FALL 2023

grow

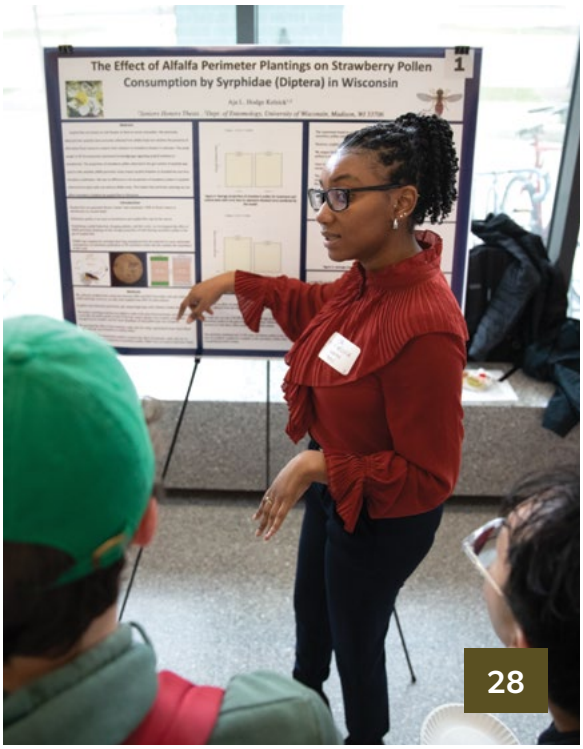
College of Agricultural & Life Sciences
University of Wisconsin–Madison

Rural Communities, Connected

CALS and UW–Extension help bring broadband internet to underserved parts of Wisconsin PAGE 20

+ NUTRITION AND THE FAMILY TREE
THE POTENTIAL OF AGRIVOLTAICS
TURF MANAGERS IN TRAINING
OUTSTANDING YOUNG FARMERS

Steven Martínez looks on as he and fellow students stretch a mozzarella string during a March 2023 cheesemaking short course for native Spanish speakers, the first of its kind to be offered at the Center for Dairy Research. Photo by MICHAEL P. KING



Wisconsin's Magazine for the Agricultural and Life Sciences

grow

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FEATURES

DEPARTMENTS

ON THE COVER Studies show that broadband internet access is increasingly relevant to rural entrepreneurship and boosts rural economic growth. Read more on page 20. Photo illustration by JANELLE JORDAN NAAB. Photo by ISTOCK.COM/JAMESBREY

Images, from top, by MICHAEL P. KING

Photo by MICHAEL P. KING

DEAN GLENDA GILLASPY

Of New Majors, New Departments, and New Ways of Problem-Solving

We have some changes in the works here at CALS. For example, in recent months, we've made two significant academic and administrative moves to enhance how we serve students, conduct research, and deliver outreach and extension programs. And it's all with an eye toward helping solve society's grand challenges — either directly through the college's work or by sending well-prepared students out into the world to do great things.

On the student preparation front, this fall, CALS added a new major to the UW undergraduate course guide. The animal and veterinary biosciences major is for students who care about the health and well-being of animals — from the smallest companion kittens to the largest livestock — as well as the relationships these animals have with humans and the environment. It will replace our animal science major, which will be phased out after all current students have graduated.

This new major offers much more flexibility for students. It has a wide array of courses, so students can tailor their studies to prepare for veterinary medical school or other animal-related careers — all of which have higher-than-average projected job growth. The new major's flexibility also makes it easier for students to add a certificate or a study abroad semester to their academic plan. And it can help them graduate in less time.

Many pathways are available in the major, such as animal welfare, genetics, nutrition, or meat and animal biologics. And one of the best parts: Students don't need to walk these paths alone. New this year, all sophomores in the department will be paired with faculty mentors to help them find the academic and career directions that are right for them. The major is already proving popular. As of August 2023, 82 students had enrolled, a 55% increase over the prior year for the animal science major.

That's one new and improved effort on the academic side, but we're also streamlining our departmental structures. This summer, following an extensive planning process, our former agronomy and horticulture departments merged to create a new Department of Plant and Agroecosystem Sciences. While several of our peer land-grant universities have combined their plant science departments, our merger is unique because it incorporates agroecosystem science, the study of ecosystems supporting food production at all scales — one of our core strengths at CALS. I am excited about the new department's plans to offer cutting-edge programs of study that engage students in this critical area.

These changes will help us expand and improve the ways we confront the grand challenges I mentioned above. The undertaking will include research, education, and extension and outreach programs that range from investigating the inner workings of plants to assessing their relationships with landscapes and climate.

EXPLORE ONLINE

Animal and Veterinary Biosciences Major
go.wisc.edu/AnVetBioSciMajor

Department of Plant and Agroecosystem Sciences
pasdept.wisc.edu

This is just the beginning of our efforts to reimagine and restructure how we can achieve our mission to advance and share knowledge; discover solutions; and promote opportunities in food, agriculture, bioenergy, health, the environment, and human well-being. Look for more to come.

I enjoyed hearing from those of you who reached out after my last column, and I encourage readers to share thoughts with me at **glenda.gillaspy@wisc.edu**.

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College of Agricultural & Life Sciences
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Five Energizing Facts about Agrivoltaics

By CHRIS KUCHARIK

In the quest to combat climate change, the idea of using agricultural landscapes in the Midwest to support renewable energy production has focused primarily on building wind farms and growing plant feedstocks for biofuels. Another option, called agrivoltaics, represents a new opportunity to support farmers, increase diversity in agricultural landscapes, and facilitate energy production. Here's how.

1. Agrivoltaics refers to the integration of agriculture and photovoltaic energy production. This concept includes growing crops, grazing animals, or increasing pollinator habitats underneath or between solar panels that are simultaneously generating electrical power. Agrivoltaics is viewed as a potential path to reduce competition for land between the energy and agricultural sectors while also supporting the U.S. goal of achieving carbon-free electricity by 2035.

Illustration by MARY QUINN

2. It's not a new concept, but rapid growth in agrivoltaics is a very recent phenomenon. The first mention of agrivoltaics is often connected to research in Germany in 1982, but the most substantial growth has occurred during the past few years. Based on data from the National Renewable Energy Laboratory, there are approximately 2.8 gigawatts (GW) of power generated at U.S. agrivoltaics sites, and they most commonly include sheep grazing and pollinator habitats. Wisconsin is going through a period of rapid growth in both solar and agrivoltaics. In 2023, there were already 36 agrivoltaic sites in Wisconsin producing a combined 82 megawatts (MW) of power on 445 acres of land, with more planned in the coming years. By 2026, the Public Service Commission of Wisconsin projects that 4.6% of total electric generation in the state will be solar.

3. Displacing prime farmland with solar arrays is often a barrier to large-scale solar installations. Opposition frequently stems from concerns about trade-offs between food production and energy security, reductions in farmland, and the feasibility of pursuing agriculture within solar arrays. For example, many crops grown in the Midwest, such as corn, cannot be cultivated at solar farms because the plants are too tall, or the arrays don't allow room for conventional planting and harvesting equipment. Other concerns include the loss of identity and a way of life in small, rural communities. Agrivoltaics represents a potential avenue to reduce tensions and minimize compromises between food and energy that would otherwise occur.

4. When it comes to testing the viability of agrivoltaics, universities and utilities can be effective partners. For example, UW is collaborating with Alliant Energy to design and build a solar farm at the 300-acre Kegonsa Research Campus just outside of Madison, in the Town of Dunn (near Stoughton). Alliant Energy will lease 15 acres, and when the research site becomes operational in 2024, it will produce 2.25 MW of electricity — enough to power about 450 homes. Besides hosting research, the project will serve as a living laboratory for students and the public, providing educational tours and reliable information.

5. Agrivoltaics presents many unknowns, so more research is urgently needed — and UW is contributing. A university-led project funded by the Wisconsin Alumni Research Foundation will use the Kegonsa solar farm as a Midwestern model system to investigate the impacts of solar arrays on many of the benefits we receive from nature — forage crop production, soil quality maintenance, pollinator habitat creation, carbon sequestration, heat island prevention, and groundwater recharge. The project will also explore how solar and agriculture might coexist. The hope is it will lead to a better understanding of how solar arrays can be designed to maximize shared benefits across the food, energy, water, and environmental sectors and serve as a resource for agricultural and rural communities.

Chris Kucharik is professor in the Department of Plant and Agroecosystem Sciences. He is collaborating on agrivoltaics research at UW with **Josh Arnold**, campus energy advisor; **Ankur Desai**, professor and chair, atmospheric and oceanic sciences; and **Steve Loheide**, professor of civil and environmental engineering, and he acknowledges their contributions to this article.

ROSALIE POWELL

Broad Experience, Sharp Focus

A CALS undergraduate prepares to help global communities adapt to climate change.

By NICOLE MILLER MS'06

Photo by MICHAEL P. KING

Rosalie Powell BSx'24 has taken full advantage of her college experience, embracing everything that UW has to offer — from coursework and research to internships and study abroad.

"I'm interested in big-picture issues, so I've just been enjoying mixing and matching [my courses and activities] and getting a really interdisciplinary education," says Powell, who is double majoring in environmental sciences and life sciences communication (LSC). "I think now is the best time to explore."

At first glance, her approach may appear a bit scattershot, but there's a purposeful strategy behind it all. Powell, a Madison native, aspires to a career in climate change communications. She hopes to partner with communities around the globe to help them address and adapt to climate change. Since the issue is so complex, it's a career direction that benefits from a broad, well-rounded academic background.

At the same time, it requires practical skills to connect with strategic audiences — skills Powell is developing through her LSC classes. "LSC is not just the [communication] theory. I'm also picking up a lot of different skills, such as Photoshop, digital video production, social media," she says. "For me, the most important thing is application — how to actually put [what I've learned] into play and help people."

Powell's first major opportunity to apply her communication skills came after her first year at UW, when she took an internship with the Farmland Preservation Program at the Wisconsin Department of Agriculture, Trade and Consumer Protection (DATCP). The program is designed to promote practical land-use planning, keep locally important farmland in agricultural use, and encourage conservation practices.

"Rosalie relished the opportunity to engage with individuals from different backgrounds and geographies to discuss their farms, their passions, and to promote environmental advocacy," says **Katy Smith**, land and resource management section manager at DATCP, who served as Powell's supervisor. "[She learned about] the value systems of rural and agricultural communities, and then she used storytelling as a tool for community-based social marketing of conservation."

During her sophomore year, Powell joined the lab of UW ecologist **Ellen Damschen**, who studies plant communities in a changing world. Through the university's National Science Foundation–funded Research Experience for Undergraduates program, Powell designed and conducted her own field experiment to explore ways for land managers to help prairies adapt to climate change. She's now preparing a manuscript, as first author, for publication in an academic journal.

Powell's other college experiences include being a communication intern with the NASA Health and Air Quality Applied Sciences program, spending a summer in Brazil to learn Portuguese, and opening and operating a polling location on campus during the COVID-19 pandemic. Powell is the youngest chief election inspector in Madison history.

All these activities make Powell a notable student. She received a WALSAA Outstanding Sophomore Award in 2022. In 2023, she was named a Udall Scholarship Honorable Mention and a Truman Scholarship finalist — honors that recognize her leadership, public service, and other achievements.

On track to earn her diploma in spring, Powell plans to attend graduate school — but not right away. There's still more exploring to do. She's working on a Fulbright grant application, hoping to fund an outreach project to study the effectiveness of sustainability incentives available to Brazilian farmers.

