2019 ANNUAL REPORT

Prepared for the Wisconsin Alumni Research Foundation Board of Trustees

MORGRIDGE
INSTITUTE FOR RESEARCH


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Our partnership with WARF: Infinitesimal images, massive rewards

A decade ago, faculty at UW–Madison recognized that a transformational technology was being born: Cryo-electron microscopy, or cryo-EM for short.

Cryo-EM is a revolutionary imaging technology that, combined with specialized and high-volume computation, allows biologists to see the structure of molecules within cells. The technology now allows scientists to peer into the very surfaces where drugs and proteins interact, or where viruses orchestrate their cellular attacks. Simply, cryo-EM could transform the development and delivery of precision medicine.

This technology set the stage for a decade-long venture at UW–Madison. The Department of Biochemistry took the lead and the Morgridge Institute joined with significant financial and organizational support. This attracted collaborators in the School of Medicine and Public Health, the Office of the Vice Chancellor for Research and Graduate Education, and several other campus units. Now, the fruits of this collaboration will arrive in summer 2020 with the grand opening of the UW–Madison Cryo-EM Research Center in the Biochemistry Building.

Cryo-EM is a fitting theme for our 2019 annual report. You'll find a detailed account of the milestones chronicled by Morgridge Virology Investigator Paul Ahlquist, a key catalyst from the beginning. You'll also learn how the Morgridge investment in cryo-EM goes well beyond financial support to include an invigorating yearlong seminar series and building a computational framework for scientists.

We also recognize that cryo-EM will be essential to the future of Morgridge research.

It's currently the driving force in Paul's work to visualize — for the first time — the molecular structures viruses build to hijack specific functions of host cells. It will also be critical to Metabolism Investigator Dave Pagliarini's need to define various protein functions within mitochondria, including elements that contribute to dysfunction and disease.

In regenerative biology, virtually all actions needed for a cell to move from an undifferentiated to a defined state are happening at the molecular level, so this will expand our understanding of stem cells. And the central theme of our medical engineers is multi-scale imaging, looking at things all the way down to molecules and atoms, and integrating this information to improve healthcare.

It might be tempting to think cryo-EM is a final frontier in biological imaging, but it is only the beginning. Our newest investigator, Tim Grant, is dedicated to dramatically improving the resolution and functionality of this still-fuzzy universe.

In science, of course, there is always the next frontier. And the best scientists should always be poised to explore it.

Brad Schwartz
CEO, Morgridge Institute for Research

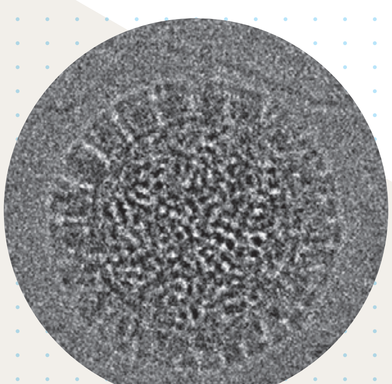
Timeline of the Cryo-Electron Microscope Partnership

Bringing a project to life of the magnitude of the cryo-EM facility — which required almost a decade of work and roughly $16 million in total support — required a community of partners, creativity and determined persistence against many obstacles.

Among many crucial UW–Madison collaborators in these endeavors, the Morgridge Institute especially thanks Brian Fox, Elizabeth Wright, Robert Landick and others of the UW–Madison Biochemistry Department; Marisa Otegui of Cellular and Molecular Biology; Richard Moss, senior associate dean of the UW–Madison School of Medicine and Public Health; and Norman Drinkwater, Steven Ackerman, and Cynthia Czajkowski of the Office of the Vice Chancellor for Research and Graduate Education.

These interactions provide a model for how the Morgridge Institute and UW–Madison can partner on transformational science, and it is already inspiring new joint directions.

BY PAUL AHLQUIST, DIRECTOR, JOHN W. AND JEANNE M. ROWE CENTER FOR RESEARCH IN VIROLOGY



2012 First UW Cryo-Electron Microscope

Bolstered by substantial Morgridge Institute matching funds, a faculty group led by Morgidge Affiliate Marisa Otegui, Morgridge investigators Kevin Eliceiri and Paul Ahlquist and others raised more than $2 million in NSF and other funding for UW's first cryo-electron microscope. This instrument, sited in the Nanoscale Imaging and Analysis Center, has benefited greatly from College of Engineering operations support.

2014 First UW Direct Electron Detector

UW's cryo-EM capabilities were upgraded by adding a radical new EM camera, a direct electron detector, that increased resolution ten-fold. Morgridge investigator Paul Ahlquist obtained nearly half of the $1 million cost from the Howard Hughes Medical Institute, and led efforts that raised the rest from the Morgridge Institute and UW Biochemistry Department, Medical School, Vice Chancellor for Research and others.

2015-16 Cross-Campus Commitment for Major Cryo-EM Expansion

By mid-2017, pledges by Biochemistry Chair Brian Fox, Morgridge Institute CEO Brad Schwartz, the leadership of the Medical School, and others assured funding for the planned new biological cryo-EM facility, to be housed in Biochemistry Department space. Key equipment funded included a state-of-the-art Titan Krios automated cryo-EM microscope, other cryo-EM microscopes for sample validation, and varied sample preparation equipment.

2017 New UW Center for Biological Cryo-EM

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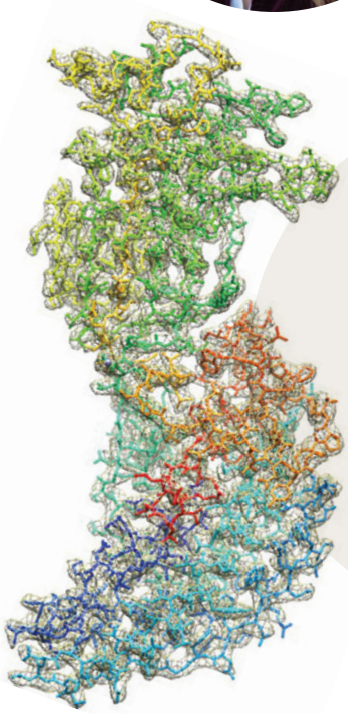
2018-2019 UW Faculty / Morgridge Investigator Hires in Cryo-EM

To balance the new infrastructure, the following faculty were hired through support respectively from the Biochemistry Department, a UW campus faculty cluster hire in molecular virology, and the Morgridge Institute:

2018 – Biochemistry Professor and Morgridge Affiliate Elizabeth Wright was recruited from Emory University to lead the new UW Biological Cryo-EM facility.

