BIO

A publication for alumni, donors and friends of the
COLLEGE OF BIOLOGICAL SCIENCES at the UNIVERSITY OF MINNESOTA

ALL SYSTEMS GO

Global change biology research is providing unprecedented insights into our impact on the planet.

A colorful quest

CBS undergraduate Leah Hallett searched for plants that produce colored nectar.

Finding colored nectar sounds simple, and for pollinators it likely is. For humans, not so much. It takes close examination and an eye for detail. Leah Hallett has spent hours in the CBS Conservatory nectar spotting. So far, the undergraduate has identified a handful of these flo al renegades.

"We're trying to see how colored nectars influen e pollinators and what kinds of interactions they have between each other," says Hallett. "We also want to determine what the pigments are in these nectars."

Most plants produce clear nectar or no nectar at all. Nectar functions as a reward for pollinators, a "thank you" for doing the work of moving pollen around. Not a lot is known yet about why plants produce colored nectars, but Clay Carter, a professor in the Department of Plant and Microbial Biology and Leah's advisor on the project, is looking into it.

The fir t step is finding the plants with this relatively unique type of nectar. "There are only 68 species known to make colored nectars, but since nectar is often overlooked as a trait, we figu ed that there are likely many more out there," says Carter. "Leah found several 'new' species with colored nectars in her fir t hour or so of looking in the Conservatory's collection. To me, this suggests there are hundreds if not thousands of species out there with colored nectars, many of which likely have novel chemistries and associated plant-pollinator interactions." *—STEPHANIE XENOS*

PHOTO BY CLAIRE WILSON

INSIDE THIS ISSUE

BIO Spring 2022

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Aiming for authenticity

Giving students the chance to learn biology by doing biology means ensuring access to meaningful research experiences.

Earlier this spring, we welcomed scholarship and fellowship recipients along with alumni and supporters to campus for our annual recognition dinner after more than a two-year hiatus. The evening had many highlights including a singalong of the Rouser led by Professor Emeritus John S. Anderson. For me, what resonated most were the inspiring words of our keynote speaker Dr. Cheryl Quinn, an alumnus and longtime supporter of the college along with her spouse Dr. Robert Buck.

Cheryl is an accomplished scientist and biotechnology leader whose curiosity, creativity and commitment to learning propelled her to the top of her field She talked about the value of a rigorous biology education and about how the most important thing students learn is, in fact, how to learn – and keep learning – for life.

Considering the rapid pace of change in the biological sciences, this seems like a particularly important insight and one that is embedded in the college's approach to undergraduate education. We are constantly adding to and refining our knowledge of the living world, which is why CBS is committed to teaching students to be active participants in the scientific p ocess. As Cheryl pointed out in her speech, learning facts and techniques isn't enough. Innovation requires the ability to critically evaluate new information rather than falling back on existing assumptions.

Learning requires doing. Going back to the launch of our Foundations of Biology courses nearly two decades ago to the opening of our active learning lab in 2020, the College has moved steadily in this direction and away from the passive, prescriptive style more common in the past. We know hands-on research experiences are vital to learning biology by doing biology, and as a world-class public research university, undergraduate research should be a given.

Here at CBS, our goal is to provide opportunities for students to engage in authentic research experiences in which they spend time in a faculty lab alongside seasoned researchers. We know research experiences are incredibly important and provide students with valuable opportunities to directly participate in the scientifi process. Last summer, we launched the Dean's Research Program to close the gap for students who may not have had that opportunity. The response from students and faculty was overwhelming.

The Dean's Research Program provides paid positions for students in research labs. By providing financial support we level the playing field or students with financial nee and provide a pathway for transfer students who must fit esearch experiences into a shorter timeframe.

As one supporter of the program commented: "Doing undergraduate research was immensely influentia in my career path. I could not be more excited to help make research more accessible to all students." With support from the CBS community we hope to grow this program in the years to come and ensure an authentic research experience for every student.

VALERY FORBES, Dean
College of Biological Sciences

SCISPARK 2022

WOMEN IN SCIENCE AT CEDAR CREEK

Join us for an evening of bio-inspired activities, short talks and community.

From examining microscopic life to deciphering images from NASA satellites, Cedar Creek Ecosystem Science Reserve researchers study how nature is responding to a changing world. Many women scientists have shaped Cedar Creek's groundbreaking research efforts. Join us for an evening of celebrating the contributions of women in science — past and present — with research ties to Cedar Creek.

The event is family-friendly, great for kids and adults alike, and free!

JUNE 2 AT THE BELL MUSEUM

DOORS OPEN	5 p.m.
ACTIVITIES & FOOD	5-6:15 p.m.
LIGHTNING TALKS	6:30-7:30 p.m.

z.umn.edu/scispark2022

A flo a foray

The CBS Conservatory's Botany Bus brought plants to a local elementary school for a lesson in plant immunity.

The scales of one red pine cone lie open, while the scales on another are sealed tightly shut. Just asked how the cones differ, a group of elementary students sit deep in thought. Finally, a young girl tentatively raises her hand. "Do they open up to let all the seeds out when they're ready?" She grins at finding out she's right, and the boy next to her cheers.

This was the scene at Webster Elementary earlier this year. The CBS Conservatory & Botanical Collection's Botany Bus returned to local schools after a pandemic-driven hiatus. The Botany Bus brings plants and lessons to local schools, cutting out the costs and logistics of bussing students to the Conservatory.

During the visit to Webster, Conservatory staff and member of Professor Fumiaki Katagiri's plant immunity lab, led 30 students through three stations. A highlight included students donning lab coats, gloves and goggles to complete an experiment. Students infected plants with a bacterium used to study plant immunity. The classes kept the plants and over the following days monitored the plant symptoms as the bacteria caused leaves to develop brown spots.

FIELD BIO BOOM!

Enrollment in field biology courses at Itasca Biological Station and Laboratories hit a record high this year. The station will buzz with students collecting samples, listening to bird calls and more this spring. Classes include field mic obiology, mycology, ornithology, animal behavior and mammology.

TO MARKET WE GO!

Market Science will return to the farmers markets across the Twin Cities again this summer! You will fin our scientists at the Midtown Farmers Market, Richfield armers Market and at the Minnesota State Fair! For a full schedule and list of topics, visit the events calendar at the bottom of the homepage.

More information at **marketsci.org**

Making their case

The first annual CBS Case Study Competition asked teams of students to work collaboratively to tackle health and environmental issues.

Dozens of students gathered to research, collaborate and present for the fir t annual CBS Case Study Competition this January. The event aimed to foster social responsibility, problem solving and communication by providing an opportunity to tackle real-life issues.

Students organized themselves into teams and then selected from one of two case studies — one option centered on health inequities and the other on an environmental challenge. Teams researched the topic, developed a solution and pitched their plan to a panel of judges all in a few short hours.

The winning team in the health category proposed a multi-pronged solution to addressing breast cancer mortality differences through improved diagnostic access, ensuring access to healthy food and a focus on community education. The winning team in the environment category proposed that no additional dams be constructed due to the negative impacts they have on the local community and environments and encouraged that funds instead be used to build flood- esistant, pursue other alternative energy options and promote ecotourism to the region.

