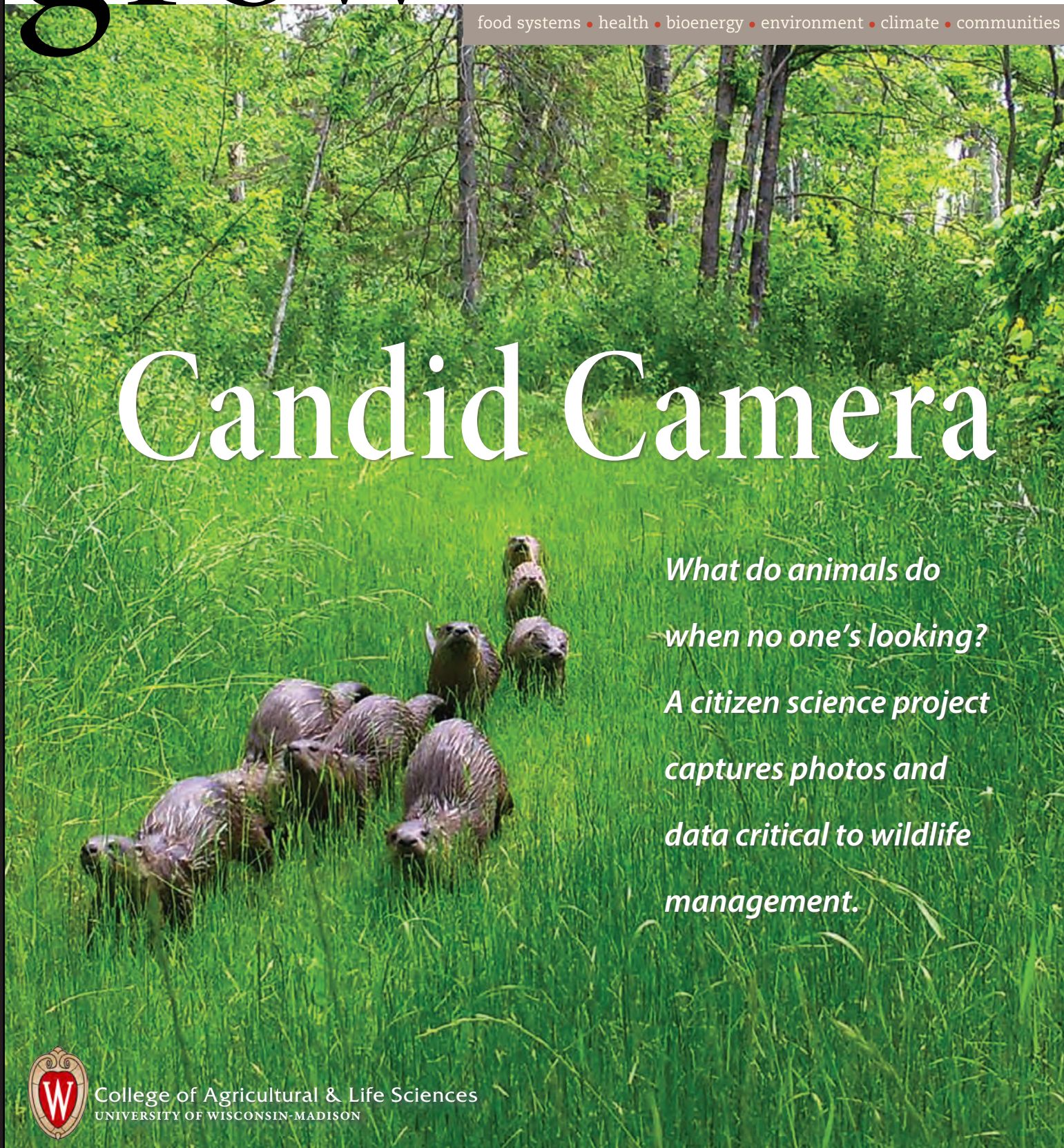
grow

Wisconsin's Magazine for the Life Sciences • Summer 2017

food systems • health • bioenergy • environment • climate • communities

Candid Camera



What do animals do when no one's looking? A citizen science project captures photos and data critical to wildlife management.