"I'd like to work with people from other countries because climate change is such a global issue that we really need to have international cooperation," says Powell. "We need to be gathering ideas and communicating with people from all over."

On the Origin of the Species

This card-based competition, created by a team in genetics, teaches key aspects of evolution to K-12 students.

By JORI SKALITZKY BS'22

Students play Speciation with doctoral student Emma Howell MS'22 at the Wisconsin Science Festival. Photo courtesy of BRET PAYSEUR

Speciation, the formation of new and distinct species over time, is an abstract concept that can be difficult for younger students to grasp. Multiple factors from genetics to animal behavior influence and complicate this evolutionary process. But an educational card game developed in the Department of Genetics is making speciation easier to comprehend.

Genetics professor **Bret Payseur** and colleagues in his lab spend much of their time on evolution and genetics research. However, they're also committed to outreach and community service. This includes educating students about complex research topics. After brainstorming many ideas for how best to meet students' needs, Payseur and postdoc **Megan Frayer** PhD'22 created a card game focused on speciation.

"We collaborated with [education and outreach manager] **Travis Tangen** and his team at the Wisconsin Alumni Research Foundation and [former outreach director] **Kevin Niemi** at WISCIENCE to develop resources to help teachers teach speciation," Frayer says. "I learned a lot about how outreach and teaching resources are developed."

In the card game — fittingly named Speciation — players compete to form new species with cards denoting factors that contribute to speciation. It's designed for middle and high school audiences, but anyone interested in understanding speciation can play.

"Speciation is important to understand because it's the process that generates biodiversity," Frayer says. "The game can help students understand important aspects of speciation — such as the different types of reproductive isolation — in a way that is fun and engaging. I hope the game will also help students connect with research, as the game features many diverse examples of speciation studies."

Students got a chance to play Speciation with Frayer, Payseur, and other members of Payseur's lab during the 2022 Wisconsin Science Festival, which was held in mid-October at locations across the state.

"Even with the limited amount of time they had, the students asked good questions and seemed to be learning," Frayer says. "I hope that players appreciate that the complexity is part of what makes speciation interesting and fun to study — every instance is unique!"

Speciation was developed with funding from the National Science Foundation.

EXPLORE ONLINE

Learn more about outreach and service in Bret Payseur's lab at **payseur.genetics.wisc.edu/outreach-and-service**.

FOLLOW-UP

INVASIVE SPECIES ALTER MENDOTA'S MICROBES

In the fall 2017 issue of *Grow*, **Erik Ness** highlighted bacteriologist **Katherine (Trina) McMahon** and her quest to understand Lake Mendota through its microbial species. Since then, her long-term research program has analyzed decades of data from lake samples. One recent study found that two previously identified incursions by invasive species — a zooplankton known as the spiny water flea in 2009 and the early stages of a zebra mussel infestation in 2015 — had profound effects on water quality, toxicity, and algae blooms in Mendota.

McMahon, former graduate student **Robin Rohwer**, and their team found that in the years following both invasions, cyanobacteria (blue-green algae) began appearing in the lake during late spring, when the water used to be crystal clear.

Focus on Rural and Tribal Wisconsin

UW has launched new projects that partner with communities on solving their unique challenges, and CALS is contributing to the effort.

By HEIDI ZOERB

Four projects, including two from CALS, that will support Wisconsin's rural communities and tribal nations have been selected to receive funding through UW's Wisconsin Rural Partnership initiative.

First announced in December 2022, the initiative was established with $9.3 million from the U.S. Department of Agriculture. The big-picture goals are to advance the land-grant mission of the university, support community-based projects, and create new partnerships to better meet the needs of rural communities.

The university's Wisconsin Rural Partnership initiative is part of a broader $28 million USDA-funded Institute for Rural Partnerships, housed at UW, Auburn University, and the University of Vermont. The institute aims to promote equitable, resilient, and prosperous food and agricultural systems and expanded opportunities for rural community development. It will also foster collaborations with community-based initiatives and local research, institutions, and subject matter experts.

"Here in Wisconsin, our rural communities face unique challenges to growing their local economies, and it's important we provide them the tools and resources they need to thrive in a changing environment and economy," says Sen. **Tammy Baldwin**, who helped secure the institute's federal funding.

The Wisconsin Rural Partnership has already provided funding for the Wisconsin Environmental Mesonet, a statewide network of 90 environmental monitoring stations that will help the agricultural community boost harvests and protect resources (see "One Step Ahead of Wisconsin's Weather," *Grow,* Summer 2023). The partnership is also helping to fund the state climatology office, located in the UW Nelson Institute's Center for Climatic Research.

"We are grateful for this funding and the support of Senator Baldwin," says CALS Dean **Glenda Gillaspy**. "It's inspiring to see UW experts from many disciplines throughout the university focusing on problems facing our rural communities."

CALS and the Division of Extension sponsored a competition to solicit the best community-based research, extension, and education projects that engage local partners to solve challenges faced by rural communities and tribal nations in Wisconsin. Two CALS-affiliated projects were selected.

More details about the Wisconsin Rural Partnership and its funded projects can be found at **go.wisc.edu/cals-WRP**.

Photo by MICHAEL P. KING

"The Rural Livability Project," led by **Tessa Conroy**, professor and extension specialist in the Department of Agricultural and Applied Economics, looks to identify the key assets needed to sustain rural communities and to find the best ways forward in developing community economic development policies and strategies to support rural livability.

"Connecting Cultural Values and Indigenous Research Towards Food System Resilience" is co-led by **Dan Cornelius**, an outreach program manager in CALS and the UW Law School, and **Tricia Gorby**, director of Extension's Natural Resources Institute. **Erin Silva**, associate professor and extension specialist in plant pathology, will also be contributing. Their project aims to engage tribal nations and a broad network of partners to co-create an understanding of high-priority, Indigenous-led research, education, and outreach projects to help Wisconsin tribes sustain and expand food sovereignty in the face of the state's environmental challenges.

Trina McMahon wades in the shallows of Lake Mendota.

Photo by SHARON VANORNY

This extended the length of the seasons in which harmful algae blooms persisted in subsequent years. In addition, they discovered that a far more diverse range of cyanobacteria thrived in the lake during the summers following the invasions.

The proportions of many other kinds of bacteria also changed during this time. The dominant species grew while the smaller populations dwindled. This finding shocked microbiologists because heterotrophic bacteria (those that, unlike cyanobacteria, get nutrients from plant or animal matter) were thought to be less sensitive to changes in their surrounding ecosystems.

Another finding: Following the zebra mussel invasion, toxic water conditions in Mendota rose, and the toxin-production season lengthened. Specifically, detectable levels of microcystin, a common toxin produced by cyanobacteria, increased.

Thanks to this long-term data collection and analysis, researchers now have a deeper understanding of the interconnectedness of Lake Mendota's microbial communities and how they are subject to long-term environmental change.

—Peyton Mueller BSx'24

The Turf Manager's Apprentices

A Farm and Industry Short Course program provides "supercharged" training for turfgrass management roles at golf courses, lawn care companies, and more.

By CAROLINE SCHNEIDER MS'11

Emerging from the tree line onto The Lido golf course is like walking into a different world. Sand stretches over rolling hills where green grass parts the sea of beige. No trees interrupt the sight lines, and water hazards glimmer in the distance. First-time visitors may feel dwarfed by the vast surroundings, but **Dillon Nelson** is coming to know these 850 acres better than his own backyard.

Nelson has worked on the grounds of The Lido at Sand Valley Resort in Nekoosa, Wisconsin, since 2021. At that time, construction was still ongoing at the course — a re-creation of a famed Long Island club of the same name that was demolished for a military base during World War II. In fall 2022, as the opening of The Lido neared, Nelson entered the UW–Madison Turfgrass Apprenticeship Program (TAP) to both expand and fine-tune his turfgrass expertise.

"Everything we were taught was useful, and we dove into everything — maintenance practices, disease and weed management, budgeting, irrigation, equipment training," Nelson says. "We learned so much in so little time, and it's so beneficial for me and the golf course."

The two-part TAP curriculum consists of a 12-week boot-camp and a field-based apprenticeship. The program was started by **Paul Koch** BS'05, MS'07, PhD'12, professor and extension specialist in the plant pathology department, and **Doug Soldat** BS'01, MS'03, professor and extension specialist in soil science, as part of UW–Madison's Farm and Industry Short Course. Their aim is to train newcomers to the field as well as those already working in turfgrass management who want to increase their knowledge.

"The material we provide for students is specialized for turfgrass," Koch says. "We offer the classroom section in the winter, so students can continue to work in the spring and summer. TAP costs less and takes less time than a liberal arts degree. It's a supercharged amount of training in a short period to help students advance their turfgrass management careers."

The turfgrass industry is an important contributor to Wisconsin's economy: Golf alone provides an annual economic impact of $2.4 billion. Koch and Soldat have seen a lot of interest in TAP from employers and turfgrass associations looking for more qualified managers who can reinforce the industry. Many associations have even sponsored TAP

Plant pathology associate professor Paul Koch works with Turfgrass Apprenticeship Program students on turf species identification at D.C. Smith Greenhouse on the UW campus. Photo by MICHAEL P. KING

Dillon Nelson, a student in the Turfgrass Apprenticeship Program and an assistant in training at The Lido, one of Sand Valley's golf courses near Nekoosa, Wis., uses a GPS device to digitally plot a future walking path between holes. Photo by MICHAEL P. KING

students. A total of $13,000 in financial aid was available to students this past year thanks to donations from organizations such as the Wisconsin Turfgrass Association, the Wisconsin Golf Course Superintendents Association, the Wisconsin Sod Producers Association, and the Wisconsin Sports Turf Managers Association, which provided a scholarship for Nelson.

Two other strong supporters of the program are **Rob Duhm**, director of agronomy at Sand Valley, and **Jimmy Humston**, superintendent of The Lido. For them, the trained managers coming out of the program are invaluable to the resort. In fact, five students who earned certificates from TAP have worked at or currently help manage courses at Sand Valley.

"Through the program, people find out this is a career and get started on their journey in the turfgrass field," Duhm says. "We need around 40 individuals on every course at Sand Valley — and we have five courses — just to get through each day, and we want to bring knowledgeable students from the program here."

Humston adds, "The program springboards people who decide they want to do this job. They come back from the program more prepared and ready to take on more responsibility."

TAP grew from five students to 19 in its first two years, and Koch and Soldat have been impressed by their dedication, excitement, and appreciation for the program's format. During the boot camp, students attend "shop talks" to learn directly from superintendents and equipment maintenance experts. Then they complete their internship in the spring. Students can earn two certificates in the program — one for the boot camp and the other for the internship.

EXPLORE ONLINE

For more information about the Turfgrass Apprenticeship Program, visit **go.wisc.edu/tap**.

To develop internship requirements, Koch and Soldat worked with golf course managers, sod growers, and landscapers to create an extensive inventory of skills that would demonstrate competency in the turfgrass field.

"We now have lists of tasks for each type of internship," Soldat says. "For a golf course internship, you might have tasks in many areas, such as financial management, record keeping, and guest relations. Students have to complete a certain percentage of tasks to get their second certificate."

Students who finish the program take their expertise to positions at golf courses, lawn care companies, sports complexes, and sod farms or other areas of turfgrass management. Nelson now has a full-time position at The Lido, which opened in May. He's excited to see golfers enjoy the course and looks forward to using all that he's learned to maintain and improve it — from the tees to the greens to the bunkers.