"We're always looking for opportunities to engage students in conversations and experiences that explore the intersections of the life sciences, leadership and community connections," says Aryn Lipnicki, assistant director for student engagement and the event organizer.

They're golden!

The CBS Student Board honored faculty in a range of categories from funniest to most engaging at its annual Golden Pipettes event earlier this spring.

AWARD WINNERS PICTURED:
(from top left) Christian Mohr, Nathan Springer, Emilie Snell-Rood, David Matthes Niel Olszewski, Robert Brooker, Esther Krook-Magnuson, Clarence Lehman, Tamar Resnick and Kenneth Leopold

"We're now interested in going beyond silica ... to develop novel engineered living materials for a range of applications."

—CLAUDIA SCHMIDT-DANNERT

A LIFE OF THEIR OWN

Early research sets the stage for a future with self-healing construction and biomedical materials.

Homeowners dread the appearance of chipped paint. Fixing the blemish involves sanding, priming and painting. It often involves re-painting the entire wall for a seamless fix If you've experienced this, you've dreamed of a better way.

Imagine instead a paint that self-heals. When a chip appears, a homeowner would simply spray a solution that kick starts the "living paint" to fix the chip. This behavior, which resembles how human skin closes after a paper cut, would revolutionize construction and maintenance, with wide-reaching economic and environmental implications.

While this scene is a ways off, critical early research led by Claudia Schmidt-Dannert, Distinguished McKnight Professor and director of the BioTechnology Institute, represents a step forward in bringing this idea to fruition.

Engineered living materials combine the strength of run-of-the-mill building materials with the responsiveness of living systems. Currently, the vast majority of engineered living materials rely on adding a living component into a material. "While this additive approach has benefits it ultimately falls short of the aspirational material — a product that grows, self-organizes and heals itself," says Schmidt-Dannert.

A recent study led by Schmidt-Dannert demonstrated how to transform silica, a common material used in plaster and other construction materials, into a self-assembling, dynamic and resilient material. Researchers used a well-studied and benign bacteria, *Bacillus subtilis*, which goes dormant in unfavorable conditions and springs to life when conditions are favorable for growth. This trait — akin to a seed waiting for warming spring rains before germinating — makes it a strong candidate as the aspirational product would need to be both shelf-stable and easily activated.

Equipped with this bacteria, the research team made some tweaks and studied different approaches to integrate the bacteria seamlessly into the silica structure. Optimizing this step takes careful and repeated takes.

"The fir t time we saw that the bacteria and the silica were cross-linking and forming a rigid material was pivotal," says Schmidt-Dannert. "At that moment, we knew it was working."

The findings p ovide a framework for designing novel engineered living materials for coatings and plasters, key building materials. Silica is an important material used in building, but is just one of a handful so Schmidt-Dannert's research team is beginning to look at new starting materials. While seeing this new category of adaptive materials on consumer shelves is a ways off, the research sheds new light on this promising advancement, which shows promise beyond building materials, including biomedical applications.

In the meantime, homeowners will need to keep sandpaper, putty and matching paint colors on hand. *—CLAIRE WILSON*

PROTEIN POTENTIAL

Fine-tuning the quest to understand protein function — and malfunction — has far-reaching implications.

Sometimes the best way to figu e out how something works is to break it. In the case of a protein, that often takes the form of altering genes so the proteins they encode have extra amino acids in various locations. An insertion that makes it impossible for the protein to do its job right likely has hit an Achilles' heel — a region that is integral to proper function.

"The idea is, if the insertion location is important for, say, folding of the protein, or it's in the active site of a protein, then that perturbation will be very disruptive," explains Daniel Schmidt, an assistant professor in the Department of Genetics, Cell Biology and Development. "If it's in a location that's less important, then that perturbation will be tolerated. And by doing this in a systematic way, you can annotate regions of the protein that are critical for function and structure, and regions that are less critical."

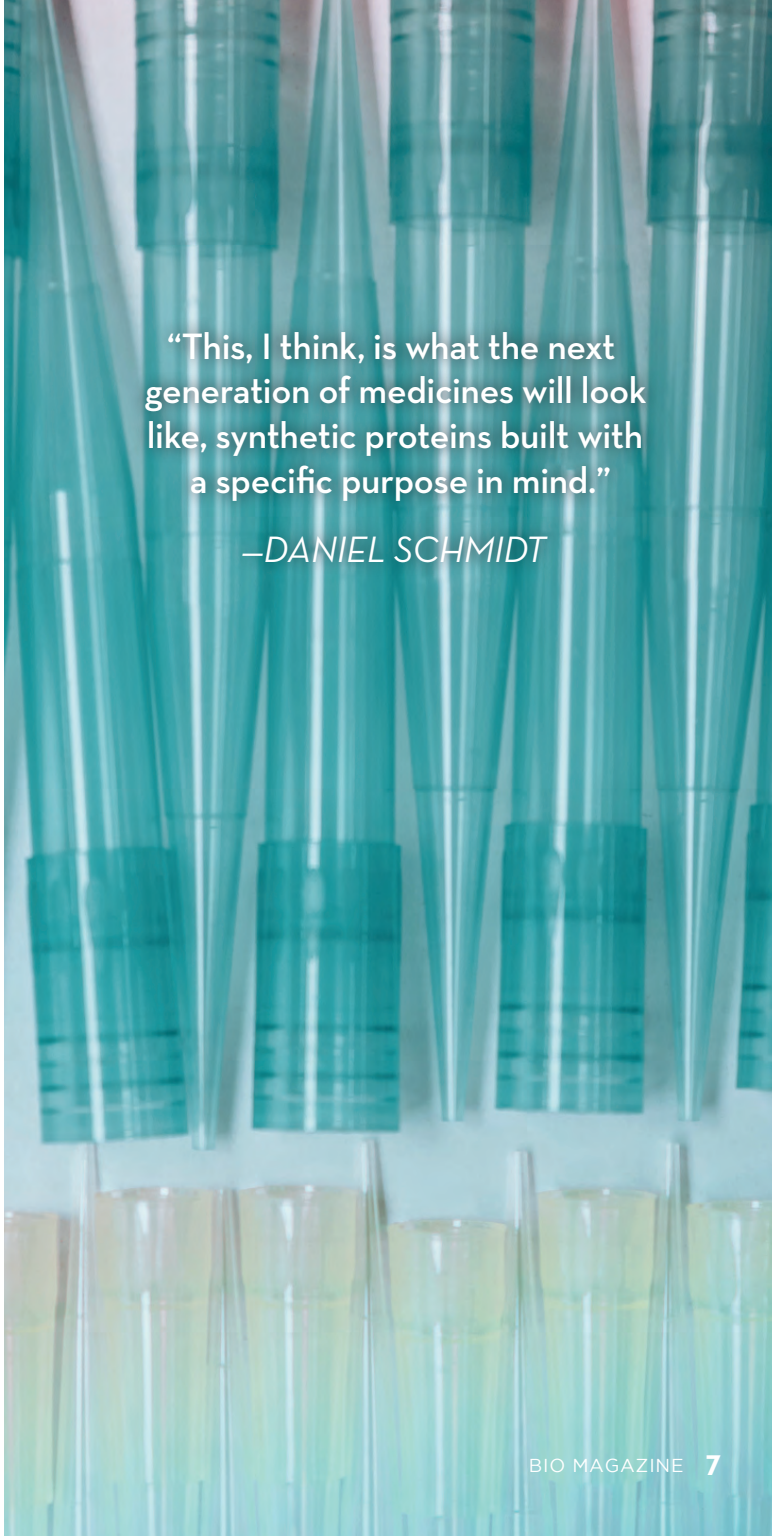
When developed decades ago, this approach was limited to replacing or inserting individual amino acids. More recently, scientists have discovered how to add entire protein domains, a process that resembles the domain-shuffling t t evolution has used to produce diverse proteins with new and useful functions. Until now, domain insertion has been random, creating large quantities of throw-away variation that make extracting useful insights from the data difficul time-consuming and expensive.

