# research

at THOMAS JEFFERSON UNIVERSITY

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ALSO INSIDE

Patient Voices Create Stronger Studies
Sustainability in Research
Latest Findings

## When Less is More

HOW CUTTING CALORIES COULD TRANSFORM CANCER TREATMENT PAGE 16

RESEARCH at THOMAS JEFFERSON UNIVERSITY no. 06 APRIL 2025

EDITOR
Karuna Meda, PhD

EDITORIAL TEAM
Edyta Zielinska, MS, MFA
Deborah Balthazar, MA

EXECUTIVE
CREATIVE DIRECTOR
Tracy Donofry

VICE PRESIDENT
CONTENT STRATEGY
Barbara Henderson

DESIGN TEAM
Erin Bracken
Leanne Manion
Barry Smith

WRITERS
Jill Adams
Deborah Balthazar
Moriah Cunningham
Merrill Meadow
Karuna Meda
Queen Muse
Marilyn Perkins
Edyta Zielinska

COVER ART
Kouzou Sakai

PHOTOGRAPHY
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Photography Services
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ILLUSTRATORS
Matt Chinworth
Sam Falconer
Kouzou Sakai
Karolis Strautniekas
Sayo Studio
Alexander Wells

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***Research* at Thomas Jefferson University**
published by:

President
Thomas Jefferson University
**Susan C. Aldridge, PhD**

Deputy Provost for Research
**David Whellan, MD**

Executive Vice President,
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Communications and
Consumer Experience
Officer, Jefferson
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Senior Vice President,
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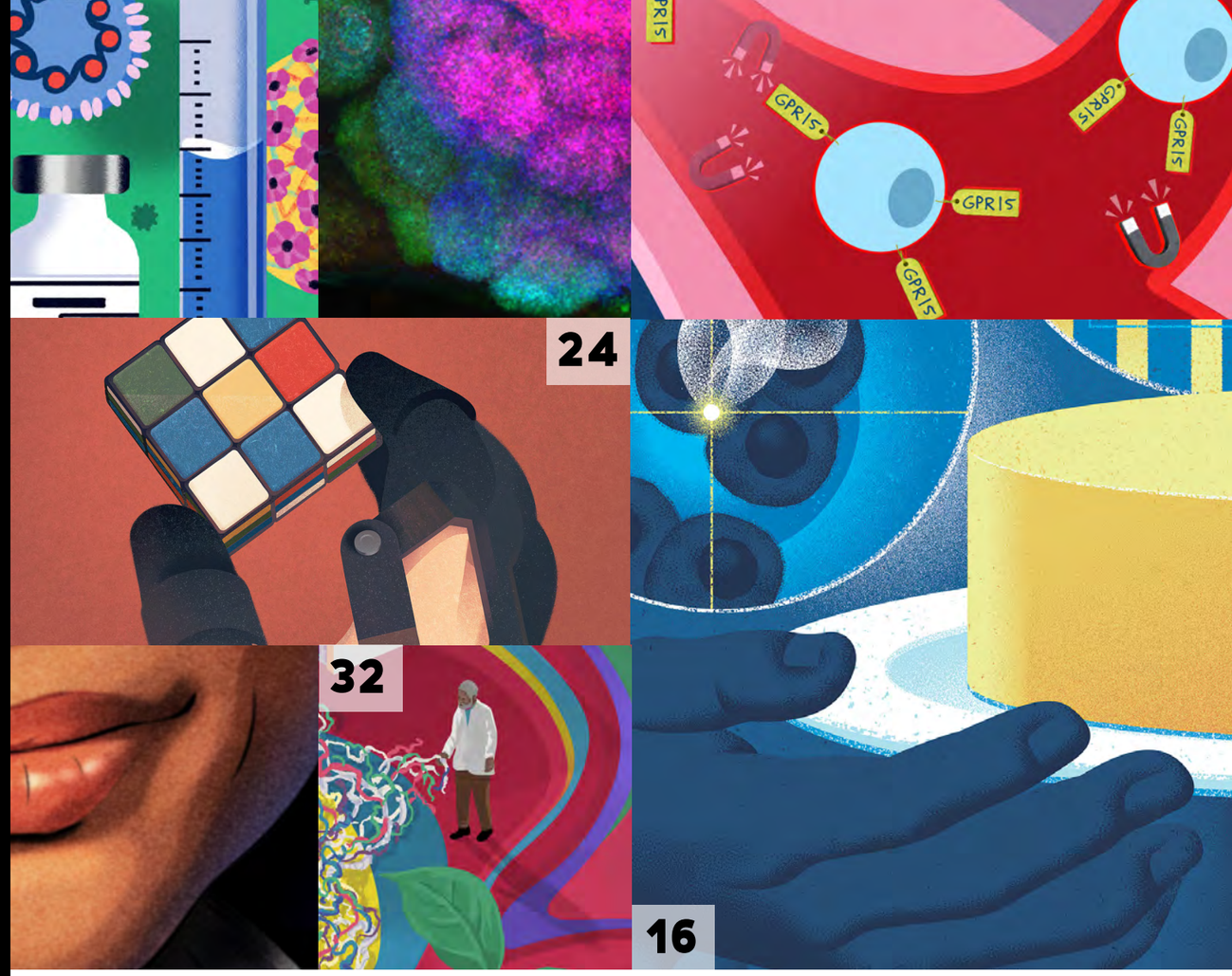


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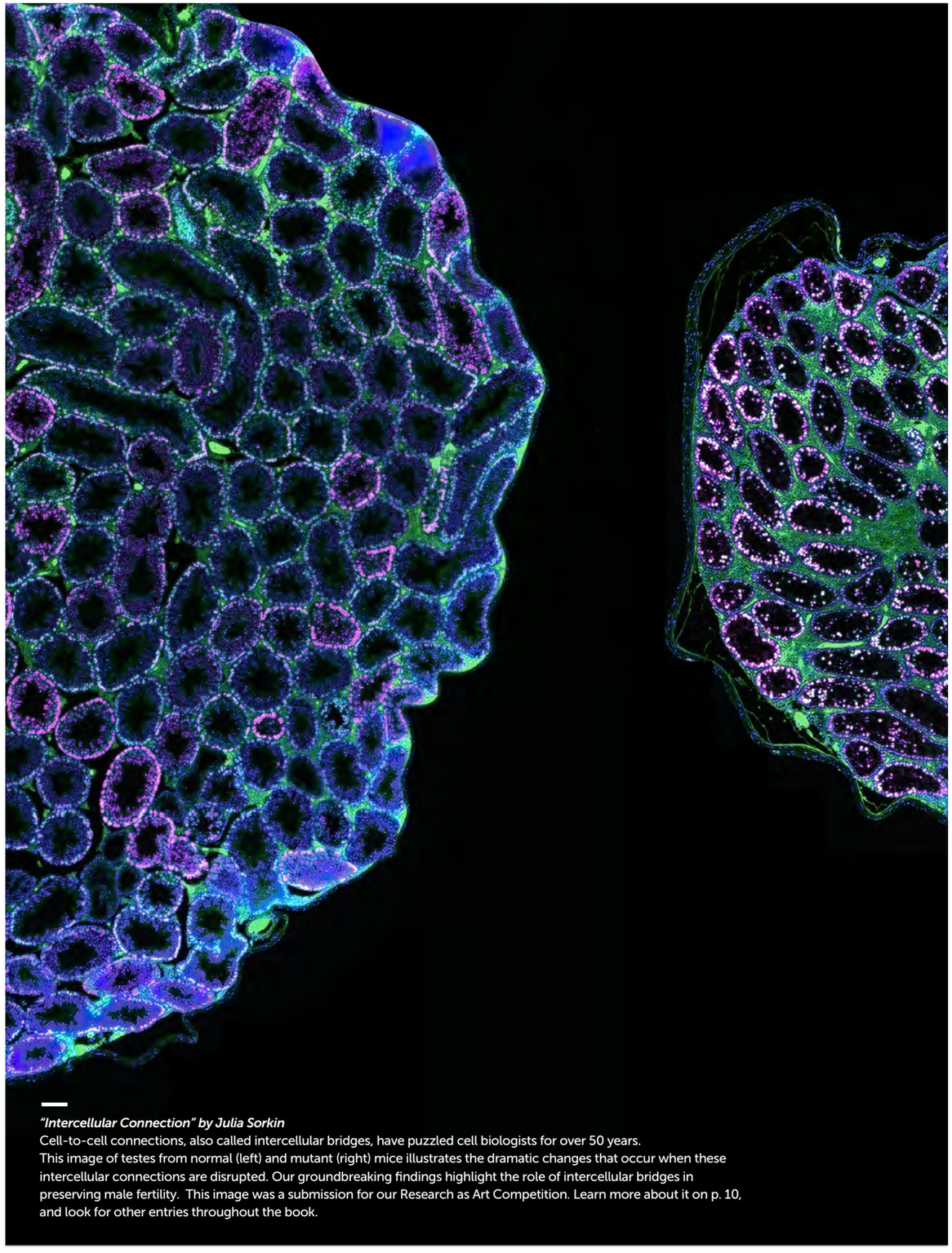


***"Intercellular Connection" by Julia Sorkin***
Cell-to-cell connections, also called intercellular bridges, have puzzled cell biologists for over 50 years. This image of testes from normal (left) and mutant (right) mice illustrates the dramatic changes that occur when these intercellular connections are disrupted. Our groundbreaking findings highlight the role of intercellular bridges in preserving male fertility. This image was a submission for our Research as Art Competition. Learn more about it on p. 10, and look for other entries throughout the book.





# THE CATALYTIC ROLE OF PRIVATE FUNDERS

DAVID WHELLAN, MD
JAMES C. WILSON PROFESSOR OF MEDICINE, DEPUTY PROVOST FOR RESEARCH

Now entering its third century, Jefferson is building on a 200-year legacy of scholarship, discovery and application — helping define what research looks like and what it can accomplish in the decades ahead.

This edition of *Research at Thomas Jefferson University* offers a snapshot of the rich, multifaceted work being done across Thomas Jefferson University's 10 colleges and Jefferson Health's 32 hospital campuses, and in partnership with dozens of community-based organizations. But I want to point out something that's not always evident in these compelling and intriguing articles: The catalytic role that external funding plays in driving research and innovation at Jefferson — especially in enabling us to pursue the kind of intellectually courageous studies that lead to paradigm-shifting discoveries and breakthrough applications.

Hundreds of our researchers receive grants from traditional funders such as federal and state agencies, ranging from the National Cancer Institute's Cancer Moonshot initiative to Pennsylvania's Manufacturing PA Innovation Program. As important, though, are the philanthropic contributions we receive from individual donors, foundations and corporations. These contributions — whether large or small — often have outsized impact. Why? Because they can empower our most creative and skilled investigators to develop innovative research methods and test counter-intuitive solutions to major problems.

Keep that in mind when, for example, you read about the work of neuroscientist Mijail Serruya, MD, PhD, and his team: Not only have they developed wearable and implantable devices for people who have lost arm or leg function, they're also enabling patients to be true partners in the research design and evaluation process. And remember that as you learn about the efforts of radiation oncologist Nicole Simone, MD, to demonstrate that calorie restriction can help short-circuit cancer cells and enhance the tumor-killing ability of existing treatments. Her dogged pursuit of that previously unconventional and controversial idea is yielding growing evidence that calorie restriction can indeed help destroy solid tumors.

In those cases, gifts and grants from individual donors and foundations provided essential support for the researchers' early stage work. Dr. Serruya credits a grant from the I AM the Vine Foundation and Dr. Simone points to support from philanthropist Jane Karatzas for enabling their research teams to develop initial results and demonstrate the "proof-of-concept" that subsequently led to major grants and concrete impact for patients.

While biomedicine and population health are central pillars of Jefferson's research enterprise, we are advancing discovery and application across the sciences, social sciences, arts and design, humanities and business. The article *Making Waste Productive* offers a multifaceted view of how our researchers are collaborating across disciplines — from chemistry and plant biology to business, textile engineering and textile design — to help global society achieve sustainable economic development. And our *Research Briefs* describe interior designer Lisa Phillips' studies of how people's emotions and perceptions are affected by the nature of the materials comprising the spaces where we live, work and receive care. In those cases, too, donors, foundations, and corporations have provided resources to advance R&D in ways that directly benefit individuals, communities and businesses.

So, as you marvel at the people, ideas and achievements highlighted in this magazine, keep in mind the tremendous resources needed to fuel cutting-edge research and scholarship. And, please, consider how you could help advance the exciting work taking place throughout the Jefferson research enterprise.