And just how many bunkers are out there?

"One hundred forty," Nelson says (without missing a beat) as he heads back onto the otherworldly course. "And eighty-three and a half mowable acres."

How Waste Becomes a Resource

Using fermentation and genomics, Victor Ujor helps microorganisms turn what's useless into something useful.

Interview by NIK HAWKINS | Photo by MICHAEL P. KING

Victor Ujor's fascination with microorganisms — bacteria, fungi, viruses — began with an issue of *Time* magazine. What he encountered in the pages of that publication, combined with a passion for the life sciences and a distaste for hospitals, made him bypass possible careers as a lawyer or a doctor. Instead, he chose to pursue microbiology.

A native of Enugu, a city of more than a million people in Nigeria, Ujor studied microbiology and fermentation at his hometown university, where he dabbled in home brewing to gain a deeper understanding of the microorganisms he loves. He then earned master's and doctoral degrees at the University of Westminster in London.

Now, as an assistant professor in the Department of Food Science, Ujor leads a campus lab that studies how microbiological tools, such as molecular engineering and natural fermentation biology, can convert waste products into biofuels, renewable chemicals, and sustainable materials. His main goal is to use these processes to help solve the world's ecological challenges, from climate change to population growth.

What about microorganisms fascinates you? And how did your fascination originate?

Just about everything.

One day, late in high school, I went to a relative's house, and she gave me an issue of *Time* magazine, where Dr. David Ho was named Man of the Year. He had come up with a new treatment for HIV using special inhibitors that prevent the virus from penetrating T cells. And there were scientific stories talking about what people could do in immunotherapy using microorganisms. I started thinking about these little bugs that mostly we can't see with our eyes, how they can really affect us, how they can benefit us.

And then I had the opportunity to go to a scientific lab, where someone allowed me to look through the microscope. You look at the slide, there's nothing; then you place it and look through the microscope, and everything becomes colorful, beautiful.

So, I kept wondering about how they do what they do, how we can contribute to society through them. I fell in love with studying them. And I never fell out of love with them, just trying to figure out how we can get microorganisms to do what we want rather than what might hurt us.

And those experiences led you to your undergraduate university?

Yes, I went to the Enugu State University of Science and Technology, where I studied microbiology and brewing science. What a beautiful combination. I was just trying to learn more and more and more; and as I did, I realized I liked the applied aspect of it, manipulating microorganisms, growing them to produce something.

And I recall brewing beer for the first time from scratch. I actually malted my own grains at home, and my brothers watched. I finished brewing the beer three or four days later, and they said, "We're not going to drink it with you because we're not sure what you've cooked up. But if you are alive by tomorrow, then we'll help you finish it." It tasted good, and the next morning, when I woke up, they said, "All right, let's go try some beer."

What got you thinking about using microorganisms as tools for solving problems like climate change, population growth, and waste generation?

I think that started when I was wrapping up my bachelor's degree. I studied bacteria that breakdown crude oil and, in doing so, I read about the massive Exxon Valdez oil spill in Alaska [in 1989]. It made me wonder how we could find a way to meet our energy needs without leaving us prone to such a disaster. Then I went to graduate school in London. That's where I realized that biofuels were becoming something really big. And not just fuels: We refine oil into about 6,000 different chemical compounds, and the vast majority of them are so crucial to the economy that we cannot live without them.

And that spurred more interest in the role of microorganisms. I was doing a massive project on extracting antibiotic compounds from fungi. We found that the fungi made a different set of compounds depending on the conditions you grow them in and the nutrients you feed them. I realized, if you can keep fine-tuning the conditions, you can get a wide array of chemicals, and a good number of them can have applications.

You've described the focus of your research as using microbial fermentation and synthetic biology to develop new ways to convert organic wastes, pollutants, and agricultural residues into value-added products. Let's talk more about that.

Often, with fermentation, we think of cheese, beer, and wine. But there's a lot more to it. You can grow microorganisms under the same or similar conditions used to ferment [those food products], but you get a different set of products. For example, you can grow microorganisms and produce something like butanol, which is used to make paint and synthetic rubber.

The beauty of it is that, with genomics today, we can understand what different organisms are doing at the molecular level. And we can bring together the traits of different organisms to make new, useful compounds.

Why is it important to explore this?

There's water scarcity in different parts of the world, more than ever before, and our population is growing. We can't run from it. If we're going to be sustainable and actually thrive on this planet, we have to find ways to use most of the resources available to us. And waste is something we generate a whole lot of. We have to start thinking of waste as a resource.

That's what my research is trying to do. We can take excess plant materials, like wheat straw, extra corn stover, forest residues, and then extract sugars from them. And we can feed those sugars to the microorganisms during fermentation to make different [potentially useful] compounds. Then we sort of coax them to make more. Examples of these compounds of interest are 2, 3-butanediol [used in the manufacture of fuel additives, foodstuffs, pharmaceuticals, and more] and 1, 3-propanediol [a common solvent, also used to make adhesives, composite materials, and laminates, among other things].

Can you give us an example of a potential practical application you're studying?

We're looking at societal waste that is extremely difficult to manage. For example, there's a process called anaerobic digestion. We use it to treat waste, things like animal manure. You put it in a big tank and naturally present bacteria break down any residual carbon to produce methane, a natural gas you can use to generate electricity. So, that's a very wonderful process. But at the end of the day, there's yucky stuff that comes out of that — it's full of phosphorus, ammonia, and you need to find a place to safely put it. Maybe you can use it on farms for fertilizer, but there aren't enough farms that want it. And transporting it with trucks introduces carbon dioxide into the atmosphere, which is not very eco-friendly.

ONLINE EXTRA

Want to learn more about how microbiological tools can convert waste products into sustainable materials? Visit **grow.cals.wisc.edu** to find links to three of Ujor's published research papers.

So, we figured out that we can actually harness the power of this waste to make different compounds by just introducing them at different concentrations in our fermentation process. One of our studies showed that the microorganisms pull out most of the phosphate, the ammonia, the light metals, heavy metals, the sulfate, the chloride. Close to 50% of the minerals were reduced significantly.

That sounds very promising. Are there other possibilities you hope to pursue in this area?

We are mainly looking at anaerobic digestion as a process to make different compounds from waste. Hopefully we can scale it at some point so waste can serve as a reliable source of minerals for fermentation. And hopefully we can make the process more sustainable.

Next, if we can prove what we're doing with anaerobic digestion, we'd like to extend it to a much harder-to-treat waste, such as landfill leachate [chemicals drawn out of landfills when rainwater filters through the waste]. Leachate is also full of minerals.

If we can find more ways to mine organic waste as sources of minerals, minerals that microorganisms can use at different concentrations as ways to make valuable compounds, we can reduce the cost of the minerals and hopefully compete more efficiently with crude oil–derived chemicals, in terms of cost.

More than 175 years have passed since the founding of the University of Wisconsin, the state's first public university. Throughout this time, UW has led the way in everything from groundbreaking research discoveries to defining cultural movements.

The UW–Madison campus is honoring these historic moments as part of a yearlong celebration, which began on July 26, 2023 — 175 years to the day since the university was created. Programming will run through May 2024, and you can stay up to date at **175.wisc.edu**.

CALS is making its own contributions to the important occasion, and highlights of the college's rich history will be featured here in the pages of *Grow*.

Clockwise from top left: L. F. (Laurence Frederick) Graber, an agronomy instructor at UW from 1910 to 1957, was known as "Mr. Alfalfa." Here, he talks to a group about the plant.

Ph.D. student Sadegh Ranjbar prepares a drone for a data collection flight over an alfalfa field at Arlington Agricultural Research Station.
Photo by MICHAEL P. KING

Corn at Hancock Agricultural Research Station, circa 1924.

Professor Bill Tracy and former graduate student Adrienne Shelton MS'12 sample organic sweet corn in the field at the West Madison Agricultural Research Station.
Photo by WOLFGANG HOFFMANN

Mixed modes of transport in the "parking lot" at the Marshfield Agricultural Research Station during a field day, circa 1925.
Historic photos courtesy of UNIVERSITY OF WISCONSIN–MADISON ARCHIVES

Doug Soldat BS'01, MS'03, professor of soil science, speaks to attendees during the 30th anniversary Field Day at O.J. Noer Turfgrass Research and Education Facility in August 2022.
Photo by MICHAEL P. KING

The Evolution of the Agricultural Research Stations

By NICOLE MILLER MS'06

The UW Agricultural Research Station (ARS) system features a statewide network of outdoor laboratories and classrooms. At these facilities, faculty, staff, and students (and sometimes university partners from farms or industry) conduct research related to the unique agricultural and environmental challenges found in Wisconsin's distinct regions.

The ARS system, led by CALS, is the product of more than a century of expansion and evolution. The first station was established in Spooner in 1909, and the most recent — the O.J. Noer Turfgrass Research and Education Facility in Verona — was created in 1992. The network includes 11 off-campus stations and the on-campus CALS Greenhouses. Combined, they encompass more than 8,000 acres.

That's a lot of land. But this acreage is key for developing and testing new crop varieties, a significant activity at many ARS stations. From their earliest days, the stations have hosted a variety of plant breeding programs, producing many notable successes. A major milestone was the release in 1952 of vernal alfalfa, a winter-hardy, disease-resistant, high-yielding crop whose genetic ancestry can now be found in more than 1,000 alfalfa varieties. Other plant breeding triumphs include the Snowden potato, a popular potato chip variety, and the HyRed cranberry, a fast-ripening berry designed for Wisconsin's short growing season.

Beyond plant breeding, the stations host hundreds of research projects led by agronomists, biological systems engineers, dairy scientists, entomologists, horticulturalists, meat and animal scientists, plant pathologists, soil scientists, and wildlife ecologists. Their overarching goals are to develop profitable, sustainable farming systems and preserve environmental quality. Results and recommendations are shared widely, including through public "field days" held at the stations every summer.

Ewe Are What Your Grandparents Ate?

Through a first-of-its-kind study, CALS animal scientists show us how our diets could modify the DNA of our grandchildren — and beyond.

By **Caroline Schneider** MS'11 + Photos **Michael P. King**

"You are what you eat." We've all heard this old adage before. But during pregnancy, maternal nutrition can have a large impact on a baby, as well, suggesting you're also what your mother eats. Now, new research from the Department of Animal and Dairy Sciences is taking that one step further by showing that you may in fact be what your grandparents — or even great grandparents — ate.

It might be time for a new adage.

Professor Hasan Khatib and colleagues in his lab have spent several years studying how a specialized diet in one generation of animals might affect those that come after. More specifically, they're looking at the DNA of animals — sheep, in this case — to see if changes get passed on to their offspring, their offspring's offspring, and so on. However, they're not examining the sequence of the DNA, the order in which nucleotides are arranged. Instead, they're focused on the epigenetics of the animals.

Left: Polypay sheep at the Arlington Agricultural Research Station's Sheep Unit.

Right: Todd Taylor, research program manager at the sheep unit, prepares feed.

"When we say epigenetics, we're talking about something beyond the genes, beyond the sequence, that dictates what the genes do," explains Khatib. "These aren't changes or mutations in the sequence; they are small methyl groups (molecular structures) that get added to the DNA and can turn a gene on or off."

Epigenetics acts as a mediator between the environment and genes. For example, identical twins may have different phenotypes, or observable traits (such as birth weight, personality, and susceptibility to disease), even though they have the same gene sequences. That's because environmental conditions can alter their epigenetics.

