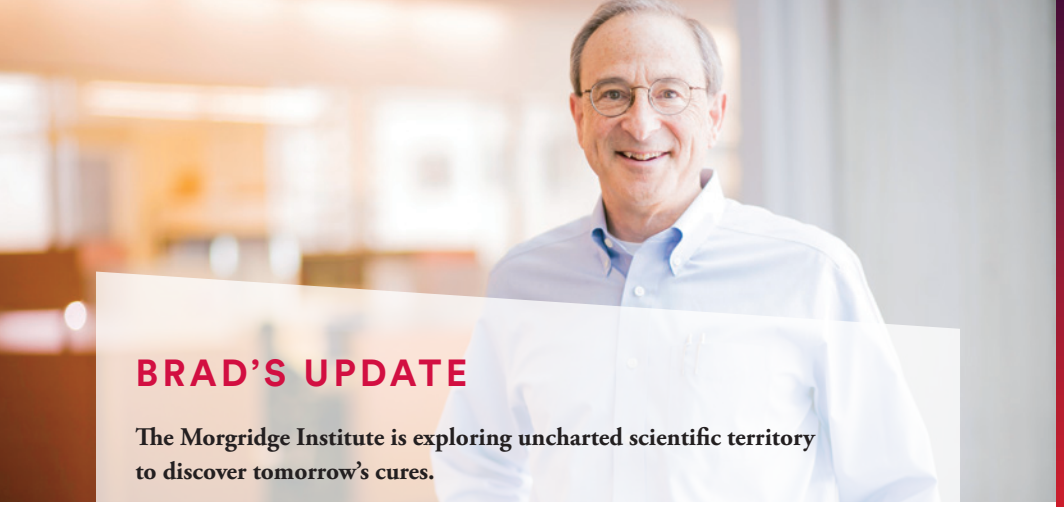
MORGRIDGE
INSTITUTE FOR RESEARCH

YOU make a difference

INSIDE



BRAD'S UPDATE

The Morgridge Institute is exploring uncharted scientific territory to discover tomorrow's cures.

Basic science, the core of what we do, is all about the work. It's a commitment to go where the science takes us, even if it's in an unexpected direction. It is rigorous, determined and made stronger by a community of scientists and supporters like you.

You make it possible to study promising areas of biomedicine that can lead to important discoveries and improve human health. Not only that, but you support science outreach and education programs that bring the wonders of science to underserved children and families across Wisconsin.

In this report, you will read about new research to create arteries for transplant surgery — a story truly about the potential, and promise, of stem cell science. You'll also read about an exciting partnership between medical engineers and obstetricians to better understand the risk of preterm birth. And there's plenty more to read.

Of course, this report is just a small sampling of our efforts to improve human health and bring science to the curious public.

As scientists, we know that improving human health requires dedication, curiosity and integrity. Your financial support continues to invigorate and inspire us.

Thank you for supporting the Morgridge Institute for Research. Donors like you are critical to our mission, and we are so grateful for the trust you've placed in us.

Brad Schwartz, M.D.
CEO, Morgridge Institute for Research

P.S. I am so thankful for your support. If you have any feedback about this report, please email me at **brad.schwartz@morgridge.org**.

The Morgridge Institute explores uncharted research to go where the science takes us. By asking the right questions and following the highest standards of quality research, we will improve human health.

Science can change our lives.

With support from **donors like you**, scientists are pursuing biomedical research to improve human health.

Your gift is working to fight disease, understand the depths of biology, and unlock ways to stop cancer, HIV, and many more disorders.

You're also supporting science education and outreach programs that bring the wonders and joy of science to children and families across Wisconsin who might not otherwise have these opportunities.

SCIENTISTS CLEAR ANOTHER HURDLE IN CREATING TRANSPLANT ARTERIES

JUE ZHANG

Private support from donors like you helps stem cell scientists. Thank you for supporting science that has opened doors for thousands of patients worldwide.

Cardiovascular disease is a major cause of death worldwide, and treating it isn't easy. The disease wreaks havoc on patients' blood vessels and can require complex surgery to repair the damage.

Scientists at the Morgridge Institute for Research are working toward a dream of creating artery banks — similar to blood banks common today — with readily-available material to replace diseased arteries during surgery.

"Cardiovascular disease is a major cause of death worldwide," says James Thomson, Morgridge regenerative biologist. "In the U.S. for example, heart disease and stroke are the No. 1 and No. 3 killers, respectively. And this work also has implications beyond making vessels for transplantation; it's sort of a stepping stone to more advanced tissue engineering."

The latest work in the Thomson Lab puts the science one step closer to that goal.

