a family.

By 2003, Bulik and Sullivan had settled in Richmond, Virginia. So, when Bulik received a call from the UNC School of Medicine to apply for the first endowed professorship in eating disorders in the U.S., she turned it down.

"They were persistent," Bulik says. "They had me visit campus at the end of March when the skies were blue and everything was in bloom, and the meetings with potential colleagues and collaborators were energizing."

As it turned out, the newly formed genetics department was looking for someone with Sullivan's expertise, so the family moved one more time.

## Making a research home

Bulik and Sullivan settled in quickly at Carolina and got to work creating care and research programs to support their ambitious goals.

In 2003, Bulik became the founding director of the Center of Excellence for Eating Disorders and has led it ever since. It's a world-renowned center that focuses on clinical service, training, and research, which includes genetics-based collaborations with Sullivan's lab.

"This program is near and dear to my heart," Bulik says. "The genetics findings have established that anorexia nervosa is not only a psychiatric disorder but is also a metabolic disorder. We've opened this whole new line of inquiry to investigate the disease and ultimately to improve treatment."

Sullivan worked to uncover why some people are more likely to suffer mental illness than others. In 2007, he co-founded the Psychiatric Genomics Consortium, a group of more than 800 scientists from 36 countries. Collectively, the consortium has published around 600 papers and increased understanding of the basis of psychiatric disorders.

"Everything we learn, we make the information available publicly because we're all about wanting to make things move as quickly as possible to understand the genomic and scientific implications of conditions like depression and schizophrenia," Sullivan says.

During their time at UNC-Chapel Hill, Sullivan and Bulik also applied for separate grants to conduct research at Karolinska Institutet in Sweden. They were both awarded their grants — but found out at different times.

"My notification came before hers, which made for an awkward three weeks," Sullivan says. "Yet, it is another example of the great fortune we've had over the years."

From 2014-2020, the pair spent half their time in Sweden leading research teams. With their kids out of the nest, it was another adventure in science and life. And then the pandemic hit.

## A legacy of collaboration

Bulik and Sullivan continued to lead their teams at Karolinska from afar, while redirecting some of their focus at home.

"I was able to get back into clinical practice with the Taking Care of Our Own Program, which provides psychiatric and psychological care for UNC medical professionals," Sullivan says. "It was amazing to have the privilege of assisting these talented and dedicated individuals."

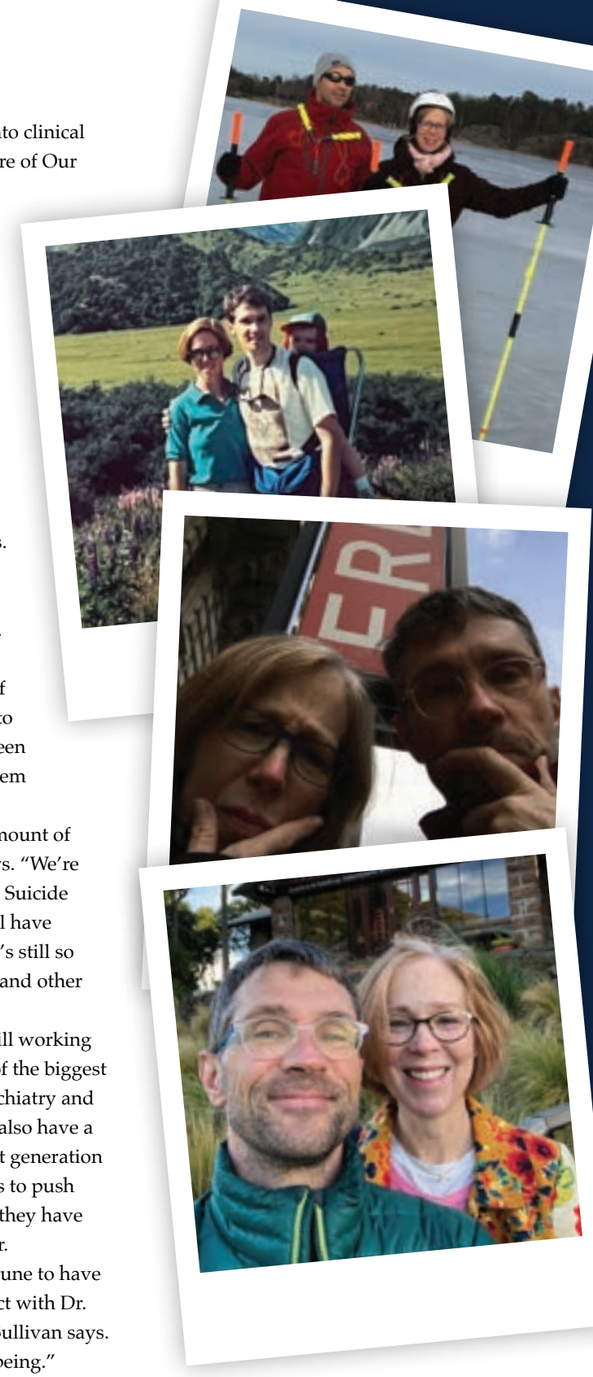
On the heels of the pandemic in 2022, mental health was at the forefront of health care conversations. The Suicide Prevention Institute was established with Sullivan as its director. He pulled together a team of 40 faculty at the School of Medicine, including Bulik, to reduce suicide in patients seen across the UNC Health system and beyond.