Khatib and his colleagues aim to document the transmission of these epigenetic changes caused by environmental cues from one generation to another, a phenomenon called transgenerational epigenetic inheritance.

"Transgenerational epigenetic inheritance, or TEI, means that you have an environmental factor that affects one generation," Khatib says. "That effect is then passed to subsequent generations that were not exposed to the original environmental factor themselves."

Research has shown that TEI is at play in some organisms. In plants and in *C. elegans* (a roundworm often used as a research model), it has been documented through more than 20 generations. But in mammals, there is less evidence — and there's even disagreement about whether it exists.

Khatib wanted to take a methodical and thoughtful approach to determine if TEI occurs in mammals, and he decided to use sheep as his model organism. Camila Braz, who was a postdoctoral researcher in his lab and is now an assistant professor at the University of Illinois Urbana-Champaign, worked with Khatib on the project. They also enlisted the help of Todd Taylor, the research program manager at UW's Arlington Agricultural Research Station.

Taylor grew up around sheep in Wyoming and has more than 20 years of experience managing research animals at Arlington. Over the last five years, he has helped Khatib and his team breed

The Study of Human TEI Emerges

Questions about whether transgenerational epigenetic inheritance (TEI) might be possible in humans arose during World War II when Dutch mothers suffered through a famine. Studies of the children and grandchildren of those women showed that even the grandchildren experienced changes to their traits that could be related to the effects of the grandmothers' famine diets. However, these data don't truly show TEI. This is because studying TEI in females can complicate matters. When a woman is pregnant, her growing offspring (in embryo form) is exposed to what she eats, but so are the germ cells (ovum) in the embryo. This means that, during the Dutch famine, the eggs that would potentially grow into the grandchildren of the pregnant women were also exposed to limited nutrition. To truly show TEI, researchers would have had to look at the next generation — the great grandchildren who had no exposure to the famine diet.

and study sheep to determine if they could find evidence of TEI. Experimental design was extremely important for this project since direct comparison of epigenetics between sheep fed a specialized diet and those fed a control diet would be the best way to show TEI. So, Khatib and Taylor turned to Polypay sheep.

"Polypay sheep have a lot of twins, triplets, and even quadruplets," says Taylor. "They were developed in the 60s to increase the number of lambs born each year. They were specifically selected to be more prolific, and that works perfectly for Dr. Khatib's studies, since he needs twins to compare."

Researchers planned to feed the males (rams) the specialized diet. But questions remained. What should that diet be, and how could they give it to the sheep? Khatib decided to feed the treatment group a diet supplemented with methionine, an essential amino acid. Methionine is used to add methyl groups to DNA, so it influences the epigenetics of the animal.

Finding the best way to feed the sheep took some trial and error. At first, Taylor fed the sheep individually to ensure each one ate the supplemented diet; but with so many sheep, the process became too labor intensive. So, he devised a feeding container with multiple sections that would allow only one sheep in the pen to eat from each compartment. This way, every sheep would get their own portion of the special diet.

"The methionine diet is just a small amount, so we make sure that those pieces of food are right at the top," explains Taylor. "They pretty much get the methionine in the first bite. And we know each sheep in the treatment group is getting it because they each eat from their own section."

Another piece of the feeding puzzle was timing. Khatib and his team wanted to affect the germ cells of the sheep — in males, the sperm — so they fed the rams from weaning to puberty, before the point at which the sperm cells start developing. Only the "zero" generation (F0, those fed the diet) and the first generation (F1, derived from F0 germ cells) would be exposed to the methionine diet. If any epigenetic changes were seen in the second generation of sheep (F2, the grandchildren of the rams fed methionine), that would be evidence of TEI, since those offspring had no exposure to the specialized diet.

And that's just what Khatib and his colleagues found. In a study published last spring in the *Proceedings of the National Academy of Sciences Nexus*, the research team presented evidence of

Todd Taylor prepares the special diet for an epigenetics study being conducted at the sheep unit.

Hasan Khatib, left, professor of animal and dairy sciences, and graduate student Jessica Townsend at the Arlington Agricultural Research Station's Sheep Unit. The two are part of a team of researchers studying epigenetics in the herd.

epigenetic changes due to the methionine diet out to the third generation (F3, the greatgrandchildren). Searching for those changes is quite the effort. Khatib's lab used a technique called whole genome bisulfite sequencing to look at every single cytosine in the DNA sequence to see which had methyl groups attached (i.e., were "methylated"). Cytosine is one of four nucleobases found in DNA, and it's a common site for methylation.

"More than 100 cytosines that were methylated due to diet in the treated generation were also methylated in the F1 and F2 generations," explains Khatib. "The consistent trends of these methylated cytosines across three generations is a strong indication of TEI."

Documenting those epigenetic changes, however, was just one half of what Khatib wanted to accomplish. He also wanted to know if those modifications on the DNA would result in changes in the observable traits of the sheep, the phenotypes. Jessica Townsend, a graduate student in Khatib's lab, travels to Arlington often to work with the sheep and help Taylor take the measurements they need.

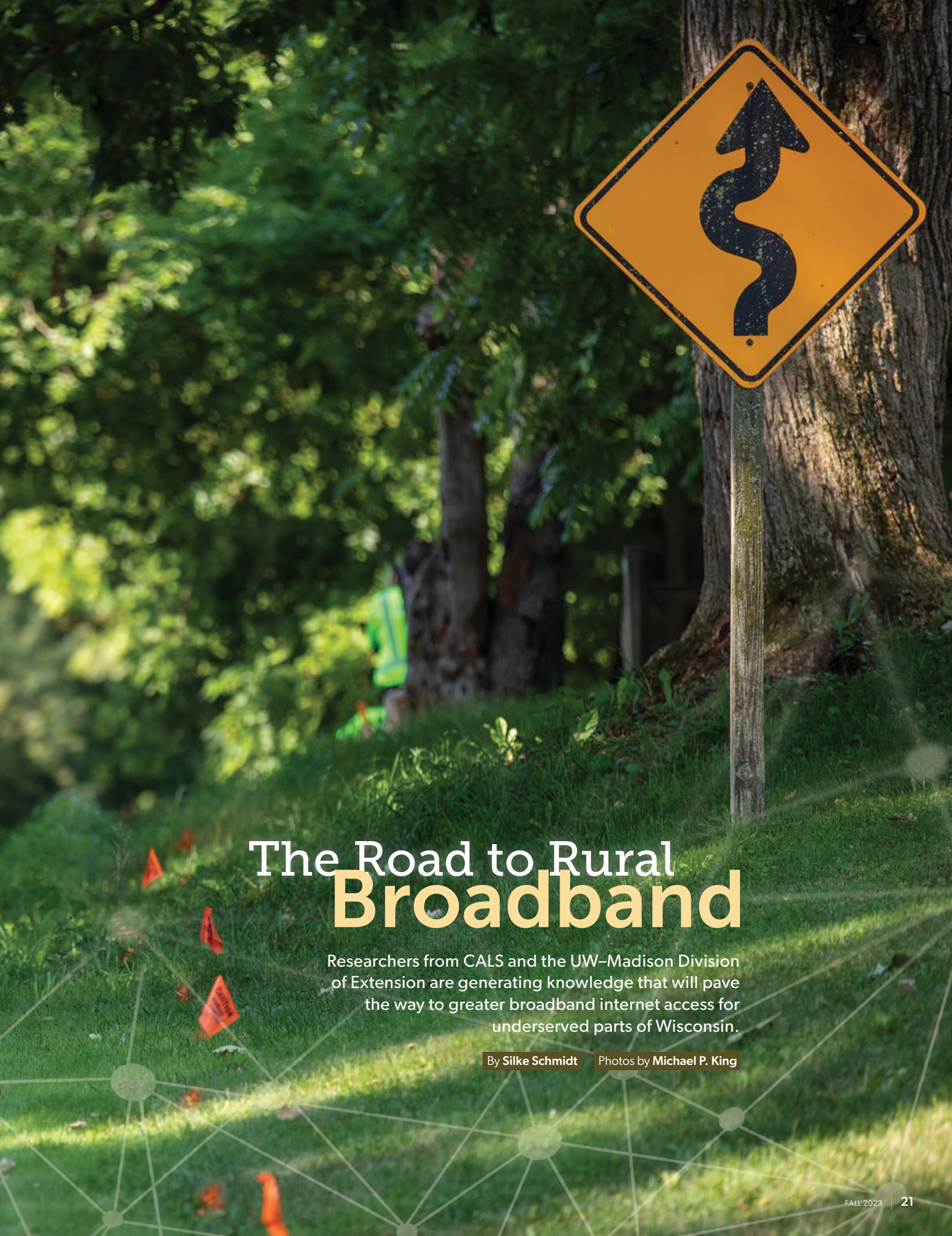
"Recently, we were looking for phenotypes in close to 90 rams," says Townsend. "We take weights, measure the scrotal circumference, and then perform ultrasound for the loin muscle depth."

When the researchers looked at scrotal circumference, a measure of testicular size and often an indirect measure of function, they found that the circumference was reduced through the F2 generation in the animals fed methionine. They also found that loin muscle depth, a phenotype related to growth of an animal, was lower in the F2 generation. These data suggested an influence of diet on male reproductive and growth traits in subsequent generations of sheep that were not fed the methionine diet.

With the publication of this comprehensive study, Khatib and his team have shown evidence of TEI in mammals. They are working to learn more about the phenomenon through other studies, namely feeding ewes methionine and discovering how the diet might affect embryo development. And, if TEI is shown to occur in humans, Khatib is also interested in the social implications.

"TEI covers basic scientific questions as well as applied questions," says Khatib. "In humans, it would intersect with social responsibility, thinking about how what we eat affects others, as well as social justice, as we consider how those in war zones or experiencing trauma might pass epigenetic changes on to subsequent generations. There's so much to consider, and these studies will advance our understanding of the relationships between nature and nurture." g

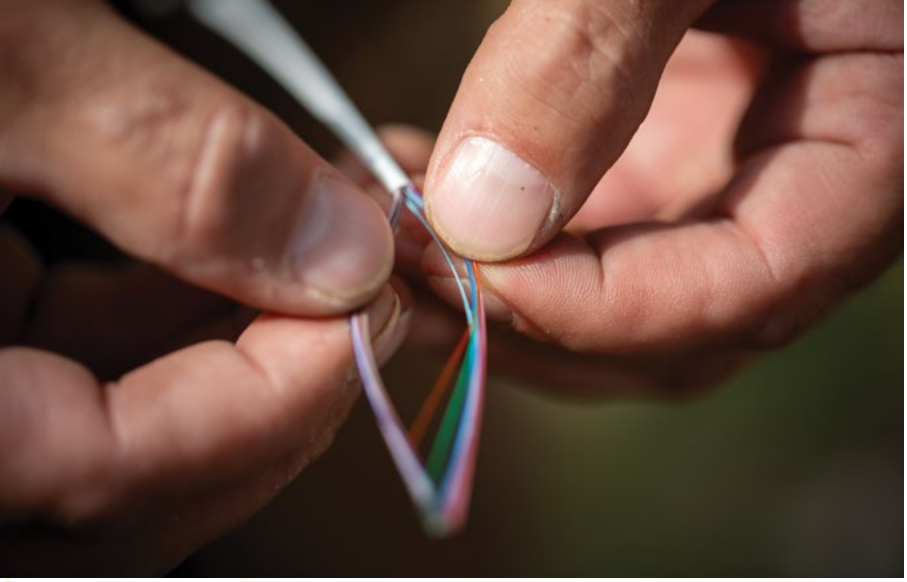
Bobby Wunnicke from TDS Telecom walks along Enchanted Valley Road, a fiber broadband expansion site in the town of Springfield, Wis.