College of Agricultural & Life Sciences
UNIVERSITY OF WISCONSIN-MADISON

Volume 10, Issue 3 • Summer 2017

A sunflower at the CALS-based Hancock Agricultural Research Station.

Photo by Sevie Kenyon BS'80 MS'06

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Wisconsin's Magazine for the Life Sciences

On the Cover: A Snapshot Wisconsin trail camera captures a bevy of otters on important business.
Photo courtesy of the Wisconsin Department of Natural Resources

Editor Joan Fischer

Passing the Torch

It was baptism by manure.

My first story for *Grow*, as the new editor, was talking with students in John Parrish's reproductive physiology class over in the Old Dairy Barn during their first attempts to artificially inseminate a cow.

This was only one of many hands-on tasks students performed as they learned the fundamentals of modern cattle breeding, including syncing a cow's reproductive system and using ultrasound to determine pregnancy. But as students prepped for the procedure with gloved hands and arms, one could see it was the most daunting.

"The students are nervous," I observed. "The cows, not so much. But only because they don't know what's coming."

It was a great introduction to CALS. The openness and patience of the instructor, the enthusiasm and good humor of the students, the pursuit of knowledge that promises tangible improvements to our world: those were all qualities I came to recognize and value as the CALS signature, and I had the good fortune to see them again and again over the course of six-plus years and 20 magazines in stories that I wrote and edited.

It has been a genuine pleasure to highlight these compelling stories and share them with the wider world.

As you may have surmised, I am moving on—heading off to retirement in California, where I grew up. In departing I am joined by two other retirees: Diane Doering, a graphic designer with CALS for 38 years—she designed *Grow* when it launched in 2007, and she's designed every issue since—and Sevie Kenyon, whose superb photographs have graced so many issues (see the beautiful sunflower on page 2), in addition to his other communications and audiovisual work with CALS over the past 15 years.

But no worries, we will be succeeded by talented people who will keep *Grow* strong. I say this with certainty because we've already got a great new editor, starting with the next issue: Nik Hawkins (photo left), who comes to us from the UW–Madison School of Veterinary Medicine, where he has been director of communications and public relations since 2012. His duties included serving as the chief editor, writer and photographer for the school's flagship publication *On Call*, which Hawkins last fall transformed from a tabloid newsletter into a magazine.

Hawkins is excited about coming to CALS. "I'm a longtime admirer of *Grow*, and I've always been impressed by what it showcases within its pages," he says. "CALS and its alumni seem to produce an endless supply of wonderful work that can improve the lives of people in Wisconsin and beyond. And so often this work engages the people it's designed to help in the search for better solutions. Through *Grow*, I hope to continue telling compelling stories of these partnerships."

It has been a genuine pleasure to highlight these compelling stories and share them with the wider world. Thank you, CALS community, for making my job so gratifying.

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Safer Native Foods

A CALS bacteriologist is working with Alaska Natives and other groups to keep botulism out of seal oil and other traditional favorites

At the edge of a remote Alaskan peninsula, 30 miles north of the Arctic Circle, lies the city of Kotzebue. Snow-covered in winter and starless for weeks in summer, Kotzebue is home to roughly 3,300 people, most of whom are native Iñupiat Eskimos.

People there consume a diet rich in animals found in the region, including caribou, seal and whale. Following Native tradition, foods often are fermented or consumed raw.

But they sometimes are contaminated with one of the most poisonous known toxins: botulinum toxin, produced by a bacterium called *Clostridium botulinum*. In fact, Alaska has one of the highest rates of food-borne botulism in the U.S., most likely because of those traditional foods. Botulism can cause paralysis, respiratory failure and death, so traditional foods are not allowed to be served in state-run facilities like nursing homes.

A group called the Seal Oil Task Force, comprising Native organizations like the Maniilaq Association along with state government partners, has formed to try to change that. They want Native elders to continue enjoying foods they have known their whole lives.

