



MORGRIDGE
INSTITUTE FOR RESEARCH

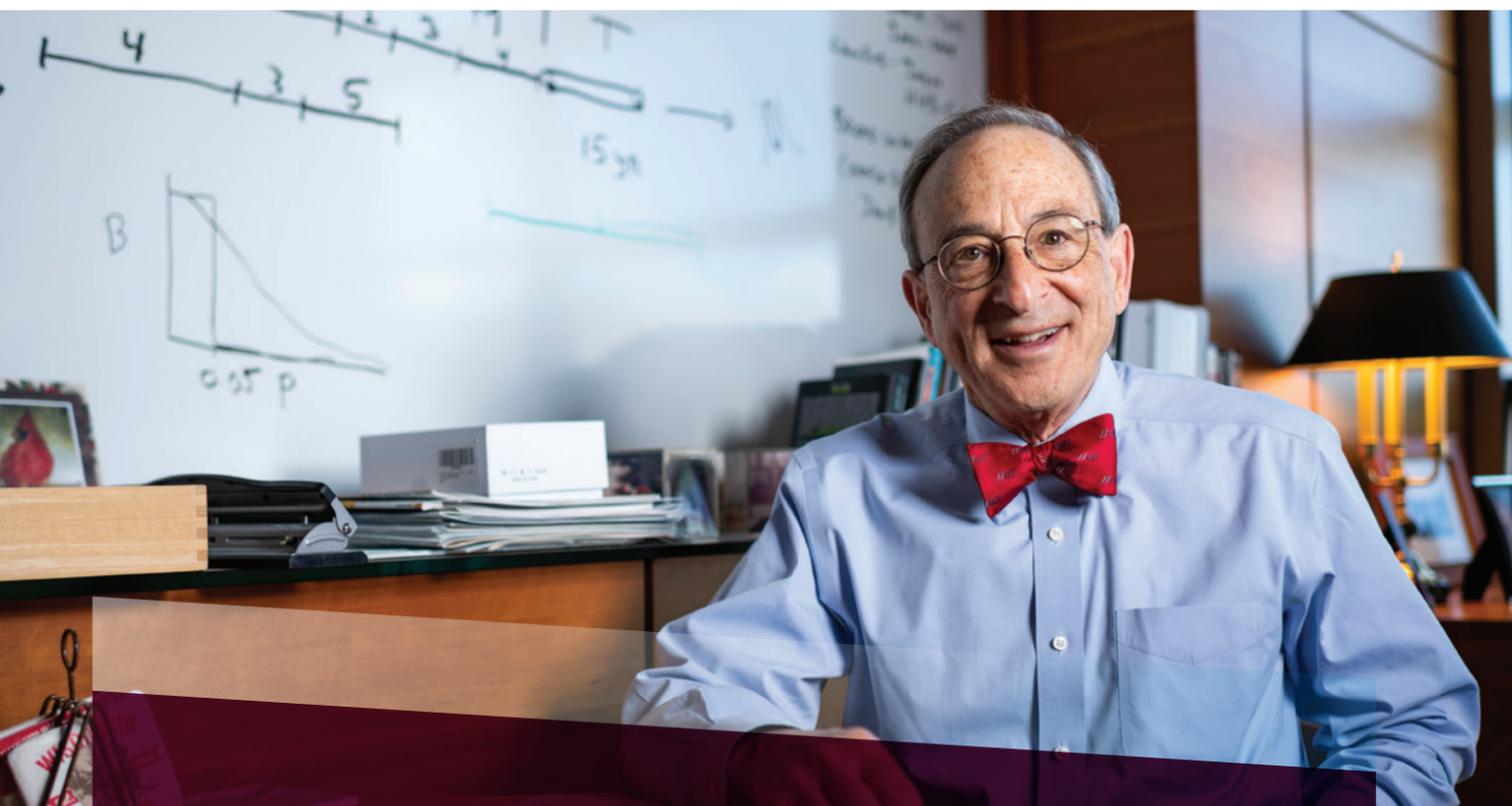
FALL 2023

YOU MAKE A DIFFERENCE

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A special report for
supporters of the
Morgridge Institute
for Research



BRAD'S UPDATE

Autumn is sweeping across our campus, and I am delighted to bring you the latest updates from the Morgridge Institute for Research. Your steadfast support has been instrumental in fueling our pursuit of knowledge, innovation, and transformative breakthroughs.