The Road to Rural Broadband

Researchers from CALS and the UW–Madison Division of Extension are generating knowledge that will pave the way to greater broadband internet access for underserved parts of Wisconsin.

By **Silke Schmidt** Photos by **Michael P. King**



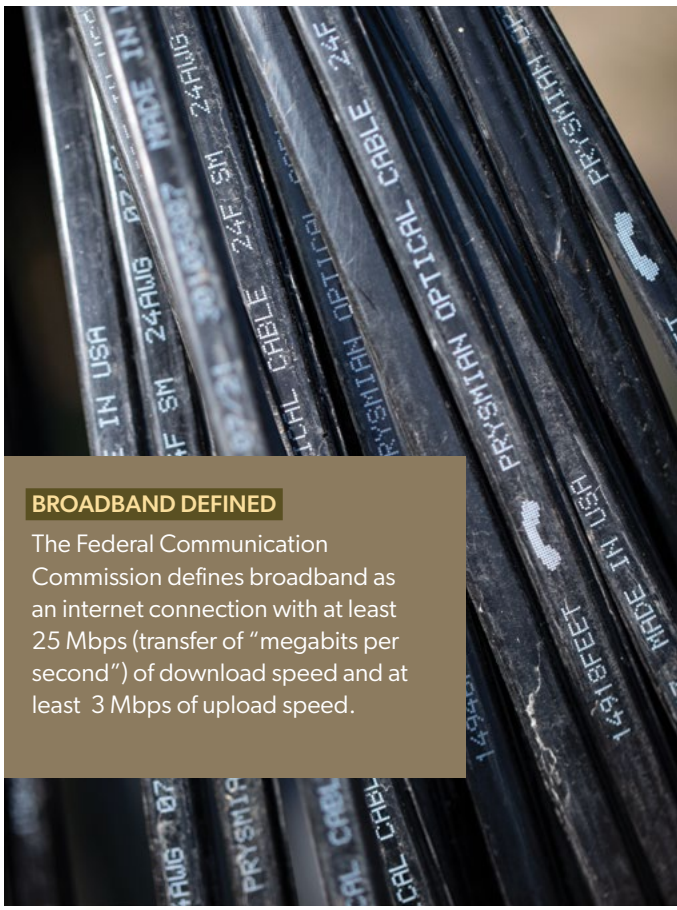
The South Shore of northern Wisconsin — where Bayfield County meets Lake Superior — is known for its natural beauty. Summer used to be the main tourist season, except for the occasional year when the Apostle Islands ice caves attracted cold-season visitors. But things are different now.

"A huge impact of the broadband expansion up here was that we're now getting year-round visitors," says entrepreneur J Erin Hutchinson. "During the pandemic, people were looking for an escape from the cities and discovered the South Shore as a destination, in part because Minnesota's North Shore was getting crowded." High-speed internet allowed people to work from their destination of choice.

This has changed not only tourism but also broad swaths of the local economy — a big deal for Bayfield, whose manufacturing sector is much smaller than in neighboring Ashland and Douglas counties. Remote work, fostered through broadband access, spurred the housing market and related businesses. And buying homes (or land to build on) is more appealing when local companies can help with short-term rentals while the owners aren't using the property themselves. At her property management company, Hutchinson has noticed a big change in the importance of broadband to her clients. "People interested in renting a summer cabin didn't use to ask about high-speed internet," says Hutchinson. "Now it's the first question I get."

Bayfield County — one of Wisconsin's least populated counties at about 11 people per square mile — is a perfect example of the difference broadband can make. Its main internet service provider is Norvado, a telephone cooperative established in 1950. Decades after the company's founding, the conversion of telephone lines to fiber optic cables became a new income stream, and Norvado received federal broadband grants to improve and expand that infrastructure. Hutchinson, who moved to the area in 2016 from California's Silicon Valley, saw that money put to good use. "Just anecdotally, I bet 75% of the people I knew up here five years ago complained about not having broadband," she says. "Now I can hardly think of anybody."

But not all of Wisconsin's 72 counties have been as lucky as Bayfield. That's something CALS researchers and their partners at the UW–Madison Division of Extension are working to change.



BROADBAND DEFINED

The Federal Communication Commission defines broadband as an internet connection with at least 25 Mbps (transfer of "megabits per second") of download speed and at least 3 Mbps of upload speed.

Far left: Craig Foster of TDS Telecom shows the individual fiber optic strands within a single cable.

Left: While local residents and farmers pass by, Bobby Wunnicke operates a horizontal boring machine as he and a crew from TDS Telecom work on a fiber broadband expansion along Enchanted Valley Road in Springfield, Wis. With the headset, Wunnicke communicates with a crew member who is monitoring the direction and position of the bore's head.

Bottom, far left: A fiber optic cable loop.

Bottom left: The head of a horizontal boring machine (also called horizontal directional drilling) passes through a sight hole where it crosses the path of another underground utility.

Availability vs. Adoption

The issue of greater access to high-speed internet in urban than in rural America has received much media attention and spurred federal and state efforts to improve the country's broadband infrastructure. Nationwide, 77% of households in counties that are completely rural or have an urban population below 2,500 have internet compared to 87% for counties with metro populations above one million. (In Wisconsin, those figures are 81% and 88%.) Lower population densities deliver less return on investment for internet service providers, and the cost of laying cables is higher in remote areas due to fewer roads and longer distances between homes.

But Steven Deller, a CALS professor of agricultural and applied economics and extension specialist, is more concerned about a larger gap. "There are many pockets of low-income people who can't afford broadband regardless of where they live," he says. From the most rural to the most urban counties, only 57–69% of households that earn less than $20,000 have internet access compared to 92–96% of households earning more than $75,000.

That income gap means building up the infrastructure to improve *availability* is only the first step. "Since cost is a huge barrier, the mantra 'if you build it, they will come' doesn't apply here," says Deller. Instead, the policymakers charged with allocating federal and state dollars to the nation's broadband-deficient counties need to improve *adoption*. To do so, they will require two equally important pieces of information: accurate maps of existing broadband service and a reliable estimate of people's ability to pay for internet service once it arrives.

Deller is working with Extension geographer Matt Kures on the first part. The current maps from the Federal Communications Commission (FCC) are unreliable because they are based on service providers' subscription information. In practice, this means an entire neighborhood is marked as "having broadband" even if only a single household is in the provider's database. Extension is partnering with the Public Service Commission's Broadband Office to improve the FCC maps and fill the *actual* service gaps.

The second part — estimating internet affordability — is a research project for Deller's graduate student, Mckenzie Boyce. She started her Ph.D. program in agricultural and applied economics in fall 2022, and she's focusing on community economic development. Her interest in broadband is both professional and personal.

"I have plenty of first-hand experience with internet challenges from growing up in rural northern California in a town of 1,000 people," she says. "When I woke up in the morning, I never knew

whether I would have internet that day — or how long it would last."

Soon after Boyce arrived on campus, she began working with Deller and extension specialist Kristin Runge PhD'17 to develop the Wisconsin Broadband Survey. Runge oversaw its distribution to a representative sample of residents. Next, Boyce and Deller used statistical "willingness to pay" models to analyze the survey responses from 703 Wisconsin households.

Willingness to pay estimation is a popular strategy for determining the value of goods and services that aren't sold in retail markets, such as parks, lakes, and other natural resources. In this case, it will help target broadband expansion efforts to each county's demographic and socioeconomic profile.

To estimate willingness to pay (stratified by household income), the researchers provided eight realistic broadband packages of varying speeds and reliability, each at three price points, from which survey respondents could choose. For example, package 1 options ranged from $75 for 50 megabits per second (Mbps)/occasional outages to $150 for 300 Mbps/rare outages; the range for package 6 was $20 for 25 Mbps/occasional outages to $100 for 100 Mbps/rare outages. For all scenarios, respondents could also choose not to purchase any service.

Some of the main findings: Lower-income households (annual income below $35,000) are willing to pay $46.72 per month for 25 Mbps services compared to $165.76 for higher-income households (above $150,000). The respective numbers are $10.85 and $38.48 per month for services with fewer outages, suggesting that many consumers value speed more highly than reliability. In addition, rural residents chose to not purchase internet services less frequently than urban residents.

"These results will help local officials decide whether to seek out additional funding to reduce the monthly cost of internet and by how much," says Boyce. "For example, we can predict for each county how many more people would likely sign up if the monthly cost was $75 instead of $120."

That information is critical for two parties: the communities planning to apply for federal broadband funds and the regulators that oversee this effort. "The Governor's Task Force on Broadband Access [formed in July 2020 to advise the governor and the Wisconsin State Legislature] is eagerly awaiting our WTP results," says Deller.

And there's a third interested group: internet service providers who build the infrastructure and care about their return on investment from future subscriptions. They play an especially important

Graduate student Mckenzie Boyce meets virtually with Steve Deller and Kristen Runge to discuss their research related to rural broadband access in Wisconsin. Photo by DIMITRIS FRIESEN MS'22

role because communities need to partner with specific providers to be eligible for federal infrastructure grants. According to Deller's analysis of 2016 national FCC broadband data, a commercial provider's decision to invest in a new region depends mostly on three factors: population density, educational attainment, and household income. Higher values provide greater incentives for providers to spring into action.

A Boon for Entrepreneurs

Economic growth can help reduce the income gap that contributes to the urban-rural digital divide. Two of the building blocks of economic growth are human capital and entrepreneurship. The latter is of particular interest to Tessa Conroy, an associate professor of agricultural and applied economics and an extension specialist.

On a per-capita basis, rural counties have similar levels of entrepreneurial activity as their urban counterparts; but, Conroy says, they are more frequently held back by a lack of broadband access. And broadband, she adds, is not the only factor that has changed the nature of American entrepreneurship since the 1990s. The share of women-owned businesses has also grown, from 26% in 1997 to 36% in 2012.

This prompted Conroy to study the role of broadband and gender in rural entrepreneurship. She analyzed businesses launched between 2005 and 2007 in 1,990 nonmetro U.S. counties. The reference point for her analysis was a typical rural county with 25,000 residents, an average of 1.4 broadband providers, and 228 new business launches per year. Conroy found that an above-average number of broadband providers in an otherwise similar county caused 85 additional business launches, for a total of 313 per year. This effect was about four times larger than that of banks offering above-average loan amounts.

Digging deeper, Conroy found this was primarily due to a strong causal relationship between broadband access and women-owned businesses in remote rural areas without paid employees. The ability to include these "nonemployer" businesses in her dataset was especially important to Conroy because they are more likely to be owned by women, regardless of where they live. Studying these businesses helps her understand differences between male and female entrepreneurship.

"Policies that support entrepreneurship often focus on job creation via businesses with paid employees, but this implicitly disadvantages women-owned firms," says Conroy. "Our study showed that we can support a more diverse set of business owners more equitably by expanding broadband access."

How Much Speed Do You Need?

Below are examples of minimum download speeds required for online activities.