Which is how CALS bacteriology professor Eric Johnson, one of the world's foremost experts on *Clostridium*, came to find himself on a boat in Kotzebue last summer, traveling to a Native processing facility where seal oil is produced.

Seal oil is to many Alaska Natives what soy sauce is to some Asian cultures: a staple of their diets, Johnson explains. It is also especially prone to botulinum contamination. The task force contacted Johnson in 2015 to see if he could help.

"Many of the foods they absolutely cherish can result in botulism," Johnson says. "They want to integrate food safety into traditional Native foods."

The catch is that any new processing methods cannot alter the final product or significantly stray from traditional production. For instance, heating the oil would kill the bacteria, but it also changes the taste.

Photo courtesy of Eric Johnson

Partnering for safety: Bacteriologist Eric Johnson (right) chatting with a colleague in Kotzebue.

Johnson is working with the task force to determine how the bacteria are contaminating traditional food products. This has involved rendering seal oil back in his campus lab, testing for toxin as the blubber stripped from hunted seals emulsifies at ambient temperature into the nutrient-rich, yellow-hued delicacy.

In Kotzebue, seal oil is produced by cutting fresh blubber into pieces, placing it in a covered vat, and stirring—twice a day—until the fat eventually gives way to oil.

Johnson has a theory that *Clostridium*, found naturally in soil, may colonize minuscule pockets of water present in the fat as it breaks down. He wants to develop a method to prevent the bacteria from contaminating the oil, or a method to neutralize the toxin.

In the process, Johnson is learning more about Alaska Native culture and believes his work could have even greater reach. "It could have an impact on cultures elsewhere," Johnson says.

—Kelly April Tyrrell

A CALS "Bridge to Business" Turns 20

The Renk Agribusiness Institute has earned its laurels, but with a new director and fresh ideas for the coming decade, the institute has no plans to rest on them

Each January, the Renk Agribusiness Institute hosts the Wisconsin Ag Outlook Forum and releases the Status of Wisconsin Agriculture report—a sure sign for the agricultural business community that the new year is here. And each fall sees the arrival of a new cohort of Renk Scholars, undergraduates selected for a scholarship program emphasizing leadership in contemporary agricultural issues and agribusiness.

The Renk Agribusiness Institute was founded 20 years ago to coordinate the university's agribusiness teaching, research and outreach activities, provide financial assistance to students pursuing agribusiness degrees and offer professional development programs for agribusiness executives. The institute originated with a gift from the Renk family of Sun Prairie, founders of the Renk Seed Company. The institute is housed in the Department of Agricultural and Applied Economics (AAE) and draws on the expertise of faculty from across campus.

This year the institute has a new director: AAE professor Paul Mitchell, who is eager to increase the visibility and reputation of agriculture and agribusiness in CALS and UW and build more connections between the campus and agribusinesses in the state and region.

"Whether by offering educational and training opportunities for agribusiness professionals, or exploring new options to facilitate connections between campus and the state's ag industry, the institute can play an important role to help maintain and enhance the innovation capacity of Wisconsin agribusiness," Mitchell says.

The Renk Scholars program offers a great way to help fuel growth, notes Mitchell.

"I inherited a solid student program from my predecessors, with a thriving agribusiness management club and a number of undergraduates participating in national student competitions," says Mitchell. "Through the high-caliber work of the students, I hope to build the program's reputation and visibility on campus and especially in the private sector as the number of Renk alums continues to grow. Through these experiences, we're establishing cohorts among the students that generate synergies—and lifelong connections for both students and campus to capitalize on."

Mitchell, along with colleagues on campus and partners around the state, a committed board of advisors and new associate director Jeremy Beach, is taking time this year to consider exactly how the institute should grow.

"There's plenty of work to do and we are still in the visioning stages," says Mitchell. "I've been looking more carefully at data analytics or 'big data' as a possible focus for the institute as it builds on the strengths of the department and college, but we have many other ideas on the table as well."

Paul Mitchell takes the helm at the Renk Agribusiness Institute.