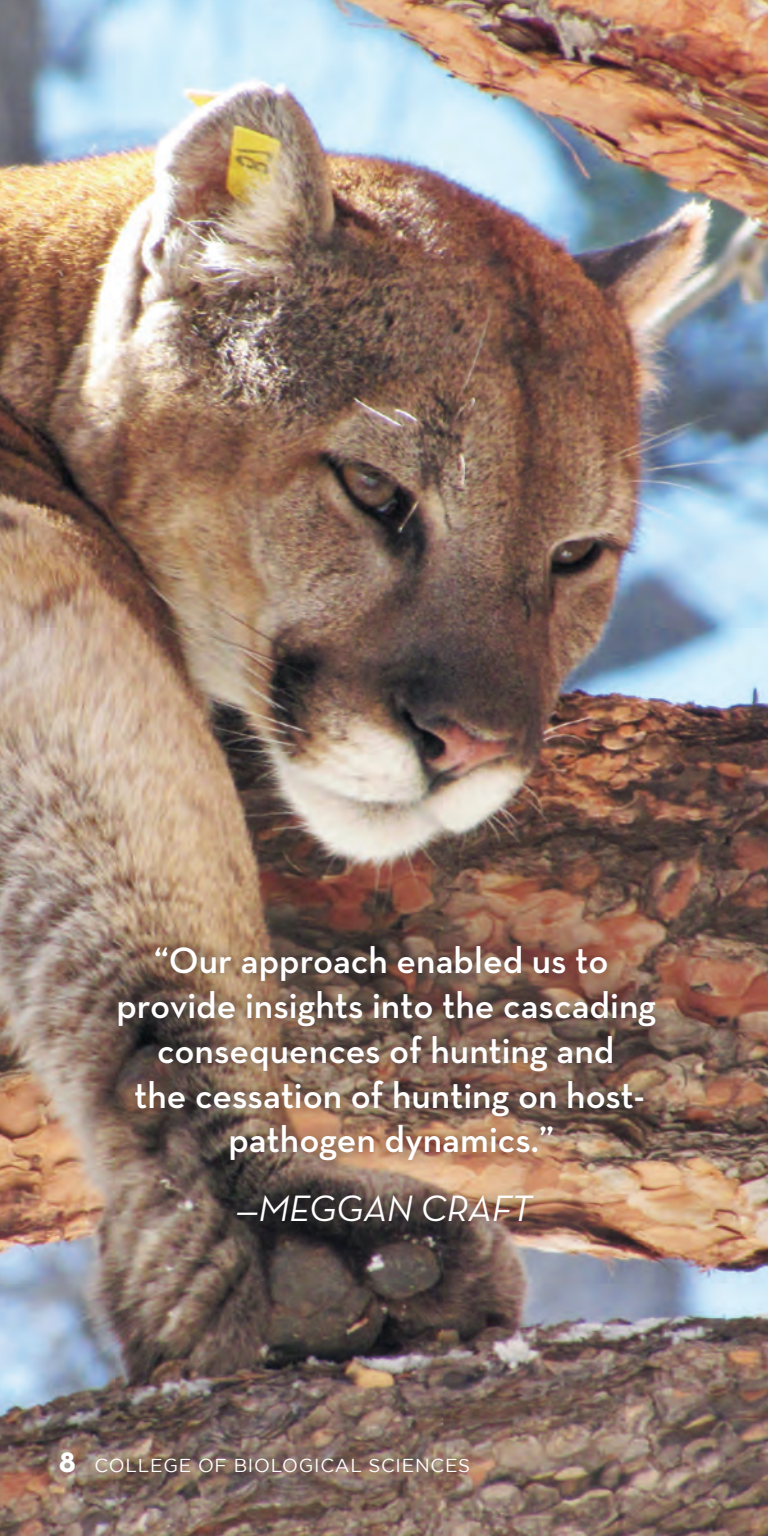
Schmidt's lab recently developed a more targeted and scalable way to insert domains into proteins. Called Saturated Programmable Insertion Engineering (SPINE), the approach makes it possible to deliberately insert domains where they are most likely to provide useful information about protein function. They're applying it to improve our understanding of a class of membrane proteins known as Inward Rectifier $^{+}$ channels. This ion channel family is particularly intriguing because observations in different organisms indicate that it has evolved by rearranging domains. In addition, malfunctions play a role in a whole host of human disorders, from Parkinson's disease to kidney dysfunction.

"What we have done with SPINE is to program exactly where a domain is inserted," Schmidt says. "This allows us to interrogate structure-function relationship in a protein at an unprecedent scale in a cost-effective way."

The data generated from this research will make it possible to predict which kinds of K^{+} channel mutations will cause disease, and which are simply benign variations on the theme. It also will shed light on some of the universal rules that nature employs when assembling domains to make a functioning protein — akin to the grammar we use to make comprehensible sentences out of words.

"This, I think, is what the next generation of medicines will look like, synthetic proteins built with a specific purpose in mind " he says. "In order to do that, we need to understand how we can build these proteins, so we don't have to do this by trial and error." *—MARY HOFF*





ON THE HUNT

Researchers find that hunting alters virus evolution and transmission in pumas.

Pumas are famously solitary creatures. They typically avoid contact with humans, which makes them a challenge to observe. As a result, very little is known about their movements and even less about how diseases move through puma populations. A study offers rare insight into the pathway of a common virus in pumas and the relative impact of different wildlife management strategies.

The study, led by Meggan Craft, a professor in the College's Department of Ecology, Evolution and Behavior, and Nick Fountain-Jones, a disease ecologist at the University of Tasmania who previously worked in Craft's lab, traced the transmission of feline immunodeficien y virus using DNA to identify patterns of evolution across puma viral genomes.