ACTIVITY	MINIMUM DOWNLOAD SPEED (MBPS)
Internet browsing, social media, and email	1
High-definition personal video call	1.5
Streaming standard-definition video	3 to 4
Online multiplayer gaming	4
High-definition video teleconferencing	6
File downloading	10
Online learning	5 to 25
Telecommuting	5 to 25
Streaming ultra high-definition 4K video	25

Source: FCC Broadband Speed Guide, 2020

The study reaffirmed Deller and Conroy's earlier work: Broadband is increasingly relevant to rural entrepreneurship and boosts rural economic growth. Not surprisingly, it is also positively correlated with housing values. Deller's analysis of the 2016 FCC broadband data showed that a 10% increase in coverage of at least 0.2 Mbps is associated with a $661 increase in the median rural house value.

Broadband also supports economic growth in a sector of particular relevance to Wisconsin: agriculture. Online marketplaces provide new opportunities for farmers, especially those in remote rural areas, to sell their products directly to consumers. For example, Hutchinson, the South Shore entrepreneur, started a nonprofit online marketplace for farmers, artists, and artisans in the Herbster area in 2020. And precision agriculture — the use of networked technology to generate the same output with less input — relies heavily on broadband.

More workers capable of operating such modern agricultural technology will be needed in the future, and broadband helps educate that workforce. An analysis of U.S. counties by Conroy, Deller, and their Extension colleagues showed that counties with more broadband access had higher average third-grade reading test scores and a greater proportion of college-educated adults.

An Encouraging Mechanism for Broadband Expansion

Similar to the Norvado telephone cooperative in northern Wisconsin, electric utilities can help bring broadband to rural areas more quickly than large commercial providers.

Taryn Seymour and her family own three businesses in rural Sauk County, about a 30-minute drive northwest of Madison. For the past 10 years, their home internet service has been too slow and unreliable to meet their business needs. "We're on our third provider at our house, but none of them have worked out great," Seymour says.

As a possible solution, in 2016, the family purchased a nearby building that had been an elementary school until only a year prior. They had hoped the existing fiber optic cables could be reconnected, but they balked at the price tag of $1,200 a month (plus a $2,500 one-time fee) from the service provider.

Although DSL internet at the old school building has been more reliable than their home service, Seymour is eagerly awaiting the Reedsburg electric utility's fiber optic cables, scheduled to arrive at both buildings in fall 2023. The utility, established in 1894 for water and electricity, began providing fiber internet to the City of Reedsburg in 1998 and started its rural expansion in 2011, which included an upgrade to 10 Gbps (gigabits per second) in 2022. Thanks to multiple state and federal broadband grants, residents can get a line to their home or business installed for free by signing up early for the new service.

The Reedsburg electric utility is a promising model that could be used for broadband expansion elsewhere, if compatible with local and state policies.

Health Boost via Broadband

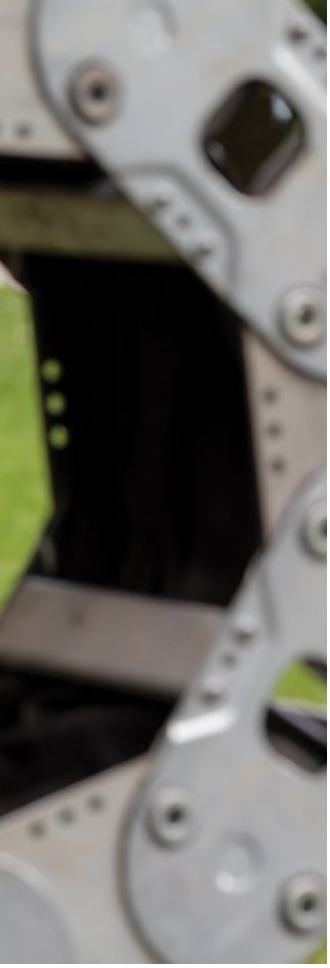
Human capital, another pillar of economic growth, includes education and labor market participation, and someone's physical and mental health can impact their ability to pursue professional training and employment. But agricultural and applied economics graduate student Vikas PD Gawai noticed a dearth of studies on broadband and mental health in the economic literature. He talked to Deller about combining national broadband and health outcome data to see if the two factors were related.

"I had seen a 2022 paper in a top economics journal showing that the rollout of social media at U.S. colleges had a negative effect on the mental health of young adults, especially girls, due to frequent social comparisons," says Gawai. "That made me wonder about the relationship between broadband and older adults." He thought internet access might improve the wellbeing of seniors by increasing their social connectedness.

The Health and Retirement Survey (HRS) provided Gawai with a high-quality source of health outcome data. Launched in 1990, the survey's University of Michigan researchers contact the same 20,000 participants — a nationally representative sample of adults over age 50 — every two years to ask questions about their health and economic circumstances. For those who apply for access, the HRS data is provided at the U.S. Census tract level, a county subdivision with an average of about 4,000 residents.

Gawai combined this so-called panel dataset with the staggered rollout of fiber optic internet between 2010 and 2018, according to the FCC. The proportion of Census tracts with access to fiber internet grew exponentially, from 20% to 75%, during this time. Although the FCC maps are imperfect, Gawai says the information about the year in which at least one

Left: Utility conduit on a trailer at a TDS Telecom fiber broadband expansion site in the town of Springfield, Wis.



A warning sign for underground utilities is framed by part of a horizontal boring machine at a TDS Telecom fiber broadband expansion site.

household in a Census tract received fiber is considered to be reliable.

Next, Gawai calculated an index of social connectedness for the HRS participants that he could track from 2010 to 2018. Before broadband became available, averaging that index across Census tracts produced a number close to zero. After the arrival of broadband, the number did not change immediately, but it began to grow and was significantly greater than zero about six years later.

"I think that makes sense because many older people are less tech-savvy than younger populations, and it may take them a while to learn new things, such as emailing, texting, or making video calls," says Gawai.

His parents in India, where Gawai grew up, are a perfect example. "Once they had broadband access, my sister taught them how to make WhatsApp video calls, and now they call me every week," he says. "That's just one example of being more connected when you cannot see people in person."

In another analysis, Gawai analyzed the number of self-reported symptoms of depression, such as restless sleep and feeling sad or lonely. A binary variable, with the value 1 meaning at least five of eight symptoms and 0 meaning zero to four, is positively correlated with a clinical diagnosis of depression, according to mental health researchers.

Gawai identified a 10%–15% decrease in depressive symptoms six to eight years after the arrival of broadband. Interpreting this relationship as causal requires assumptions that are difficult to test, meaning that other, unmeasured factors may also play a role. However, says Gawai, the observed increases in several health-related variables — social connectedness, online health literacy, and the use of health-related apps — suggest plausible mechanisms for mental health improvements. The link between broadband and depression was stronger in rural than urban Census tracts and also stronger in women, who are more likely to use the internet to seek health support and research medical information.

Mental health is only one part of the equation. In another ongoing project, Deller is using U.S. county health rankings, compiled annually since 2010 by the UW Population Health Institute, to analyze the link between broadband, physical health, and life expectancy. Preliminary analyses suggest that access to broadband has a positive effect on health, but this varies across the country. For example, the relationship holds for the northern parts of the Upper Midwest but not for New England. Deller hopes to tease out some potential reasons for these spatial differences.

Knowledge to Action

With such a wide range of broadband-related benefits, taking research findings beyond the walls of CALS is a top priority. Deller likes to think of this as a three-pronged approach. Part one consists of building a research foundation for quantifying the impact of broadband. Studies of rural entrepreneurship and housing values have already been published; analyses of other outcomes, such as health and remote work, are in the pipeline.

Part two involves providing data to policymakers to inform their decisions and funding allocations. That includes more accurate coverage maps and the willingness-to-pay survey. Part three builds upon the long-standing partnership between CALS and Extension. Extension specialists regularly attend community meetings all around the state to speak with local leaders and the general public and share evidence-based advice on how to expand each county's broadband infrastructure.

There is no one-size-fits-all approach for that advice, of course. "A rural community in Iowa County is very different from one in Vilas or Crawford, where you have one lake after another, and it's very difficult to install fiber optic cables," says Deller.

Figuring out which strategy is most effective in delivering broadband to all Wisconsinites requires a deep understanding of local economies and geographies. Local history is also important: Thanks to the former telephone coop that became Bayfield County's main internet provider, this community on Lake Superior's South Shore has become a poster child for rural broadband success stories. With any luck — and the continued support of CALS and Wisconsin's public universities —the rest of the state will eventually follow suit. g

Gather and Connect. Experience and Serve. Learn and Grow.

Student organizations at CALS help undergraduates socialize and gain valuable professional skills while benefitting the communities around them.

BY **Jori Skalitzky** BS'22

Photos clockwise from top by iSTOCK.COM/COPRID, JAZZIRT, T_KIMURA, HOMEWORKS255, CHRISTIANJUNG, FLOORTJE, JOHNGOLLOP

It's a cool Sunday morning in early September, and over a dozen UW students are meeting at a farm plot in Eagle Heights Community Garden. They quickly get to work, gathering everything from pumpkins to Swiss chard. The day's harvest is bountiful. With more than 400 pounds of produce, the students make their way to East Campus Mall to hand out every single ounce for free.

Bringing fresh produce to the campus community is just one of the many activities in which nearly 40 CALS-affiliated student organizations engage — activities that benefit both the students and those around them.

"These organizations allow students the opportunity to build skills and gain experiences they may not have even considered when starting college," says LauraLee Berrey Norton, academic advising manager in CALS, who oversees the student orgs. "They participate in service projects, competition teams, industry exploration, and community engagement — all while gaining invaluable leadership skills."

Joining a student org is just one aspect of a CALS education. CALS students explore their interests through First-Year Seminars, gain global perspective in courses with an international focus, and customize their paths of study by pursuing certificates, second majors, elective courses, and honors programs. Many students also complete independent research experiences or participate in internships.

"Along with their strong academic education, participation in student organizations is a main way for students to grow both personally and professionally," says Berrey Norton. "I have seen students start as members, join projects or committees, take on leadership roles, and, after four years, be launched directly into successful careers."

The organizations highlighted here are just a sample of the communities in which students can grow during their time at CALS.

Members of the campus community choose from a variety of free, freshly picked fruits and vegetables at a Harvest Handout event on East Campus Mall in fall 2023. The food was gathered that morning by the F.H. King Students for Sustainable Agriculture.
Photo by BRYCE RICHTER

Planting seeds, taking care of plots, harvesting produce, general farm maintenance — it's a ton of work. But undergraduates Lucy Merkel and Connor Reilly BSx'24 willingly — and frequently — lace up their work boots and jump into the thick of it.

Merkel and Reilly are farm co-directors for **F.H. King Students for Sustainable Agriculture***, a student-run agricultural collective that aims to connect people with locally sourced and organic quality food. They also promote sustainable and regenerative agricultural techniques.

F.H. King's activities center around their organic farm plot at Eagle Heights Community Garden on the northern edge of UW's campus. There, the group grows produce such as garlic, kale, zucchini, radishes, spinach, carrots, and lettuce. This produce, once ready to harvest, is given away during weekly "Harvest Handouts" during the summer and fall.

As farm co-directors, Merkel and Reilly manage the planting and harvesting efforts, but running a farm needs some additional help. Luckily, volunteers are abundant.

"F.H. King is pretty accessible for anyone who wants to volunteer for it," says Reilly. "It's also fun and low pressure for a student organization, especially if you're just volunteering. The expectation is that you come to the farm, you help us out a little bit, learn something, talk to people, and just enjoy yourself."

