



MORGRIDGE
INSTITUTE FOR RESEARCH

SPRING 2021

YOU make a difference

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A SPECIAL REPORT
FOR SUPPORTERS
OF THE MORGRIDGE
INSTITUTE FOR
RESEARCH



BRAD'S UPDATE

I hope this report brings you a sense of optimism. Yes, optimism!

Let's first address that we are more than a year into the COVID-19 pandemic, and life is far from normal.

Still, I have high hopes for 2021. The COVID-19 vaccines are proving to be highly effective. Deaths and hospital admissions are declining. Vaccine supply and distribution systems are improving each day. We are turning the tide against the pandemic.

I am also hopeful because scientists here at the Morgridge Institute are working to understand the novel coronavirus and prevent future pandemics.

You make life-saving research possible.

Your generosity as a donor helped Morgridge scientists and researchers quickly join the global effort to stop the pandemic. I hope you enjoy reading about the science and research you've supported on page 3.

But Morgridge scientists are improving human health in many other ways. We are studying biology to help fight heart disease, cure the neglected tropical illness schistosomiasis, stop the spread of HPV and pancreatic cancer, and develop new tools to help doctors save lives.

That's why this report includes a story about stem cell pioneer Jamie Thomson. For years, his lab has been working on a transformational project to develop a safe and functional stem cell-based artificial artery. These arteries could be pulled off the shelf and used by vascular surgeons to replace damaged arteries and veins.

You help scientists like Jamie push science forward, especially now when so many aspects of human health are being impacted.

In this report, you can also read about the Discovery Field Trip Program. For more than ten years, the program brought elementary and middle school students and teachers to Madison for a day of exploration. But during the COVID-19 pandemic, we moved the field trips online. Now, more than 28 classrooms across the state of Wisconsin will meet virtually with scientists and researchers.

This newsletter is called "You make a difference" because that is what you do.

Your ongoing support provides tools and resources to quickly to help scientists, while serving students from rural and underrepresented communities.

All of us at the Morgridge Institute believe that society has placed enormous trust in us. It is our duty to search for truth using the highest scientific principles to improve our world.

Thank you for being a part of this scientific community. We truly count on donors like you who make a difference.

I hope you are healthy, happy, and, yes, hopeful as you read this report.

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

P.S. Your voice matters. If you have any questions about the stories in this report, please don't hesitate to contact me at giving@morgridge.org



THE DIFFERENCE YOU'VE MADE

Donors like you play an important role in science and outreach. Thanks to private support, the Morgridge Institute provides resources, training, talent and new tools to help researchers, students and teachers.

Here's a look at some of the milestones made possible by you.

Students discover their science identity

The inaugural **Summer Science Workshop Series** sparked enthusiastic engagement for 102 high school students and 15 high school teachers last year. The new virtual workshop featured Morgridge scientists who illustrated their diverse paths leading to scientific careers.

Thank you for supporting new, innovative science programs to help students in-need.



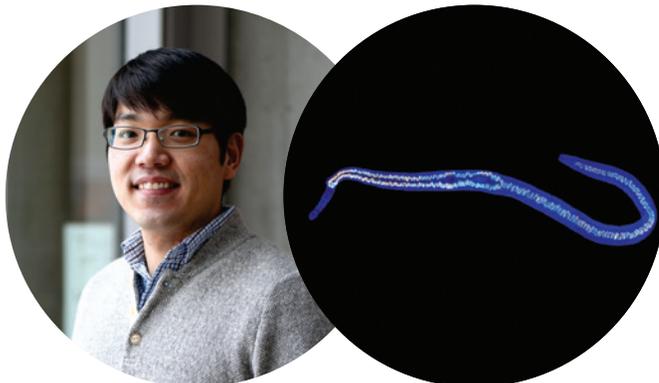
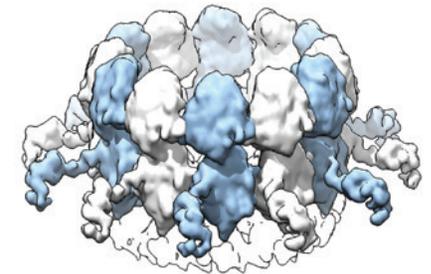
Zooming in on a viral crown

The **Rowe Center for Research in Virology** generated near-atomic resolution images of a major viral protein complex responsible for replicating the RNA genome of a member of the positive strand RNA viruses — the large class of viruses that includes coronavirus and other pathogens.