## HOW CAN I SAFELY NAVIGATE

# SUPPLEMENTS IN A HEALTHY DIET?

BY MORIAH CUNNINGHAM

***Understanding the benefits and risks of dietary supplements and tips for making informed choices.***

It's been reported that 70% of Americans use dietary supplements, most commonly vitamins, minerals, proteins, herbs or botanical essences. Supplements can be a useful tool to help with deficiencies and overall wellbeing. Unfortunately, supplements are not regulated before they're sold to consumers in the U.S., which means that the purity, dose or even active ingredients aren't guaranteed. Despite this, there are safe ways to navigate supplements and choose the right ones. Gastroenterologist Dina L. Halegoua-De Marzio, MD, whose research explores how supplements affect organs like the liver, shares tips on how to do so.

### *What are some common misconceptions about supplements?*

Over half of patients surveyed in a recent study believe supplements effectively prevent disease. In the same study, 30% of patients believed supplements could treat disease. Many patients have reported using supplements in place of, or in combination with, their medications. Although there are sometimes benefits to taking dietary supplements, there are also risks, especially when the active ingredient in these products interacts with medications you've been prescribed.

Ginseng, for example, is an herbal supplement that, when used alone, has not been linked to liver damage. However, when used in combination with certain medications, it can cause hepatotoxic effects. Another example is curcumin, the active ingredient in turmeric, which our research has shown to be associated with liver injury even when taken on its own. That's why it's important to consult with your doctor or pharmacist if you want to take dietary supplements in combination with your medications, to better understand the benefits or potential risks.

### *How can supplements affect the body?*

When supplements are ingested they go into the bloodstream and are absorbed by the liver. The liver breaks down the supplement into the active ingredients, and excretes the waste product in the bile. Sometimes, supplements can contain contaminants that aren't properly broken down by the liver and can cause liver injury. Exposure to these contaminants can cause inflammation, which can eventually lead to liver failure. In addition, some natural compounds also change how the liver processes other medications, in essence increasing or decreasing the expected dose, which can also stress or damage the liver. Not all supplements cause liver injury, but the risk increases with higher dosages.

Some common symptoms associated with liver injury include abdominal pain, nausea, diarrhea, jaundice, itchy skin and fatigue. If you suspect you are experiencing liver injury from a supplement, you should stop use immediately and consult your doctor.

### *How to heal your liver after ingesting harmful supplements*

- Stop taking the supplement immediately and seek medical attention.
- Drink lots of water to clear out the toxins.
- Eat a healthy diet; food should be your first source for vitamin or mineral deficiencies.
- Give your liver time to heal before starting any new supplements after having a bad reaction. This process can take weeks to months and should be monitored by a medical professional.

### *How to take supplements safely*

- Always consult with a doctor prior to taking a new supplement.
- Everything in moderation. If you begin a new supplement, only take the recommended dose. Going over the recommended amount can cause serious side effects.
- Read the label. Make sure that the supplement does not have ingredients that don't benefit you. Some specific ingredients to avoid include: Green tea extract, Aloe Vera, Anthraquinones, Ashwagandha, Black Cohosh, Ephedra, Garcinia Cambogia, Kava, Kratom, Polygonum multiflorum, Skullcap, Turmeric.
- Look for a stamp of purity. Supplements that are USP verified are tested for potential harmful contaminants. For sport-related supplements like protein powder, look for BSCG verification.
- Use LiverTox, an NIH database to learn more about supplements. You can also read about cases and injuries that were previously associated with your supplement of interest.

# SIX STEPS FORWARD

*exploring recent discoveries at Jefferson*





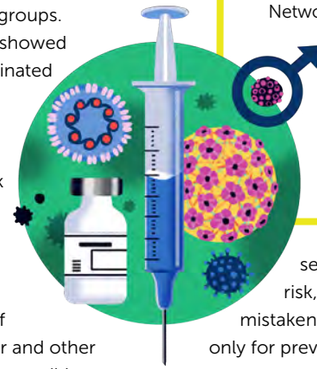
ILLUSTRATIONS BY
MATT CHINWORTH

## 01.

### HPV VACCINE'S EXPANDED ROLE IN CANCER PREVENTION

While the human papillomavirus (HPV) is historically linked to cervical cancer in women, head and neck cancer has become the most common HPV-associated cancer in the U.S., with a growing prevalence among men. A new study suggests that the HPV vaccine could help beyond its well-known protection against cervical cancer.

The research team, led by otolaryngologist Joseph Curry, MD, analyzed over a million health records of individuals ages nine to 39, comparing the outcomes of vaccinated and unvaccinated groups. Their findings showed that men vaccinated for HPV had a lower risk of developing head and neck cancers, and vaccinated women experienced a reduced risk of cervical cancer and other pre-cancerous conditions.



According to Dr. Curry, it's a positive step toward addressing misconceptions surrounding the HPV vaccine, especially among groups that may not see themselves as at risk, such as men who mistakenly think the vaccine is only for preventing cervical cancer.

"I hope these results will encourage healthcare providers and policymakers to endorse HPV vaccination initiatives as a measure to prevent cancer on a larger scale," he says.

The team's future studies will follow vaccinated individuals as they reach the typical age for developing these cancers, allowing researchers to better assess long-term vaccine efficacy in preventing head and neck, and other HPV-linked cancers.

BY QUEEN MUSE

## 02.

### PREVENTING MATERNAL DEATH ACROSS THE GLOBE

One of the leading causes of maternal death is sepsis, a sudden and overwhelming reaction to infection; it is a medical emergency that, once triggered, can be very challenging to interrupt. A recent study by Jefferson researchers, collaborating with global partners, found that a single dose of a common antibiotic can reduce the incidence of sepsis during labor and delivery.

Nearly 30,000 women at eight clinics in seven low- or middle-income countries were assigned to receive either a single dose of azithromycin or a placebo when they went into labor. The antibiotic group experienced a 33% decreased risk of sepsis and maternal death over the placebo group.

"The size of the effect was greatest in Africa — about a 40% reduction," says Richard Derman, MD, associate provost of Global Health at Jefferson. "It was a little smaller, but still meaningful in South Asia — about 11%."

The sheer size of the study was made possible by the Global Research Network, which encompasses data collected on over 800,000 deliveries. It is funded by the National Institute of Child Health and Human Development and often supported by the Gates Foundation grants. "Our collaboration has been actively involved in the Network since its inception more than 20 years ago," says Dr. Derman.

BY JILL ADAMS

## 03.

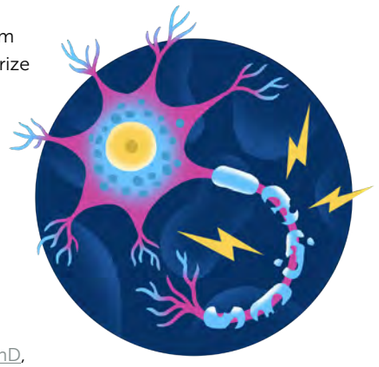
### WHY ONLY MOTHERS PASS MITOCHONDRIAL DNA TO THEIR CHILDREN

Mitochondria, which produce energy for cellular functions, have their own genome — and we all inherit our mitochondrial DNA entirely from our mothers. Researchers theorize that if maternal and paternal mitochondrial DNA both ended up in a fertilized egg, they would compete in ways that are detrimental. However, the precise mechanisms behind the loss of paternal mitochondrial DNA have not been elucidated — until now.

Biochemist Dmitry Temiakov, PhD, and colleagues, used a sensitive method to detect DNA in sperm and showed that mature sperm do not carry any intact mitochondrial DNA. Dr. Temiakov's team looked for clues by exploring molecular pathways involved in sperm maturation. They identified a specific protein called mitochondrial transcription factor A, or TFAM. In most other cells, TFAM serves as a helper molecule for mitochondrial DNA, but during sperm generation, the protein is modified and is unable to gain entry into mitochondria. Without TFAM, the genetic material in mitochondria is unprotected from degradation, and thus, mature sperm are left without any mitochondrial DNA.

"Nature ensures maternal mitochondrial DNA inheritance," Dr. Temiakov says. "There are likely multiple pathways to prevent the transmission of paternal mitochondrial DNA. We have uncovered one of them." While the discovery is exciting, he adds that there is much more to learn. Dr. Temiakov's work earned the 2023 Michael and Melina Pellini Award for Innovation in the Biomedical Sciences.

BY JILL ADAMS



## 04.

### STUDYING INFLAMMATION IN MULTIPLE SCLEROSIS

Nearly three million people worldwide suffer from multiple sclerosis (MS). The disease is a result of immune cells attacking a patient's own brain cells, leading to symptoms that include vision loss, decreased muscle strength and sensory issues. Relapsing-remitting MS (RRMS) is the most common form of MS, whereby patients have flare-ups followed by periods of remission.

Neurology researcher Silva Markovic-Plese, MD, PhD, and her team have been studying RRMS for more than a decade. They had previously found elevated levels of an immune chemical called IL-11 in the cerebrospinal fluid surrounding the brain and spinal cord of RRMS patients. They wanted to explore why.

***If future studies on the neuroprotective effect of IL–11 antibodies continue to show promise, this treatment could be available for MS patients in the near future.***

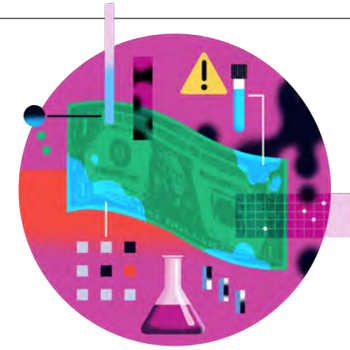
In the current study, researchers found that IL-11 promotes migration of inflammatory cells to the brain, which contributes to disease progression of RRMS. When they reduced the IL-11 levels in mice, they found lower levels of inflammation and disease progression compared to controls.

"Although this study is still in the pre-clinical stages," Dr. Markovic-Plese says, "blocking IL-11 could possibly prevent disease development by blocking the early inflammatory response." If future studies on the neuroprotective effect of IL-11 antibodies continue to show promise, this treatment could be available for MS patients in the near future.

BY MORIAH CUNNINGHAM

## 05.

### STUDY REVEALS ALARMING LEVELS OF DRUG RESIDUE ON U.S. CURRENCY



In a new study using a novel method of analysis to examine one-dollar bills collected from 13 cities across the U.S., fentanyl, a potent opioid, was detected on 63% of the bills. The research sheds light on the widespread presence of this dangerous substance in everyday transactions.

Matthew P. Hewes, a 2023 graduate of Jefferson's forensic toxicology master's program and first author of the study, observed that, in addition to fentanyl, cocaine and methamphetamine were even more prevalent, found on virtually all bills in significant amounts.

The risk of someone experiencing toxicological or pharmacological effects from handling contaminated currency is low for the general population, reassures Alex J. Krotulski, PhD, senior author of the study and forensic toxicology researcher.

***...in addition to fentanyl, cocaine and methamphetamine were even more prevalent, found on virtually all bills in significant amounts.***

However, the study found that regions with higher fentanyl use had higher rates of contaminated bills. Dr. Krotulski believes this insight suggests that analyzing currency could serve as a valuable tool for tracking drug trends on a regional and national scale, providing timely information to public health organizations and law enforcement agencies.

"Currently, most of the data we get about drug trends comes from police seizures, and that data is sometimes backlogged for almost a year," Dr. Krotulski explains. "This is an alternate path to get insights faster."