In a recent paper published in *Stem Cell Reports*, Jue Zhang — lead author and a Morgridge associate scientist — highlights a better way to grow smooth muscle cells, one of the two cellular building blocks of arteries, from pluripotent stem cells. The work also identifies a potential drug for reducing post-surgical risks in patients who undergo bypass surgery.

The Thomson Lab's latest finding is a major step to create transplantation arteries for vascular surgery. Morgridge scientists, working with a world-class team of surgeons and engineers at UW–Madison, hope to one day grow new blood vessels for patients suffering from heart disease.

Their latest work demonstrates the continued power of stem cell science.

Stem cell science has opened doors for thousands of patients worldwide. Patients with spinal cord injuries are now participating in clinical trials to help restore movement to paralyzed limbs. And new therapies may one day help patients living with Parkinson's disease, blindness, Type 2 diabetes, and heart disease.

RURAL SUMMER SCIENCE CAMP EXPANDS IN 13TH YEAR

Summer means one thing: it's camp time!

The Morgridge Rural Summer Science Camp, where rural high school students and teachers take a deep dive into scientific research over the course of a week, expanded this summer. Thanks to new support from the National Science Foundation (NSF), a third week of camp was offered this year.

One more week of camp meant an additional five teachers, 25 more high school students, and five more schools were represented, including schools from the Upward Bound program that focus on underrepresented and first-generation pre-college students.

The camps have been — and will always be — free of charge for students and teachers **thanks to donor support**.

Dan Murphy, outreach coordinator at the Morgridge Institute for Research, says the additional week allows for more attendees, as well as a bolstered experience for scientists.

"This third week offers up more opportunities for people to get involved, and with new researchers come new activities," Murphy says. "It's very cool to see the camp evolve with the science each year."

Sean Palecek, an engineering professor at UW–Madison whose lab has presented activities in the camp for more than a decade, was a core part of the camp expansion. Palecek is part of the NSF Engineering Research Center for Cell Manufacturing Technologies (CMaT), a large multidisciplinary center meant to stimulate growth of research related to cell-based therapies.

One activity presented by the Palecek Lab that's always a hit with the students and teachers involves heart cells beating in a petri dish. The heart cells — known as cardiomyocytes — were differentiated from human stem cells.

In the activity, the campers see the live cells beating and watch how things change when they apply different drugs.

Donors like you ensure the camp has been — and will always be — free of charge for students and teachers.

"Not only can we make these beating cells in a dish, but say you wanted to treat someone who's had a heart attack," Palecek says. "What types of quality control would you want to do before you put the cells into a patient? It's very different watching them in a dish and making sure that they're safe and effective in treatment."

Other camp activities include lessons on bioreactors, CRISPR gene editing, cancer imaging, and how bioinformatics accelerates research. This year the camp is also partnering with LRNG, an online learning platform, to provide career development micro-credentials to the student participants.

"We want to highlight the connection between the camp activities to career development and job development in Wisconsin," Murphy says.

COMMUNITY RALLIES FOR RURAL STUDENTS AND TEACHERS

More than 60 donors made financial contributions to support the 2019 Rural Summer Science Camp. Thanks to donors like you, the Morgridge Institute is proud to provide free science education programs for children and families in Wisconsin.

Since 2007, more than 300 students from nearly 80 schools across Wisconsin have participated in the summer camps. That includes some schools with enrollments of 50 or fewer students!

Because of donor support, the camps have included students and teachers from every corner of the state — from Shell Lake in the Northwest; to Laona in the Northeast; to the Oneida Nation in Central Wisconsin; to Darlington in the Southwest; to Elkhorn in the Southeast.

Thank you for making a difference.

MORGRIDGE, MERITER RESEARCH PROJECT TARGETS THE PERSISTENT RISK OF PRETERM BIRTH

KAYVAN SAMIMI

Because of your support, scientists have more resources to collaborate on critical medical issues and improve human health.

Of the approximately 4 million births in the United States each year, at least 400,000 of them still trigger a state of desperation in maternity wards.

Parents, doctors and medical staff feel this way over the challenge of managing high-risk pregnancies. There is a surprising lack of precise science behind diagnosing risk for preterm birth, or intervening at the right time or with the right methodology.

Even worse, U.S. preterm birth rates have actually increased in recent years to almost 10 percent, and along with them a surge of long-term medical and social distress for families.

Against this backdrop, the Morgridge Institute for Research launched a project intended to give doctors new tools to improve health outcomes and lower premature birth rates.

The project includes partners at the University of Wisconsin-Madison Department of Medical Physics, Intermountain Healthcare in Utah, Columbia University and the Meriter Hospital Birthing Center in Madison.