Members of F.H. King Students for Sustainable Agriculture pose with their June 2023 Harvest Handout bounty — 46 pounds of turnips, radishes, garlic scapes, little leaf lettuce, head lettuce, spinach, kale, and arugula.
Photo by LUCY MERKEL

Volunteering during the growing season is a large part of F.H. King, but the group also hosts many fun activities throughout the year. Past events include workshops on propagating plants, pickling produce, and decorating shirts with natural dyes, as well as guided tours of local farms. They're enjoyable social events, but they also educate attendees on sustainable practices and how to connect with the land.

"There's also an emphasis at F.H. King on community and inclusivity," says Merkel. "Whenever we give out produce, it's free for anyone. Things like that bring together a community that's focused on organic agriculture and sustainability and welcoming everyone into it."

Harvest Handouts, which sets up shop at the centrally located East Campus Mall, is the group's main way of serving the community during the summer and fall semesters. Students, faculty, staff, and even passersby are welcome to take fresh, local produce grown by F.H. King's volunteers.

For Reilly, who is majoring in community and environmental sociology, F.H. King is the perfect opportunity to apply what he's learned in class. "Through my major, I had been studying everything from afar — especially from a theoretical perspective," says Reilly. "But here, I get to apply the same values I've been studying in a real-life setting. F.H. King is also at the scale where you can really see the benefits of what you're doing."

F.H. King's farm is a modest half-acre, but it has a profound impact on the students who take care of it. Merkel, a senior majoring in international studies, is glad she found a student organization that allows her to explore her passions. "Everything involving F.H. King is something that I care about, whether it's organic agriculture or community-based agriculture," she says.

Merkel is unsure where her career will take her, but wherever she goes, she hopes to keep making food systems more accessible for everyone.

F.H. King Students for Sustainable Agriculture

@thepeoplesfarm.uw
fhking.wixsite.com/fhking

*The organization announced a name change on Oct. 1, 2023. More at **go.wisc.edu/uw-peoples-farm**.

For a student-managed Tik Tok account, reaching 1 million views for a single post generates some excitement. The **Food Science Club** reached that milestone with a video of new club members attempting to catch small dollops of whipped cream in their mouths. Most students were unsuccessful and had to walk off screen with disappointed expressions, careful to avoid splats of whipped cream on the floor.

Posting short, humorous videos like this one has proven to be an innovative way for the Food Science Club to connect with students, club members, and the public. The club is for students interested in anything and everything about food. Hosted by the Department of Food Science (which is housed in Babcock Hall, home to UW's famous Babcock ice cream), the club is a food lover's dream.

While open to all undergraduates at UW, the club tends to attract many students majoring in food science — especially those who are campus novices. "If you're a new undergrad in food science, you're taking a lot of gen eds and not food science–specific classes," says Connor Mills BSx'25, a food science student and communications chair for the club. "It's nice to see other students in your major in a different environment."

Mills oversees the club's social media accounts — Facebook, Instagram, and TikTok. The TikTok account highlights the sillier side of club activities (e.g., playing with whipped cream), but it also promotes social events, such as ice cream and chocolate socials, and more educational (but fun) content, such as making homemade lozenges.

Monthly club meetings are the ideal place for students to learn about career options in food science. At most meetings, different company's representatives share information about their roles and their organizations. They also promote internship opportunities. Denali Ingredients and Organic Valley are just two examples of Wisconsin-based companies that have visited with club members recently.

In summer 2022, Mills worked as an intern at Good Foods Group, a Wisconsin-based manufacturing company, and returned in summer 2023. "In the future, I would like to do research and development for new flavors and products," says Mills. "On my first day [as an intern], I got to see the raw ingredients and how they get processed down the line and turn into a finished product. It was really cool."

Getting the inside track on internships is one benefit to joining the club, but just engaging with its community makes membership worthwhile. "You meet a lot of people," says Mills. "Seeing all the other food science people really makes me want to continue pursuing it — even when I'm going to a four-hour organic chemistry lab." He has found inspiration in the perseverance and success of his fellow club members.

The club wrapped up the spring 2023 semester with its annual social, cohosted with the Department of Food Science. The event, which included tastings of cheese and wine (for those of age), gave club members an opportunity to mingle with peers, engage with faculty, and enjoy what brought everyone together in the first place — food.

Claire Sipple BS'23 accepts the Department of Food Science's D.B. Hyslop Academic Award during a wine and cheese social event co-hosted by the Food Science Club in spring 2023. Sipple was club president at the time.
Photo by MICHAEL P. KING

Just before graduating last May, Jackson Krull BS'23 accepted a position as a consultant for Optum, a health technology firm. A big topic of conversation during his job interview was the **Science Communication Club**. "They asked me a lot about it," says Krull. "Being a part of Science Communication Club is something that employers are interested in. That's just another thing that this club enhances — your versatility."

The Science Communication Club aims to connect undergraduate and graduate students who share a common fascination: communications focused on science and all its spheres. Whether its health, the environment, or agriculture, all students are pursuing skills that will help them communicate effectively.

"Our mission is to form a community of people who are interested in communication regarding scientific and technological topics," says Krull. "We can connect them with science communication–related opportunities, faculty members, and research opportunities."

Hiram Smith Hall, which houses the Department of Life Sciences Communication (LSC), is reflected in the glass windows of the Microbial Sciences Building. LSC hosts the Science Communication Club, but the group encourages students from all majors to join.
Photo by WOLFGANG HOFFMANN

Krull served as the club vice president for the 2021–22 academic year and then as the president in 2022–23. He earned his bachelor's degree in life sciences communication. The Department of Life Sciences Communication (LSC) hosts the Science Communication Club, but the group encourages students from all majors to join.

A main goal of the club is to connect students with academic- and career-oriented opportunities. Each club meeting usually has a speaker or a panel of speakers that give insight on their careers and advice on how to succeed in a professional environment. Previous meetings have included a panel of LSC faculty members, presentations by industry professionals (such as employees from the pharmaceutical health and wellness advertising agency AbelsonTaylor), and UW alumni who went into science communication careers.

The club also hosts professional development workshops on topics such as effective resume building. "Taking it a step further from the classroom is something that we really try to focus on," says Krull. "You can take what you learn in class and apply it more practically."

Krull also found that his leadership positions and overall participation in the Science Communication Club prepared him professionally, which helped him land his position post-graduation. Krull's success is possible for other members — and the club has plans to expand with more leadership and volunteering opportunities in the future.

Tressa Peskar BS'23, at the time an undergraduate studying agronomy and Badger Crops Club member, works to identify an issue faced by a farmer during the NACTA Crops Judging Competition in Modesto, Calif., in April 2023.

Photo by CALLI ANIBAS

For Sabeel

Abuhakmeh BSx'25, a major in agronomy wasn't his original plan. "I chose agronomy pretty much on accident. I didn't know what it was going into it," he says. He joined an introductory class, Agronomy 100, unsure of his path, but he finished the course set on a future in the field — and as a member of **Badger Crops Club**.

"Every field is different, especially agriculture," says Abuhakmeh. "The Badger Crops Club, and talking to people who've either gone to or started grad school, has given me insight about my career."

Badger Crops Club is the place to be for undergraduates who are interested in agriculture, specifically the crops side of things. Students who take an introductory agronomy class become familiar with the name — its members are committed to recruitment and to developing interest among students who are just starting their college experience.

"Our main goal is to get people ready and interested in the future, hopefully in agronomy or other types of agriculture," says Abuhakmeh. "We're here to provide information and prepare students."

The club is unusual in its approach. At the start of each academic year, the faculty advisor (currently Calli Anibas MS'20, a member of the teaching faculty in the Department of Plant and Agroecosystem Sciences) surveys the club about their interests. Responses are then used to plan events, field trips, and speakers tailored to those interests.

Each monthly meeting features a presenter from research or industry who shares the latest updates in their field, provides career advice, and even recruits members for internships. A past club meeting included a visit from Bayer Crop Science (part of the multinational pharmaceutical and biotech company, Bayer AG), which focuses on innovation in plant traits, pest and pathogen control, and predictive analytics for growing conditions. In addition to monthly meetings, the club frequently hosts fun events, such as trips to watch the Milwaukee Brewers and visits to local farms and businesses, such as dairy operations and cranberry marshes.

Badger Crops Club

facebook.com/badgercropsclub

Members end up spending a good amount of time with each other, an advantage of a well-developed club. "I think it's very important to have a community that's interested in the same things as you," says Abuhakmeh. "I think that indirectly helps support higher education."

Abuhakmeh's involvement in the club also led him to other opportunities. He joined Alpha Gamma Rho — the CALS-affiliated agricultural fraternity on campus — and the Badger Crops Judging team. Badger Crops Judging is a component of the Badger Crops Club and usually has 12 active members, up to 10 of whom travel for competitions. Every year, the team competes in the national North American Colleges and Teachers of Agriculture (NACTA) Crops Judging Competition, which involves four sub-competitions that test the team's knowledge on agronomy concepts and plant identification.

In the latest NACTA competition in April 2023, the Badger Crops Judging team took fourth place out of their division's 13 teams in the NACTA Crops Contest. Other team competition are held throughout the year. In July 2023, the team took first place in the North Central Weed Science Society Division at the National Weed Science Contest. They're looking forward to the next round of competitions in 2024.

CALS Health and Research Society (CHARS)

@wisconsinchars

Amara Benn BS'23, at the time an undergraduate studying nutritional sciences, presents research about dairy nutrition during the CALS Honors Symposium in the Meat Science and Animal Biologics Discovery Building. The event is hosted annually by the CALS Health and Research Society.

Photo by MICHAEL P. KING

Biology student

Sophia Schoenfeld BSx'24 is already an experienced researcher. In the labs of Laura Hernandez and Milo Wiltbank (both professors of animal and dairy sciences), she helps conduct studies on reproductive endocrinology and lactation physiology. But she doesn't stop at generating findings — she also helps make them known to the world. In April 2023, Schoenfeld presented her research at the CALS Undergraduate Research Symposium.

"[The symposium] was lovely," says Schoenfeld, "People in the audience asked me questions. Not only could I demonstrate my research and explain it, but I could also answer questions to help facilitate audience understanding."

The CALS Undergraduate Research Symposium is hosted every year by the **CALS Health and Research Society (CHARS)**, a student organization for research-focused undergraduates — especially those who are looking to pursue careers in research or health fields.

"CHARS is open to all students," says Ravi Jain BSx'24, symposium director for the club, "and we're a great resource on campus that provides a community setting for undergraduates who are interested in gaining some pre-professional guidance."

The club meets biweekly and offers a wide variety of resources throughout the academic year. They discuss recommended courses, look over resumes, assist students in finding research opportunities, and give insight into career options. "The commu-

nity setting really provides academic support and enhances social interactions — like networking — between students and faculty on campus," Jain says.

CHARS frequently invites UW faculty and staff who are principal investigators (PIs) on research projects to speak to the group. PIs provide perspectives and knowledge from first-hand experience and highlight the different kinds of research happening on campus. Each semester, the group tries to showcase a variety of research programs; they have hosted speakers representing fields from entomology to integrative biology.

CHARS hosts one large event each semester — a Research@UW Seminar in the fall and the CALS Undergraduate Research Symposium in the spring. The seminar provides an additional opportunity for students to gain insight from PIs in a panel discussion setting. The symposium, on the other hand, is for students like Schoenfeld who are already participating in research on campus. It offers them a chance to highlight their research — either through a poster session or a 15-minute presentation — and develop some professional skills. And it's an excellent opportunity to network with faculty, staff, and peers.