BY QUEEN MUSE

## 06.

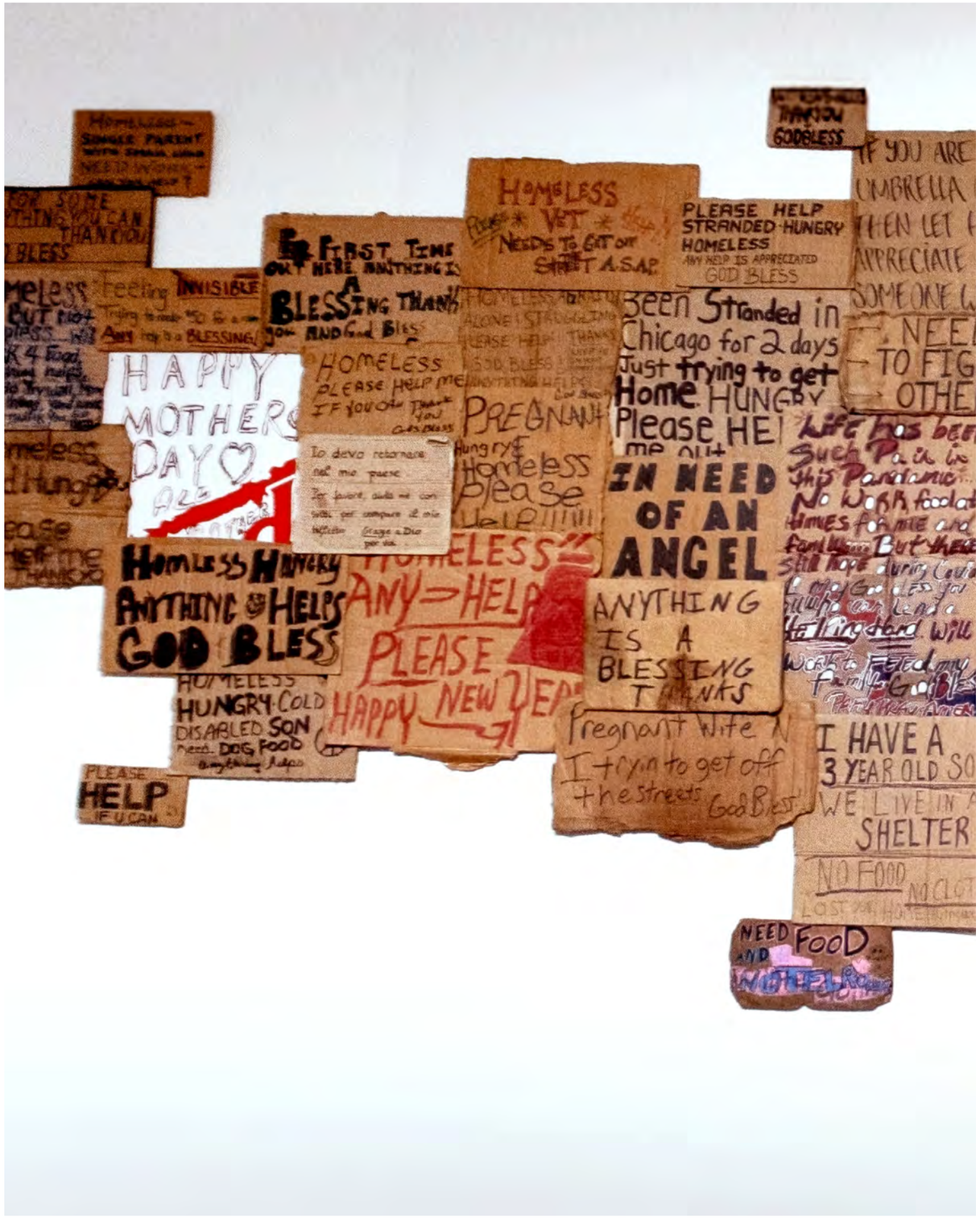
### HOW OUR ENVIRONMENT AFFECTS OUR MOOD AND BEHAVIOR

"Our physical environment isn't just a backdrop for our experiences," says interior design researcher Lisa Phillips. "The qualities of the space around us instinctually interact with our senses and emotions to shape how we feel and how we experience the world." For example, her research has shown that textured materials like stone and wood are often associated with feelings of strength, tradition and connection to nature, while smooth materials like glass or metal are connected to feelings of calmness and modernity.

Phillips is currently teaming up with psychology, physical therapy and emergency medicine researchers to explore how human-centric planning could put people more at ease in hospital waiting rooms. For this project, which is sponsored by the Jefferson Institute for Smart and Healthy Cities, the team surveyed 126 patients, caregivers and staff members in the emergency department waiting area, gauging participants' anxiety levels and reactions to elements in the built environment. The researchers used the survey findings to inform development of three design schemes which are currently being evaluated.

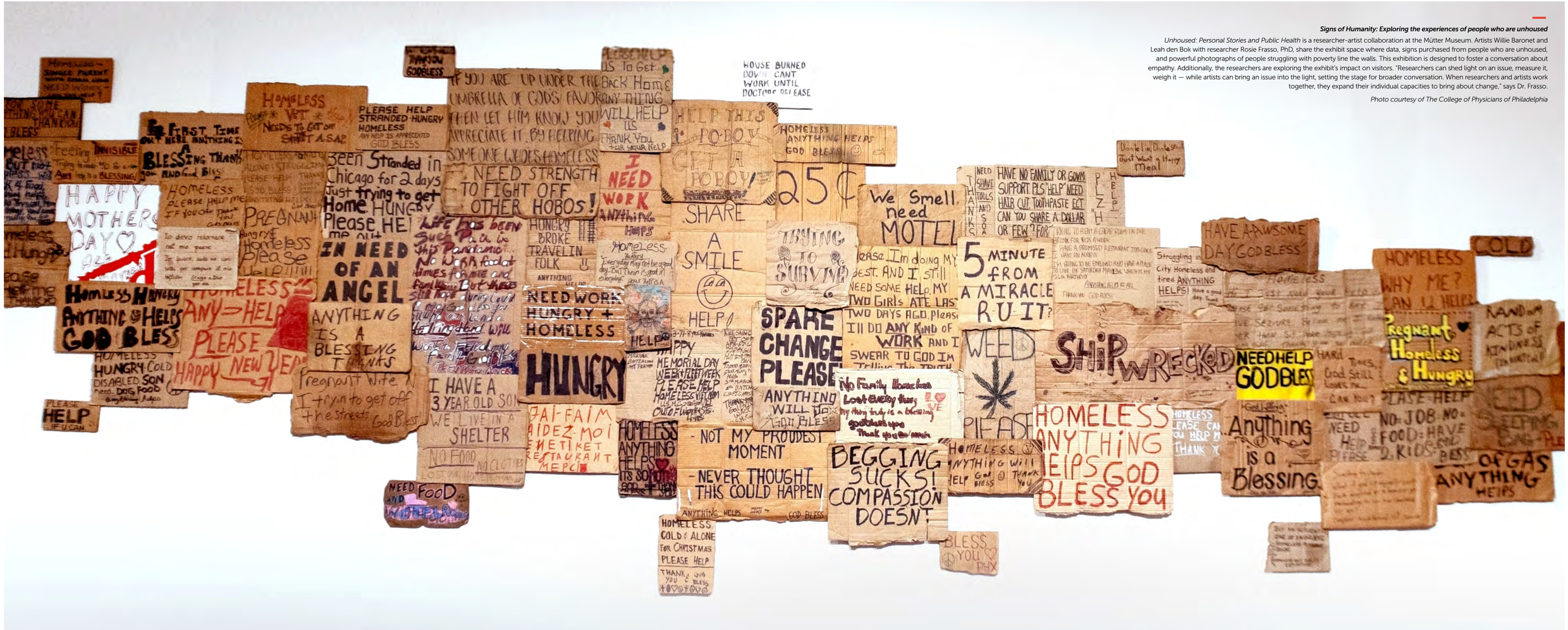
In parallel, Phillips studies design pedagogy. "I'm exploring how collaborative learning works and what methods prompt more creativity," she says. "My goal is to enable tomorrow's designers to create highly functional spaces that support the wellbeing of those using them."

BY MARILYN PERKINS AND MERRILL MEADOW




# SEEKING *artistry in* RESEARCH

Jefferson's Research as Art Competition celebrates all Jefferson faculty, students, and staff who have an eye for the beauty in their research or scholarship. Explore a sampling of submissions here and learn about the winning entries and judges at **research.jefferson.edu/art-competition**




***Signs of Humanity: Exploring the experiences of people who are unhoused***

*Unhoused: Personal Stories and Public Health* is a researcher-artist collaboration at the Mütter Museum. Artists Willie Baronet and Leah den Bok with researcher Rosie Frasso, PhD, share the exhibit space where data, signs purchased from people who are unhoused, and powerful photographs of people struggling with poverty line the walls. This exhibition is designed to foster a conversation about empathy. Additionally, the researchers are exploring the exhibit's impact on visitors. "Researchers can shed light on an issue, measure it, weigh it — while artists can bring an issue into the light, setting the stage for broader conversation. When researchers and artists work together, they expand their individual capacities to bring about change," says Dr. Frasso.

*Photo courtesy of The College of Physicians of Philadelphia*

MEGHAN KELLY, MS

# THE ART OF THE SOCK

Using knitwear to find creativity and innovation in everyday materials.

BY MARILYN PERKINS
PHOTOGRAPH © THOMAS JEFFERSON UNIVERSITY PHOTOGRAPHY SERVICES

When students in Meghan Kelly's advanced weft knitting course start their sock-making projects, the classroom is initially filled with confused faces. The first hurdle is programming knitting machines to construct the right patterns of stitches. Once they've navigated their way around the technology there's still more to do: The machine produces an abstract shape, reminiscent of unfolded origami. At first, the students wonder how to turn this odd shape into an actual, wearable sock. But, as they start to pull away waste yarn, seam the sides together, and add finishing touches, there's a "lightbulb moment."

Random rows of knitted stitches take on the shape of feet, and the students light up, inquiring about each other's projects: "How'd you do this part?" and "Show me this on the program!" Kelly watches as her students become teachers, delighting in their problem-solving processes. "That's what makes it rewarding for me," she says.

Kelly, a professor and researcher of textile design, uses the humble sock to teach her students the ins and outs of production knitting. "One of my creative passions is exceptional accessibility — that something commonplace can also live in the realm of extraordinary," she says. Between her dual focus on machine knitting and pedagogy, she studies ways to develop and analyze formulas of knit-stitch configurations, and expands on simple knitting concepts to create lessons that provide students with foundational techniques they can build upon. The current manifestation of this approach is socks. "Socks are very commonplace and not necessarily innovative in themselves, but that familiarity helps students explore how to build three-dimensional shapes using knit stitches."

An avid knitter herself, Kelly sees knitwear as both a utilitarian object and a beautiful art form. "Everyone, and I mean with few exceptions, everyone, is wearing knits almost every day," says Kelly. "Textiles are an integral part of our life, but they're often overlooked and taken for granted."

Kelly's journey into textile design began at the Kansas City Art Institute, where she learned to knit by hand and machine. After college, she explored different mediums, including working at a bronze foundry as a metal artisan. During that time, she was inspired to cast a knitted piece in bronze. The process returned her to knits and fibers, and she decided to pursue a graduate degree in textile design at Jefferson (then Philadelphia University). Afterwards, she worked at Kelbourne Woolens, where she honed her design skills and learned the intricacies of the yarn business. This experience paved the way for her to become a full-time faculty member in Jefferson's textile design program, where she now shares her expertise with students.

**"One of my creative passions is exceptional accessibility — that something commonplace can also live in the realm of extraordinary."**

Kelly's work pushes the boundaries of knitting by transforming traditional techniques into innovative art forms. One of her notable endeavors is her Sock Scarf, where she uses the component parts of a sock — the toe, the heel and the cuff — to create a long scarf that invites a second look. Through these works, Kelly not only showcases her technical prowess but also her ability to blend functionality with artistic expression, inviting others to reconsider the potential of everyday materials.

Her approach to teaching and research reflects this philosophy, encouraging students to think outside the box with their designs. While making a comfortable, wearable sock is their ultimate goal, colors, textures and patterns all add a unique flair to the students' designs. At the end of the semester, the classroom is filled with displays of everyone's work, from rainbow gradients and wavy 3D textures to lacy cutouts.

Kelly says even those who don't study knit textiles have personal connections to them; beloved sweaters or childhood blankets can spur strong sentimental bonds, and she's grateful to pass on the ability to make such special pieces to her students.

"Being able to design a textile that affects someone's life is a gift and a responsibility," says Kelly. "Teaching students that their creative vision can have a positive effect on someone else is a literal dream come true."


MATTHIAS SCHNELL, PHD

# REWIRING RABIES

Exploring how molecular biology can turn a deadly disease into promising vaccine candidates. →

BY DEBORAH BALTHAZAR
PHOTOGRAPH © THOMAS JEFFERSON UNIVERSITY PHOTOGRAPHY SERVICES

In 1990, rabies surged in the red fox population in East Germany, after the fall of the Berlin Wall. Rabid foxes roamed the city and the countryside. Reports said that at least 10 people had been bitten, putting them at risk. Researchers restarted the large-scale rabies oral vaccine program, air-dropping doses and placing them in food near fox dens.

At the time, Matthias Schnell, PhD, was a young graduate student in the midst of completing his thesis at the Federal Research Centre for Virus Diseases of Animals in Tübingen. The government quickly made research funds for rabies available. While most of the funding was dedicated to vaccine development, some was set aside to help understand the molecular basis of the virus. And Dr. Schnell and his team were able to sequence and generate the entire rabies genome — an early milestone in genetic sequencing. Although their molecular breakthrough did not directly contribute to Germany's oral vaccine for rabies, which eliminated the disease officially in 2008, it did help create a new generation of vaccines for wildlife and domesticated animals and made the oral vaccine even safer.