2019 – Assistant Professor Robert Kirchdoerfer was recruited to a joint Biochemistry – Molecular Virology faculty position to use Cryo-EM to study the structure and function of selected viral assemblies.

2019 – Morgridge Investigator and Biochemistry Assistant Professor Timothy Grant was recruited to develop advanced approaches in Cryo-EM image analysis.



2019 Complementary EM Capabilities

Growing campus cryo-EM strength was augmented by a successful application to a special HHMI Transformative Technology Competition led by Morgridge Affiliate Marisa Otegui and HHMI investigator Ed Chapman, and formally endorsed by Morgidge and HHMI investigators Phil Newmark and Paul Ahlquist. This $2 million package, funded primarily by HHMI with substantial matching funds from the Morgridge Institute, Medical School and Vice-Chancellor for Research, purchased a 200 kV cryo- and tomography-capable electron microscope being installed in Bock Laboratories, adjacent to Biochemistry. Otegui also led a successful NIH equipment grant for a high-pressure freezer for important types of EM sample preparation. These facilities provide crucial capabilities for cell biology that synergize well with the functions of the new cryo-EM Facility in Biochemistry.

Current Cryo-EM Data Handling and Processing

Since cryo-EM imaging is inherently computational, this research requires highly advanced data handling and processing. To meet these needs, Morgridge investigators Anthony Gitter, Miron Livny and others recently received UW2020 funding to initiate development of a shared pool of graphical processing units (GPUs) that can greatly accelerate computation for cryo-EM image processing and certain other applications. Further critical work to improve data acquisition, storage, transfer and computation for cryo-EM and other structural biology techniques is being led now by Morgridge scientists Brian Bockelman and Miron Livny.

Summer 2020
Opening of the New Cryo-EM Facilities

Guelay Bilen-Rosas: Protecting the most vulnerable patients during anesthesia

Dr. Guelay Bilen-Rosas, Pediatric Anesthesiologist at UW Health

As a pediatric anesthesiologist, I have long been concerned by how difficult it is to detect breathing problems among young patients during anesthesia. We are trusted by parents to protect the love of their lives, a healthy baby, and we're administering very potent medications. It doesn't matter how many years you're trained, it is really a high-risk situation and a lot can go wrong.

These concerns led me to the groundbreaking engineering design work being done at the Morgridge Institute **Fab Lab** led by institute investigator **Kevin Eliceiri**.

Anesthetics or sedatives slowly degrade a patient's ability to protect their breathing. Slowly, structures in the airway start collapsing. The tongue can fall back. Conditions like laryngospasm, the sustained closing of the vocal cords, can impair breathing. Those changes, as we administer anesthesia, are not very easily detected, and they can develop quickly.

These problems are difficult to teach to prospective anesthesiologists, especially in pediatric patients who are being anesthetized with inhalation agents. During this very delicate period, breathing troubles can be subtle, and there is no good way for me to instruct trainees quantitatively about when a patient is reaching a critical point and when early interventions are needed. This is particularly true for children, who by nature of their physiology, are especially susceptible to developing airway changes quickly. Children also have lower levels of respiratory reserves—this makes timely recognition imperative to initiate rescue maneuvers.

I thought maybe there would be some device on the market, like a real-time monitor that would alert us if a patient was deteriorating. But to my surprise, no such device existed.

That led me to the **BerbeeWalsh Prototype Pathway** and the Fab Lab at the Morgridge Institute. I had a vision of what the clinical device would be, but that idea has evolved so much over the years working with talented engineering students and staff engineers such as **Robert Swader**, **George Petry**, and **Ben Cox**.

Our first prototype we dubbed ROAM (Respiratory Obstruction Airway Monitor) and was developed by the biomedical engineering students, who are an amazing group. It was big and clunky. It really looked like a brick.

Over several semesters with input and design expertise from the Fab Lab, we made improvements in the algorithms and interfaces needed to make it work. The machine also has become smaller and sleeker. We now have a touchscreen panel. For the first time, we have a machine that tells us: "Now is the time to intervene. Now is the time to do the measures needed to start troubleshooting." ROAM detects a critical threshold when the patient's breathing goes below safe levels. The device sends audible or visual alarms to the anesthesiologist.

Related to the same clinical problem addressing respiratory deterioration across all patients, my lab is separately developing a novel methodology using ultrasound signaling. I am excited for what's next. We've entered the second phase of our ultrasound project with support from the **WARF Accelerator Program**. Creation of phantom models for our bench test by the Fab Lab has substantially contributed to the collection of important ultrasound data, which was presented for the Phase 2 Accelerator Program Funding.

The Morgridge Institute is a little island of professionals who just thrive by the thought: How can they make things better? Not only for themselves but for the community.

Helen Feltovich:
Reducing the perils of preterm birth

Dr. Helen Feltovich, Obstetrician at Intermountain Healthcare, Utah, and UW–Madison Faculty Member in Medical Physics

As a high-risk obstetrician, I run out of Kleenex in my office every day. Women come to me when they are at risk of a preterm birth, which has recently surpassed infectious diseases as the leading cause of death in children under five years old. This is a critical global problem, yet we still don't have a fix on what's causing it.

A preterm birth is defined as delivery that occurs before 37 weeks, and an early preterm birth is under 32 to 34 weeks. Babies born preterm can have lifelong health problems, such as vision or hearing loss, cardiovascular issues, or cognitive learning disabilities. This is something that touches all areas of society, not just the baby but also their family and their community.

The situation is pretty desperate. Globally the preterm birth rate ranges from about 6 percent to 16 percent, and about 10 percent in the United States. There are some things that can reduce the risk of preterm birth in some women, but they've been around a very long time, like progesterone supplementation. The best thing we have for defining risk for women, which is measuring the cervix, is basically no better than flipping a coin.

Fortunately, an exciting new area of research is emerging. In pregnancy we're dealing with two people, the mother and the baby, and a third entity with a life unto itself called the placenta. Three entire systems are interacting in amazing ways, and we are just beginning to understand the complexities. The National Institutes of Health recently opened up the **Human Placenta Project** to support this kind of research.