As we reflect on the impact of your generosity, I am thrilled to share the exciting developments of the past few months. In July, we welcomed two new investigators who bring powerful, innovative technologies to study human biology and disease: **Randy Bartels** (page 2) and **Juan Caicedo** (page 4). Together, they are looking for bold new approaches to image biology — to see what is currently unseeable.

Randy and Juan are here because of the enormous support of donors like you. You make it possible to hire leading scientists dedicated to improving human health.



You are also a pivotal partner in science education, engagement, and outreach. This summer we hosted 50 students and 10 teachers at the annual, beloved Summer Science Camp. Campers hailed from 14 school districts across Wisconsin where finances may be tight and local science enrichment opportunities may be few and far between. The campers found untold value in the interaction they have with with real scientists, and the sense that they too could succeed pursuing a science career.

You can read more about the Summer Science Camp — and a number of other wonderful outreach experiences — on **pages 8 and 12**.

As we enter the season of gratitude, I'm extending my heartfelt thanks for your unwavering support. Your belief in the power of research and discovery inspires us daily and motivates us to reach new heights. Together, we are shaping a brighter future for generations to come.

Brad Schwartz, M.D.
Chief Executive Officer
Morgridge Institute for Research

P.S. What's on the cover? You'll see a middle school student using DIY electrosopes to test and measure the static charge of materials Read more on **page 15**.

THANK YOU
for being a donor
and supporter of the
Morgridge Institute
for Research.



MEET RANDY BARTELS

**SUPER-RESOLUTION AND ULTRA-DEEP:
NEW MORGRIDGE SCIENTIST PUSHES
LIMITS OF IMAGING**



**Ph.D., Electrical Engineering
University of Michigan (2002)**

**MS, Electrical Engineering
University of Michigan (1999)**

**BS, Electrical Engineering Oklahoma
State University (1997)**

Colorado physicist Randy Bartels, an expert in creating technologies that shed light on unseen worlds in biology, joined the Morgridge Institute this summer as an investigator in the biomedical imaging initiative.

Bartels specializes in the development of light microscopy and laser technology for applications such as ultra-deep imaging of tissues and vastly improved resolution of cell populations. Before joining the biomedical engineering faculty at UW–Madison, he was a professor of electrical engineering at Colorado State University in Fort Collins.

“I’ve been working in the space of biomedical imaging for more than 15 years, but Morgridge and UW–Madison will offer an opportunity to work with a wider range of collaborators in biology,” says Bartels. **“I think true innovation has to be collaborative, built on conversations across disciplines and lots of trial and error. I’m really excited to work with biologists who want to push what we’re capable of imaging.”**

Two current Bartels research projects have captured the attention of the “Frontiers of Imaging” program at the Chan Zuckerberg Initiative (CZI). In 2020, Bartels received CZI support for a project to image more deeply into tissue by developing ways to suppress scattered light and increase resolution. And in 2022, Bartels partnered on a CZI project to develop a laser technology that can illuminate large populations or regions of cells, at much

faster speed and higher resolution than conventional techniques.

A foundation executive once told Bartels they are drawn to researchers who think more like venture capitalists, willing to go after high-reward challenges despite the elevated risk of failure that goes hand in hand with such endeavors. Bartels says that the Morgridge Institute’s embracing of “advisable risk” in research is in keeping with that philosophy.

Bartels has earned high honors for his work. He was awarded the Adolph Lomb Medal from the Optical Society of America, a National Science Foundation CAREER award, a Sloan Research Fellowship in physics, an Office of Naval Research Young Investigator Award, a Beckman Young Investigator Award, and a Presidential Early Career Award for Science and Engineering.

One class of experiments Bartels plans to pursue at Morgridge is developing optical correlative imaging with cryo-EM and MRI. In the case of cryo-EM, he will exploit unique properties of his new fluorescent super resolution imaging technique. In particular, this form of microscopy can image large sample volumes, even when optical aberrations are present.

Working at Morgridge will also enable a class of experiments to develop correlative MRI and optical imaging, Bartels says. This line of inquiry will rely on the development of a new label-free molecular detection approach based on non-resonant transient absorption.

MEET JUAN CAICEDO

DECODING THE UNSEEABLE: NEW SCIENTIST SEARCHES FOR PATTERNS IN DISEASE



**The National University
of Colombia**

Ph.D, Computer Engineering (2013)

**M.Sc., Systems and Computer
Engineering (2008)**

B.Sc., Computer Engineering (2005)

Juan Caicedo, a computer scientist employing machine learning to decode complex patterns in human biology, joined the Morgridge Institute this summer as a biomedical imaging investigator.