The researchers partnered with colleagues at Colorado State University and Colorado Parks and Wildlife over a 10-year period to gather puma DNA samples in two comparable regions of the state and to sequence the virus. In one region, hunting was banned for fi e years and then reinstated. In the other region, hunting was less commonly practiced.

The team found disease transmission dynamics changed markedly in the region where hunting was banned and then reinstated. Less hunting led to higher levels of disease transmission and occurred primarily among males. Since hunters tend to target males, there were more males present during the no-hunting period, which potentially increased competition for territory, a higher likelihood of male-to-male contact and disease spread.

"We had a unique opportunity to test what happens when a population is changed by hunting," says Craft, who studies the spread of diseases in animal populations. "Our approach enabled us to provide insights into the cascading consequences of hunting and the cessation of hunting on host-pathogen dynamics."

Craft is known internationally for her work in disease modeling in ecological systems and disease transmission in wild and domestic cats. Her lab uses data generated by collaborators to model disease transmission that is widely applicable across other wildlife disease systems.

The SARS-CoV-2 virus, which has now spread from humans to wild and domestic species including wild cats, further illustrates the importance of this work.

"The key lesson from our research is that whenever species management changes, enhanced disease surveillance is a smart idea as there can be unintended consequences for virus evolution and spread," says Fountain-Jones.

Future studies will further analyze puma behavior and movements to better understand the circumstances in which the disease is transmitted in different ecosystems. *—STEPHANIE XENOS*

A BACTERIAL BULL'S-EYE

Graduate student Maddy Bygd identifies a promising new candidate for remediating "forever chemicals"

Polyfluorin ted chemicals — often known as PFAS — are in a wide range of products including the ubiquitous nonstick pans in kitchen cupboards. The chemicals degrade slowly, earning them the nickname "forever chemicals." While their staying power often boosts their effectiveness, it also creates problems downstream turning them into a major environmental liability. These compounds aren't readily found in nature, so there are few microbes equipped to break them down.

Finding the few that can break down these chemicals is a bit like finding needle in a haystack. However, researchers — including Microbial Engineering graduate student Maddy Bygd and her advisor, Biochemistry, Molecular Biology and Biophysics Professor Larry Wackett — recently identified a candidate to break down one of these polyfluorin ted compounds.

The researchers wanted to find a bac eria that could convert harmful chemicals to harmless fluoride and carbon. Identifying a bacteria naturally found in soils makes it more likely to succeed down the line as a remediation tactic because it

is primed for the unique conditions. Using a new method she devised, Bygd identified a bac eria that fit the bill *Pseudomonas putida*. The bacteria is readily found in soils and has been previously shown to break down compounds that resemble polyfluorin ted chemicals.

Identifying a candidate was only the fir t step. Bygd went to work to find out how *Pseudomonas putida* does what it does, setting the stage for future applied research. "We started working through the mechanism and it made a lot of sense, why it was happening, how it was happening," says Bygd. "So we started to be able to kind of unravel that story."

Inspired by her work with Wackett and others to pursue this line of inquiry while still an undergraduate., Bygd spent a summer working in the Wackett lab before entering the Microbial Engineering graduate program. "I realized the intricacies of microbiology and biochemistry and I really, really started to enjoy learning about the environment and how essential microbes are to global cycles, health and agriculture."

Bygd, who has her sights set on a career in industry, continues to add new knowledge in this vital area. "Maddy has followed up her excellent work for the *mBio* paper by devising a high-throughput screening method to detect new PFAS-degrading bacteria and enzymes," says Wackett. "Overall, she is making a big impact in the field of PFAS research." *—STEPHANIE XENOS*

LIFE, ILLUMINATED

The Developmental Biology Center shines light on the building blocks of life.

When a caterpillar wraps itself into a cocoon and emerges later transformed into a colorful butterfl , what drives this drastic change? Look to developmental biology.

Researchers with the Developmental Biology Center (DBC) at the University of Minnesota aim to better understand the biological bases and processes of the world around us, from determining cell type to the creation of organs.

"I still remember my own emotion of pure surprise, awe, and wonder when I fir t watched the process of a caterpillar transforming into a butterfl and the cleavage of a sea urchin embryo," says Hiroshi Nakato, the new director of the center. "The researchers in the DBC aim to better understand how cells like these work, replicate and grow into systems that play a role in not only our knowledge of the world, but also human health, from stem cell research to regenerative medicine and cancer biology."

As head of the DBC, Nakato leads more than 60 faculty looking to better understand the ways developmental biology plays out in real life. With faculty specializing in areas ranging from synthetic cells to gene expression, developmental genetics and cellular signaling pathways, the center brings experts in these disparate topics together to better understand developmental biology as a whole.

"The DBC naturally connects and integrates U of M scientists in all these fields promoting collaborations and intellectual exchange," says Nakato. "With these unique strengths, the DBC will grow further as the field expands and new members with different expertise join us." *—LANCE JANSSEN*

ALL SYSTEMS

GLOBAL CHANGE BIOLOGY DESCRIBES THE FULL SPECTRUM OF HUMAN-DRIVEN FACTORS AFFECTING ECOSYSTEMS ACROSS SCALES FROM CHANGES IN LAND USE AND CLIMATE TO SPECIES INVASION AND BIODIVERSITY LOSS.

GO

As humans move Earth's life-support systems into unprecedented states, the University of Minnesota is leading international efforts to understand and guide global change biology research.

A community meeting set to discuss impacts of a recent flood in the Driftle s region of Wisconsin kicks off as a social scienti t takes notes in the background. During a virtual lab meeting, researchers from the University of Minnesota sort through images taken from a National Aeronautics and Space Administration satellite. A half a world away, researchers carefully review a protocol and call local hardware stores to inquire about the availability of rototillers to use in the field

These scenes appear completely unrelated. They're not.

Humans have dramatically altered just about every aspect of the planet, from the microbiomes of some animals to the composition of the entire atmosphere. And change is accelerating as one shift triggers countless others in interlinked domino chains of intended and unintended consequences. The research to understand how rapid change is accelerating as one shift triggers countless others in interlinked domino chains, takes a broad array of expertise and experiences.