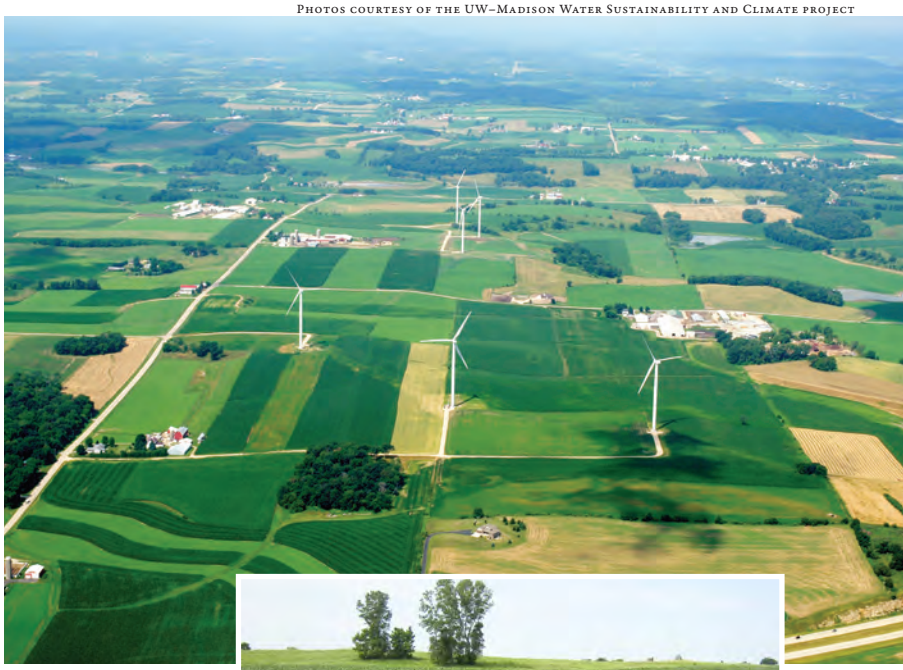
Photo by Ben Vincent

For more information on the Renk Agribusiness Institute and the Renk Scholars Program, please visit **https://renk.aae.wisc.edu/**

"Legacy Phosphorus" and Our Waters

A new study quantifies the need to reduce phosphorus in our soils—for the health of our lakes and rivers

Photos courtesy of the UW–Madison Water Sustainability and Climate project



Cropland in the Yahara watershed has an overabundance of soil phosphorus. Researchers say that makes clean lakes and rivers possible only with big changes in land and water management.

For decades, phosphorous has accumulated in Wisconsin soils. Though farmers have taken steps to reduce the quantity of the agricultural nutrient applied to and running off their fields, a new study reveals that a "legacy" of abundant soil phosphorus has a large, direct and long-lasting impact on water quality.

The study, published in the journal *Ecosystems* and focused on southern Wisconsin's Yahara watershed, may be the first to provide quantifiable evidence that eliminating the overabundance of phosphorus will be critical for improving the quality of the state's lakes and rivers.

For example, the results indicate that a 50 percent reduction in soil phosphorus in the Yahara watershed's croplands would improve water quality by reducing the summertime concentration of phosphorus in Lake Mendota, the region's flagship lake, by 25 percent.

"If we continue to apply phosphorus at a greater rate than we remove it, then phosphorus accumulates over time and that's what's been happening over many decades in the Yahara watershed," says Melissa Motew, the study's lead author. Motew, working with CALS agronomy professor and co-author Christopher Kucharik, is a doctoral candidate at the UW–Madison Nelson Institute for Environmental Studies.

Phosphorus seeps into soils primarily by way of fertilizer and manure, and what crops and other plants don't use to grow then leaks into waterways with rain and snowmelt runoff. Scientists have long believed that excess soil phosphorus is a culprit behind the murky waters and smelly algal blooms in some of Wisconsin's lakes and rivers.