Thanks to donors like you, scientists are contributing new research to help end the COVID-19 pandemic.



PAUL AHLQUIST



JAYHUN LEE

How parasites evade our immune systems

Postdoctoral Fellow **Jayhun Lee** in the **Phil Newmark Lab** discovered how schistosomes, parasitic worms that infect more than 200 million people in tropical climates, use their esophageal gland to help survive the host's immune defenses.

Basic research can help alleviate human suffering. Donors like you ensure scientists and researchers can work to improve human health.



Scientists get 'fearless' in the face of the pandemic

The new **Fearless Science Speaker Series** features scientists and experts discussing innovative biomedical research. The free, open-to-all series debuted in 2020 and attracted hundreds of viewers across the state and nation.

Thank you for helping scientists engage with the public.

Illuminating T cells to help stop cancer

T cells are the immune soldiers at the frontlines of the battle to infiltrate pathogens that seek to cause disease. The **Melissa Skala Lab** developed an imaging method to measure T cell activity by observing the natural autofluorescence. The method could help assess T cell involvement in cancer treatments or other immunotherapies.

Scientists are developing and testing novel techniques to fight cancer. Thank you for supporting scientists.



MELISSA SKALA



TIM GRANT

New national imaging center could transform medicine

A national research initiative places the **University of Wisconsin–Madison** at the forefront of a revolution in imaging fostered by cryo-electron microscopy and cryo-electron tomography — technologies that can illuminate life at the atomic scale. The NIH grant is providing \$22.7 million to create a national research and training hub.

The Morgridge Institute is recruiting new world-class scientists like Tim Grant, a cryo-em expert, with support from donors like you.

THE HEART OF THE MATTER

THOMSON LAB LOOKS TO MAKE MAJOR HEALTH IMPACT WITH ARTERY ENGINEERING PROJECT

People suffering from a wide range of health problems need vascular transplants — replacing damaged arteries and veins. Cardiovascular disease accounts for one in every three deaths each year in the United States, more than all forms of cancer combined.

At the Morgridge Institute, stem cell pioneer James Thomson is leading a potentially transformational project to develop a safe and functional cell-based artificial artery that could be pulled from off the shelf and used by vascular surgeons.

“People with diabetes and sclerosis frequently suffer from blockage in

the main arteries in their legs, a debilitating condition that often leads to amputation and even death,” says Thomson. “So far, we have used artificial grafts made of synthetic materials. But as the grafts get smaller and smaller, they fail at a higher and higher rate. And for smaller arteries like in the heart, they aren’t used at all.”

Producing arteries in the lab requires two essential cell types: endothelial cells, which line the interior of blood vessels, and smooth muscle cells from pluripotent stem cells, Thomson says. In 2017, the Thomson Lab was able to generate and characterize endothelial cells. Now, its latest research focuses on the smooth muscle cells. Healthy smooth muscle cells need the ability to contract so they can distribute blood throughout the body and regulate blood pressure.

The lab is developing scaffolds from natural and synthetic materials to provide structure and shape for the artery. UW–Madison biomedical engineer Naomi Chesler is working on a bioreactor that provides an environment in which the arterial cells can grow around the scaffolding.



“There are still challenges, such as the body rejecting artificial arteries, and there is also a risk of cancer, so we have a lot of work to do,” Thomson adds.