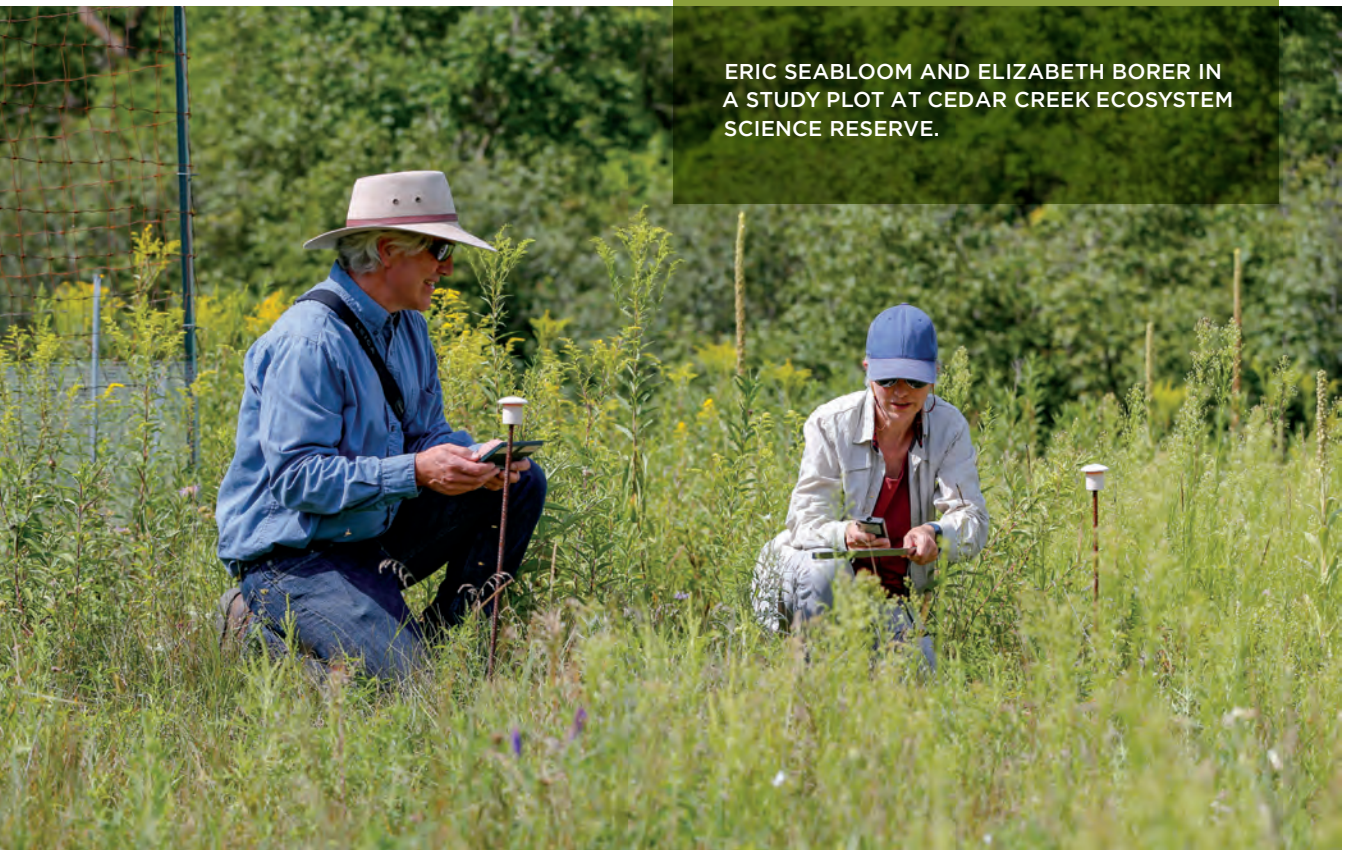
Whether humans and other living things can thrive in the face of such massive change depends on the extent to which we can understand how the systems underlying them work and what we need to do to keep them operating. It's an incredibly complicated undertaking that encompasses everything from the effect of the nutrients we use to grow crops to biodiversity loss and climate change.

Global change biology attempts to do just that, and College of Biological Sciences faculty are leading the charge. Ranked number one in the United States in ecology and environment, the University of Minnesota is driving discovery in this critical area. No other institution brings together so many leading investigators working to understand our impact on the planet. They form a nexus for understanding global change and working to keep it within safe, sustainable boundaries.

"This area of inquiry is fundamental to understanding our impact on the planet. Our ability to create sustainable systems spanning urban, rural and natural landscapes depends on advancing knowledge of how those systems work," says College of Biological Sciences Dean Valery

"This area of inquiry is fundamental to understanding our impact on the planet. Our ability to create sustainable systems … depends on advancing knowledge of how those systems work."

—VALERY FORBES



ERIC SEABLOOM AND ELIZABETH BORER IN A STUDY PLOT AT CEDAR CREEK ECOSYSTEM SCIENCE RESERVE.

Forbes.

PAST IS PROLOGUE

In 1940, the University established Cedar Creek Ecosystem Science Reserve (then Cedar Creek Natural History Area), a nine-square-mile ecological research site north of the Twin Cities. By that time, Raymond Lindeman had already made his paradigm-shifting observations about how organisms depend on each other and their environment for survival doing field work at Cedar Bog Lake. His insights transformed how we think about ecosystems and were the foundation for modern ecosystem ecology.

Over the decades, the research station has yielded highly consequential insights related to the interplay of climate, land use, biodiversity and other variables experiencing rapid change around the world. In 1982, the National Science Foundation designated it a long-term ecological research (LTER) site. Fast forward to the present and the research station is now home to the world's longest running biodiversity experiment, started by Director Dave Tilman, the most cited ecologist in the world.

"Cedar Creek really put the University of Minnesota on the map for global change research," says Ecology, Evolution and Behavior (EEB) Professor Eric Seabloom, who directs the LTER. "The depth of expertise in global change biology on which these projects are built really reflects the long-term legacy of Cedar Creek."

Researchers have studied a stunning breadth of ecological topics using data generated through these long-term experiments. Some of these focal areas centered around human-induced change include studying the effects of temperature, precipitation, carbon dioxide levels on ecosystems; restoring savannas using bison grazing and fi e; and advancing understanding of how environmental factors support or harm biodiversity, ecosystem stability and resilience. Now, it's a springboard for some of the University's newest global change initiatives.

ACT LOCAL, THINK GLOBAL

Long-term studies at a single location are valuable for understanding how ecosystems function over time. But they can only tell you so much since it's impossible to discern site-specific findings om more universal realities about critical traits like tipping points and resilience. If results from a single site are good, results from multiple sites are better.

With that in mind, Seabloom and fellow EEB Professor Elizabeth Borer came up with a plan to replicate experiments across similar ecosystems around the world using identical protocols.

Fifteen years ago when they created the Nutrient Network, the researchers had been studying the interplay of plant productivity, nutrients and herbivory. Recognizing the value of being able to extend what they were learning to other grassland ecosystems, they invited scientists from around

the world to join them in this work using identical protocols.

With more than 300 scientists at 140 sites in 27 countries, the Nutrient Network today is the world's largest global change biology experiment. From Argentina to Tanzania to Norway, collaborators are experimentally manipulating factors that are changing on a global scale — nutrients, herbivores, climate, land use change, invasive species — to see how various combinations affect ecosystems.

"This has pulled whole regions into the scientific enterprise that are underrepresented," Borer says. "These are great scientists who can't necessarily buy expensive equipment, so experiments are specifically designed to use things that are readily available such as fencing and agricultural fertilizers."

As valuable as it is in its own right, the initiative has also become a model for a way to study global change biology at scale. Two years ago, it even spawned a second University of Minnesota–based study, Disturbance and Resources Across Global Grasslands (DragNet). It's like NutNet but with more active manipulation of conditions, and more research sites and researchers, too.