"There's an enormous amount of work to be done," Bulik says. "We're just getting started with the Suicide Prevention Institute, we still have teams in Sweden, and there's still so much to learn about eating and other psychiatric disorders."

Bulik and Sullivan are still working diligently to answer some of the biggest questions remaining in psychiatry and psychology. And now they also have a passion for training the next generation of researchers and clinicians to push forward the advancements they have made over decades together.

"I've had such great fortune to have met and consistently interact with Dr. Cindy Bulik for 45 years," Sullivan says. "She's an amazing human being."

"We've grown up together as people because we met so young," Bulik says. "And we've grown up together as scientists too."



The pair have lived and worked in California, Pennsylvania, New Zealand, Virginia, and North Carolina. Being outdoors and active has always been a part of their life. (photos courtesy of Cynthia Bulik and Patrick Sullivan)

## Mapping Marsh Futures

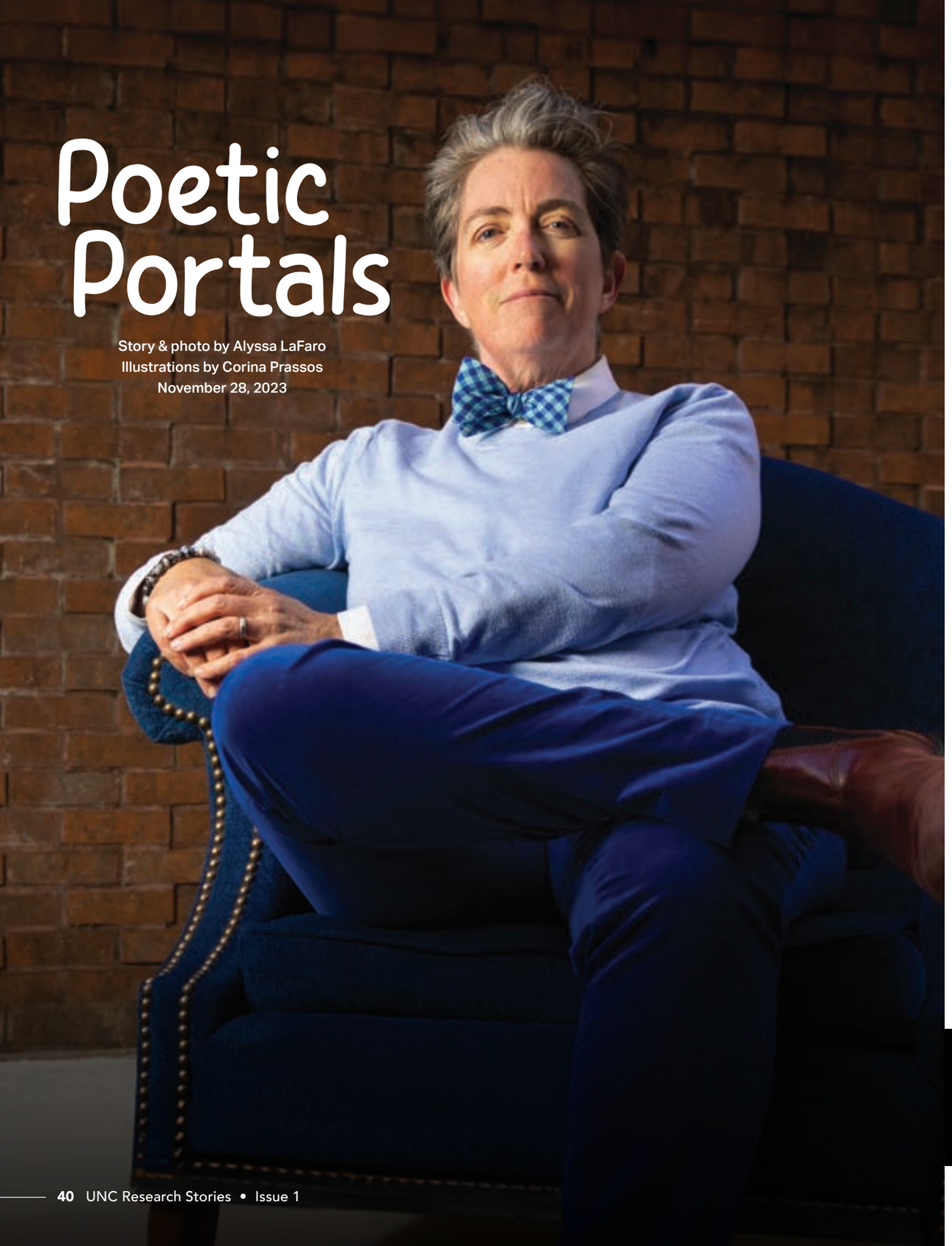
Story & video by Megan Mendenhall | August 22, 2024