The lab has discovered a small molecule, known as RepSox, that has the best potential to produce cells with the properties that allow arteries to bend and stretch. The characteristics that make RepSox good for differentiating smooth muscle cells also make it a desirable drug candidate to reduce risk of post-surgery complications. “We are now seeing some hopeful results with peripheral artery disease,” Thomson says.

Thomson adds that there is similar work taking place in Europe where

they remove a vein, culture the endothelial cells for about a month, and then line the artificial vessels and put them back in, and they work about as well as veins.

The lab is hoping to create tissue with cells banked from a unique population of people who have genetic characteristics that help circumvent rejection. It has been estimated that about 100 different cell lines from this rare population would be enough to cover a majority of the U.S. population.

“If we can replace those cells in a way that is tolerated, it’s probably going to work,” Thomson says. “My confidence level is very high.”



ONLINE FIELD TRIPS BRING SCIENCE TO THE STATE

MORE THAN 28 FIELD TRIPS WILL HELP STUDENTS EXPLORE SCIENCE

During the spring semester, high school students at KM Global School will take a field trip to the UW–Madison, where they will turn an Easter egg into a little generator.

But the students won't exactly be in the lab at the university. Instead, they'll log online and participate in a Zoom classroom where they'll meet face-to-face with scientists from the UW Materials Research Science and Engineering Center (MRSEC) Education and Outreach Group.

The students will build triboelectric nanogenerators using a bouncy ball, an Easter egg, aluminum foil, clear office tape, a few wires, and an LED light.

That activity is part of more than 28 field trips organized by the Discovery Outreach team this spring with nine school districts across Wisconsin in Beloit, Fish Creek, Madison, Milwaukee, Medford, Muskego, Oconto, Racine, Wales, and other locations statewide through the Upward Bound/Forward Service Corporation.

Field trip workshops are geared toward K-12 students of all ages with activities like the triboelectric nanogenerators, but also "Finding Buried Treasure" with a

fossil activity led by the UW Geology Museum, and "Meet the Lab: Cancer Detectives – Superpowered by Laser Microscopes" led by the Melissa Skala Lab at the Morgridge Institute where students uncover some of the patterns researchers use to find new cancer treatments.

For more than ten years, the Field Trip Program at the Discovery Building has brought students and teachers to Madison, for a day of activity and exploration. But when the COVID-19 pandemic shuttered on-campus outreach activity, the Discovery Outreach Team had to get creative (which is a job they are already very good at).

It was clear last spring that the pandemic was in for the long haul. But the team wasn't discouraged. They honed an online approach that is engaging, inspiring, and fun.

"If students can actually meet a scientist and hear what their favorite color is, or where they went to school — and maybe they're from your same rural hometown — that's the impact that we are so proud to make," says Val Blair, senior outreach coordinator at the Morgridge Institute.



Everyone is quick to point out that in-person field trips to campus are the most impactful experience for students — the trip itself, the hands-on experience, and the lab spaces always bring a 'wow' factor.

"Bringing kids to campus makes them feel like this could be where they could go someday," says Anne Lynn Gillian-Daniel, education director at the MRSEC.

But until it's safe to return, the Discovery Outreach team is bringing science online.

One way is to create a "shared experience" for each field trip. That may include a kit mailed to each classroom with materials for building nanogenerators, or it may be a video

tour of a researcher's lab, or even a link containing images from cancerous tumors collected off a microscope.

The Discovery Outreach team can't entirely replicate the impact of hands-on science, but this spring semester is still packed with science.



SERVING UP SCIENCE THIS SUMMER

ONLINE WORKSHOP WILL HELP STUDENTS AND TEACHERS AGAIN THIS YEAR

Temperatures dipped below zero in February, but the Discovery Outreach team had summer on their minds.

Typically, the team would be hard at work planning an in-person, on-campus Rural Summer Science Camp. The camps, which have run for 14 years, invite 75 high school students and 15 teachers to the UW–Madison campus to dig into a week of hands-on science.