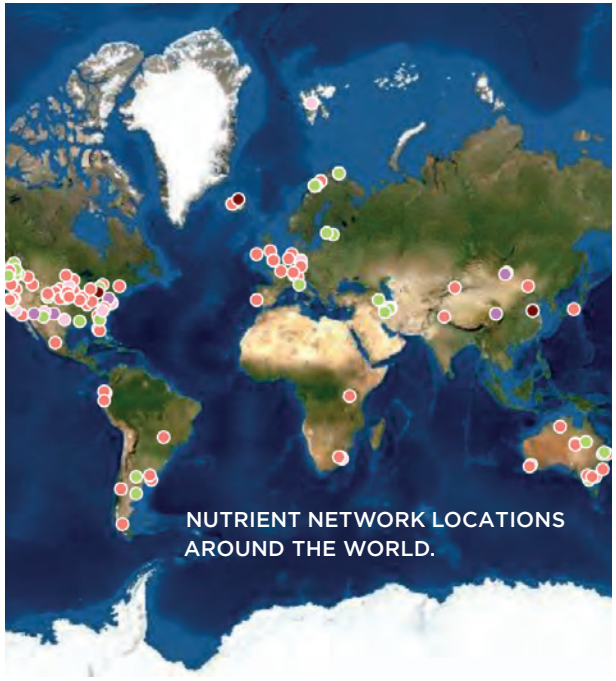
"NutNet and DragNet are conducting global-scale tests of ideas developed and fir t tested at Cedar Creek," Seabloom says. "We hope this will help sort out how humans are impacting the Earth."

CITY SMART

Nowhere on Earth is the human footprint more visible than in urban areas, where packed-together people dramatically alter everything from hydrology to air temperature. Cities can be positive for the environment since they concentrate impact and allow for economies of scale, but making the most of these advantages going forward will require an elevated understanding of how people interact with urban nature. Enter the Minneapolis-St. Paul Metropolitan Area Urban Long Term Ecological Research Program (MSP LTER).

Like its counterpart to the north, the MSP LTER is designed to support investigations that extend over years. One of only two such centers in the nation, the LTER is bringing together community members, university partners, government official and others to explore the role cities play in both contributing to and mitigating global change.

"We are simultaneously trying to understand ecological function of urban nature, how people interact with nature and how nature might be managed to be more resistant to the impacts of things like climate change and pollutants and pests and pathogens," says MSP LTER Director Professor Sarah Hobbie. "We're also trying to understand the social side, the effectiveness of different policies and practices currently in place, and how to make them more effective."



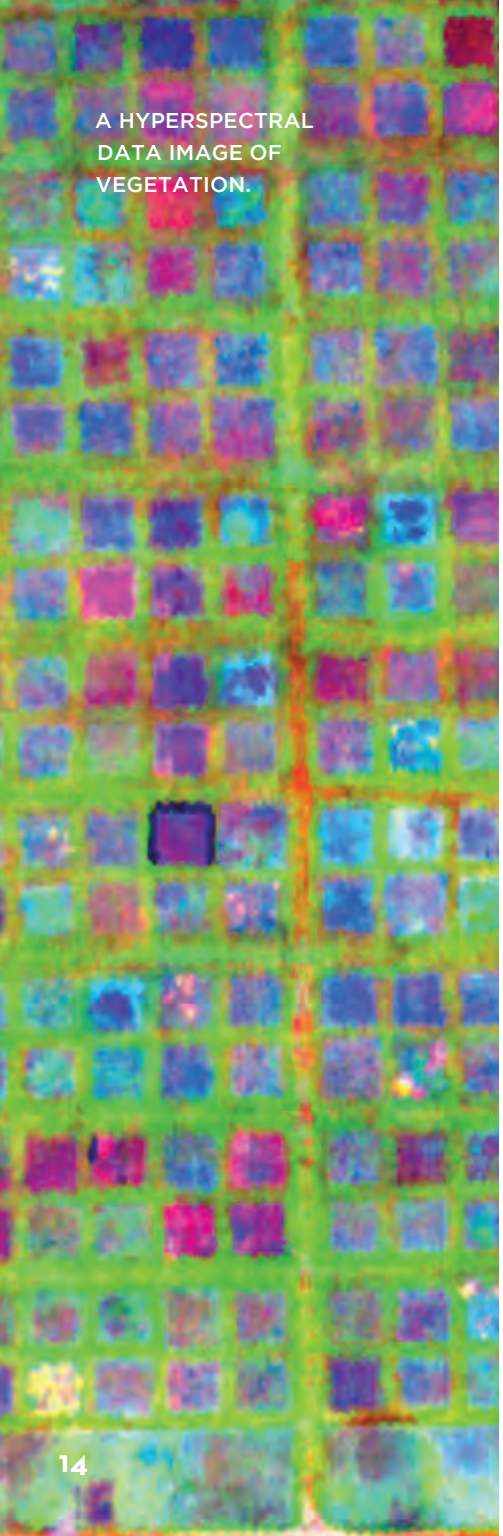
NUTRIENT NETWORK LOCATIONS AROUND THE WORLD.

The Twin Cities is a microcosm of the many issues facing cities far and wide. It's experiencing change in temperature, precipitation and storm intensity. It's also undergoing social change as it comes to terms with racial disparities and other inequities. It's an especially good spot for an urban LTER because it's at the intersection of three major biomes, so there's potential for substantial ecological shifts as climate changes. Moreover, it comprises more than 100 communities, and there are tons of disparate data to bring together to create insights on the relative merits of various environmental management practices.

"We're trying to develop relationships with partners on different levels, and also engage with communities that have not historically had the opportunity to be engaged with the University, including marginalized communities and communities of color," Hobbie says. "Our ultimate goal is to address inequities that exist in the access that people have to the benefits of urban nature, to improve environmental outcomes for people across the Twin Cities, and also, along the way, to build meaningful relationships between academia and the community, especially communities not so engaged with the University."

WHEN CHANGE IS INEVITABLE

Climate change is one of the most obvious and urgent dimensions of global change. Addressing the causes is only part of the equation. The Midwest Climate Adaptation Science Center (MW-CASC), a partnership between a consortium of institutions and the U.S. Geological Survey, is concerned with helping advance policies and practices that help humans and other living things cope with rising temperatures, erratic precipitation, floods fi es, ▶



A HYPERSPECTRAL DATA IMAGE OF VEGETATION.

shifts in plant and animal populations, and other climate-related threats.

"The question we need to ask is 'How do we use those natural landscapes to withstand the threats of climate change in a variety of settings?'" says Professor Jessica Hellmann, who directs both MW-CASC and the University's Institute on the Environment.

Though regionally bounded, the center is decidedly crosscutting, bringing together eight partner organizations, including fi e universities, a tribal college, The Nature Conservancy, and the Great Lakes Indian Fish and Wildlife Commission.

Engaged partnerships like MW-CASC are critically important, says Hellmann, because the task is to co-create the future. "When the climate is changing, there isn't automatic agreement on how things should go, so we need to ask how it could be, what is biophysically feasible, what is likely to happen," she says. "Our role is to provide empirical evidence and creative solutions, and to interject possibilities and ideas into the conversation, but we don't get to decide outcomes. We have to do that in collaboration with different stakeholders."