Dr. Schnell's early success and path to biology were unexpected. As a boy, Dr. Schnell collected butterflies, raised frogs, and was surrounded by animals, becoming fascinated with the natural world. However, he grew up in the city of Stuttgart, known for the excellent craftsmanship of famous brands like Porsche and Mercedes-Benz. His father was an electrical engineer and Dr. Schnell spent his early years in the company of people who built complex machines. While he respected that work, Schnell wasn't interested in the mechanics of built structures.

"I was more interested in being an engineer of things in nature than an engineer of things made by man," Dr. Schnell says.

After finishing his PhD, Dr. Schnell went to Yale University as a postdoctoral researcher, where he worked with a rabies-like virus, exploring how it could be used to create vaccines, with the ultimate goal of applying that knowledge back to building a better rabies vaccine.

Rabies had caught his intellectual curiosity because once symptoms develop in an infected individual, it is 100% fatal, making it one of the most deadly diseases in the world, Dr. Schnell explains. And although it is a dangerous disease — making animals more aggressive and fearless, and therefore more likely to spread the virus — it is also relatively simple in its makeup. Humans have some 20,000 genes, whereas the rabies virus has just five. "Because it's so small, we know every function of every gene, making this virus so versatile as a base for vaccine production," Dr. Schnell says. "But we still don't understand the whole thing."

> "I was more interested in being an engineer of nature than an engineer of things."

In the summer of 1997, Dr. Schnell joined the faculty at Jefferson, where he continued his work on rabies, and is now the Dr. V. Watson Pugh and Frances Plimpton Pugh Professor of Microbiology and Immunology. He focused on two main areas: The basic pathogenicity and molecular biology of the rabies virus, and the development of rabies-based vaccine platforms. His successful engineering has brought to life vaccines against emerging diseases, such as Ebola and Marburg fever, which are major threats in Africa. These vaccines hold the added benefit of protecting against rabies as well, which continues to be fatal in parts of Africa.

One of Dr. Schnell's most recent and promising projects is a vaccine for Lassa fever called LASSARAB, which recently received FDA approval to begin phase one clinical trials. Lassa fever is a severe hemorrhagic disease that is endemic to parts of West Africa, causing up to 500,000 infections and over 5,000 deaths annually. There is no vaccine currently to protect against infection. Dr. Schnell's vaccine is one of three candidates in development. It uses a rabies virus modified to be harmless and trains the immune system to recognize and fight Lassa fever while also providing long-term protection from rabies in a single dose.

Dr. Schnell's lab is also currently developing a vaccine against the H5N1 avian flu intended for cattle, to help prevent transmission of the disease from cows to humans.

"I'm proud of the impact this work has had on rare diseases," he says. "As a basic scientist, you rarely see the direct influence of your work, so it's quite exciting to see the difference it can make in people's lives."

# When Less is More: How Cutting Calories Could Transform Cancer Treatment

BY MARILYN PERKINS
ILLUSTRATED BY KOUZOU SAKAI

# Early animal research shows reducing calories enhances radiation therapy.

# Could this hold true in patients, giving them an active role in their care? →

Caryn W. was diagnosed with breast cancer just last year. The 53-year-old mother of one had been feeling twinges of pain in the months leading up to a doctor's appointment, and though she wasn't scheduled for a mammogram until summer, her gynecologist urged her to move the scan up. The test showed some abnormalities, and Caryn went back for a biopsy. The results revealed early-stage carcinoma.

"It's earth-shattering to hear something like that," says Caryn, a resident of southwest Philadelphia and an administrative assistant for a women's club. "I was devastated. I needed to find out what to do and what was the best course of action."

She found herself in the hands of Jefferson Health radiation oncologist Nicole Simone, MD, the Margaret Q. Landenberger Professor. Dr. Simone was launching a new clinical trial, and Caryn was intrigued. She'd receive radiation therapy first — to shrink the cancerous cells — then a straightforward procedure to remove any remaining tumor tissue. But, the most important part of Dr. Simone's clinical trial wasn't the radiation treatments or even the surgery: It was something Caryn would have to do every day in her own home, all on her own.

Dr. Simone wanted Caryn to cut her daily food intake by a quarter — not with the goal of dropping weight, but rather to help radiation destroy her cancer cells. It was an unconventional and controversial idea, but the trial is just the next step in an expanding body of research that suggests calorie restriction may be an untapped method for short-circuiting cancer cells, enhancing traditional treatments and killing tumors more efficiently. The approach could also empower cancer patients to be more involved in their own care.

## CALORIE RESTRICTION — STRESSOR OR SOLUTION?

In 2010, Dr. Simone was studying the cellular effects of stress while working at the National Cancer Institute as an assistant clinical investigator. She was curious about how different types of stress, like radiation therapy or chemotherapy, changed the genetic makeup of cells, and what happened to them on a molecular level. Looking for new ways to induce stress, she started tapering down how much food she gave her cells; she expected that less food would weaken them and increase molecular signatures of stress. Instead, she found something unexpected — the slightly-hungry cells were actually getting stronger while the cancer cells got weaker.

She then tested out this discovery in mice, probing whether the cancer cells, weakened by calorie restriction, were more vulnerable to cancer treatment. She confirmed that starting animals on a calorie-restricted diet during radiation enhanced the therapy in models of breast cancer. Compared to control animals, the mice eating fewer calories had tumors that grew slower and metastasized less, and they ultimately survived longer.

Though it's a new concept in cancer treatment, the health benefits of calorie restriction have been studied for the better part of a century. As far back as 1935, studies showed that low-calorie diets extended the lifespan of mice, and over the years, these benefits have been shown to hold true in humans, too: People who stick to lower-calorie diets tend to show fewer molecular signs of aging, have lower blood pressure and are less susceptible to diabetes.

According to Dr. Simone, calorie restriction's benefits in cancer stem from the fact that healthy cells are better equipped to handle fluctuations in nutrition than cancerous cells. While healthy cells can meet their metabolic needs by drawing on different energy reserves, cancer cells have fewer options, meaning they're more vulnerable.

"Normal cells can almost hibernate, whereas tumor cells can't deal with the stress of radiation and calorie restriction at the same time," says Dr. Simone. "Their machinery doesn't work as well, and they die faster."

Part of the "machinery" behind calorie restriction's effects is the IGF-1R pathway — a cascade of cellular reactions responsible for breaking down sugars and helping cells grow. Cancer cells often have an overactive IGF-1R pathway — meaning they burn up lots of sugars and grow quickly — which is partly why cancer develops explosively compared to healthy cells. Restricting calories can hamstring this pathway, and therefore cancer growth. Furthermore, Dr. Simone has shown that cutting calories during radiation treatment in mice also stimulates the immune system, leading to a spike in cancer-fighting cells.

With a solid foundation of evidence that calorie restriction enhanced the effects of cancer treatment in animal models, Dr. Simone wanted to see if the same held true in patients.

## "NOBODY WILL EVER DO THIS IN HUMANS"

Dr. Simone's theory was straightforward. Translating it into humans was less so. "When I was applying for grants somebody told me, 'You know, nobody will ever do this in humans,'" says Dr. Simone.

In oncology, conventional wisdom emphasizes keeping cancer patients as comfortable as possible, and at a steady weight. As a medical student, Dr. Simone learned to encourage her patients to drink milkshakes and other high-calorie comfort foods, not to avoid them.

But, says Dr. Simone, keeping weight on isn't as much of a concern as some would think. Though late-stage cancer patients can become dangerously frail, Dr. Simone is working with patients in earlier stages of the disease, who are unlikely to dip into underweight territory from a short diet. For these patients, calorie restriction can have a double benefit — more than one out of ten Americans has diabetes and two out of five are obese. These conditions are both associated with higher cancer risk and lower survival rates, but they can also be controlled partially through diet.

With all this in mind, Dr. Simone had to first demonstrate that a low-calorie diet was feasible and safe for cancer patients. In a pilot study of 35 women with breast cancer that began in 2013, she tested whether they could reduce their calories by 25% over the course of their radiation treatment. More than 80% of the women were able to stick to the diet, and they didn't experience any negative effects from cutting calories. Moreover, patients started telling Dr. Simone they were glad to have something they could do to take their treatment into their own hands.

"Ever since I've been a resident, a lot of my patients have asked what they can do to help themselves," she says. "This is letting patients take back some control."

Caryn's breast cancer surgeon Seye Adekeye, MD, PhD, who works closely with Dr. Simone, says that by employing a dietary approach, physicians hope to treat cancer more comprehensively, building on the current standard of care.

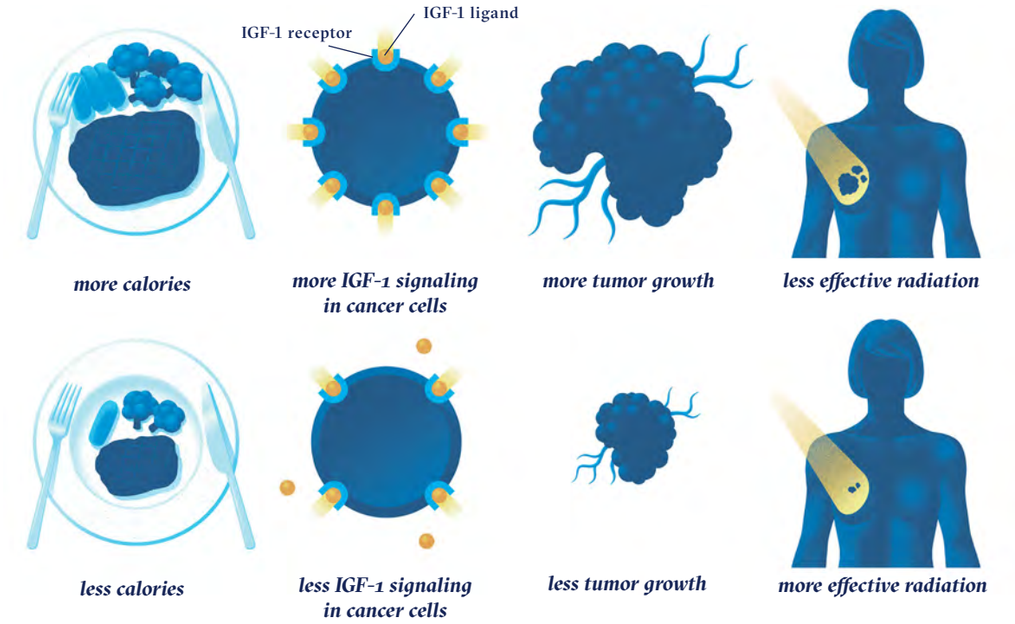
"Beyond the cancer cells, what about all the other things that are encouraging those cells to grow, like the tumor microenvironment?" says Dr. Adekeye. "We have to look at the whole body, not just the cancer."

Now that Dr. Simone had shown it was possible — and even empowering — for cancer patients to follow a calorie-restricted diet, it was time to show that calorie restriction actually enhanced the effects of radiation.

## A CANCER-FIGHTING DIET

In 2023, Dr. Simone started a clinical trial to test whether a 25% calorie reduction can enhance the tumor-shrinking effects of radiation that is administered before surgery.

After talking through her concerns with Dr. Simone and Dr. Adekeye, Caryn was ready to join. She first had a radiation planning session and would then undergo five subsequent radiation treatments. Back at home, she would work on her diet.




***Top row:*** *A cell signaling pathway called IGF-1, which turns on when the IGF-1 ligand binds to its receptor, is important for cell survival and reproduction. This pathway is overactive in cancer cells and drives tumor growth, making it harder for cancer treatments to work effectively.* ***Bottom row:*** *Calorie restriction reduces the number of IGF-1 receptors, hampering IGF-1 signaling. When people eat fewer calories, they remove the "fuel" for this pathway, slowing down tumor growth, and potentially making radiation more efficient as the cancer cells are already weakened.*

"It wasn't too terrible," says Caryn. She used to enjoy late-night snacks, but that habit was the first to go — no more popcorn, pie, or ice cream after dinner. She switched out soda for water and home-made iced tea, and subbed pie and cookies for trail mix. To satisfy her sweet tooth, she used a special blender to make "ice cream" out of frozen bananas and oat milk.

The changes seemed to work: After only five radiation sessions, new mammograms showed the cancer had shrunk. Dr. Adekeye operated on Caryn to remove the remaining tumor, and after the surgery, her cancer had significantly retreated. Full results from other patients in the trial will take time to be published, but Dr. Simone says Caryn isn't the only success story; all patients had decreases in the size of their cancer, and in some, there was evidence of their breast cancer disappearing entirely through the combination of a calorie-restricted diet and radiation.