Conventional efforts, like no-till farming and cover crops, have tried to address nutrient runoff by slowing its movement from soils to waterways. However, the study shows that simply preventing runoff and erosion does not address the core problem of abundant soil phosphorus, and this overabundance could override conservation efforts.

"Solutions should be focused on stopping phosphorus from going onto the landscape or mining the excess amount that is already built up," says Kucharik.

Using newly advanced computer models, the study shows the watershed has about four times more phosphorus in its soil than is recommended by UW–Extension, which writes the state's nutrient management recommendations based on what crops need and a landscape's potential for nutrient runoff.

Currently, the only method known to draw down soil phosphorus is harvesting crops, but Kucharik explains that plants take up only a small amount of the surplus each year.

"It is unlikely that any cropping system will quickly draw down the excess," he says.

It will require working with farmers to practice better nutrient accounting and counter the tendency of some to apply more fertilizer, as an insurance measure, than is needed.

Food production need not be compromised by potential solutions, Kucharik says. There is enough excess phosphorus in our soils "to support plant nutrient needs for a long time."

The research, funded by the National Science Foundation, is part of UW–Madison's Water Sustainability and Climate project.

—Jenny Seifert

Early Excitement

CALS faculty work with elementary school students and teachers to help improve science learning

Genetics professor Audrey Gasch BS'94 loves questions. It's her job as a scientist to ask questions and then seek answers. She also has a passion for helping others ask questions, including some of Wisconsin's youngest future scientists.

Science outreach and public service have always been important to Gasch. When she was setting up her lab in 2004, she began looking for ways to take her love of science beyond campus. She found the perfect partner in Dolly Ledin, program director of Adult Role Models in Science (ARMS), a program of the UW–Madison-based Wisconsin Institute for Science Education and Community Engagement.

ARMS works with campus partners and local elementary and middle schools to help teachers develop more robust science education and get students excited about science by connecting them with role models.

Within just one hour of her first call, Ledin connected Gasch to 10 different schools in Madison.

Some dozen years later, Gasch remains as passionate as ever about enhancing science education for kids. Teachers, Gasch says, especially at the elementary level, don't always have the capacity or training to teach a robust science curriculum.

"Public schools are under so much pressure on all fronts," says Gasch. "It's harder for teachers to be innovative in those areas if they are not a major point of focus."

So Gasch and other campus scientists partner with teachers to help them build curriculum and bring new projects to classrooms.

ARMS participant Emily Grace Johnson, a CALS biology major, working with elementary school kids on water filtration systems using soil, rocks and grass.

Photo courtesy of Emily Grace Johnson

Photo courtesy of UW–Madison/Forward Motion

A student learns the science of bubbles with the help of Andrew Denu, then a biology undergrad with ARMS.

Photo by Bryce Richter/UW–Madison Communications

Professors Audrey Gasch and Sean Schoville believe in the power of ARMS.

Photo courtesy of Sean Schoville

The learning is a two-way street, notes entomology professor Sean Schoville, another ARMS participant.

"The teachers have incredible knowledge of how to get kids excited and to engage them in hands-on teaching," he says. "So they have, in turn, taught me quite a bit about teaching."

Melina Lozano, a teacher at Hawthorne Elementary in Madison, has partnered with ARMS for years and says working with UW scientists has made a big impact on her two-thirds bilingual classroom.

"My students need as many high-quality educational experiences with adults as possible," says Lozano. "And working with talented young scientists at UW–Madison has been an indispensable experience."

An important part of the ARMS outreach team is the many undergraduates who work with the schools on a weekly basis. Students like senior biology major Hanna Peterson, who has been involved with school science outreach since she took a service learning course taught by Dolly Ledin.

Peterson, who also does science outreach at the Dane County Juvenile Detention Center, says that the most important thing is to create excitement.

"A lot of times, Dolly tells us we just want you to go get the kids excited," Peterson says. "Do your best, get your science point across, try to teach them some things—but just get them engaged in science. Make them want to learn more. Which I think is a really cool approach!"

Building excitement and curiosity, Gasch says, is the trick to connecting young minds to science.