Caicedo joined the faculty of biostatistics and medical informatics at UW–Madison, following his post as a Schmidt Fellow at the Broad Institute of MIT and Harvard.

Caicedo invents computer vision tools to analyze vast amounts of biological data — in some cases, millions of cellular images — to recognize patterns that could be meaningful to human disease.

Biomedical imaging is a thriving research community at Morgridge and UW–Madison, with hundreds of scientists working on microscopy and computation innovations to better understand basic biology.

“I really appreciate having the support of a private institute to do research that is kind of risky,” Caicedo says of Morgridge. “And I like the institute’s vision of ‘fearless science,’ in which you can really go after the most difficult challenges that may be hard to approach with

traditional ways of conducting research. I like the freedom to explore new ideas and embrace new challenges.”

Caicedo says that, as humans, every time we encounter some kind of obstacle, we are driven to invent new tools to overcome them — whether it be microscopes to see biology or machines to build cities.

One example in Caicedo’s lab concerns cancer mutations. His team studied genetic mutations from tumors of cancer patients that were sequenced to identify their functional impact. Finding those mutations linked to cancer proliferation gives clinicians a potential target for new therapies and treatments.

Caicedo’s team at the Broad Institute designed an experiment to artificially introduce hundreds of mutations into cells,

one at a time, and then analyze the imaging data through machine learning. They scanned images of cells to study as many as 300 mutations in a single experiment. Then they developed automatic methods to detect the phenotypes expressed in these different mutations, helping identify the important ones more rapidly and efficiently.

Brad Schwartz, CEO of the Morgridge Institute, says Caicedo’s research is like bringing together “an army of pathologists” to study disease in a more systematic way.

As an underrepresented minority in science, Caicedo is passionate about issues related to diversity, equity and inclusion in the science workplace. At Broad, he became involved in a group devoted to women in science and became deeply involved in diversity and inclusion efforts. He hopes to continue those efforts at Morgridge.

**THANK YOU
for nurturing talented
researchers. Your
partnership is an
investment in the future
of science, and we are
deeply thankful for
your dedication.**





BACK IN SESSION

CAMPERS EXPLORE SUMMER SCIENCE



Over two week-long camps in July, 50 students and 10 educators spent their days experiencing science firsthand at the 17th annual Summer Science Camp.

The campers hailed from rural high schools in 14 towns across Wisconsin, with about half of them represented through the Upward Bound program.

Some students traveled from as far north as Park Falls, Wis., near the Chequamegon-Nicolet National Forest, and others from rural communities only a few hours away, including Strum, Darlington, and Monroe, Wis.

“The students were among the broadest representation of high schoolers from rural communities across Wisconsin that we’ve had at the camps,” says Dan Murphy, outreach and lab manager at Morgridge. “They were the most passionate group of young scientists — ‘fearless science’ at its best.”

The Summer Science Camp is a unique, immersive program for high school students and teachers in rural communities and from historically underrepresented groups in science. For four days, participants stay overnight in campus residence halls, explore hands-on activities in state-of-the-art

facilities, learn from renowned scientists, and gain extraordinary research experience in a supportive community.

The Summer Science Camp is entirely free of charge for all students and educators, and is made possible by support from donors like you.

“The camp is just plain fun. It’s a whirlwind week where laughter and learning come together. And it’s unforgettable for many campers,” says Murphy.

This year, campers explored computer modeling, stem cell science, quantum mechanics, microscopy, imaging, and more — often using the same tools and technologies used by experts.

One activity involved an immersive virtual reality tour of viruses. Led by Dr. Raison Dsouza, a research scientist in the Ahlquist Lab, the activity helped visualize SARS-CoV-2 protein structures as a model.

Students also jumped into quantum mechanics and witnessed how stem cells work in unison to beat together as heart cells in a Petri dish — an experiment that highlights the legacy of the landmark research of Morgridge Investigator Jamie Thomson, who first isolated human embryonic stem cells in 1996.

“I cannot thank you enough. The experience you provided for my students and myself was more than I imagined,” says a teacher who participated as a first-time camp chaperone. “The breadth of science expertise and variety of research we were exposed to was inspiring.”

The students concluded their camp week by participating in a Science Showcase, where they became the presenters and shared what they learned during their experience with the Morgridge community.

Thank you for changing lives. Your support ensures the Summer Science Camp is entirely free of charge for all students and educators.