Schoenfeld is also a part of the CALS Honor Program, on the "Honors in Research" track. Many of her program peers participate in the research symposium because CHARS and the Honors in Research program share the goal of providing more research opportunities for students.

CALS Honors in Research, usually a four-year program, connects students with a faculty member and a cohort of fellow students. These students carry out an independent research project, attend interactive seminars, complete a senior honors thesis, and develop a close connection within and between cohorts.

"The best part about the Honors Program is that it is so wonderful for CALS students who already plan to do research," says Schoenfeld. "It's enhancing my journey as a student researcher, not only through that connection with my peers — which is an aspect that sets the CALS Honors Program apart from other university honors programs— but also through the seminars, which are led by researchers and PIs who have lot of expertise to share." g

EXPLORE ONLINE

These five groups only touch upon the diverse array of opportunities and benefits that students can find with CALS-affiliated student organizations. More can be found at **go.wisc.edu/cals-student-orgs**.

Incoming students explore booths for student organizations during a CALS orientation event at Allen Centennial Garden.

Photo by MICHAEL P. KING

Outstanding Young Farmers

Farm and Industry Short Course alums win prestigious state and national awards for achievements in agriculture, conservation, and service.

Story by JIM MASSEY | Photos by MICHAEL P. KING

When **Kyle** and **Rachel Zwieg** (both FISC'07, '08) first arrived at the National Outstanding Young Farmers (NOYF) Awards Congress in Appleton, Wisconsin, back in February, it didn't take them long to conclude that the competition would be stiff. Many of the other nine finalists had large, diverse farming operations, and the Zwiegs were simply happy to be in the room, having qualified by winning the Wisconsin OYF competition in 2022.

But when the names of the national winners were announced two nights later, the Zwiegs were one of the four couples selected, much to the delight of the many local attendees.

"We were a little bit bummed that our Congress was in Appleton in February — it was in South Carolina last year and will be in Washington state next year. But it was cool when we won; there was a hometown crowd," Kyle says. "There were quite a few past winners from Wisconsin there, and my parents were able to be there. They wouldn't have been able to come if it was a long ways away."

"I was extremely shocked," Rachel says. "It wasn't something that we expected."

The NOYF Awards Program, administered by the Outstanding Farmers of America Fraternity, recognizes candidates' achievements in agricultural career progression, soil and water conservation practices, and community service. Eligible nominees must be between ages 21 and 39 and derive two-thirds or more of their income from farming.

The Zwiegs operate a 1,450-acre dairy and crop farm, known as Zwieg's Maple Acres, near Ixonia in Dodge County. The farm has been in the Zwieg family since 1856. Kyle represents the sixth generation to operate the farm, and Kyle and Rachel's children — Theodore, 7, and twins Landon and Logan, 6 — are the seventh generation to live there.

As a student at Oconomowoc High School, Kyle wasn't sure he wanted to join the Zwieg farming operation. He was concerned the farm wouldn't generate enough income to accommodate another family. His parents and grandparents were milking about 40 cows and cropping about 150 acres at the time.

"If I was going to come back to the farm, it was going to have to be under a new situation," Kyle says.

Kyle went to work at the neighboring Koepke farm, where the Koepkes (a family with several CALS alums) encouraged Kyle to attend the Farm and Industry Short Course (FISC) to gain more farming knowledge. In fact, the Koepkes were "relentless" in their motivation, Kyle says. They gave him a campus tour and offered to pay for half of his tuition.

"I kind of just went out of obligation to them more than anything," Kyle says. "But it was fantastic. I took it seriously while I was there. I don't think there could have been a better program

to provide direct access to production agricultural information than the short course."

Rachel attended FISC at the same time with an eye on advancing her horticulture knowledge. She had worked in a greenhouse and hoped to make a career in the industry.

"It was really nice to be with other people who had similar interests," Rachel says. "I was shy and awkward in high school, but the short course helped get me out of my shell. The connections we made and the knowledge we gained have really benefited the farm."

Kyle and Rachel, both 35, fondly remember their time at FISC, with each recalling instructors who had a positive influence on them. Kyle says **Dick Wolkowski** BS'76, MS'78, PhD'89, a soil science professor at the time, planted the idea of no-till farming in his mind. The technique, which involves significantly less soil disturbance, has helped reduce farm labor and increase profits on the Zwieg farm.

"You get all these kids who come to your class, and you can tell pretty quickly those who are truly engaged," says Wolkowski, who retired in 2011. "It was pretty clear from the outset that Kyle and Rachel wanted to learn. I expect I taught 1,200 to 1,500 students over the years, and they were certainly in the top 10 who left a memory in my mind."

The Zwiegs, who met while juniors in high school, have expanded their cropping operation incrementally by adding neighboring rental properties. They have also reduced dairy farm labor by installing a DeLaval robotic milking system. The system was installed in 2020, in the depths of the COVID-19 pandemic, which the Zwiegs found a bit unsettling, given milk prices were so uncertain at the time.

"But I would never go back," Kyle says. "It was one of the best decisions we've ever made."

Kyle says the switch from a stanchion barn, where cows are milked in stalls, to robotic milking, where the cows pass through one-way gates to an automated machine that milks them up to four times per day, helped improve their efficiency. Now they're DeLaval's highest producing robotic herd in North America on a per-cow annual average — 114 pounds per head for their 70-cow herd.

The attached free-stall barns are designed so they can be expanded to accommodate up to 240 cows, but the Zwiegs don't have any immediate plans to do so.

Because of the low-labor dairy and cropping systems on their farm, the Zwiegs don't use any out-of-family labor. Kyle's father, **Joe Zwieg**, is still involved in the operation, and Kyle says there isn't much Rachel can't do on the farm. When he's planting or harvesting crops, she takes total charge of the dairy operation.

"I try not to let him know what I can and can't do," Rachel quips.

ENGAGE

ATTEND THE 2023 DAIRY SUMMIT

The Fourth Annual Dairy Summit will be held Nov. 15 in a hybrid format at the University of Wisconsin–Platteville. This free, public event features the newest research and outreach funded by the Dairy Innovation Hub, a $7.8 million-per-year state investment that harnesses research and development at UW–Madison, UW–Platteville, and UW–River Falls to keep Wisconsin's $45.6 billion dairy community at the global forefront. The summit will include an on-farm research panel and a state leader discussion. More at **dairyinnovationhub.wisc.edu/dairy-summit.**

ACCOLADES

DISTINGUISHED UW ALUM

William Campbell MS'54, PhD'57, whose research led to the development of ivermectin, an antiparasitic drug widely used in veterinary medicine, has received the 2023 Distinguished Alumni Award from the Wisconsin Alumni Association. A Nobel laureate, Campbell earned his degrees in veterinary science, a former CALS graduate program.

PEAK POSTDOC PERFORMANCE

The Life Sciences Research Foundation has selected **Heidi Pak** PhD'22, a nutritional sciences graduate, as one of 18 early-career scientists to receive three years of funding to investigate questions surrounding human health and disease. Pak is a postdoctoral researcher at the University of Texas Southwestern Medical Center.

Left: Farm and Industry Short Course alums Kyle and Rachel Zwieg with their children, from left, Landon, Logan, and Theodore, at their seventh-generation dairy and crop farm.

Right: A robotic milking system operates at the Zwiegs' farm.

Below: A sign posted at the entrance to the farm.

Kikkoman Marks 50th Anniversary in U.S. with $3 Million Gift to CALS

By CAROLINE SCHNEIDER MS'11

Fifty years ago, Kikkoman Foods opened its first U.S.-based soy sauce production plant in Walworth, Wisconsin, launching the company's partnership with the state and its flagship university. To celebrate this enduring connection, Kikkoman has presented CALS with a $3 million gift. The donation will support two CALS research programs that aim to protect the assets that drew the world's leading soy sauce producer to Wisconsin in the first place.

"The time-honored, traditional brewing process for soy sauce uses just four simple ingredients: water, soybeans, wheat, and salt," says **Yuzaburo Mogi**, honorary chief executive officer and chairman of the board of Kikkoman Corporation. "Through this donation, we're providing meaningful benefits to the region and the world because we're helping ensure the sustainability of agricultural systems and natural resources that contribute to producing soy sauce into the future."

The gift will be directed to the Wisconsin Integrated Cropping Systems Trial (WICST) and Grassland 2.0. Both programs serve as hubs for researchers and outreach specialists from across the college, including the agronomy, soil science, entomology, plant pathology, and community and environmental sociology departments.

Housed at the Arlington Agricultural Research Station, WICST is a long-term field experiment where researchers manage nine cropping systems that represent much of Wisconsin's agricultural landscape. (See "The Science Farm," *Grow*, Spring 2017, and "Can Farms Pull Carbon from Sky to Soil?" *Grow*, Summer 2023.) Studies there explore how alternative approaches to crop and livestock production affect yields, soil carbon, nutrient dynamics, greenhouse gas emissions, and biodiversity.

WICST is unique among long-term agroecological experiments in both its scale and scope. It incorporates organic and nonorganic commodity-grain, dairy-forage rotations, rotationally grazed livestock on pasture and prairie, and grasslands harvested for second-generation biofuels.

"The value of the program for understanding agroecosystem sustainability increases over time, but the ability to support it with grant funds becomes more difficult," says **Randy Jackson**, WICST director and professor in the Department of Plant and Agroecosystem Sciences. "Kikkoman's support helps ensure the integrity of our 34-year-old cropping systems experiment into the future."

Grassland 2.0 is a research, engagement, and teaching project; its goal is to understand how cropping systems can be transformed to function more like the original prairie. This work includes exploring how cropping systems, such as soybeans, wheat, maize, alfalfa, and grasslands, can be configured on landscapes to improve soil health, cleanse waterways, reduce flooding, and enhance biodiversity, all while providing opportunities for young and new farmers.

INVEST IN OUR ASSETS

Interested in supporting research at CALS? Contact Jaxon Gross at 608-284-1633 or jaxon.gross@supportuw.org, or visit **go.wisc.edu/give-to-cals**.

"The support we are receiving from Kikkoman for Grassland 2.0 will help us grow the project into a movement that's focused on local community processes of placemaking, which are geared toward helping communities be more sustainable and resilient in the face of 21st-century challenges," says Jackson, who also leads Grassland 2.0.

Kikkoman hosted an anniversary celebration on June 9, 2023, at the Wisconsin-U.S.-Japan Economic Development Conference, in Lake Geneva, Wisconsin. The celebration included a special event to recognize the donation to CALS. UW Chancellor **Jennifer Mnookin**, CALS Dean **Glenda Gillaspy**, research scientist **Gregg Sanford** MS'07, PhD'12, and Jackson attended to accept the gift. Governor **Tony Evers** was also at the event to proclaim June 9 as Kikkoman Day.

An organic soybean plot, part of the Wisconsin Integrated Cropping Systems Trial, at Arlington Agricultural Research Station.
Photo by GREGG SANFORD

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Genetics and genomics major **Brenen Skalitzky** BSx'24 snapped this photo of a red-eyed tree frog — an iconic resident of tropical forests in Central and South America — at a nature reserve in Sarapiqui, Costa Rica, during a UW experiential learning trip. In the background is neurobiology major **Emily Olvey**. Witnessing the biodiversity of other parts of the planet, Skalitzky says, better prepares students to advocate for fragile ecosystems. The photo was selected as one of the winners of UW's 2023 Cool Science Image Contest.