"The main goal isn't to just learn facts," Gasch says. "I care about kids being able to learn about a fact and then think about it critically. My main goal is to use science as a tool to teach critical thinking."

Gasch is developing a new program called "Ask a Scientist." The premise is simple: Get kids excited about science by encouraging them to continually ask questions, and then recruit UW scientists to help answer those questions. She piloted the program last year at Lowell Elementary and now is working to expand it.

"It's like having a science pen pal," says Gasch.

—Mark Bennett

Meat Meets the Future

Illustration courtesy of Potter Lawson

If you've taken a stroll on Observatory Drive of late, then maybe, just maybe, you've noticed a 1.75-acre construction site roughly across from the Natatorium. It is the home of the future Meat Science Building, slated for completion in October 2018 and opening for use in January 2019.

Beyond meat science, the state-of-the-art facility will be used by researchers from engineering, veterinary medicine, animal sciences, food safety and biology. That reflects the project's mission to serve not only as a home for developing the best, safest meats but also as a hub for high-value non-food products for use in human and veterinary medicine.

To stay current on the project, including seeing the latest photos, visit **http://meatsciences.cals.wisc.edu/**.

classAct

Sam Schmitz

Big discoveries in little worlds

There are still some mysteries left in the world—even if, as Sam Schmitz has learned, you sometimes have to dive pretty deep to find them.

One place abounding with mystery is Africa's Lake Tanganyika. Divided among four countries, it is the world's second-largest, second-deepest freshwater lake. Its depth (4,820 feet) and relative calmness discourage water layers from mixing, and oxygen is scarce. But life perseveres, even thrives, in these conditions.

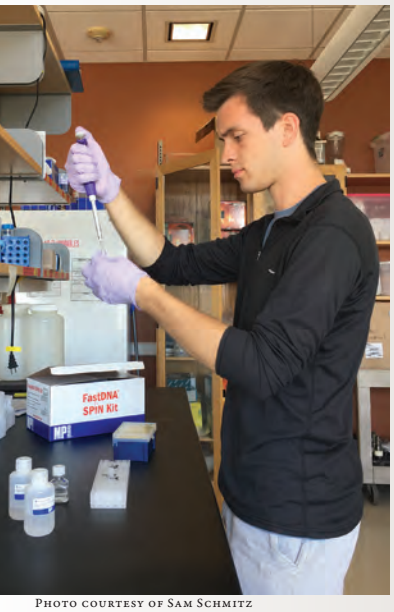


Photo courtesy of Sam Schmitz

Schmitz, a senior majoring in microbiology and French (with an honors in research), has had the opportunity to study this remarkable body of water without actually going there. As the recipient of an Undergraduate Research Fellowship Program grant from the American Society of Microbiology, Schmitz is analyzing water samples collected at Lake Tanganyika by UW–Madison limnologist Peter McIntyre and his team.

Using DNA sequencing, Schmitz has found that the deepest depths of the lake are home to incredibly diverse microbial communities. He and his fellow researchers have already identified numerous unclassified bacteria.

"The microbiome of the lake has not yet been thoroughly studied, so the lake may hold many more unique, undiscovered bacteria," says Schmitz—a revelation that amazes him, given how much is known about other ecosystems. These same microbes, he says, may drive the processes that sustain life in the lake's depths.

As his research project, Schmitz hopes to build on existing knowledge of the dynamics between microbial communities and their ecosystems. "I have always been interested in microbial communities and their interactions with the environment," Schmitz says.

Such research comes at a time when the lake's fragile ecosystems are most vulnerable, Schmitz notes. Climate change threatens to disrupt a natural order eons in the making. Better understanding the role of microbes in the cycling of lake nutrients could help us understand how Lake Tanganyika currently supports such abundant life, Schmitz says.

As a fresh graduate this summer, Schmitz plans to work in industry for a few years before returning to school—and his passion for research—to pursue a Ph.D.