The project, led by Morgridge postdoctoral researcher Kayvan Samimi, uses placental tissue samples provided by the Meriter Birthing Center. The tissue, normally discarded after birth, comes from 50 pregnancies of different circumstances, including full-term birth and preterm vaginal and cesarean deliveries. Researchers then use novel imaging tools to examine differences in the structural properties of those tissues to better understand what goes awry during preterm labor.

The catalyst behind the project is Dr. Helen Feltovich, an obstetrician at Intermountain Healthcare in Utah who specializes in high-risk pregnancies and works with hundreds of patients annually.

“The issue for me was going to work every single day to face this problem that no one has solutions for, and no one is

“You need the data before you can get the NIH funding, and you can’t get the data without the person to do the work. We wouldn’t be doing the study without Kayvan.”

– MELISSA SKALA

getting anywhere with,” Dr. Feltovich says. “The point is we flat-out do not understand how spontaneous preterm births happen.”

The Meriter Birth Center staff’s response to the project has been very enthusiastic, says Melissa Skala, a Morgridge medical engineering investigator who is overseeing the project. “They’re really excited to learn about what’s happening with their patients, because they’re frustrated,” she says.

Skala says the project is a prime example of how the Morgridge Institute can help seed risk-reward research that may be too early-stage to get funding from the National Institutes of Health. Samimi was hired under an interdisciplinary postdoc program created by Morgridge to delve into this kind of uncharted territory with UW–Madison partners.

“You need the data before you can get the NIH funding, and you can’t get the data without the person to do the work,” Skala says. “We wouldn’t be doing the study without Kayvan.”

MELISSA SKALA

HELEN FELTOVICH

INSPIRING CHILDREN WITH BIOMEDICAL RESEARCH

'PROTEIN PINBALL' MACHINE ILLUMINATES BIOINFORMATICS

Walk into one of the second-floor teaching labs at the Discovery Building, and you will find a jumbled mass of wires, microcontrollers, cardboard and tinfoil that roughly resembles a pinball machine.

In the coming months, these materials will transform into a fully functional, laser-cut, tabletop pinball machine complete with an LCD screen and data-collecting mechanism.

This pinball machine is an important part of an ongoing project at the Morgridge Institute for Research led by Anthony Gitter, a principal investigator in the John W. and Jeanne M. Rowe Center for Research in Virology.

"One thing we've been looking at with various collaborators is how cells pass messages within individual cells," Gitter says. "Proteins in cells have ways of using chemical changes to do the messaging, and that's what we're very interested in studying computationally."

Gitter wanted to translate his work into something a child could understand and enjoy. That led him to the Discovery Outreach team where Travis Tangen, education and outreach manager, and undergraduate students Matias Figari and Max Schleck, teamed up to develop a pinball machine and bring Gitter's vision to life.

"The game is supposed to be a cell. And inside the cell there's proteins and the proteins are talking to one another. And that's being mapped out on a small LCD screen that's hooked up to the game," Figari explains.

Figari and Schleck built the first iterations of the pinball machine from scratch over the course of a summer and tested the prototypes with children during various Discovery Building events. It was a hit.

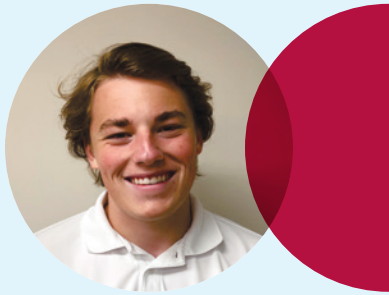
"My favorite part [of this project] was the first meeting where I saw the pinball prototype machine," Gitter says. "The interns had so many of their own ideas, all this creative energy, and then the prototyping engineering programming skills to actually make it happen."

The team hopes to construct 15 laser-cut models of the Protein Pinball machine for the public to access during events such as Saturday Science and the Wisconsin Science Festival.

Laura Heisler, Morgridge Director of Outreach, is optimistic about protein pinball and excited about its potential impacts, which will reach beyond Madison and even Wisconsin.

"This project is a perfect example of how it's possible to find engaging ways of connecting diverse audiences to really complex science concepts by tapping into the process of discovery and research," Heisler says.

MATIAS FIGARI



MAX SCHLECK

"Bringing the big world into our small communities is a huge positive. Some of our areas are so poverty-stricken, so traumatized, it's good for these students to have this opportunity. Where they might not normally branch out and feel secure enough to explore … some of these kids can now say, '**I can do this.**'"

– GEORGI, A TEACHER IN THE WAUSAUKEE SCHOOL DISTRICT AND A 2018 RURAL SUMMER SCIENCE CAMP PARTICIPANT

MORGRIDGE
INSTITUTE FOR RESEARCH

THE DISCOVERY BUILDING
330 N. ORCHARD STREET, MADISON WI 53715
608.316.4100 / MORGRIDGE.ORG