Researchers from the Carolina Drone Lab — a collaborative research unit within the UNC Institute for the Environment — visited four marsh sites along the Currituck Sound as part of a study on the applications of drone technologies for coastal resilience and habitat monitoring. They are partnering with Elizabeth City State College and Audubon of North Carolina to aid in understanding the status of marshes and the future management of the sound.

**Read this story at**
***research.unc.edu/mapping-marsh-futures/***

# Poetic Portals

Story & photo by Alyssa LaFaro
Illustrations by Corina Prassos
November 28, 2023



Gabrielle Calvocoressi has spent most of their life flitting between worlds: the past, the present, and the one inside their head.

Raised by their grandparents in Middle Haddam, Connecticut — which today has fewer than 450 residents — they admit there just wasn't much to do when they were growing up. While this riverfront community overflows with lush forests and farmland typical of New England towns, playing outside wasn't an option because Calvocoressi has nystagmus, an eye condition that reduces vision and depth perception.

Instead, there was a lot of daydreaming.

"I think the story behind why I became a writer is pretty common," Calvocoressi says. "But there are also things about it that aren't common at all."

When they were 13, their mom took her own life.

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"And all of a sudden this thing I didn't have language for was constantly around me, and people didn't want to talk about it," they say. "Even though I was only 13, I understood that something had happened. That was probably a defining moment in my life."

Calvocoressi can't recall who it was that gave them their first journal, but they began filling it with words. It wasn't until they showed it to one of their summer camp counselors that they had language for what it was they were doing: writing poems.

"I was like, *Oh, poems*. That felt quite important," Calvocoressi says with a laugh. "That gave me a name and a structure and a vessel — and that vessel was the only rational thing I had in my life to try to put that experience into."

For the last 30 years, the Carolina creative writing professor has used poetry to revisit the people they have lost, unpack their feelings around gender and identity, and recognize the small joys of everyday life. The key, they say, is to stay curious and open to learning new things.

"Research for a creative or a poet like me is being in the world," Calvocoressi says. "It's going into the archive and building a world — and not just thinking, *Oh I know exactly what I'm talking about*. And the archive is something you build inside yourself."

Calvocoressi often spends months researching a topic for just one line of a poem.

This approach works. Calvocoressi has been published in *The New Yorker*, *The New York Times*, *Paris Review*, and *Boston Review* and was a finalist for the *LA Times* Book Prize. They spent the 2022-23 academic year as a Radcliffe Fellow at Harvard University, where they worked on writing their fourth book of poetry: "The New Economy."

## Word experiments

When Calvocoressi wants to incorporate a topic into a poem, they spend hours thinking about it, talking to experts, and reading relevant books and articles. They might end up writing just one line about that topic, but they'll spend months or even a year learning about it.

Consider bees.

---

How do you tell your children
They'll never get away?
Tell them their only choice
is factories or the mines,
bent heads or blackened lungs.
Amelia Earhart is a dream
my daughter won't give up.
*-from "The Last Time I Saw Amelia Earhart"*

"Millions of people write poems about bees. Now that I have a beehive in my backyard, I recognize that most poets who write about them don't have beehives," Calvocoressi says, chuckling. "Bees are weird and amazing and violent. They are their own world. Spending time with them and the beekeeper has made me realize that if I want to write about bees, I need to learn everything I can. Otherwise, they become some boring metaphor everyone has heard before."

Calvocoressi plans to teach an entire unit on bees. They will gather materials on the topic at Wilson Library and collaborate with Carolina professor Eliza Richards to lead a class on Emily Dickinson, who wrote more than 100 poems about the insects.

Calvocoressi believes poems aren't all that different from science.

"Years ago, I had these two science students, and when something wouldn't work in their writing, they wouldn't take it personally," they recall. "It's not that it didn't bother them, but they would look at each other and say, 'Why do you think that happened?' And then they'd talk it through and get excited about why it didn't work and what they'd do instead."

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Firstly, I was terrible at science.
I got as far as slicing the frog's abdomen
open. Then I made an excuse
and walked the halls 'til the bell rang.
I know what you're thinking.
That's biology. When I looked inside
the cavity I knew I didn't have what
it took. For a life in science. God,
I have intestines like that frog. They
pulse and shine like his.