—Ben Vincent

NAMED director of the Wisconsin Institute for Discovery and a professor of plant pathology, **Jo Handelsman PhD'84**. The appointment marks Handelsman's return to UW–Madison faculty after more than a half-dozen years as a professor at Yale University. Handelsman also served as the associate director for science in the White House Office of Science and Technology Policy.

AWARDED Douglas D. Sorenson and Vilas Distinguished Achievement professorships: **Caitilyn Allen** (plant pathology), **Rick Eisenstein** (nutritional sciences), **Alfred E. Hartemink** (soil science), **Rick Lindroth** (entomology), **Patricia S. McManus** (plant pathology). Awarded the O.N. Allen Professorship in Soil Microbiology: **Thea Whitman** (soil science).

NAMED a Fellow of the American Phytopathological Society (APS), **Andrew Bent**, a professor of plant pathology. Bent received the honor for internationally renowned research that has significantly advanced knowledge of the molecular mechanisms underlying plant disease resistance.

WINNER of an annual Educator Award from the North American Colleges and Teachers of Agriculture (NACTA), **Michel Wattiaux**, a professor of dairy science. The award recognizes individuals whose efforts represent the very best in agricultural higher education.

RECIPIENT of a Hilldale Award, entomology professor **Kenneth Raffa**. The honor, bestowed annually, recognizes UW–Madison faculty for their distinguished contributions to teaching, research and service.

HONORED for her story, "Potato, Interrupted," **Nicole Miller MS'06**, news manager in the CALS Office of External Relations. The piece, which originally appeared in the winter 2016 issue of *On Wisconsin*, will be reprinted in the summer edition of *Utne Reader*, a quarterly digest of some of the nation's best, most thought-provoking journalism.

Number Crunching

40,000

POUNDS OF CHEESE are produced each year in the Babcock Dairy Plant on the UW–Madison campus. The plant produces about 15 kinds of cheese, ranging from such "classics" as Colby, cheddar and brick to more adventurous varieties such as jalapeño juustoleipa. Babcock's output accounts for roughly 0.0014 percent of Wisconsin's cheese production, which is nearly three billion pounds per year.

Five things everyone should know about . . .

The Soils of Wisconsin

By James Bockheim and Alfred Hartemink

1 | **Wisconsin's soils were first mapped more than a century ago.** The first soil map of Wisconsin was also the first ever made in the United States. It was produced in 1882 by geologist T.C. Chamberlin. In 1926, CALS soils professor Andrew Whitson created the second state soil map for his book *Soils of Wisconsin*. The third map followed 50 years later, compiled by eminent CALS soils professor Francis Hole. Since that time much new information and many insights have been gained, and these have been summarized in a fresh edition of *The Soils of Wisconsin*.

Photo by Jeff Miller / UW–Madison Communications

2 | **The soils of Wisconsin are highly diverse.** Nearly 80 percent of the state is covered with glacial deposits that differ in texture, composition, thickness and age (the Driftless Area, in western Wisconsin, was not glaciated in the most recent glacial period). There is a strong relationship between the soils and parent materials. The history of human impacts on soils in Wisconsin extends back 13,500 years but became intensified during the Late Woodland period (1,600 to 500 years Before Present) when fires were used to clear land, and further intensified in the mid-1800s when European settlers arrived and land clearing and large-scale crop production began.

3 | **Many of Wisconsin's soils are unique.** There are more than 700 soil series (groups of soils with similar properties) in Wisconsin, and of these, 20 percent are considered endemic, having developed here through a unique combination of geology, plant communities and other factors. The "tension zone" between Wisconsin's northern and southern forests contains 40 percent of these endemic soils while covering just 13 percent of the state's land area. This zone also marks a transition not just in vegetation but in soil. The soils of the prairie, or Mollisols, mainly occur below the tension zone, and acid Spodosols, which often are forested, exist above it.

4 | **Soils are affected by changes in climate.** The melting of glaciers 11,000 years ago is a climatic event that affected Wisconsin's soils, depositing millions of tons of glacial till and windblown, silty soil. For the future, we expect rising temperatures and increasing rainfall that will affect our soils and land use. In the winter, soils will cool more because of thinner snowpacks and less protection from freezing. The warming up will result in land use changes. Corn and soybean, for example, might be grown in areas that previously were unsuitable.