This year, participating Wisconsin schools included:

- Chequamegon High School in Park Falls
- Darlington High School in Darlington
- Eleva-Strum Central High School in Strum
- Evansville High School in Evansville
- Mayville High School in Mayville
- Monroe High School in Monroe
- Phillips High School in Phillips
- Spooner High School in Spooner
- Upward Bound (Barron, Gillett, Mauston, Shawano, Shell Lake, Siren, Tomah, Tri-County, Turtle Lake, Unity, Wautoma and Westfield sites)

Since 2007, the Summer Science Camp and the Summer Science Workshop Series have helped over 700 high school students and over 150 teachers from more than 100 state high schools.





CONNECTING COMMUNITIES THROUGH SCIENCE

FELIPE ROSAS GOMEZ JOINS THE MORGRIDGE INSTITUTE

“I don’t know if I have the answer for you, but I would love for you to talk to us about it and we can figure it out together!”



That’s Felipe Rosas Gomez’s approach to working with students in his new role as assistant outreach coordinator at the Morgridge Institute.

As a first-generation immigrant and college graduate, Gomez came to the institute in June after graduating from UW–Milwaukee in 2022, where he studied community engagement, education, and education policy.

Gomez’s passion for education grew when he took a job working in alternative education in Milwaukee, with 17- to 21-year-old students who needed high school level education after being expelled or falling far behind their peers.

It was there that Gomez found himself working closely with a math teacher. Math (and science) were not his top subjects in school — he found them extremely intimidating — but working alongside a math teacher colleague, Gomez found he was better at math than he remembered.

“If someone would have given me the opportunity and brought that out of me back when I was in traditional school, then maybe

I would have been a doctor, you know, who knows?” he laughs.

In his role, Gomez works with Outreach Coordinator Jerrod Buckner managing Science Expeditions, designed for afterschool programs or events at local community centers. He is enthusiastic about continuing the institute’s mission to spark scientific curiosity and build partnerships with society.

Growing up as a young Latino, Gomez recalls how his parents and community think about science in terms of doctors, nurses, and the medical field. But there are many other branches of science where Gomez hopes to inspire students — whether its biochemistry, geology, or biomedical science.

“I really want to help students explore and develop those skills,” he says. “I want to be able to make those changes or be in a room where we’re making those decisions. Now that I’m in this position, I’m excited to really collaborate with communities like the ones that I grew up with, to bring our programming and bring them some of the great science we have here.”



AFTERSCHOOL EXPEDITIONS BRINGS SCIENCE EXPLORATION TO COMMUNITY CENTERS

MORGRIDGE COMMUNITY ENGAGEMENT
TAKES SCIENCE OUT ON THE TOWN

Come into a community center on Madison's northside on a weekday afternoon. Inside you'll see a group of students. They're building triboelectric nanogenerators.

The students combine common household items, including a plastic Easter egg, a bouncy ball, a few copper wires, an LED light, and aluminum foil. Their tiny handmade electronics are powered by triboelectricity, more commonly known as static electricity. This is Afterschool Expeditions, an outreach program at the Morgridge Institute that brings science exploration to community nonprofit centers in Madison.

The power of Afterschool Expeditions is the unique way it works: UW-Madison scientists and researchers are paired with college students in the Badger Volunteer program. Together, they travel once a week to community centers across the city during the spring, fall, and summer.

"We go to underserved communities to promote the Wisconsin Idea," says Jerrod Buckner, who runs Afterschool Expeditions. "We're a research institute that connects UW-Madison researchers, college students, and youth. It's collaborative, not informative."

The Wisconsin Idea — a long-held principle that the university should serve all people in the state — is embedded in the Morgridge Institute's mission to inspire curiosity and a love for science.

For Buckner, that really means going outside the institute and the university. During his six years at Morgridge, he's transformed Afterschool Expeditions from a previously on-site program to one that travels weekly to meet a specific community's needs.

"There's a large community center resource here in Madison," Buckner says. "They serve many origins of people and cultures, and they all do very different things. Creating partnerships with these communities is a powerful way to share the Wisconsin Idea."

The summer schedule has crisscrossed the isthmus, partnering with Vera Court Neighborhood Center, Neighborhood House, the Elver Park Neighborhood Center operated by the Wisconsin Youth Company at Elver Park, MSCR-Midvale, BLW Center, and Goodman Community Center, just to name a few.

"Jerrod, his team, and the Morgridge Center have been such a wonderful

resource for our community center and summer programming. Having the opportunity to expose our kids to spaces they may have never seen before is an invaluable experience and truly makes a difference in our families' lives," says Tom Qualls, program director at Vera Court.

Each week, a scientist brings an hour of programming for up to 20 elementary students and sometimes middle schoolers. It's about having fun through exploration and autonomy, says Shelly Grandell, assistant director of education and outreach at the Materials Science Research Center at UW-Madison.