*-from "Some Thoughts on Building the Atom Bomb"*

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That's when Calvocoressi realized that writing poetry is like a hypothesis. The lines and structure are the experiments. Some work; others don't. And when they fail, the poet analyzes what went wrong and tries something else.

"Poetry is so cool like that," Calvocoressi says. "I get a lot of physics and pre-med students who aren't just using it because they need a creative thing on their CV. There's something about the way their minds work that draws them to the artform."

## Veneration for vessels

Much of Calvocoressi's work focuses on vessels. The poem itself is a vessel for communication.

So is the human body. Because of their nystagmus, Calvocoressi didn't learn to walk until they were 3 years old. But they did develop a keen sense of hearing — and today their poems overflow with sensory language.

---

But I know how the grass sounds
when the locusts come, like a spaceship
taking off and how it makes the air shake.

*-from "Captain Lovell"*

---

"I was always imagining a different body for myself, imagining another life," Calvocoressi shares. "And so a lot of my poetry has to do with gender identity and what it means to be in my nonbinary, queer, trans vessel."

Calvocoressi learned how to talk more openly about these topics during college. They attended Sarah Lawrence College and Columbia University for bachelor's and master's degrees. New York City provided a safe space for exploring their writing and queerness.

"I wanted to be somewhere where there was creative writing. And lesbians," Calvocoressi says. "And that's really where my writing life began."

---

I admit it:
this body's not enough for me.
Still I love it.

*-from "Praise House: The New Economy"*

---

While many of Calvocoressi's poems are spent making sense of themselves and their tumultuous childhood, they also include moments in U.S. history. Their first book of poetry, "The Last Time I Saw Amelia Earhart," explores emotions around the famed flyer's disappearance and delves into other "ominous shadows" of small-town America, like a 1944 Ringling Bros. circus fire that killed 168 people.

"My poems are a portal," they say.

Most of the time, they are a portal to lost loved ones, like their mother, their grandparents, and two beloved Carolina colleagues: Jenny Tone-Pah-Hote and Randall Kenan. They use their words to reflect, reconnect, and soothe — something anyone who's experienced loss can relate to.

---

Do not care if you just arrive in your skeleton.
Would love to take a walk with you. Miss you.
Would love to make you shrimp saganaki.
Like you used to make me when you were alive.

*-from "Captain Lovell"*

---

## The beautiful and the terrible

During last year's Radcliffe Fellowship, Calvocoressi worked on their latest book of poetry, "The New Economy."

"This book of poems is about how we keep going," Calvocoressi says. "I have had many moments in my life where I did not want to keep going."

---

The days I don't want to kill myself
are extraordinary. Deep bass. All the people
in the streets waiting for their high-fives
and leaping, I mean leaping,
when they see me. I am the sun-filled
god of love. Or at least an optimistic
under-secretary. There should be a word for it.

*-from "Hammond B3 Organ Cistern"*

---

As the child of a person who took their own life, Calvocoressi admits that they think about suicide often. It is a part of them. But they also think a lot about life and its joys. It is these thoughts that they've been collecting in a nonfiction book called "The Year I Didn't Kill Myself."

"I've been working forever on this nonfiction book about why people kill themselves. And it's a question of like, well, why doesn't everybody kill themselves? And that's not a hopeless question because there are answers. So maybe my poems are me just trying to answer that for myself."

Calvocoressi pauses and points to a patch of leaves in the trees. They are lime-green, illuminated by a halo of mid-morning sunlight.

"Look at the light," they say. "It's so gorgeous right now. And I get to think about that. And I get to think about my students and how they are going to blow my mind in class today. It's like the beautiful and the terrible. I'm always working on that."

RESEARCH UNCOVERED

A Q&A series showcasing the many faces of research at Carolina, from undergraduate students to faculty across all disciplines.

# Jasmine King

Jasmine King is a postdoctoral researcher in the UNC/NC State Joint Department of Biomedical Engineering. She develops innovative and novel drug-delivery platforms to treat cancer.