The trial, which aims to enroll 90 breast cancer patients, is still underway, with results expected within the next two years. Ultimately, the researchers plan to compare

> **"Tumor cells can't deal with the stress of radiation and calorie restriction at the same time."**
>
> — *Dr. Simone*

tumor remission rates of those undergoing radiation alone, to those using radiation alongside diet. The researchers hypothesize that the diet and radiation combination will prove more effective. And with even more clinical trials under her supervision, Dr. Simone believes she'll soon have definitive results that can link the benefits of calorie restriction to cancer care on both a molecular and clinical level. As patients like Caryn complete their breast cancer care for early-stage cancer, Dr. Simone is also studying how intermittent fasting might improve outcomes for breast cancer that has metastasized to the brain. She's also exploring how precise changes in diet — such as increasing or decreasing fat intake — might affect prostate cancer outcomes.

## MEETING PATIENTS WHERE THEY ARE AT

Though Caryn didn't find the diet too challenging, Dr. Simone wanted to set up a support network for patients who did. She works with a team of students and specialists who call patients to check in on their diet and make sure they're still getting the nutrition they need. She's also collaborated with behavioral scientist Kuang-Yi Wen, PhD, to develop a text-messaging platform that helps participants stick to an eating schedule and monitor their food intake.

"That human touch is really what keeps a patient accountable for making change," says Dr. Wen.

Having that support system is essential when every patient comes from a different background, with a different understanding of nutrition and access to healthy foods.

More than half of Dr. Simone's patients come from a lower socioeconomic background. Her team ensures each patient's treatment plan works for them, as some may struggle with the time, money or transportation necessary to make major dietary changes.

The beauty of the calorie-restricted diet, says Dr. Simone, is that anyone can eat a little less of the same foods. While some patients, like Caryn, choose to go the extra mile with bigger dietary changes, they can also achieve similar effects by simply changing portion sizes of the food they already eat.

Keeping their method accessible to everyone and understanding how social factors influence cancer are core principles of Dr. Simone's team. "Your environment, your food, your access to health care, your financial status — all of these can cause stress within your body that impact cancer," explains Dr. Adekeye. In her own research, she's interested in how cancer disparities play out in Black women in particular, who die from cancer at higher rates than other racial and ethnic groups in the U.S.

One reason that may be is because Black women tend to have higher expression of IGF-1R, a protein implicated in cancer growth. Dr. Simone's laboratory manager, Noëlle Francois, MS, found that calorie restriction and radiation quelled growth of cancer cells derived from Black women with breast cancer more than radiation alone. Francois, who recently completed her master's degree thesis, hopes discoveries like these can help level the playing field in cancer treatment and provide Black patients with better care — and show that calorie restriction can be a valuable tool to treat more aggressive forms of cancer.

"A lot of people of color are left out of clinical trials," says Francois. "If we want to care for a population, we should really get to know them and their specific needs."

## LOOKING FORWARD

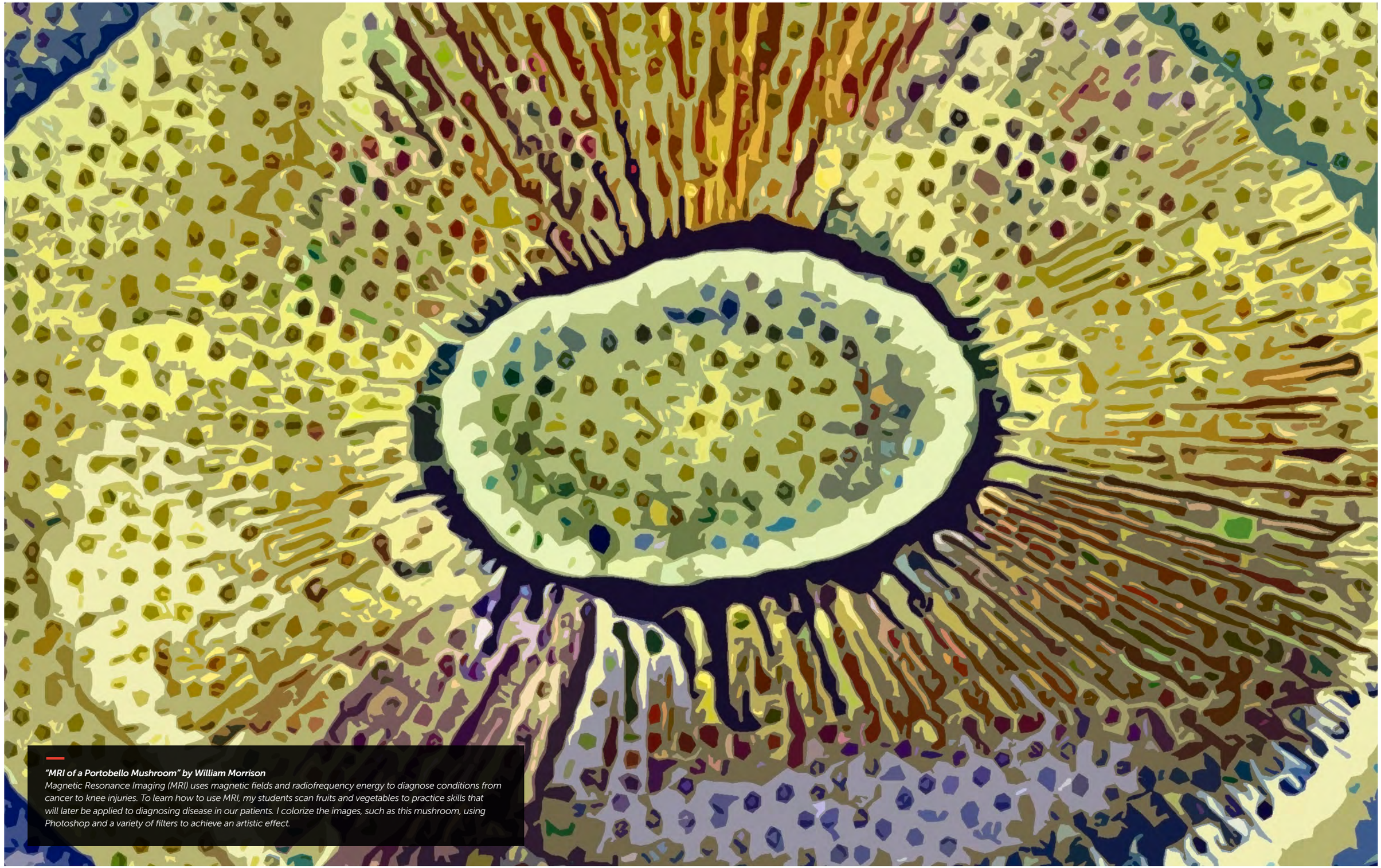
Though her last pathology report showed no signs of breast cancer, Caryn isn't done with her treatment. She needs to take medication to keep the cancer at bay, and she deals with side effects daily. She's awaiting upcoming mammograms to ensure the cancer hasn't come back.

Still, she's keeping up with the healthier diet she started during Dr. Simone's trial. Though she no longer needs to restrict her calories, she's grown used to subbing out pie for trail mix and exploring dairy-free options. For now, Caryn is working, volunteering with her church in her free time and spending time with her family. "I'm just trying to be optimistic and eat better," she says.

Dr. Simone says that one day, she hopes cancer care will evolve so that patients like Caryn know which food choices they can make to play an active role in their treatment. She's in the preliminary stages of investigating how certain types of tumors respond to different diets, with the goal of being able to recommend low-fat, low-glucose, or high-protein diets that target individual cancer genetics to enhance radiation and chemotherapy even more. But in the meantime, she says making small, healthier food choices is a good first step that all cancer patients could take.

"The old dogma was that diet didn't matter during cancer therapy, but I think it does," she says. "Even if you're not decreasing your calories, just making some better choices is a great start."

***Philanthropic Funding:***
*Jane Karatzas, the American Association for Cancer Research, the American Cancer Society, the American Institute for Cancer Research, Bristol-Myers Squibb Foundation, Inc., the Buck Cancer Foundation, the Ladies of Port Richmond, the Pfizer Independent Grants for Learning and Change, and the Willow Foundation Corporation.*



***"MRI of a Portobello Mushroom" by William Morrison***

*Magnetic Resonance Imaging (MRI) uses magnetic fields and radiofrequency energy to diagnose conditions from cancer to knee injuries. To learn how to use MRI, my students scan fruits and vegetables to practice skills that will later be applied to diagnosing disease in our patients. I colorize the images, such as this mushroom, using Photoshop and a variety of filters to achieve an artistic effect.*

# PATIENT VOICES SHAPE STRONGER STUDIES

Researchers are forging collaborations with participants — the end users of medical advances — to make their work more relevant and impactful.

BY JILL ADAMS | ILLUSTRATED BY KAROLIS STRAUTNIEKAS

IN 2020, Anthony Jones had a stroke that left him with paralysis on the left side of his body. He was only 50 years old, exercised regularly and enjoyed going to the gym — activities that seemed impossible after his stroke. A few years into his physical rehab treatments, he enrolled in a clinical trial for NuroSleeve™, a robotic device that fit over his left arm, designed to enable him to regain some use of that arm to handle daily tasks and to live a fuller more independent life. The NuroSleeve improved his arm mobility, but something in particular was missing: Anthony wanted to return to his workouts involving hand weights — a task that his new robotic arm was never meant to do.

Anthony's experience is remarkably common. Although many assistive devices are designed with the patient in mind, researchers and designers usually make the final call about the functions that are most important or practical to restore. And from an engineering perspective, gripping a cup or a toothbrush is a very different problem to solve than gripping and lifting a ten-pound weight.

Historically, clinical trials like the one Anthony enrolled in have been conducted on people, not with them. Rarely are study participants asked about their wants and needs during a study, and even more rarely are they consulted during the planning of a new study.

But Anthony is part of a slow revolution in medical research. The terminology may vary — research that involves, engages or includes patients — but the goal is clear: People who will be end-users of a new treatment can also be true partners in how that treatment gets studied, starting from crafting research questions to designing studies and interpreting results.

As part of his clinical trial at Thomas Jefferson University and Jefferson Health, the team behind Anthony's new powered-arm motor prosthesis is taking his goals to heart and learning and testing solutions alongside him to tweak their device to help him meet them.

## THE ORIGIN OF PEOPLE-FIRST RESEARCH

This novel approach to scientific inquiry in medicine is rooted in movements for disability rights across the globe, which have challenged negative framings about people living with physical and cognitive impairments in addition to fighting against oppression. Activists in the U.S. ditched their wheelchairs and crutches to crawl up the steps of the Capitol in 1990 when the American Disabilities Act had stalled in Congress. Around the same time, disability activists in South Africa coined the powerful phrase: "Nothing about us without us."

In 2010, Congress created a trust to fund a new institute that focuses on patient education, research and outreach named PCORI, for Patient-Centered Outcomes Research Institute. As an independent government-sponsored organization, it is guided by the mantra: "Those closest to the problem are closest to the solution."

Today, a growing number of researchers are seeking ways to engage people with lived experience and those historically underrepresented in research — throughout the clinical trial process. The approach has its challenges but is likely to yield more relevant patient outcomes. Researchers at Jefferson are leading the way, inviting people with a range of conditions, and their caregivers, to contribute to every phase of a research study and developing best practices for others to follow.

## TRY-AND-TRY-AGAIN STUDIES

For neurologist and researcher Mijail Serruya, MD, PhD, patient input is his starting place, not an afterthought. He and his team, who make up the Raphael Center for Neurorestoration at Jefferson, create wearable and implantable devices for people who have lost arm or leg function as a result of stroke or injury. The NuroSleeve device that Anthony is testing is one of the team's creations. Participants are custom-fitted with a 3D-printed splint that hugs the forearm, fingers and thumb for supported movements and is controlled by a joystick or voice command — depending on the preferences and needs of those receiving the device.

However, people with neurological impairment sometimes do express concerns about the wearable device — discomfort, different needs or goals — which might come as a surprise to researchers who assume that any kind of aid is good. Dr. Serruya's work is iterative, and his team of doctors, occupational therapists, physical therapists and engineers continues to tweak the design of the NuroSleeve based on each user's feedback — whether they are a 50-something person with stroke who lifts weights, or a 6-year-old child with cerebral palsy who wants more function to play and engage in school.