Although my clinical practice is primarily with Intermountain Healthcare in Utah, I also have a faculty appointment at UW–Madison in the medical physics department because I can't find the imaging expertise anywhere else in the world to dial down on the very specific problem of imaging the complexities of pregnancy tissues.

I'm working with **Kayvan Samimi** and **Melissa Skala** at the Morgridge Institute to understand what is going on in the placental membranes during pregnancy and delivery. Kayvan is trying to figure out the difference between the membranes that overlay the cervix and the other areas in the uterus to identify tell-tale signs of those membranes that break too early, versus on time or too late. He then wants to design non-invasive,safe imaging technology so that we can look at those membranes inside the uterus during a pregnancy.

"The truth is that babies are dying, and we need smart people to come together and fix this."

My optimism has exploded since working with Kayvan and Melissa because I've seen there are other imaging methods we can use in combination with ultrasound to find out what's going on.

Basic research is the foundation of everything. I consider myself to be an accidental researcher because I've learned how critical it is to work together. The truth is that babies are dying, and we need smart people to come together to fix this. And that's how things happen. It's what grabs you and what steals your heart and what keeps you up at night.

Through my collaboration with people like Kayvan and Melissa at Morgridge, and my very strong partnership on ultrasound with **Tim Hall** at the University of Wisconsin, for the first time I'm confident that we'll see progress in my lifetime. I may still need plenty of Kleenex in my office, but at least I'll be able to say, "This is what we're going do to find out what's going on with you."

2019 MILESTONES

Progress in the quest for bioengineered transplant arteries

Morgridge scientists are working toward a dream of using stem cells to create artery banks with readily-available material to replace diseased arteries during surgery. Their recent work highlights a better way to grow smooth muscle cells. "We decided to focus on blood vessels because cardiovascular disease is a major cause of death worldwide," says investigator James Thomson. "And this work also has implications beyond making vessels for transplantation; it's sort of a stepping stone to more advanced tissue engineering."

Human developmental clock mimicked in a dish

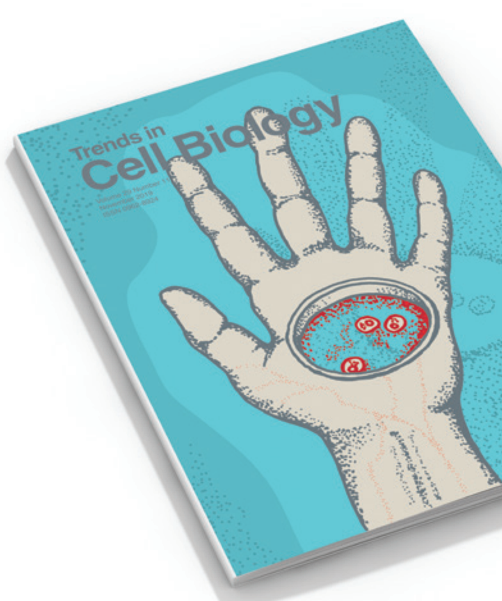
A Morgridge regenerative biology team has created a first-ever human model for developmental timing: A "clock in a dish." The team programmed human stem cells into a very early state, then, using CRISPR technology, they edited a specific gene known to be connected to timing so it would illuminate when expressed. The result: The cells growing in a dish produced a burst of color every five hours, precisely when those faithful oscillating genes repeat their instructions.

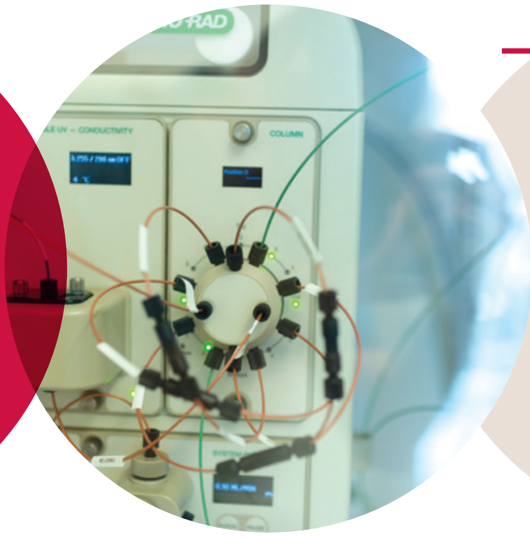
Metabolism's role in the immune system

The immune system is one of the body's most important defenders. With the growth of immunotherapies to treat diseases, particularly in cancer treatments, scientists need to better understand this complex system. A team led by Morgridge investigator Jing Fan demonstrated how changes in metabolism can regulate the different functional states in macrophages — key cells in the immune system — over the course of an immune response.

How tapeworms get 'ahead' in life

Tapeworms are famous for the enormous lengths they reach. Morgridge scientist Tania Rozario found an essential clue to this process: The stem cells that make regeneration possible were in close proximity to the worm's head. This insight helps explain how tapeworms grow in their human and animal hosts, and could be helpful in finding new ways to target the parasites.





A better understanding of lipids and health

Oil and water don’t mix. However, for our largely water-filled cells to thrive, nature needs to devise clever ways to make and move around the lipids — fat and oil-like compounds — that comprise membranes and other cellular parts. One such lipid, coenzyme Q(CoQ), is essential for energy-producing pathways in mitochondria. Scientists in the Pagliarini Lab combined structural, biochemical and computational approaches to study COQ9, a protein vital to the production of CoQ.

Can ‘smart toilets’ be the next health data wellspring?

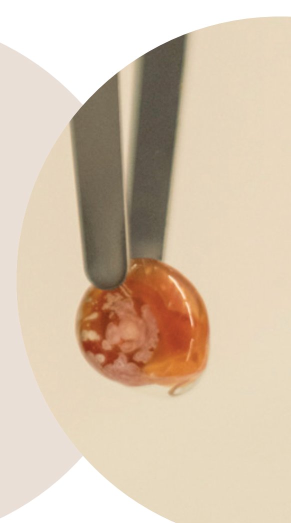
Wearable, smart technologies are transforming health, but the humble toilet may have potential to outperform them all. That’s the conclusion of a team led by Morgridge affiliate Josh Coon. His team is working to put the tremendous range of metabolic health information contained in urine to work for personalized medicine. The team completed a study that measured the metabolic signatures of urine samples using gas chromatography and mass spectrometry, and found striking results that correlate with daily life patterns, such as exercise, sleep, diet and alcohol consumption.