**Q: Describe your research in five words.**

**JK:** Reprogramming cells to weather brain-storms.

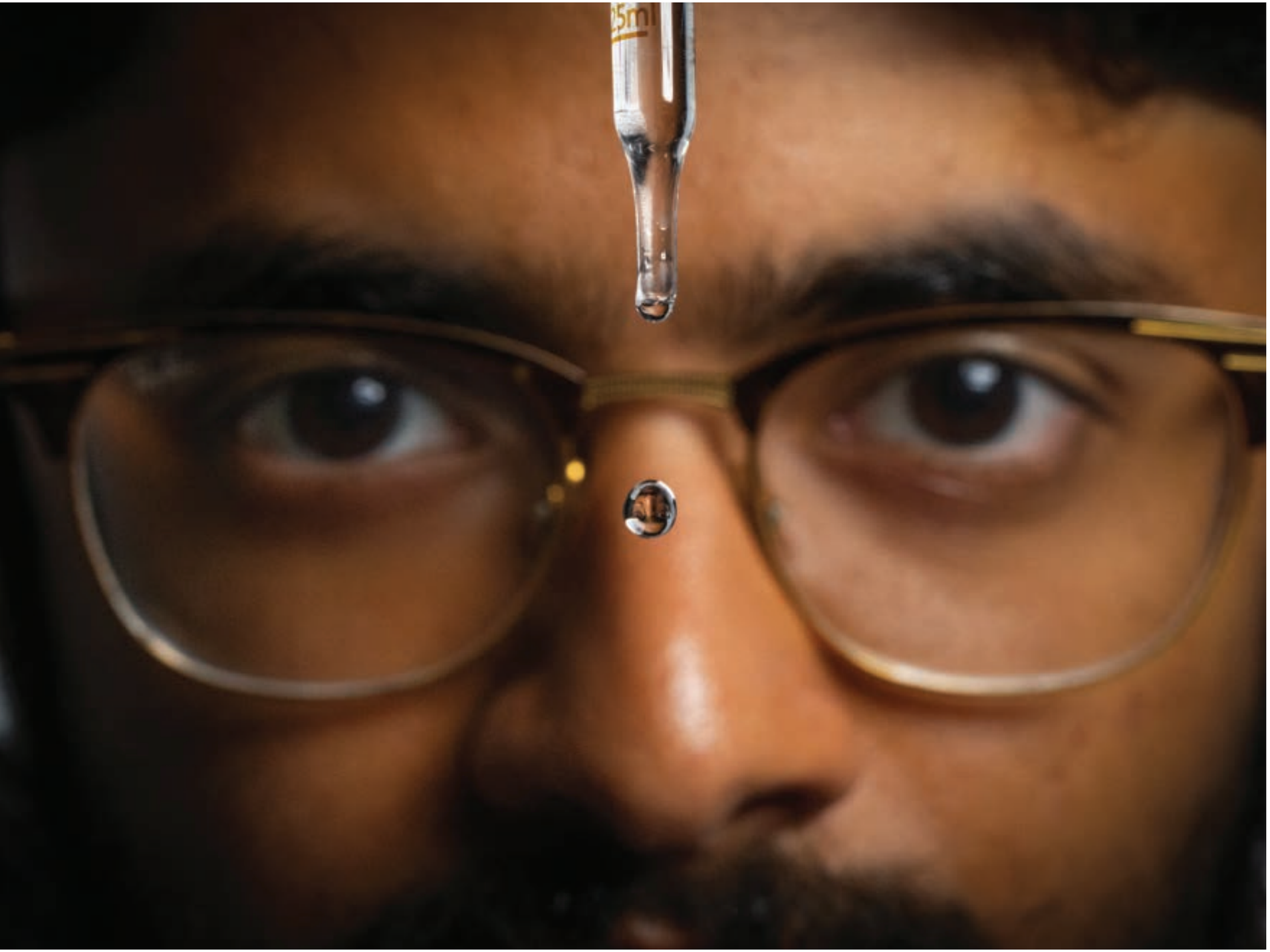
**Q: How did you discover your specific field of study?**

**JK:** When I was around 15-16 years old, I would accompany my grandmother to the infusion clinic for her chemotherapy regimen for breast cancer. Visit after visit, I would watch her and other individuals receive their treatment. I noticed that my grandmother wasn't the only individual that was 1.) drained from the multiple infusion visits and 2.) drastically changed physically from the multiple cycles of chemotherapy.

One day, I decided that I needed to know more and thought that there had to be a safer approach for delivering these therapies. During one of my grandmother's visits to her oncologist, I blatantly asked him: "Why haven't you discovered a safer drug or a new way to deliver the existing drugs?" He proceeded to tell me more about his area of expertise and explained that researchers in the field of pharmaceutical sciences design and create novel approaches to improve delivery of drugs. From that moment, I knew that I wanted to pursue a professional career in pharmaceutical sciences or a pharmacy-related field.

**Read the full interview at**
***research.unc.edu/runc-jasmine-king/***

Photo by Megan Mendenhall



# Drop by Drop

Story & photo by Alyssa LaFaro | May 10, 2024

Abel Abraham admits that he's a fan of quiet. So, he didn't mind being one of few students navigating UNC-Chapel Hill's campus in September 2020.

"I'd attend my classes online and then walk to the lab every day after to work on my experiments," he says. "It was a good reason to be on campus."

As a first-year student during the pandemic, Abraham joined the Physical Mathematics Laboratory (PML) to stay in Chapel Hill instead of taking virtual classes from home. Through the PML, he immediately took a deep dive into research.