**"It's almost like having my hand back"**

— ANTHONY JONES

When Anthony began working to regain the use of his left arm and hand, he started with the exercises the team had developed to help him gain confidence and comfort with the device. But he soon expressed a more challenging goal: to return to vigorous workouts. The team had never considered the demands of holding a dumbbell, Dr. Serruya says, but they went to work to make sure the device could handle a 5- or 10-pound weight.

Engineer Alessandro Napoli, PhD, says the team works using a continuous development model: "We implement one feature at a time and get feedback. Then we decide whether to keep it, ditch it or improve it." Iterative research is anything but easy.

When developing novel devices to improve function, a whole host of issues come up. Anthony reported that his co-workers were bothered by the noise coming from his device, so the team is seeking ways to make it quieter. Another user often tangled the wires between the NuroSleeve and the controller, so the team is working to create a wireless controller.

It's not just tinkering. Every week, Dr. Serruya's team meets to assess the challenges. A working group includes study participants who can video-call researchers from their homes to demonstrate how the device helps — or what problems they're still having with their daily life activities — as well as experts in rehabilitation science, neurology and engineering.

It's a time-intensive approach but the impact is significant, especially to end-users of the device who are desperate for improved function. With the tweaks, Anthony can now use the NuroSleeve as an exercise tool. "It's almost like having my hand back," he says. But more than his own progress, he knows he's a key player in a project to restore function to many individuals with stroke. "Dr. Serruya tells me: 'Let's try this, let's try that. I'm willing to try it with you.' It gives you a sense of excitement that it can be done," says Anthony.

However, solving the engineering problems is only part of the challenge.

## A PARADIGM SHIFT

Involving people with the lived experience in research, particularly in this iterative fashion, is a paradigm shift, says MJ Mulcahey, PhD, a professor of occupational therapy in the College of Rehabilitation Sciences at Jefferson. The current structures of research — the grant-review committees at funding agencies and promotion and tenure policies at research universities — do not jibe well with patient-centered approaches. The old saying, "publish or perish," still prevails for academic scientists.

In contrast, engaging people with the lived experience early in the process, spending the time and resources to engage in collaborative discussion, "does take more time and more money; it is slower," says Dr. Mulcahey, whose research is centered on people with spinal cord injuries, particularly children. Her team seeks to establish solid ways of measuring loss of function, which are sorely lacking. One effort to streamline the process is to create standardized questionnaires for children and their care partners that cover a range of items encompassing physical, emotional, social and school functioning.

Dr. Serruya also recognizes the barriers to doing this kind of research: "This work takes more time for back-and-forth communication and revision. We're in an in-between space; we're a bench-to-bedside incubator, and then we go back to the bench."

"Although it is changing, grant reviewers historically haven't awarded extra points for collaborating with people living with the conditions we study," says Dr. Mulcahey.

Dr. Serruya adds that he sometimes gets feedback from grant reviewers calling his research initiatives "fishing expeditions," with comments such as: "They're too far-fetched, they're too applied or practical (ironically), and they're too high risk."

Philanthropy has been critical to the development of the NuroSleeve. Dr. Serruya has received significant support for this work through the Raphael Center from the I AM the Vine Foundation, as well as institutional funding from the Vickie and Jack Farber Institute for Neuroscience at Jefferson. This work has also earned endorsement from organizations like PCORI, which value authentic community engagement in research and are passionate about supporting it.

**"It's a radical change in academic research but a necessary one that the research community is very interested in getting right."**

— DR. MULCAHEY

"We know how important this work is, but we also know it's a real challenge for researchers who aren't already committed and supported in authentic engagement of people affected by disease and injury," says Dr. Mulcahey. "That's why creating playbooks, guidelines and funding streams is so important to the success of thoughtful community engagement in research."

## SCALING INVOLVEMENT TO BE INCLUSIVE

In order to change the research landscape writ large, researchers who are new to engagement and patient-inclusivity, need to understand what it takes to get there. One of Dr. Mulcahey's colleagues, Catherine V. Piersol, PhD, OTR/L, chair of the department of occupational therapy, worked with Jenny Martinez, OTD, OTR/L, a former colleague and current public health doctoral student, on guidelines to operationalize and scale community participation.

"The idea is to give researchers some best practices on how to engage stakeholders in the community," says Dr. Piersol. "But there were no procedures in place. We had to create everything."

The big question, Dr. Martinez says, is how to best engage and include a whole community in research, especially when clinical trials require larger numbers of patients. A child of immigrants, Dr. Martinez has seen the gap and has been the bridge for family members in her own life. She sees including community members in research as a crucial way to confront the gaps in both health care and research, by increasing minority representation in scientific studies. Her current research centers on people with dementia living in nursing facilities.

Dr. Martinez and Dr. Piersol held a meeting in Philadelphia with a broad spectrum of researchers, funders and an advisory committee of stakeholders that included nursing home staff, patient advocates and caregivers. The primary goal, she says "was about building trust." This meeting was a jumping off point for ongoing communication and shared-decision making between researchers and community members. The researchers evaluated these efforts and published the Stakeholder-Centric Engagement Charter to operationalize such engagement. The Charter provides clear procedures flexible enough to be customized to any research objective. It specifically addresses how to develop meaningful collaborations with communities who are often least likely to interact with research, such as those with limited English proficiency, or with distrust in the healthcare system. The Charter covers necessities such as role expectations, study governance and decision-making procedures.

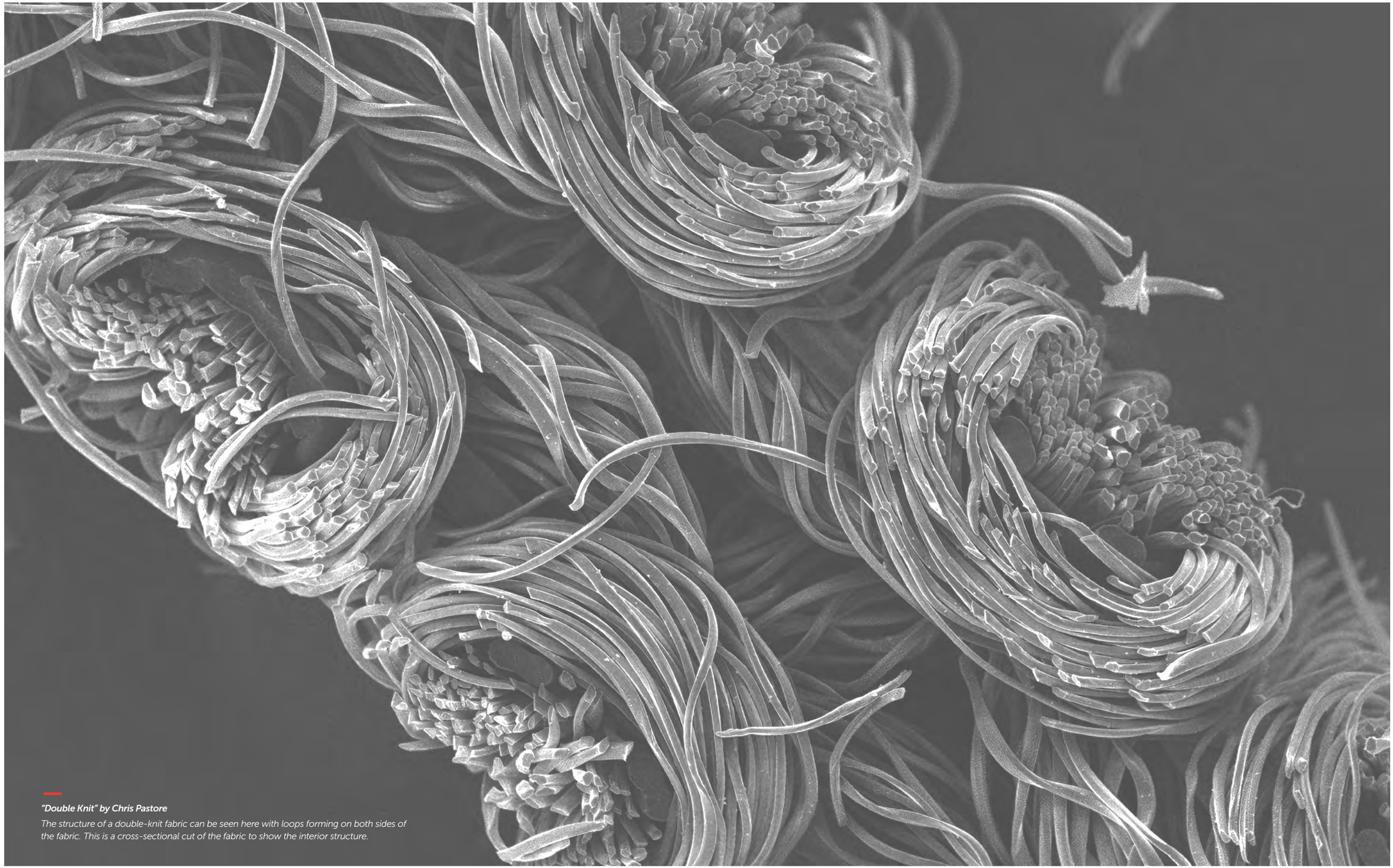
"We are in the infancy of understanding the best ways to engage the community," Dr. Mulcahey says. "It's a radical change in academic research but a necessary one that the research community is very interested in getting right."

This past fall, Dr. Mulcahey helped get some of these ideas out to others in the field as chair of the board of trustees of the American Occupational Therapy Foundation (AOTF), for the first "Engage Summit," designed to strengthen understanding and skills for community-engaged research. The goal of the meeting was for clinicians, scientists, academicians and community members to come together to discuss and learn about best practices and methodologies for authentic community engagement. Intentionally, a full third of the meeting's participants identify as a person with lived experiences of disability, chronic conditions, etc.

The Jefferson researchers committed to patient engagement are big believers in the movement. And people are beginning to quantify the advantages, Dr. Mulcahey says. "Research on community-partner inclusion is showing that it takes less time to translate research findings." That means that putting more time in up front, and including a broad spectrum of voices, ends up helping actual patients sooner, and in ways they find most beneficial.

"It does take investment to include community partners, to set up a structure, to have a coordinator," Dr. Martinez says. "But it's helping our quality of research and meeting our patients' needs better and faster."

Anthony, for one, agrees. The experience of working as part of a research team of bright minds to improve people's mobility and solve individual problems both big and small has felt very meaningful. "It's not just for the benefit of me getting better," he says, "but helping others."



***"Double Knit" by Chris Pastore***

*The structure of a double-knit fabric can be seen here with loops forming on both sides of the fabric. This is a cross-sectional cut of the fabric to show the interior structure.*

Researchers demonstrate how “innovative reuse” can be a catalyst for greener manufacturing and sustainable economic development →

# MAKING WASTE PRODUCTIVE

BY MERRILL MEADOW | ILLUSTRATED BY SAM FALCONER

Do you ever throw something away and think about where it will end up? Have you wondered if a piece of trash will ever serve a useful purpose again — and, if so, what form it may take?

Those are increasingly important questions because each year, the world creates about two billion tons of municipal solid waste. While roughly 20% of it is recycled, the rest goes into landfills — including everything from food packaging and leftover food to clothes and furniture to machinery and electronics and much more. Projections suggest that global annual waste will grow by 50% over the next several decades.

Complicating the issue is the fact that the world’s growing “waste problem” is not just a matter of determining where to dump 50% more trash. There is a clear need to reduce the amount of natural resources and energy used in producing replacement products; and to limit the toxic chemicals and environmental pollutants often employed in current manufacturing processes.

Jefferson researchers are helping drive that work forward. Employing materials found in garbage bins, trash dumps and fields overgrown with invasive plants, these scientists, engineers, business strategists and designers are finding innovative ways to reuse waste materials to develop greener research-and-development processes and more sustainably manufactured products.

## GROUNDS FOR GREENER CHEMISTRY

A huge portion of the world's economy depends on decades-old chemical processes that are expensive, energy-intensive and harmful to the environment. One of the most important challenges facing scientists today is developing new, "green" processes that achieve the same goals but are more environmentally and economically sustainable. Thus, researchers are searching for natural, nontoxic, inexpensive and readily available sources of useful chemicals.

Chemistry researcher Niny Z. Rao, PhD, and physics researcher Brian Yust, PhD, have demonstrated the utility of one such source: used coffee grounds. "Coffee has great potential as a component in green chemistry," explains Dr. Rao, who has studied the chemistry of coffee for more than a decade. "Even spent coffee grounds contain bountiful amounts of antioxidants and other naturally occurring chemicals."

In particular, their research has shown that spent coffee grounds can drive the process of creating gold and silver nanoparticles. "Nanoparticles are ultra-fine materials with unique properties, and they are essential to innovative technologies ranging from improved food packaging to advanced medical imaging," says Dr. Yust. "Unfortunately, standard processes for synthesizing nanoparticles can require hazardous chemicals and create toxic waste by-products."