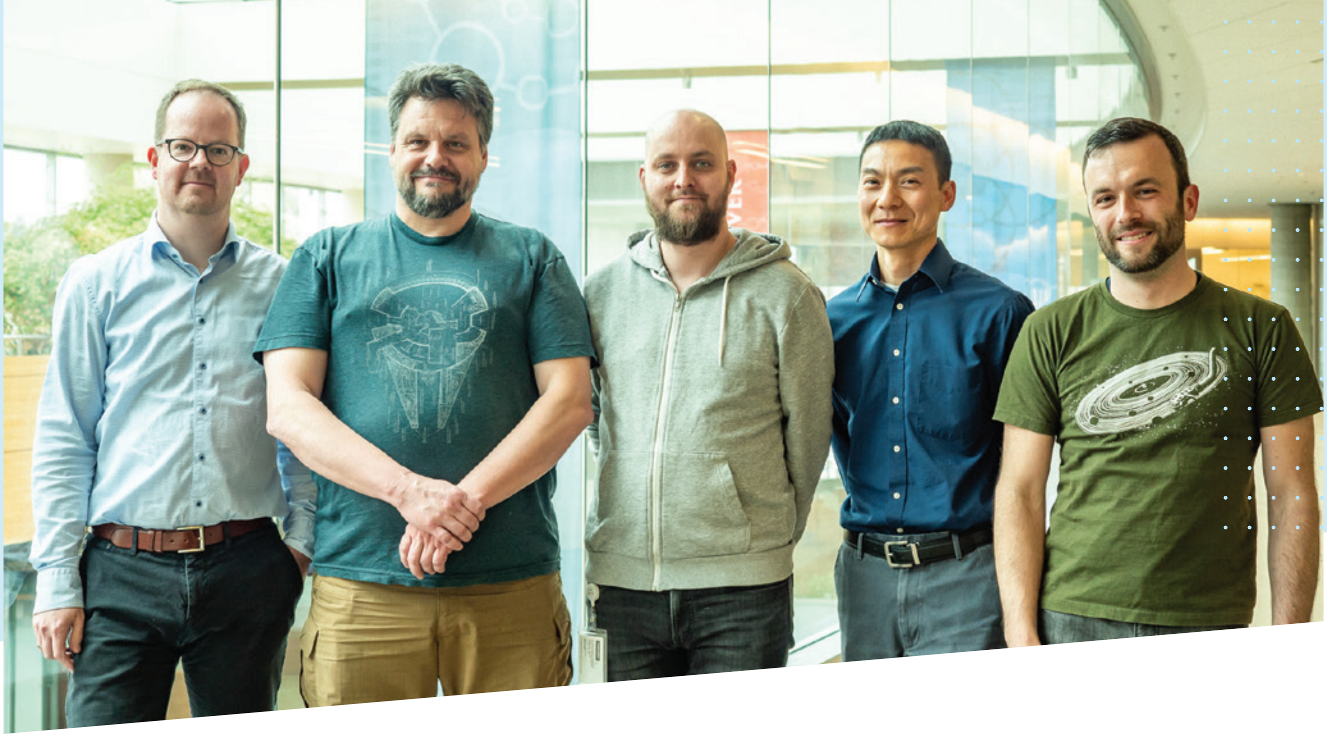
Peering into a more human petri dish

Cell culture media, the cocktail of chemicals and nutrients that keep cells alive in a dish, have been an essential tool of biology for more than 70 years. Remarkably, the composition of these potions hasn’t changed much. But Morgridge investigator Jason Cantor wants to make cell culture media more human. He’s one of the national leaders in the rise of “physiologic media,” and has perfected a media that painstakingly recreates many characteristics of adult human plasma.

A new way to fight schistosomiasis

A team led by Morgridge investigator Phillip Newmark isolated a natural chemical that acts as a potent kryptonite against schistosomes, the parasitic worms that burrow through human skin and cause devastating health problems. The chemical, which paralyzes the schistosome, is produced by tiny organisms called rotifers. The discovery could lead to new ways to fight the neglected tropical disease schistosomiasis, which affects more than 240 million people in Africa, Asia and parts of South America.





Flamingo microscopy project migrates east

While flamingoes are normally non-migratory birds, the Wisconsin-inspired portable microscopes of the same name are meant to fly anywhere in the world. In 2019, they found their first foothold among research labs along the U.S. East Coast.

Launched in 2018 by Morgridge medical engineering investigator Jan Huisken, the Flamingo Project is meant to bring powerful microscopes to biology labs — rather than the other way around. The Morgridge team is custom building light sheet microscopes called "Flamingos" designed to travel between biological research labs and serve as accessible, shareable tools for demanding imaging needs.

The Chan Zuckerberg Initiative, which has a program supporting innovative medical imaging, provided funding in spring 2019 to station Huisken Lab scientist Michael Weber in the Boston area to foster connections with researchers. By summer, the first Flamingo traveled to the East Coast and by year's end, Flamingo microscopes were in use by researchers from more than a dozen labs at Harvard University, Marine Biology Laboratory, Duke University and Boston Children's Hospital.

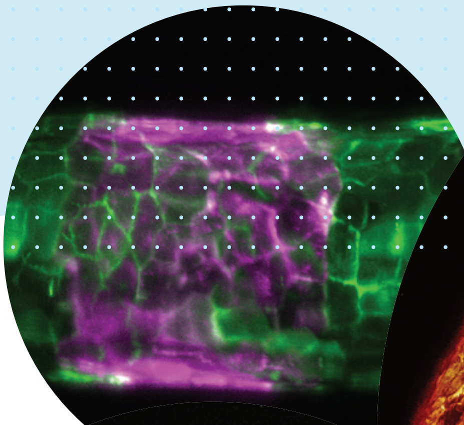
"Flamingo gives biologists with exciting imaging ideas quick and straightforward access to modern microscopy technology, without the need for their delicate specimen to be relocated," says Weber.