Carolina mathematician Pedro Sáenz directs the PML, which uses theory, simulations, and experiments to uncover new phenomena relevant to the fields of physics and engineering.

"The fact that we have labs in the math department at UNC is unique," Sáenz says. "Most mathematicians work on pen and paper, but we have in-house experiments that you can compare your theories or simulations to and draw inspiration from. And Abel is an experimentalist."

Now a senior at Carolina double-majoring in mathematics and biomedical engineering, Abraham has spent the last four years working in Sáenz's lab. He developed his own experiments, spoke at conferences, and submitted his research for publication in a peer-reviewed journal.

And, alongside the lab's other research, his project has the potential to radically change how we understand classical physics.

## From watermelons to waves

When he started college, Abraham wanted to be a surgeon. When asked why, he laughs. His mom is a pediatrician and, one day, while watching him meticulously slice up a watermelon, she suggested it.

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"I liked working with my hands," he says, still chuckling. "Growing up in a small town in Kentucky, I didn't have opportunities like Science Olympiad in school, but I liked cutting watermelon. And she noticed how patient I was and that I'd cut it systematically, removing the outside and cubing the rest."

That attention to detail aided Abraham in the PML, where he studies walking droplets, or "walkers." When added to a vibrating liquid bath, these droplets bounce repeatedly, self-propelling along the surface. Scientists observe that, even though the walkers are particles, they may behave like waves.

With Abraham's help, Sáenz's lab has discovered that these walkers can move chaotically when the floor of the bath is random, like any part of the ocean might be. During this process, the droplets mimic a phenomenon called Anderson localization (AL).

Imagine an ocean wave colliding with a dock and a pier. Upon impact, the structures break the wave's pattern, causing it to diffuse and lose energy. When Anderson localization occurs, the wave maintains its energy for much longer, bouncing between the dock and the pier in an endlessly repetitive pattern. It's like looping a song on Spotify.

AL was motivated by real-world observations. Physicist Philip Anderson theorized this phenomenon while investigating experiments that showed that metals filled with impurities can act as insulators. On a universal scale, this discovery was possible because quantum particles, like electrons, have a wave-like nature. Anderson won the Nobel Prize for this research in 1977.

While AL has been shown to occur in subatomic systems, scientists believed it wasn't possible with particles that can be seen with the human eye. In fact, Abraham's project and the overall research of the Sáenz Lab challenges what scientists know about classical mechanics.  These laws explain how large objects move — and they, typically, don't move in a wave-like pattern. That's what happens in quantum mechanics with tiny particles like electrons.

"We've been told all our lives that there are certain quantum effects, such as AL, that cannot be observed with macroscopic particles," Sáenz says. "Abel demonstrated that his system exhibits particle localization analogous to what happens in quantum mechanics."

This discovery was driven by curiosity more than application, according to Sáenz.

"We are inspired by the physicists of the 1920s, who pioneered the field of quantum mechanics," he says. "Like them, we are primarily motivated to understand nature, and hope our work will lead to many advances, as theirs unquestionably has."

This project could also increase our understanding of active matter, when a group of individuals work together to convert energy into motion. Classic examples of this include schools of fish and flocks of birds. It also has a variety of other potential applications.

"Being able to stop diffusion is useful," Abraham says. "For example, when oil spills into the ocean, that creates a lot of droplets that we don't want to spread. We want to clean them up. We want to be able to arrest diffusion."

## Failures and fixes

Abraham began working on this project in 2020, alongside lab members Frane Sazunic Antun Ljubetic and Stepan Malkov. His first task involved creating a droplet generator for the experiment. He assembled the fluid chambers, nozzles, and tubing to eject the fluid alongside a circuit to control it. His laptop would power the device via a USB cable. The first time he hooked it all up to test it, he fried his USB port on his computer.

"It was pretty stupid," he says, rolling his eyes. "There were more steps I should have taken before testing. But Pedro encouraged me and told me a story about melting a screwdriver at MIT. It was my first lesson that challenges and failures are part of every experiment."

Abraham assessed every component of his creation to determine what went wrong. He eventually rebuilt a safer circuit, which would still routinely break while producing the droplets but without the risk of harming his computer. After a year of testing, he got it right.

"What I find most remarkable is that Abel did all of these things with minimal guidance" Sáenz says. "He is the kind of student who has a solution for a problem before the adviser knows that there is a problem."

Once Abraham had a successful droplet generator, he shifted his focus to developing a 3D-printed model of random topographies, like a tiny mountain chain, to set on the bottom of the liquid bath to create a disordered environment for the walkers to bounce on.

Then, he spent the next year performing the experiments. By spring break of 2022, his results looked promising.

"We found that walking droplets in disordered environments don't spread out over time, which is also how electrons and waves behave in similar environments," Abel explains. "This is the first system where a macroscopic or large-scale particle localizes as a wave, like quantum particles do."