The scientists knew that spent coffee grounds contain antioxidants, which are great "scavengers" and attach themselves to certain other molecules. One of the most important antioxidants is chlorogenic acid, which can catalyze the nano-crystallization of gold or silver atoms in a solution. "Therefore, we hypothesized that combining coffee's natural chemicals with some gold and silver would prompt a nanoparticle crystallization process," Dr. Rao says.

They found that even relatively small amounts of spent coffee grounds — regardless of roast or initial brew method — could be used to create a variety of shapes and sizes of the nanoparticles without using corrosive chemicals or energy-intensive processing. While other research groups have explored using fresh ground coffee or newly brewed coffee to create nanoparticles, Drs. Rao and Yust have demonstrated the potential to use as little as two grams of spent coffee grounds to drive a sustainable nanoparticle synthesis process.

In the current chemistry-focused phase of the ongoing project, Dr. Rao says, "We are learning about the utility of different coffee varieties and brewing methods for creating different chemical catalysts. We're also exploring the specific role of active antioxidants present in the coffee extract, and how the full range of chemicals in spent coffee grounds can be used for other nano-chemistry purposes."

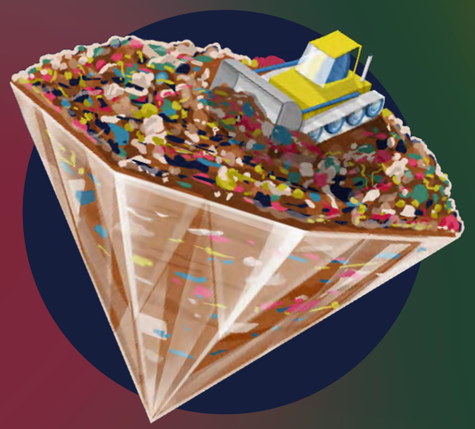
On the physics side, Dr. Yust explains, "We're exploring the effect that specific chemical constituents in the extracts have on the final size and shape of nanoparticles. Having fine control over these effects should enable us to create nanoparticles of specific dimensions and structures, such as the gold nanorod shapes that are used in a number of medical applications."

## UNWEAVING WOOL WASTE

"Waste wool" is the generic term for what's left over from the million-plus tons of wool manufactured into myriad consumer and industrial products each year. By some estimates, hundreds-of-thousands of tons of waste wool are produced globally each year — much of it ending up in landfills.

But two Jefferson researchers — Brian George, PhD, and Ryan Masoodi, PhD, — have been pursuing an initiative that, if successful, will reroute wool waste away from the landfill and towards commercially viable products that capitalize on wool's natural moisture-wicking and insulation properties. Their project could also lead to the creation of new businesses and jobs.

Dr. George says, "We are developing methods that, we believe, could be applied to many kinds of textile waste materials and used for an expanding array of purposes, from suppressing weeds to creating warmth-retaining clothing to insulating buildings or vehicles."





> "Hemp is the quintessential example of sustainable use. There appears to be a potential use for almost every part of the plant."
>
> — *Dr. George*

The first step of the project, which got underway in late 2022, was to characterize the fibers provided from waste wool provided by a Pennsylvania-based manufacturer. "We began by assessing factors such as fiber length and quality," Dr. Masoodi explains. "We then determined what nonwoven production methods would allow us to convert the raw material into sheets of fabric." Nonwoven fabrics can be created relatively rapidly because the fibers do not need to be converted into yarn first.

"Once we identified the best method to create the fabric," Dr. Masoodi says, "we engaged in a series of experiments, prototyping, and testing of products with a variety of characteristics — ranging from degree of thickness, strength and stiffness to heat resistance and flame-retardancy, insulating capacity and moisture absorption."

Then, in collaboration with their Pennsylvania-based industry partners, they identified specific commercial applications for the fabric types they had developed — for example, as sound and thermal insulation. One of the criteria was that the resulting products should be capable of long-term use, instead of single-use products that could quickly end up in a waste dump again.

At this point, they have identified two specific products with commercial potential and created samples for their manufacturing partner to use in market testing. "While we can't discuss the specific the results of the testing, our industry partners are committed to bringing sustainably focused investment into the state. So, this could be a 'win' for everyone," says Dr. George.

## USING HEMP TO PROMOTE GROWTH

Dr. George is also excited about the rich possibilities of using materials from a plant he and his colleagues consider vastly underutilized: Hemp. "It may be the quintessential example of sustainable use," he says. "No matter what the initial purpose for growing a crop of hemp, there appears to be a potential use for almost every part of the plant."

Dr. George and his colleague Jason Crook, MBA, teaching assistant professor of business, are pursuing a project to develop hemp-based growing media — the material in which seeds are started and seedlings are potted to hasten their growth. Their aim is to create a replacement for growing media that have unsustainable manufacturing and transportation processes or that harm the environment.

For example, many traditional growing media require peat, but continued peat harvest has had detrimental environmental impact. "In addition," Dr. George explains, "many existing plant-growth products are a 'black box' in terms of the ingredients and include a range of chemical ingredients and inorganic materials. In contrast, hemp is sustainable, quick-growing, and can be grown locally."

Using materials supplied by Pennsylvania farmers, the team is focusing on growth trials to determine the efficacy of their efforts.

In parallel, Crook led a group of student researchers in analyzing regional, state-wide, and national data about crops that could benefit from a new kind of growing media. "We are using that analysis to optimize hemp-processing approaches that work best for priority crops, and to identify which most effectively address the needs of existing consumer segments," Crook explains. "With those insights, we have developed go-to-market strategies that could advance sustainable economic development in Pennsylvania."

Their next steps include formally submitting a patent application and determining commercial partners.

## "REUSING" INVASIVE PLANTS

Invasive plants can have an array of negative environmental effects, from harming native species to harboring ticks that transmit Lyme disease. For the past several years, Jefferson faculty and students — led by textile design researcher Becky Flax, MS, and biology researcher Anne Bower, PhD, — have been developing a novel, sustainable-reuse approach to address the problem: Harvesting invasive plants and using them to create natural, non-toxic alternatives to synthetic dyes for textiles. Their research has focused especially on two troublesome species: Japanese barberry and wineberry.

The researchers — including undergraduate students in pre-medical sciences, biology and health sciences and graduate students in textile design, textile engineering and textile technology — first harvested and processed roots of those plants, created a variety of dyes from that material, and applied them to various organic cotton and wool fabrics used in cold-weather and outdoor apparel. "We found that the dyes were effective in creating a range of attractive earth tone-colors that retained colorfastness despite perspiration and laundering," says Flax, "They also display promising antimicrobial action against three common disease-causing bacteria."

The research team then tested dyes created from the plant's stems and berries. "Our goal is to use as much of the plant as possible," explains Dr. Bower, who brings to the project her deep knowledge of the invasive plants' biology and environmental impacts.

Those tests showed that dyes from the stems had similar efficacy to that of the root-derived dyes and resulted in similar colors. However, they found that a larger volume of berries was required to achieve the same degree of dyeing, and the berries' acidity resulted in a range of lighter-hued, almost pastel-like colors. "The berries' chemistry may enable us to achieve different effects with various dye formulations," says Flax. "And excitingly, a single plant can be used to create a broad range of dye colors — from pink to brownish orange to bluish gray."

Next, the researchers sought input from commercial dye-makers and textile manufacturers on the specific formulations and products of invasive plant-based dyes that might be most useful to them.

They learned two related lessons about the textile market: One, before adopting a novel approach to sourcing dyes, textile manufacturers will want to be assured of the supply of raw materials. Two, large-scale manufacturers will want access to large-scale harvesting of the raw materials. "That, we realized, could create an incentive for them to intentionally plant invasive species crops rather than to seek out and remove them, which is a primary objective for this project," Dr. Bower says.

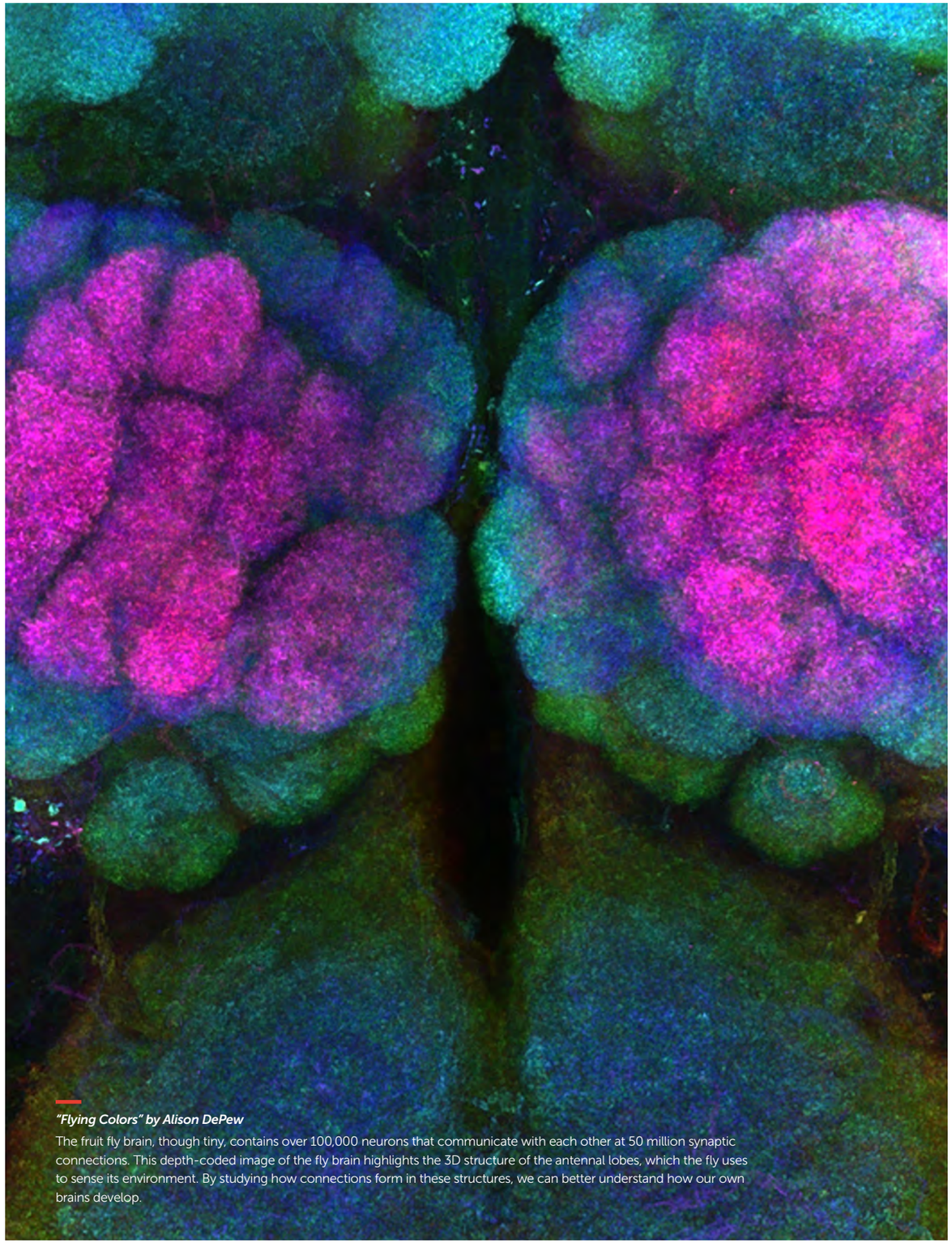
Thus, the current goals of the project are two-fold. First, the researchers have broadened the array of invasive plant species being used: Butterfly bush flower, the purple/blue flowers of which surprisingly create an orange dye; cork tree bark, which yields a vivid yellow dye; and crepe myrtle and pokeweed berries, which yield pink and purple dyes, respectively. "This allows us to increase both the range of dye colors available and the supply of raw materials," Flax explains.

Second, the research team is targeting small, niche companies that would be satisfied with the smaller-scale harvesting that would help to eliminate existing growth of invasive plants. This would also promote small-scale economic development across the region.

## CATALYZING AWARENESS AND OPPORTUNITY

Each of these projects represent early-stage initiatives focused on carefully targeted research-and-development opportunities. They all offer sustainability related benefits and could help drive new economic development. For example, "From a strategic economic development perspective, hemp is an extraordinary example of an infant-stage industry with potential to build regional, national and global markets," says Jason Cook.