But during the COVID-19 pandemic, the Discovery Outreach team pivoted — quickly — to create a new, digital experience in 2020: the Summer Science Workshop Series.

And the workshop series worked. It worked *really* well, says Dan Murphy, outreach and lab manager at the Morgridge Institute.

The workshop brought more than 100 students and 15 teachers “face-to-face” to learn online each week from Morgridge Institute scientists. Over six weeks, the students and teachers clocked 400 engagements.

That success, combined with the uncertainty of the pandemic this year, led the Discovery Outreach to double down on the winning formula—a second year of the online series.

This summer, students and teachers will again hear from scientists on the job. That experience — what the team calls “Your Science Identity” — will illustrate the diverse and personal journeys scientists take in their careers, Murphy says.

“Instead of coming to campus, they’re going to meet a scientist,” Murphy

says. “People have different personal journeys and students can relate to that — that’s something that they could do.”

Summer planning is still underway and school registration just starting, but there will be some new elements this year. The team is planning to create more “shared experiences” such as a pre-activity or a mail kit sent to the students and teachers in advance.

And like previous years, the Discovery Outreach team will be working closely with the Wisconsin Rural Schools Alliance and the Upward Bound program that focuses on underrepresented and first-generation pre-college students.

Since 2007, the Rural Summer Science Camp and the Summer Science Workshop Series have helped nearly 500 high school students from nearly 80 state high schools.

The summer experiences have been offered free of charge thanks to the support of private donors and sponsors, including the Wisconsin Rural Opportunities Foundation, BioForward, the Kathy Smith Fund, and the Melita Grunow Fund.

“Instead of coming to campus, they’re going to meet a scientist. People have different personal journeys and students can relate to that — that’s something that they could do.”

– DAN MURPHY, OUTREACH AND LAB MANAGER

HIGHLIGHTING OUR TOP HONORS

Donors like you ensure world-class scientists and researchers continue path-breaking biomedical research and outreach. Thank you for supporting basic research that will improve human health.

Stem cell pioneer and Morgridge investigator **James Thomson** was named to The Medicine Maker's Power List 2020 for his contributions to advancing the field of medicine to save lives and improve the world.



Jan Huisken, medical engineering investigator at the Morgridge Institute for Research, was awarded the 2020 Lennart Nilsson Award for outstanding achievements in biological imaging.

OnLume Surgical, a spinoff company originating from Morgridge Institute for Research, received a 2020 Wisconsin Innovation Award. The company, which develops precise fluorescence for image-guided surgery, was chosen for the award from more than 400 nominees.



Morgridge Institute investigator and UW–Madison biomedical engineering professor **Kevin Eliceiri** was elected a fellow by The Optical Society, an honor given to only one in 10 members.

Computer Sciences Professor **Miron Livny** received the 2020 IEEE Technical Committee on Distributed Processing (TCDP) Award for Outstanding Technical Achievement and the 2020 IEEE TCDP ICDCS High Impact Paper Award. IEEE is the world's leading professional organization for the advancement of technology. The awards recognize his contribution to high-throughput computing and the field of distributed systems over the last 40 years.



Morgridge Affiliate **Dominique Brossard** and Morgridge Investigator **Joshua Coon** are 2020 recipients of Kellett Mid-Career Awards, given by the Wisconsin Alumni Research Foundation every year to recognize mid-career excellence.



“The general public really needs to understand the importance of trial and error in the scientific process. It’s one of the reasons we value public engagement so much at the Morgridge Institute, because it gives people a real window into how science is done. When people understand that scientists are constantly building on our often incomplete understanding of how biology works — and that new information tomorrow could change the way we think about something important — we stand a much better chance that they will continue to have confidence in the scientific enterprise.”

– BRAD SCHWARTZ, CHIEF EXECUTIVE OFFICER



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