As a result of the project, Abraham and his collaborators produced a paper that is currently under revision, and he has spoken about his work at professional conferences — a rare feat for an undergraduate student.

## More than math

Whenever Abraham hit a roadblock in his experimental setup, he'd turn to other researchers in the lab for help, from graduate students to postdoctoral researchers. He believes that Sáenz has worked hard to create a collaborative environment that improves the overall success of the PML and the individuals within it.

**"We are inspired by the physicists of the 1920s, who pioneered the field of quantum mechanics. Like them, we are primarily motivated to understand nature, and hope our work will lead to many advances, as theirs unquestionably has."**

**- Pedro Sáenz**

"It's a unique lab environment," Abraham says. "We help each other out in any way that we can, and I learn a lot from them because they're also doing research but in different stages of their careers. All of that contributed greatly to my research direction."

While Abraham credits Sáenz for most of his successes in the department, Sáenz points to Abraham's drive as the secret sauce behind his achievements.

"He is always prone to go the extra mile," Sáenz says. "Typically with the students, I'm the one that has to set a high standard and push them a bit. With Abel, I didn't have to do that. I'd set the standard — and he would meet it and even go farther."

Abraham's achievements within the math department make it easy to forget that he is a double-major, studying both mathematics and biomedical engineering. In addition to Sáenz's lab, he works with professor William Polacheck, modeling fluids to study blood vessel function and smooth muscle cell movement.

During his sophomore year, he joined the design team of the Helping Hand Project — a student club that provides custom, 3D-printed prosthetics for children with limb differences — and eventually became president in 2023. He also modifies toys for children with disabilities through the nonprofit Carolina Adapts Toys for Children.

Most recently, Abraham received the math department's 2024 Archibald Henderson Mathematics Medal, given annually to high-performing undergraduate students. After graduating this May, he will spend a year in Bangalore as a Fulbright scholar and then pursue his graduate degree at MIT, where he'll work to understand the collective migration and organization of cells in tissue.

"All over nature, there's complex and beautiful patterns," he shares. "I hope to capture that beauty with the elegance of math and physics."

## Beyond the Stacks

Story & photo by Alyssa LaFaro | April 9, 2024

UNC-Chapel Hill's libraries and librarians are essential to the research lifecycle: a scholar asks a question, pursues research activities to answer it, documents and publishes that work, and then the cycle begins again, building on this new knowledge. Meet six scholars studying topics from art history to health science to learn how the libraries support their projects.

**Read the story & view the photos at**
***research.unc.edu/beyond-the-stacks/***

# A WOK THROUGH TIME

Story & photo by Emmy Trivette & illustrations by Corina Prassos | July 18, 2024


One of the most popular dishes in Chinese cooking is lion's head meatballs, served on a bed of green cabbage. Their name comes from their shape, resembling the head of a Chinese guardian lion, or foo dog.

More than a decade ago, Michelle King had her first child. Responsibilities like cleaning, caring, and soothing a newborn consumed her days. But King still remembers that all she wanted to do amidst the chaos was cook Chinese food for her daughter — like her mom did for her.

While thumbing through a cookbook passed down by her immigrant mother, some of the pages stuck to her fingers: It was the first volume of Taiwan TV chef Fu Pei-Mei's culinary guides.

As she flipped through the book, she noticed more than recipes beneath the binding. There were photos of Fu traveling the world, shaking hands with VIPs, and teaching cooking classes, as well as newspaper clippings praising her accomplishments in the media and the kitchen.

"As a historian, when I saw the pictures and clippings, I knew there was a paper trail and thought maybe there's something to write about," King says. "But I didn't honestly know anything about her."

King is a professor of Chinese history and gender studies at UNC-Chapel Hill. Her newest book — "Chop, Fry, Watch, Learn" — hit shelves May 7, 2024. It represents a decade of King's research into the life and legacy of culinary icon Fu. She collected stories from translators, family members, and people who were changed by the Chinese star.

In a way, Fu Pei-Mei is Taiwan's equivalent of Julia Child, a famous TV chef from the 1960s who brought French cuisine to the masses in the United States. Fu did that for Chinese cooking in Taiwan and Japan.

"I use her as that benchmark, so people have some idea of what the heck I'm talking about," King explains. "But I want people to upset their notions of primacy. Fu Pei-Mei was on television before Julia Child, by a few months."

Fu stayed on TV continuously for 40 years, wrote over 30 cookbooks, and traveled all over the world. She set a standard for an entire generation of Chinese and Taiwanese women — from Chinese mainlanders who fled to Taiwan during the formation of the People's Republic of China to migrants who left Taiwan for other countries in search of opportunity.

In any case, most readers of Fu's cookbooks were searching for a taste of home.