THE REALLY BIG PICTURE

One of the greatest challenges associated with global change is the incredible number of interacting variables involved. Understanding and managing such complexity requires integrating knowledge not only across time, space and disciplines, but also biological scales from genes to ecosystems.

The UMN-based Advancing Spectral Biology in Changing Environments to Understand Diversity Biology Integration Institute (ASCEND-BII) is using remote sensing and modeling to study the causes and consequences of biological variation in the context of a rapidly changing world.

"We are using technology that has been deployed to understand the chemical properties and to search for life on other planets and applying it to our own," says institute director and EEB Professor Jeannine Cavender-Bares. "It give us a tremendous amount of information about plant chemistry, physical structure, anatomy, and morphology, and it is informative at every scale."

Launched in 2020, ASCEND-BII emerged from proof-of-concept research conducted at Cedar Creek. Collaborators come from three continents and numerous disciplines, from molecular biology to atmospheric science. Two gatherings a year create a common knowledge base and opportunities for new insights to emerge. And a strong education and outreach component aims to seed transdisciplinary collaboration as an organizing principle for the next generation of scientists.

"It's really a powerful way of understanding biological processes on Earth at a time when we really need to understand those processes," Cavender-Bares says, "so that we can inform decision making and know where to focus efforts based on where things are changing the fastest and where we can really make a difference."

—MARY HOFF

JEANNINE CAVENDER-BARES LEADS AN INSTITUTE USING REMOTE SENSING TO STUDY BIODIVERSITY FROM ABOVE.

FORMERLY THE LARGEST WHITE PINE IN THE STATE, PART OF THE TREE BROKE OFF DURING A STORM.

A tall tale

When Minnesota's largest white pine was damaged in a storm, Itasca researchers saw an opportunity to study its afterlife.

A 40-foot white pine segment hit the forest floor during a strong storm several years ago, just across the lake from Itasca Biological Station and Laboratories (IBSL). News spread fast and station Director Jonathan Schilling, who studies wood rot, gathered some lab members and headed over the next morning. The researchers collected samples to take back to the lab.

When the white pine segment fell, it joined a slew of other logs, stumps and branches. These woody fragments make up 80 percent of the total carbon that comes from plants. Fungi and other decomposers feast on these woody delicacies, and different fungi specialize in breaking down different structures. Sometimes, carbon is released into the atmosphere and other times it is sequestered in the soil.

Brown rot fungi and white rot fungi are the two primary players in wood rot and key culprits of what brought down the white pine. If brown rot fungi made its home on the white pine, about a quarter of the decomposing white pine would end up in the soil off ilderness Drive. If white rot fungi grew on the white pine, the "waste" products from the fungi's meal would instead be released as a gas and flo t into Wilderness Drive's canopy — and beyond.

"A key uncertainty for climate models is the type of fungus responsible for the decay. If we become a 'white rot world,' all indications are that more carbon is going to end up in the atmosphere rather than sequestered in the soil," says Schilling.

Ultimately, they identified a b own rot fungus. "One way or another, every tree is going to die," says Schilling. "I'm fascinated by what happens when that tree hits the ground. The microbial battles that play out and dictate what happens next have massive implications." *—CLAIRE WILSON*

"My heart is in wildlife. ... It's not easy by any means, but it is very rewarding."

Wild *at* heart

Arduous hikes and relentless bug attacks are all in a day's work for CBS alum Maddy Jackson.

Maddy Jackson (B.S. Ecology, Evolution and Behavior, '17) has experienced things most of us never will, including stumbling into the remains of a grizzly bear after a wolf pack's investigation. As a wildlife technician with the Yellowstone Wolf Project — one of the longest running predator-prey studies in the country — she has a unique vantage point on the elusive canids.

Jackson started volunteering with the winter study at Yellowstone in 2018 and has since completed both winter and summer studies focused on wolf predation patterns and behavior. In her current role, she spends lots of time tracking the movements of the park's roughly 100 wolves using radio collars and a telemetry antenna that resemble elaborate "bunny ears" from an old television.

Winter is prime time for wolf research. Snow makes wolves easier to spot, plus packs hunt together more during the winter. As part of the winter study team, Jackson and her colleagues occasionally trek to sites where wolves have brought down prey, but a lot of the time Jackson tracks activity from afar using a spotting scope.

"You only get as close as you have to to see," says Jackson who emphasizes that avoiding encounters with wildlife is the highest priority, and that means steering clear of fresh kills and being vigilant when in more remote areas.

A career in wildlife research isn't for the faint of heart. It requires a high level of fitne s and more than average stores of resilience. Understanding your limits is also key.

"We do a lot of hiking in very rugged terrain in harsh conditions," says Jackson. "When you're in the wilderness, and it's really cold, or you're being destroyed by mosquitoes, you have to be able to calm yourself and get the job done, and not be a drag on the rest of the team."

Jackson has had lots of opportunities to get used to roughing it. As an undergraduate, she spent summers at Itasca Biological Station and Laboratories.

"When I was a freshman, I took classes there my first summer. I loved it. And I was like, 'I want to spend every summer here.' So I did," Jackson says. "I was a teaching assistant for the mammalogy class. I think I really fell in love with field biology through that."

From Itasca, Jackson moved on to volunteer positions in Minnesota, Montana and Idaho.

Looking ahead, Jackson is interested in exploring the intersection of wildlife, disease and public health. She's also hoping to help make access to careers in her field mo e accessible citing an expectation that students and those early in their careers will spend significant time as unpaid volunteers and low pay as top issues.

"My heart is in wildlife," says Jackson. "I've put lots of blood, sweat and tears literally into this career. It's not easy by any means, but it is very rewarding."

—STEPHANIE XENOS

Supporting transfer students

Transfer scholarships will help this highly motivated group of students hit the ground running.

This fall, we celebrated the successful conclusion of our Great Science at a Grand Scale campaign. Our goal was to raise $21 million for scholarships, fellowships and other priorities. We exceeded that goal by $8 million thanks to the tremendous show of support from the CBS community.

The CBS community contributed nearly $17 million for scholarships, fellowships and student support, accounting for nearly 60 percent of gifts made during the campaign. This outpouring of support means more CBS students will be able to focus on their education rather than their finan es.

Even as we celebrate the success of the campaign, we recognize that there's more work to do. The University's MPact 2025 strategic plan outlines a number of priorities relating to student success including attracting, educating and graduating students who represent the diversity, talent, workforce and citizenship needs of the future. Within this strategic framework, scholarships continue to be of paramount importance — including a renewed focus on scholarships for transfer students.

"Making sure students have every opportunity to realize their full potential and take advantage of all that the college and the University have to offer is our top priority."

Students who transfer to CBS graduate on time more often than their peers. That, in and of itself, is a tremendous accomplishment because CBS students have among the highest graduation rates at the University of Minnesota. Transfer students to the College are incredibly driven and focused. Students who transfer to CBS are, on the whole, also more diverse.