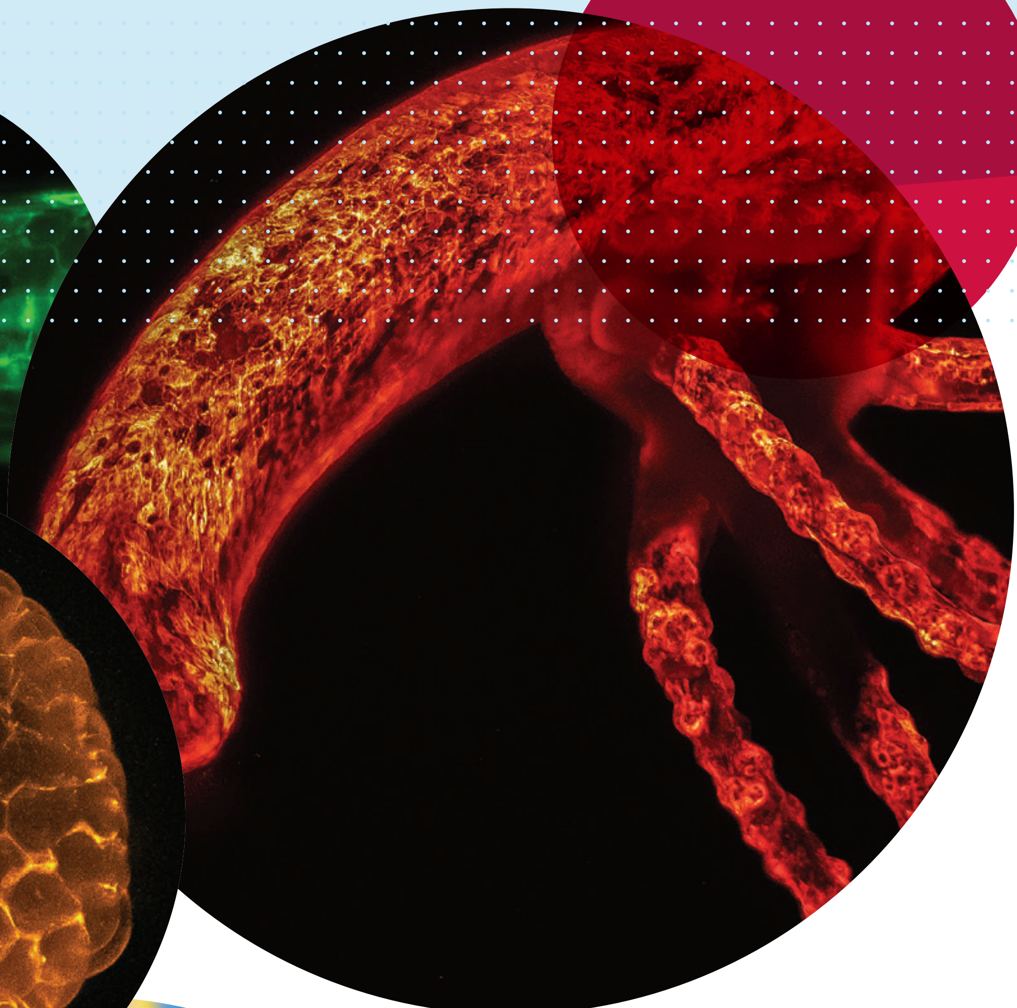
Scientists have used the Flamingo to record image data in a variety of specimens, including zebrafish, hydra, arabidopsis and several worm species. Researchers have looked at nervous system function and structure, notochord development, early embryonic development, adult bone structure and stem cell migration, among others.

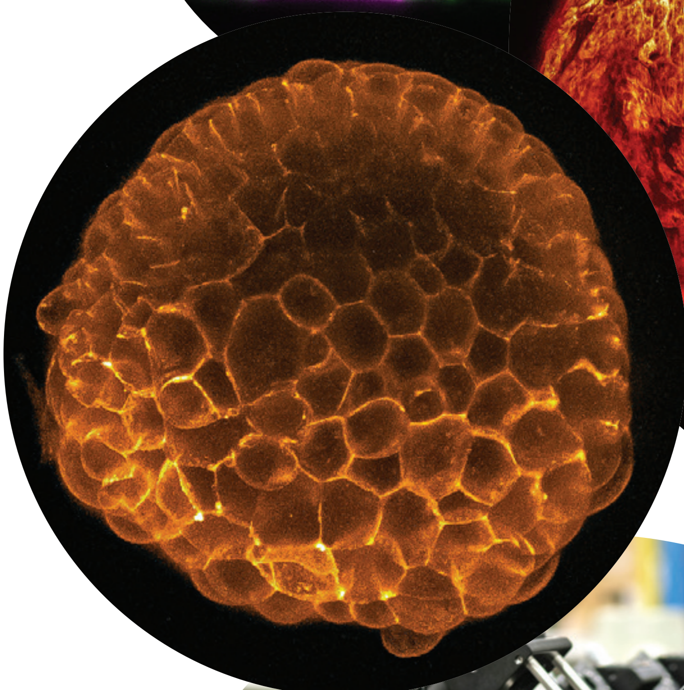
Currently, the lab is working on a complete overhaul of the software user interface and creating new hardware that can accommodate a larger variety of specimens and imaging applications. Some big names in commercial microscopy, such a PCO, Nikon, PI and Toptica, have joined forces with the Huisken Lab to build and improve the microscopes.

"Normally a lab like mine couldn't purchase equipment like this since it's too expensive. We'd need to try to find someone to share and visit their facilities. But that's not practical with our live samples. It's not easy to carry animals around to places where microscopes are and keep them alive and healthy. It's great and ideal when a high-end imaging tool can come visit your lab. Not having to travel is a big advantage, and our most important reason for using the Flamingo."

— DUYGU ÖZPOLAT, MARINE BIOLOGICAL LABORATORY, WOODS HOLE, MASS.