## Cooking up context

Fu passed away in 2004, and when King began researching her life in 2014, she didn't know anyone who'd met the cooking icon. But then, during a trip arranged by the Taiwanese Ministry of Foreign Affairs, she happened to sit next to a government official who knew Fu's younger daughter — and that she was living in Florida.

King reached out to her immediately, and then got connected to Fu's older daughter and son, who still live in Taiwan.

"And then I could interview," King says. "Suddenly, I had access to her story and learned more about her through them than I could have otherwise."

Fu was born in mainland China in 1931 and moved to Taiwan in 1949. King's book uses historical moments — from advances in kitchen technology to women's roles — to broaden the reader's scope of Fu's fame amidst a larger geopolitical conflict between China and Taiwan.

During the Chinese civil war, Mao Zedong created the People's Republic of China on the mainland, causing over 1 million people to flee to Taiwan, including Fu. These refugees went on to become the dominant socioeconomic class in Taiwan and had incredible political and financial sway. King includes these inequalities in her pages.

While the book focuses on Fu's incredible story of stardom and eventual independence from her husband — which, for that time, was unheard of — it also educates readers on the lesser-known culture and history of Taiwan.

"I think my perspective as a historian brings a context and a deeper perspective. It's not just a biography — it uses her life to talk about these other things.

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Jiaozi, boiled dumplings from northern China, were a favorite of Fu's husband and one of the few recipes that she could cook from memory.

"I'm really lucky," King adds with a laugh. "The beautiful thing is, that when you talk about Fu and when people who know her remember her, the stories just come out."

Sometimes her luck sent her chasing information cross-country. Like in North Dakota, where she tracked down and interviewed a son of one of Fu's Chinese-to-English cookbook translators.

But many times, King's work drew her back to Taiwan, where her parents were from. Her mother taught herself how to cook after she moved to the U.S. in the 1960s — using, of course, Fu's cookbooks.

"This woman publishing bilingual cookbooks in this Cold War period means she's making a statement, claiming she can speak to two entirely distinct and different audiences," King says. "She's speaking to housewives in Taiwan and Americans who are stationed there, to Americans in the United States, and to Chinese Americans who only read English now."

King also includes stories from her mother, aunts, and family friends — women from the 1940s who belong to the same generation as Fu — throughout the book.

"It was really important to me that it's not just the biography of a famous person, but that it illuminates the significance of food in women's and family's lives," King says.

## Slicing Taiwanese socioeconomics

In 2020, a UNC School of Nursing professor named Ya-Ke "Grace" Wu contacted King after reading an *Endeavors* article about her earlier Fu research.

"I reached out immediately to thank her for her contribution on this topic," Wu says. "And I felt a bit homesick to see someone tell the story about this lady I watched when I was a child."

King immediately responded with thanks — and a request for Wu to be interviewed for her book.

Wu told King about her chaotic childhood in Taiwan. Her father spent time in jail, and her mother and siblings cleaned houses. Whenever Wu finished school, she knew she'd come home to an empty house. To feel a little less lonely, she'd turn on the TV and watch Fu Pei-Mei.

But up until she'd read the article about King, Wu hadn't thought of Fu in years.

"There's always been this battle between the original Taiwanese people and the mainlanders," Wu explains. "And I didn't know this when I was a child, that this battle exists, but what I did know was the discrimination I received as a child in extreme poverty."

Wu is a native Taiwanese, unlike the Han Chinese mainlanders who emigrated from China to Taiwan in 1949 and dominated the country's socio-political culture from the 1950s to the 1980s.

She left her home to go to nursing school and spent the next two decades working as a registered nurse, then as a lecturer in Taiwan. In 2013, she moved to the U.S. to study nursing and has taught at Carolina as an assistant professor since 2020.

While she hasn't been back to Taiwan in over 10 years, she still cooks a mean Taiwanese stir-fry for her husband every week.

"When Grace told me all of this I cried, because I could not believe what this woman had done with her life and even how her story intersects with Fu Pei-Mei's," King says.

Wu cemented why King needed to include all these other voices. That the decade of research she'd done wasn't to place Fu on a pedestal alongside the 4,000 glorious dishes she'd made.

"What is amazing about this book is that it captured a very complex relationship between Taiwan and China," Wu says.

For King, this story was about the power of television, food, identity, and joy — and most importantly, people.

"The kitchen is a weird space," King explains. "On the one hand, it's entirely domestic, and we think of it as a woman's space or gendered space. But on the other hand, some women took it into the public and made an entire career out of these domestic tasks that they were basically obliged to do. It's just fascinating."

**Left:** Ya-Ke "Grace" Wu watched Fu Pei-Mei on TV while growing up in Taiwan. (photo courtesy of the UNC School of Nursing)

**Below:** Fu published over 30 cookbooks in her lifetime, with "Pei Mei's Chinese Cook Book" running for three volumes. She had over 4,000 Chinese cuisine recipies.

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