As a former community college fundraiser, I am acutely aware of the potential of transfer students — some of whom enrolled in a two-year college because of affordability and some whose high school academic preparedness necessitated a fir t step other than the University of Minnesota.

They come to the College because they know what they want from their education. They are purposeful about their path to a CBS degree. At the same time, they have a smaller window of opportunity given they typically spend just two of their four years as undergraduates in the College.

Making sure students have every opportunity to realize their full potential and take advantage of all that the college and the University have to offer is our top priority. This means removing financial barrier and doing everything we can to make sure all students, no matter how long they are at CBS, can participate fully.

One of the goals of the Great Science at a Grand Scale campaign was to raise funds to create four-year scholarships. Going forward, we hope to create scholarships that meet the needs of transfer students — shorter in duration and larger in size — so they are able to enter CBS and quickly make their mark.

REEDE WEBSTER
Chief Advancement Officer

PHOTO BY JACKSON EDDY/A FRAME FORWARD

Supporting science *with* scholarships

Since its establishment, the Monica Tsang and James Weatherbee Merit Scholarship has provided support to 170 CBS students.


MONICA TSANG

There's a cherished tradition among successful scientists to offer help to those who are just beginning their career journeys, whether through mentoring, professional opportunities or financial support Because well-timed assistance can be so important in building upon a budding scientific career, Isaac Newton's famous quote — "If I have seen further, it is by standing on the shoulders of giants" — is as true today as it was in 1675.

At the College of Biological Sciences, two scientists — Monica Tsang and James Weatherbee — are the namesakes of a prestigious scholarship program that, at a current value of $2.3 million, is the school's largest endowed scholarship. It's awarded to students who have demonstrated academic achievement in the math and science disciplines, selected rigorous courses, articulated a career path and maintained a GPA of 3.5 or better. The scholarship provides financial support and professional acknowledgment to selected students, both of which are beneficial or their future work.

"We need to be able to hear from more underrepresented voices, and scholarships are vital in helping that happen." *—TARINI GOYAL*

The story behind this particular scholarship is especially fascinating for those who believe in the long-term value that can be created when business, education and science join forces to support the development of top talent. It's also a story of Minnesota pride, in which a home-town company honors the co-founding scientists who helped them grow into the state's largest biotechnology company.

For Monica Tsang, the scholarship has been a lasting way to honor the work both of her and her late husband, James Weatherbee. "We were the fir t two scientists hired by the company that eventually became Bio-Techne," she recalls. "We started a new division to concentrate on cytokine biology. When I retired in 2007 as vice president of research, they used the occasion to thank me and my husband, who had also been a vice president there, for our contributions to the company, by establishing this endowed merit scholarship at the College of Biological Sciences."

Both the inspiration and the execution of the scholarship were the work of Howard O'Connell, a member of the company's board of directors, and Tom Oland, chairman of the board and president.

The scholarship has been an important financial boo t and vote of confiden e in the lives of many undergraduates. Tarini Goyal (CBS '11; UMN Medical School '15) was a recipient of the scholarship in 2009 and was able to attend the awards dinner on campus. Dr. Goyal is now a neurohospitalist and assistant professor of neurology at Columbia University Irving Medical Center.

"Scholarships play such an important role in science," she says. "Especially since the pandemic, we've seen a thirst for reliable and trustworthy scientific kn wledge, and that needs to come from all kinds of people. We need to be able to hear from more underrepresented voices, and scholarships are vital in helping that happen." ▶

The support of a scholarships such as this one is more important than ever for many students. "Over the past couple decades, tuition costs have grown, but the University of Minnesota's scholarship funds have grown at double the rate, thankfully," says Reede Webster, CBS chief advancement officer. "Scholarships like this one help us attract and develop top talent in the field of biology and ensure that strong candidates are able to attend our college."

Bio-Techne, the company behind the scholarship's inception, remains a significant boo ter of the University's mission, vision and values. "At Bio-Techne, we believe in the significan e of lifelong learning. Every time a scientist is supported on their journey to discovery, there's benefit or the greater scientific community, of which we're a part," says Brenda Everson, senior vice president of human resources. "The scientific b eakthroughs of the future are often spearheaded at academic institutions like the University, and this partnership aligns with our mission to positively impact human health and enable cutting-edge discoveries in fields li e oncology and autoimmunity."

In addition to the scholarship, Bio-Techne is one of several companies statewide that has committed support to a proposed seven-figu e biomanufacturing federal workforce grant, which is part of a larger vision at the University of Minnesota to advance Minnesota's bioeconomy.

—JULIE KENDRICK

SCHOLARSHIP STATS

First year of funding: 2008

Number of annual recipients: 22

Scholarships awarded to date: 170

Award amount:
Up to $5,000 per student

Purpose:
To support undergraduate students who demonstrate a commitment to academic achievement in biology

A FOND FAREWELL

CBS alumnus and longtime supporter Darby Nelson passed away January 13. Darby was an aquatic ecologist and biology professor emeritus at Anoka-Ramsey Community College. He also was an award-winning educator and author, a three-term state legislator and a respected environmentalist. Darby led with creativity and passion, and always with a positive attitude.

After completing his bachelor's, master's and doctoral degrees at the University of Minnesota, Darby went on to a distinguished teaching and public service career. Nelson taught environmental and biological science courses at Anoka-Ramsey Community College for 35 years and served three terms in the Minnesota House in the 1980s.

In addition to championing the environment in the House, he was an avid outdoors enthusiast who canoed and kayaked all over the world, and served on the board of many environmental nonprofits Darby's many contributions to Minnesota's natural places will carry his legacy onwards.

He published *For Love of Lakes* in 2011 and *For Love of a River: The Minnesota* in 2019. He met his then-future wife, Geri, as a student doing field biology work at Itasca Biological Station and Laboratories. Both Geri and Darby enthusiastically supported scholarships and the Itasca field tation, as well as many other University priorities.

Thanks *for the* memories!

CBS supporters, alumni award winners, and scholarship and fellowship recipients gathered this spring for the college's annual Recognition and Appreciation Dinner at McNamara Alumni Center.

FROM TOP LEFT: DR. CHERYL QUINN GAVE THE KEYNOTE. MINDI DEPAOLA, RECIPIENT OF A 2021 CBS EMERGING LEADER AWARD, WITH DEAN FORBES. PROFESSOR EMERITUS JOHN ANDERSON ACCOMPANIED BY MEMBERS OF THE U OF M MARCHING BAND LEADS THE ATTENDEES IN THE ROUSER.

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RESEARCH WITHIN REACH

Doing research in a faculty lab as an undergraduate prepares students to succeed. We want to make sure every College of Biological Sciences student who wants that experience can access it. As part of a public research university, CBS students have a unique opportunity to learn science by doing science with world-class researchers. But not everyone can afford to volunteer in the lab. That's why we're raising funds to support paid positions for undergraduates in faculty research labs.

Make research accessible to more students.
Contribute to the Dean's Research Program at
z.umn.edu/CBSugradresearch