FLAMINGO

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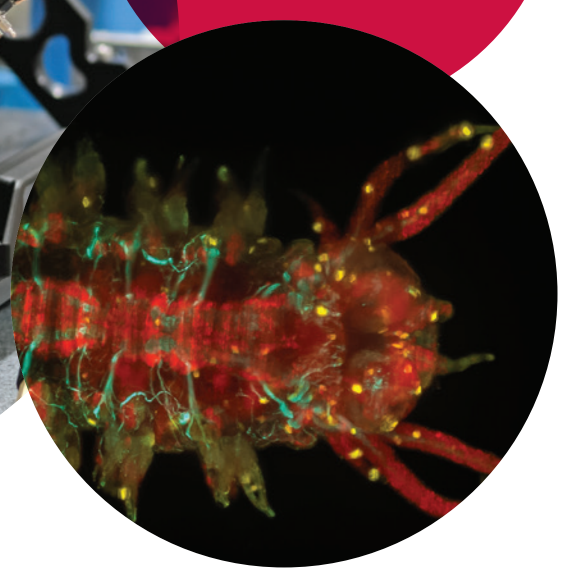
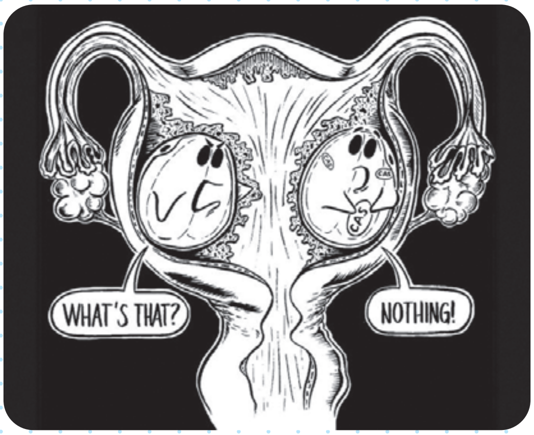


Bringing data and ethics to the mainstream classroom

Pilar Ossorio

Ethics in data science is still in its infancy as a curriculum, yet Pilar Ossorio's Ethical Conduct of Research for Data Scientists course is on the cutting edge.

Now in its fourth year, it has become a permanent fixture as an ethics elective in UW–Madison departments of Biostatistics and Medical Informatics, Population Health Sciences and Veterinary Medicine. With the increased interest, Ossorio's team will need to cap enrollment at 25 students per semester to maintain the course's unique flavor.



Five prizes were awarded in the second annual Morgridge Ethics Cartooning Competition, a contest that invites participants to make a cartoon on any ethical issue arising in or from biomedical research. The competition drew 65 entrants from more than 32 different departments and programs at the University of Wisconsin-Madison and affiliated research institutions.

The top prize went to Rush Dhillon, a comparative biologist working with the John Denu Lab at the Wisconsin Institute for Discovery (WID). Dhillon's cartoon, featured here, depicts twin embryos, one of which is furtively hiding Cas proteins within it, implying that it has been gene edited using the CRISPR technique. This refers to the scientific bombshell that broke in late 2018 when a Chinese scientist announced the creation of gene-edited twins.

"Our course is taught through a very participatory case discussion method," Ossorio says. "We are also working diligently to create instructor materials to accompany the online dissemination of our cases, since people who teach our materials may not have a bioethics or science policy background."

Ossorio's team spent a couple of years interviewing data scientists, including at Morgridge, to understand the kinds of ethical issues they confront. For example, understanding good data management is critical for reproducibility of science, involving such questions as: Are we backing up our data sets properly? Can we audit them as we need to?

Another issue that came up involves credit when publishing research. Computer scientists and biologists have slightly different conventions on who should be listed as an author and what kind of papers should be cited. People are self-examining their assumptions and having those conversations.

From their research the team built case studies for class discussion. Each case includes several ethical issues, such as conflicts of interest in research, or understanding problems like falsification, fabrication, and plagiarism and how to avoid them. For 30 percent of their grade, students are required to identify and analyze a data ethics issue in their everyday experience. Thanks to this assignment, a big project on campus is revising its policies for how it manages some of its data.

Word is spreading, and now the class draws from engineering, the medical school and biophysics, to name a few. It helps students feel comfortable talking about such issues, and gives them the ethical language and the framework for analysis.

The pinball wizards of bioinformatics

Anthony Gitter

Walk into the second-floor teaching labs at the Discovery Building, and you'll find an unusual gizmo: A customized, tabletop pinball machine complete with an LCD screen and data-collecting mechanism.

So what does pinball have to do with science teaching? Enter Anthony Gitter and his team of pinball science wizards.

This pinball machine is an important part of a research project being conducted by Gitter, a Morgridge principal investigator in the John W. and Jeanne M. Rowe Center for Research in Virology. Gitter's group investigates how computational tools can be applied to problems in human health and biology.

"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."

In 2016, the National Science Foundation (NSF) funded Gitter's investigation into this complex protein interaction. The NSF grant also supports broader impacts to connect research to the public, and Gitter decided to focus on inspiring children's understanding of computational thinking.

Gitter sought the expertise of the Discovery Outreach team, who help scientists design and implement plans to accomplish their broader impacts goals. Travis Tangen, education and outreach manager at WARF, took the lead on the project, enlisting undergraduates Matias Figari and Max Schleck to bring the project to life. After starting with robotics-based ideas, Matias and Max actually came up with the idea for a pinball machine.

"Essentially, 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 says.

While the machine is still in development, the team hopes to complete 15 laser-cut models of the Protein Pinball machine that are stand-alone and tabletop-sized, making them easy to set "out and about" at the Discovery Building. Early versions have been beta-tested and they will soon be on hand at events such as Saturday Science and the Wisconsin Science Festival.

"I think all of us on this project really are striving to make something marvelous and impactful, and that requires a little bit of ingenuity and extra work," Tangen says. "And that's what's been happening."

Taking science to society

Since 2011, Discovery Outreach has collaborated with researchers across UW–Madison to support broader impacts.

'Broader impacts' is a National Science Foundation term for research outcomes that go beyond advancing a field and focus on benefits the research brings to society more generally. This may include bringing technology to the marketplace, forming companies, training, community outreach, K-12 engagement, improving STEM education, and increasing opportunities for underrepresented students.

Beginning in 2017, Discovery Outreach became a collaborative NSF research site to understand how broader impacts activities could align more integrally with long-term research priorities. This project provides support for materials, staffing and other resources to engage more meaningfully with faculty.

"To date, we have provided letters of support to more than 70 researchers," says Laura Heisler, Discovery Outreach Director. "Of these, 25 projects have been funded and 17 of those remain actively funded. More than a dozen decisions are pending. All told, these grants have resulted in more than $15 million in funding to UW–Madison."