Grandell, who is a science teacher by training, has taken many activities on the road that invite students to learn about the materials that exist all around us — whether they are part of our everyday lives (like LEDs) or part of the natural world (like lotus leaves).

"One of the most wonderful parts about this program is that we are going into the students' safe space," Grandell says. "That's where they may be more comfortable to ask questions, interact and be a little more bold. I think that really opens up an opportunity for them to explore a little more freely."



IGNITING CURIOUS MINDS BRINGING SCIENCE TO THE WORLD

Your support is vital to expanding science outreach and education. Thank you for helping scientists and educators build partnerships with UW–Madison, our local community, and the state to bring the joy and wonders of science to children and families.

Through your generosity, we are able to develop and deliver engaging educational programs, afterschool programming, science field trips, and hands-on activities that ignite

curiosity and foster a deeper understanding of groundbreaking scientific discoveries.

Your support enables us to reach diverse audiences, from students to families, and to cultivate a passion for science that can shape the future. Together, we are building bridges of knowledge and inspiring the next generation of curious minds. Thank you for helping make science accessible, relatable, and transformative for all.

Admittedly, the hour goes by quickly. But Grandell knows that the impact is more than just that. Students may share their experience and excitement with others and she's built that into the activities, creating take-home kits when possible.

"Taking science and STEM excitement and passing it on is really one of the great things," says Grandell. "Knowing that students are going to go home and do the activities in their own space and share it

with other people — that means we're doing the good work."

Through private support, the Morgridge Institute provides funding to scientists like Grandell to purchase supplies and materials for Afterschool activities. The institute also provides a travel stipend to student volunteers who often do not have reliable transportation to travel to community centers.

THANK YOU
for sparking curiosity, inspiring minds,
and creating lasting connections





OPENING OUR DOORS

FIELD TRIPS INVITE STUDENTS TO EXPLORE SCIENCE

Embarking on a science field trip to the Morgridge Institute is an immersive journey into the heart of cutting-edge research and discovery. We open our doors to curious minds, offering an unparalleled opportunity for students to see the dynamic world of science. Through

interactive exhibits, activities and experiments, field trips provide an inspiring and educational experience that sparks curiosity and ignites a passion for exploration.

Here's a look at some recent field trips:



FROM THE NANOSCALE TO BIG ENERGY SOLUTIONS

Fifth graders from Shorewood Hill Elementary, a school in the Madison Metropolitan School District, attended a field trip to the Discovery Building in March.

Led by the Discovery Connections team,

the trip featured two activities developed in partnership with UW–Madison: “Size and Scale: Nanotechnology and a world too small to see” with the Materials Research Science and Engineering Center and “Sustainability of Energy” with the WI Energy Institute.



SUPERCOMPUTERS, SPACE PLANTS, AND SUSTAINABLE ENERGY

Seventh and eighth graders from the James C. Wright Middle School AVID program, a college readiness program, attended a field trip to the Discovery Building in May.

The field trip featured activities that allowed students to explore material science and plant research at UW–Madison. In the “Robotics, Automation, and Plant Research” activity, students learned about the techniques used by two Botany research groups that combine robotics, supercomputers, and engineering to study plants, crop systems, and how to grow plants in space.

In the activity “Sustainable Energy Through Motion,” students explored how to create triboelectric nanogenerators, which offer portable and localized electricity production without the need for batteries.



THE WIDE WORLD OF STEM AT SUMMER CAMP

In July, a group of fifty middle schoolers from the Madison Metropolitan School District participated in the WI STEM Explorations Camp on the UW–Madison campus. The 7th grade students were nominated by their science teachers to attend the week-long day camp offered through the Madison School & Community Recreation program.

This unique camp gave students a hands-on look at science activities in labs across campus. Through speaking with a diverse group of scientists and researchers, students learned that science is more than just lab coats and pipettes — though they had plenty of opportunity to do that, too — and that there are many avenues to a STEM career.

From stem cells to dairy cows, the students gained exposure to the many flavors of science and developed a bit of their own science identity along the way.

WE EXTEND OUR HEARTFELT GRATITUDE FOR YOUR SUPPORT. YOU EMPOWER CURIOUS MINDS — THANK YOU.



YOU'RE MAKING A DIFFERENCE

The Morgridge Institute for Research explores uncharted biomedical research. By asking the boldest questions and following the highest standards of quality research, we will improve human health.

We can't do this important work without YOU. Thank you for supporting fearless scientists and igniting curious minds.



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