"One of our goals is to expand the scientific and public conversation about ways to use this potent and readily available resource," says Dr. Niny Rao. She's talking specifically about used coffee, but her words reflect all four research teams' view of the enormous potential inherent in reusing the world's waste.



***"Flying Colors" by Alison DePew***

The fruit fly brain, though tiny, contains over 100,000 neurons that communicate with each other at 50 million synaptic connections. This depth-coded image of the fly brain highlights the 3D structure of the antennal lobes, which the fly uses to sense its environment. By studying how connections form in these structures, we can better understand how our own brains develop.

# COULD EATING TURKEY EASE COLITIS?

**According to data in mice, extra tryptophan could reduce the risk of future colitis flares.**

BY EDYTA ZIELINSKA AND DEBORAH BALTHAZAR
ILLUSTRATION BY SAYO STUDIO

For people with inflammatory bowel disease like ulcerative colitis, feasting at large holiday meals can be stressful. New research in mice, however, suggests that certain foods — especially those high in tryptophan, like turkey, pork, nuts and seeds — could reduce the risk of a colitis flare. The findings, published in *Nature Communications*, point to a noninvasive method of improving long-term colitis management, if the results are validated in people.

"Although there are some treatments for ulcerative colitis, not everyone responds to them," says senior author and immunology researcher Sangwon Kim, PhD. "This disease has a huge impact on quality of life and can lead to cancer."

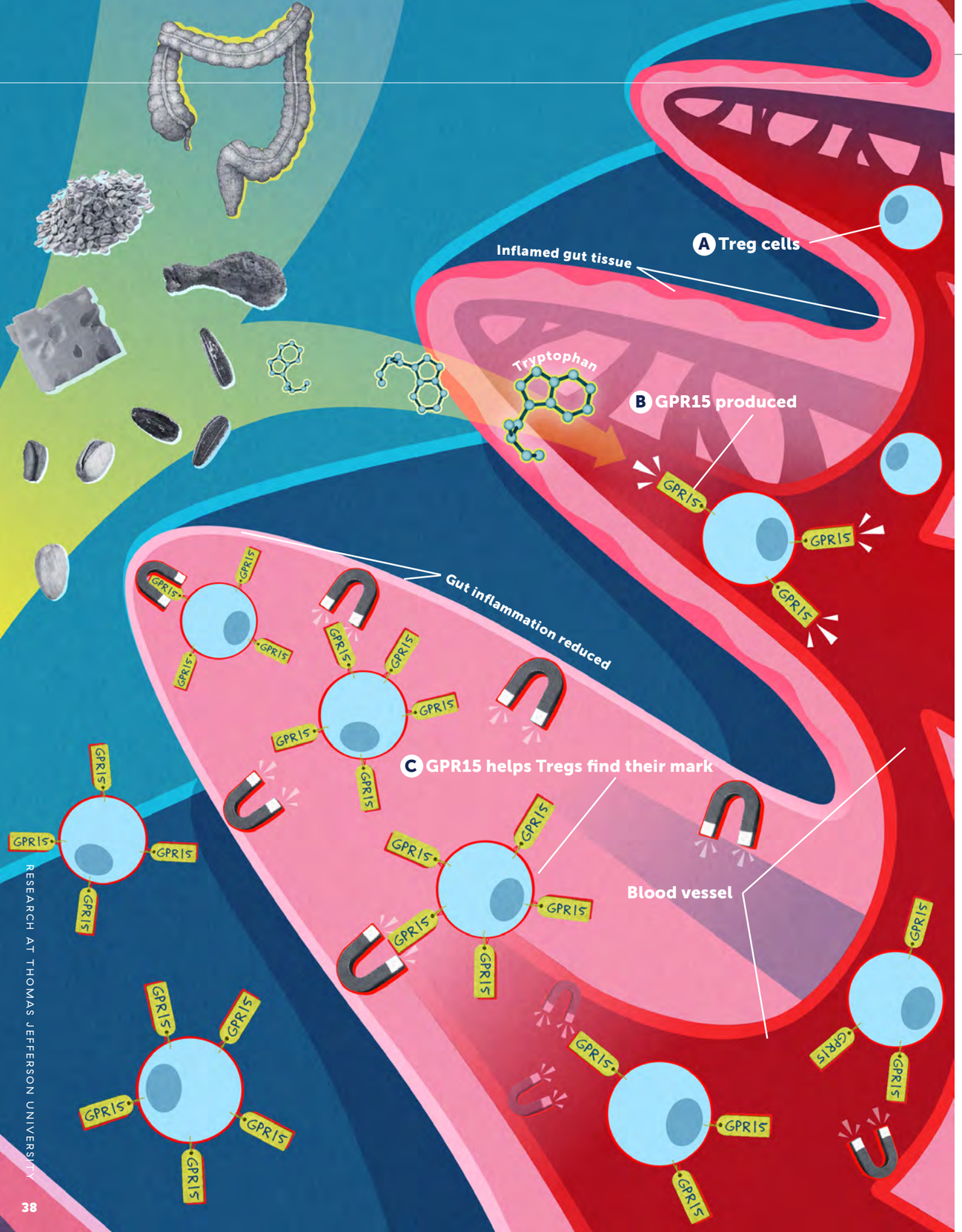
Since ulcerative colitis is caused by inflammation of the inner lining of the colon and rectum, Dr. Kim and his colleagues looked for ways to calm the inflamed tissue. They focused on a group of immune cells called T-regulatory (Treg) cells, which can help break the cycle of inflammation. If they could get more Treg cells to the colon, they thought, perhaps they could reduce the inflammation that causes colitis.

Dr. Kim's team looked into ways to attract the Treg cells and found specific receptors on the surface of Tregs that acted like an address label, helping the cells find their way to the colon. The more of this receptor (called GPR15) the Treg cells had, the more strongly they're attracted to the colon. So, they searched for molecules that could make Treg cells produce more GPR15 to turn up that attraction. They found that the nutrient tryptophan — or one of the molecules that tryptophan breaks down into — could increase the number of GPR15 receptors on the cell's surface.

To test whether these molecules could control colitis, the researchers supplemented tryptophan in the diet of mice over a period of two weeks. They saw a doubling in the number of inflammation-suppressing Treg cells in the colon tissue compared to mice that weren't fed extra tryptophan. Dr. Kim's team also saw a reduction in colitis symptoms. What's more, the effects seemed to last for at least a week after tryptophan was removed from the diet. "In human time that might translate to about a month of benefit," explained Dr. Kim, who is also a researcher at Sidney Kimmel Comprehensive Cancer Center – Jefferson Health.

Interestingly, when tryptophan was given to mice in the middle of a colitis flare, it provided little benefit, suggesting this dietary change might only be effective at preventing future flares rather than treating them.

The next step for the researchers is to test whether these results can be translated to people with colitis. Tryptophan supplementation is considered safe, as long as the dose doesn't exceed 100 milligrams per day. Using the mouse data as a guide, Dr. Kim expects that 100 milligrams could be enough to see an effect in humans and is planning further testing in clinical trials.




For people with ulcerative colitis, (A) immune cells called T-regulatory cells (Treg) can help break the cycle of inflammation. A homing receptor, called GPR15, can guide Tregs to the colon. (B) After a mouse eats food supplemented with tryptophan, the Tregs respond by generating GPR15 on their surface. (C) GPR15 is like an address label directing the cell to the right zip code. As a result, more Tregs are attracted to the gut lining, almost like a magnet, and end up in the right destination to enter the colon. The mice fed tryptophan for 2 weeks had double the number of Treg cells in the colon and less gut inflammation.

IMPROVING RACIAL DISPARITIES IN CANCER

# A graduate student passionate about community outreach is on a mission to increase awareness and access to cancer screening and treatment in her community.

BY KARUNA MEDA
ILLUSTRATION BY ALEXANDER WELLS

Moriah Cunningham has a deep connection to her family, faith and the African American community — and giving back is embedded in her work as a doctoral student studying prostate cancer.

"African American males are twice as likely to develop prostate cancer in their lifetime, compared to every other race," she explains. In fact, several of her uncles have been diagnosed with prostate cancer.

Moriah is exploring genetic differences in prostate cancer cells between African American and European American patients. She focuses on a protein called Poly (ADP-ribose) polymerase-1 or PARP-1, which plays a role in DNA damage.

Her preliminary research shows that there may be higher PARP-1 activity in African American patients. She hopes her findings will help reveal whether certain therapies targeting PARP-1 will work better in African American patients.

Alongside her research, Moriah has organized outreach events as a community liaison for Sidney Kimmel Comprehensive Cancer Center – Jefferson Health. The first event took place at her hometown church in Germantown, Pennsylvania. More than twenty attendees took advantage of free prostate cancer screening at the event.

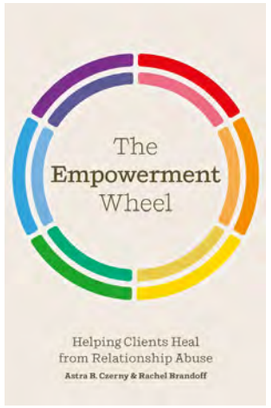
"These initiatives have been a labor of love," she says. "If we can even reach one person, it's all worth it."

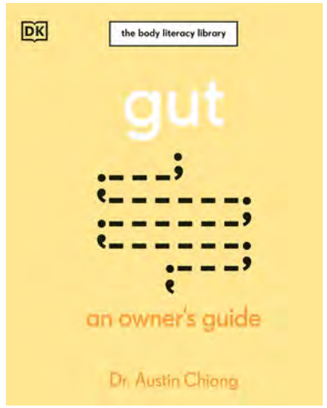
***"Herbs Under the Microscope" by Grace McCaughey***

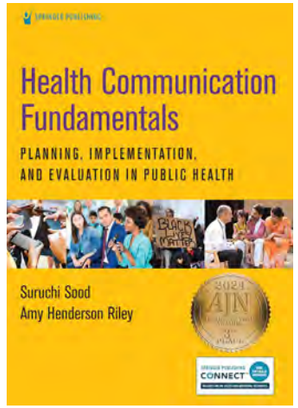
Inspired by *The Herbal Kitchen*, this display blends holistic and Western medicine through herbs. Each column showcases the cellular structure, overlaid with a sketch of the plant. Garlic (1st) lowers blood pressure and fights infections. Cinnamon (2nd) regulates menstrual cycles and supports menopause. Ginger (3rd) aids digestion, relieves nausea and reduces pain. Rosemary (4th) promotes liver health and stress relief. Oregano (5th) soothes coughs and supports digestion.

# RESEARCH READS

BY MORIAH CUNNINGHAM




## *The Empowerment Wheel: Helping Clients Heal from Relationship Abuse*

*Jessica Kingsley Publishers, March 2024*

**Rachel Brandoff, PhD, ATR-BC, ATCS, LCAT, LPAT and Astra B Czerny, PhD, LCMHC, NCC.**

Pioneered at Jefferson, this book uses art as a revolutionary way to help those in abusive relationships heal. Through self-exploration techniques, the book encourages abuse victims to explore, understand and rebuild their lives. Therapists Drs. Brandoff and Czerny identify common patterns of abusive relationships and provide creative ways to live a happier, more empowered life. Each sector of the Empowerment Wheel is supported by a creative project designed to help individuals examine their experience of red flags, boundaries, locus of control, relationship authenticity, self-talk and integrated self.

## *Gut: An Owner's Guide (The Body Literacy Library)*

*DK, April 2024*

**Austin L. Chiang, MD, MPH**

There's a common misconception that the gut is just the intestines. Digestive health is so much more. It's a gut-brain connection and even a gut-poop connection (yes, there's a whole chapter about poop and gut health!) In his new book, Dr. Chiang explores the relationship we have with our guts through providing tips, tricks and myth busters on gut health. Unlike other books about gut health, this book is colorful with lots of pictures and patient stories. Its vibrant cover entices a great conversation starter to help de-stigmatize talking about gut health with friends and family to help ensure their wellbeing.

## *Health Communication Fundamentals: Planning, Implementation, and Evaluation in Public Health*

*Springer Publishing Company, November 2023*

**Suruchi Sood and Amy Henderson Riley, DrPH, MCHES**

Health communication is all around us. The recent global pandemic illustrated the importance of communicating accurate health information. The lack of contemporary materials available to educate on health communication concepts sparked the idea for this book. Ranked third place in the book of the year ranking by the *American Journal of Nursing for Public and Population Health*, this book provides guidance on health communication in the face of public health issues. The topics investigated include social justice, response to pandemics and environmental health justice. Alongside each chapter, there are accompanying podcasts, providing a unique, immersive experience for the reader to gain knowledge directly from experts.





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