MORGRIDGE

2019 NEWSMAKERS

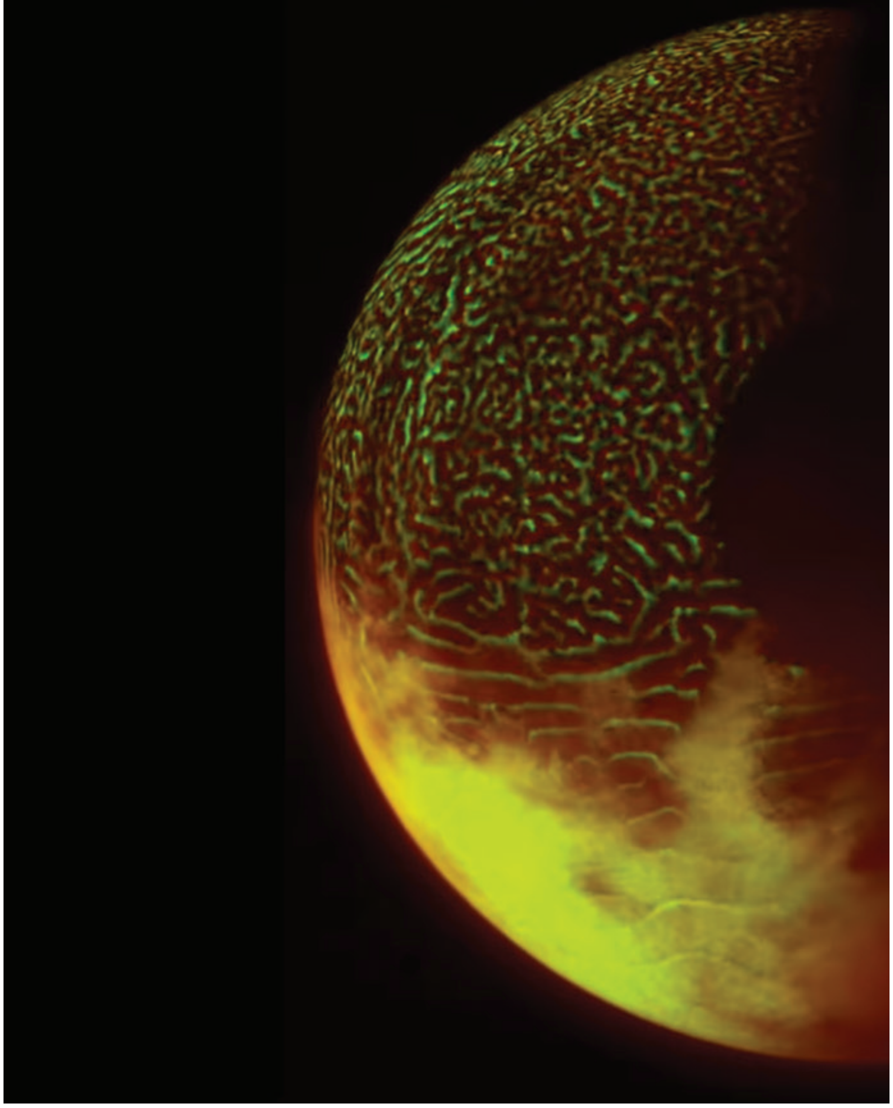
- **Tim Grant** became the newest member of the Morgridge principal investigator team in July. Grant, a pioneer in Cryo EM imaging, comes from the Howard Hughes Medical Institute's (HHMI) Janelia Farm Research Campus. He will begin in March 2020 as a Morgridge virology investigator and assistant professor of biochemistry at UW–Madison.

- **Jacquelyn Fredrick**, a longtime executive with Blood Center of Wisconsin, one of the nation's leading providers of blood health solutions, joined the Morgridge Board of Trustees in June.

- **Melissa Skala**, principal investigator of medical engineering at Morgridge, earned recognition in 2019 as a fellow of both the American Institute for Medical and Biological Engineering (AIMBE) and SPIE, an international society for optics and photonics.

- Morgridge Metabolism investigator **Dave Pagliarini** won the Earl and Thressa Stadtman Young Scholar Award given by the American Society for Biochemistry and Molecular Biology (ASBMB). Pagliarini also received a prestigious WARF H.I. Romnes Faculty Fellowship, which recognizes early career achievement.

- The Rural Summer Science Camp received a boost in March from BioForward, an association representing more than 200 bio-health companies in Wisconsin. The organization directed $2,500 in proceeds from its annual member meeting to support the camp. In addition, Morgridge CEO Brad Schwartz was elected to the BioForward Board in December.



- **Jiaye "Henry" He**, a member of the Jan Huisken Lab, won for a second straight year in the annual UW–Madison "Cool Science Image" awards. He's entry, with UW–Madison biologist Ani Michaud, showed a time-lapse look at waves of proteins cascading across a single frog cell.

- **Tom Still**, president of the Wisconsin Technology Council (WTC), focused his statewide business column in July on a novel eye research partnership between Morgridge and the Medical College of Wisconsin (MCW). WTC featured the collaboration between Morgridge investigator Melissa Skala and MCW scientist Joe Carroll at its July luncheon meeting in Milwaukee.

- As 2019 Nobel Prize announcements unfolded in October, Morgridge CEO Brad Schwartz reflected on his all-time favorite winner. "Howard Temin represented what society expects from us and had the characteristics that make society willing to fund our work," Schwartz wrote in a *Scientific American* guest column. "People want scientists who get up every morning committed to finding the truth."

- **Danielle Lohman**, a postdoctoral fellow in the Dave Pagliarini Lab, began a prestigious fellowship in January sponsored by the American Association for the Advancement of Science (AAAS). She is stationed at the State Department in Washington, D.C. and focuses on issues related to U.S. science policy.

- Morgridge Trustee **Tom Krummel**, co-director of the Stanford Byers Center for Biodesign at Stanford University, delivered the keynote address in October for WARF Innovation Day at Monona Terrace. Krummel described 25 years of fostering biomedical innovation in the Silicon Valley. "Does the Valley have a secret sauce?" he asked an audience of about 500. "Nope, it doesn't. It does have a unique ecosystem of intellectual capital, venture capital, risk capital, a flat hierarchy, and a meritocracy. That sounds a lot like Madison, Wisconsin to me."

‘Locally sourced science’ on tap with Sen. Tammy Baldwin

Modern science and childhood memories combined in October for U.S. Sen. Tammy Baldwin, who visited a Morgridge Institute lab of Dave Pagliarini carrying on the inspired legacy of her grandfather, David E. Green.

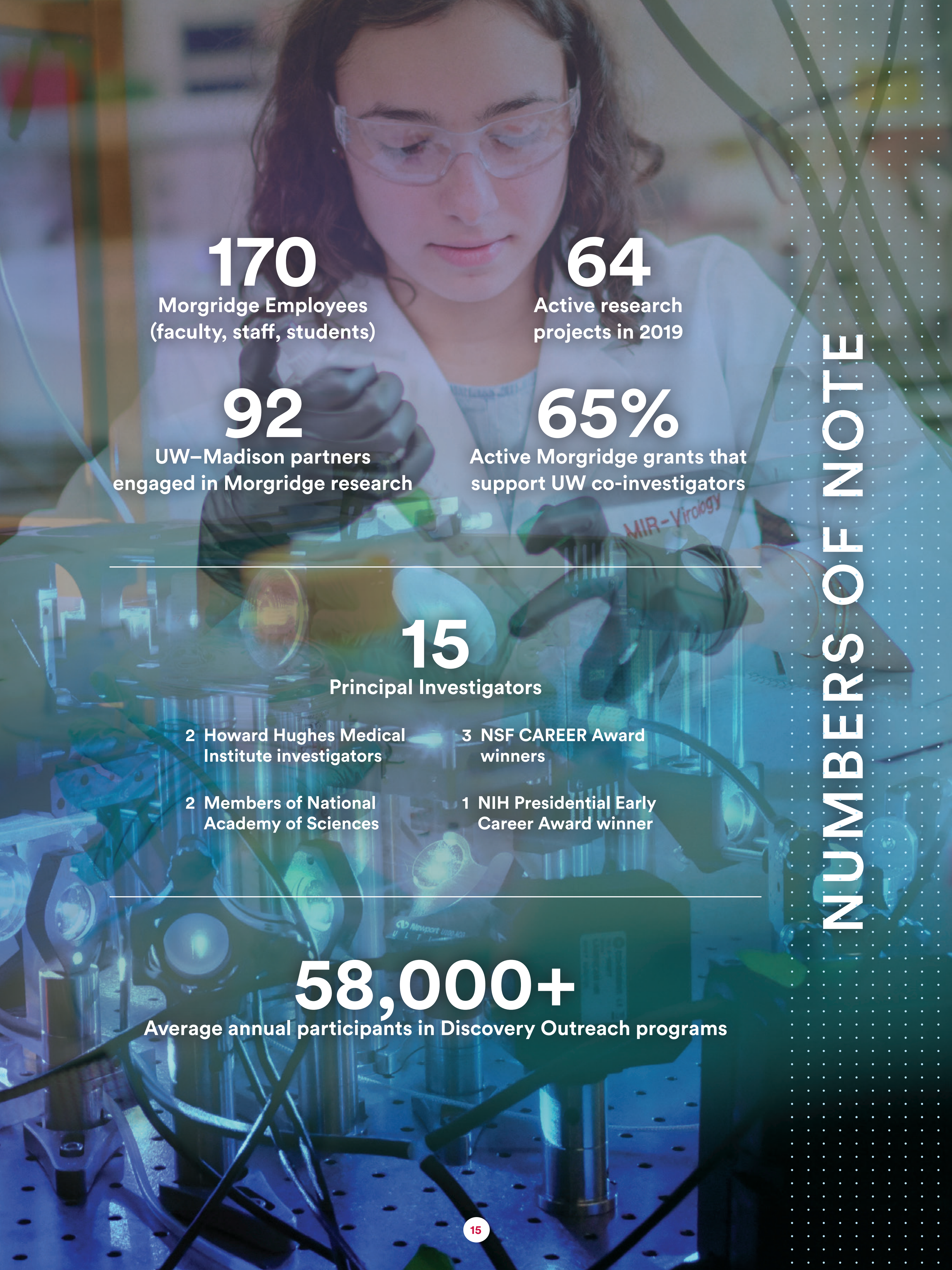
Baldwin, who was raised by her grandparents in Madison, spent many days visiting her grandfather’s lab just a few blocks away from the Morgridge Institute, at the UW–Madison Enzyme Institute. Green was the original director of the Enzyme Institute and led the program through the golden years of metabolism science, where one fundamental discovery after another was coming out of UW–Madison.

Commonly referred to as the “chemistry of life,” metabolism is the process by which the body uses food and oxygen to produce the energy and chemicals needed for essential functions and processes that constitute life. The science is having a renaissance today at UW–Madison and Morgridge.

In October, Baldwin took the opportunity to tour the Pagliarini Lab and hear about current projects, including work on coenzyme Q, lipids and mitochondrial disorders.

“There’s a lot of talk in the culinary community about locally sourced ingredients,” Pagliarini says. “This is locally sourced science. The fact that we’re building upon discoveries made just down the road is very motivating and meaningful to us.”

Baldwin says of the visit: “In any instance I would get excited about a chance to see some of the incredible cutting-edge research that is going on at UW–Madison. This is super special because of the story of my grandfather’s contribution to what is happening here in the lab right now.”



NUMBERS OF NOTE

170
Morgridge Employees (faculty, staff, students)

64
Active research projects in 2019

92
UW–Madison partners engaged in Morgridge research

65%
Active Morgridge grants that support UW co-investigators

15
Principal Investigators

- 2 Howard Hughes Medical Institute investigators
- 3 NSF CAREER Award winners
- 2 Members of National Academy of Sciences
- 1 NIH Presidential Early Career Award winner

58,000+
Average annual participants in Discovery Outreach programs

Principal Investigators

Paul Ahlquist, John W. and Jeanne M. Rowe Center for Research in Virology

Jason Cantor, Metabolism Research Group

Kevin Eliceiri, Medical Engineering Group

Jing Fan, Metabolism Research Group

Anthony Gitter, John W. and Jeanne M. Rowe Center for Research in Virology

Jan Huisken, Medical Engineering Group

Miron Livny, Core Computational Research

Pilar Ossorio, Bioethics Scholar in Residence

Phil Newmark, Regenerative Biology Group

Dave Pagliarini, Metabolism Research Group

Melissa Skala, Medical Engineering Group

Ron Stewart, Regenerative Biology Group

James Thomson, Regenerative Biology Group

Faculty Affiliates

Dominique Brossard, Discovery Outreach

Josh Coon, Metabolism Research Group

John Denu, Metabolism Research Group

Rick Eisenstein, Metabolism Research Group

Elizabeth Meyerand, Medical Engineering Group

Dietram Scheufele, Discovery Outreach

Andreas Velten, Medical Engineering Group

Justin Williams, Medical Engineering Group

Elizabeth Wright, John W. and Jeanne M. Rowe Center for Research in Virology

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