5 | **Our soils yield profits.** The soils in Wisconsin have a high yield potential and support an $88 billion industry. We observe highly significant correlations between the soil and such economic parameters as agricultural land value sales and adjusted gross income in every county of the state.

James Bockheim is professor emeritus and Alfred Hartemink is professor and chair of the Department of Soil Science. Their new edition of *The Soils of Wisconsin*, published in spring 2017, is dedicated to Francis Hole.

Experts in "Smart Energy"

A new one-year master's degree at CALS fills a needed niche helping companies with energy analysis and conservation

For decades, American energy companies have tried to persuade customers to use less energy. Using giveaways and various other financial incentives, utilities have promoted new light bulbs, miserly showerheads and smart thermostats.

Part of the goal has been to reduce emissions of carbon dioxide and other pollutants. But another incentive hits utilities on the bottom line. Electric utilities must buy enough generation capacity to meet peak demand, which explains their interest in programs, for example, to taper the use of air-conditioning on hot summer afternoons.

Bill Provencher (above and opposite, with program coordinator Bethany Glinsmann) founded the REDA program to prepare students for careers as energy and resource analysts.

The programs sound good, but do they work? That difficult analysis has been neglected, and the answers won't come solely from classical supply-and-demand economics, says Bill Provencher, a CALS professor of agricultural and applied economics. To fill that gap, Provencher last year founded the Resource and Energy Demand Analysis (REDA) program, a rigorous one-year course of study and training leading to a master's degree.

"Understanding why people do or don't sign up and carry through with these programs involves new economic theory and methods, such as behavioral economics," says Provencher. "Good intentions are not enough; results depend on whether energy is actually saved."

No matter what happens in Washington, energy analysis will remain a growing field, notes Provencher. Graduates are also prepared for jobs forecasting the demand for energy, and there will always be a need for that, he says.

"In terms of moving toward renewables, the horse is out of the barn," says Provencher. "For some states, federal changes may make a difference, but for others, not much."

Last year's REDA graduates readily found jobs in the energy industry. Graduate Emily Morris MA'16 works at New York City utility company Con Ed.

"One of my responsibilities is benefit-cost analysis of the Brooklyn-Queens demand management program, which has been able to postpone a $1 billion substation construction project for 10 years," Morris says. "Con Ed has to invest in providing the energy in other ways, or encouraging enough customers to cut back on their usage. I look at whether the program is cost-effective."

Did the CALS program help her land and perform the job? Says Morris: "I would not be here without REDA."

Another graduate, Michael Francis MA'16, works for the U.S. Energy Information Administration. He, too, credits the REDA program with exceptionally good career preparation. His REDA experience included attending as many as 20 seminars led by experts in the field. "Today I was reading a report at DOE and realized that I had personally met some of the authors during REDA," Francis says. "After the program, you will find connections in whatever city you end up working in, no matter what specific segment of the energy industry you are in."

Provencher came up with the idea for REDA in part, he says, because in his previous work for a large energy consulting firm, he was surprised at the difficulty of finding qualified applicants for analyst positions.

The analytical tasks are complex, Provencher notes. Imagine that a utility with 50,000 residential customers starts a demand reduction program—perhaps it will give four high-efficiency LED light bulbs to any customer on request. To prove whether that significantly reduces energy demand in the next year, the utility must consider a wide range of factors, including how many customers get the bulbs; changes in economic activity (people may use more electricity when they feel prosperous); and feedback to the customer (does the utility measure consumption and congratulate them for acting "green"?). And those are just a few questions.

Crunching those numbers and reaching supportable conclusions is no easy matter, Provencher says—but it's exactly what the REDA program is designed to do. In one year, graduates get grounding in econometrics—think of it as the meshing of economics with statistics—and the energy industry. They meet analysts, consultants, executives and economists in the field, and complete a "capstone" project with a local or distant utility or firm, where they must base conclusions on real customer data.

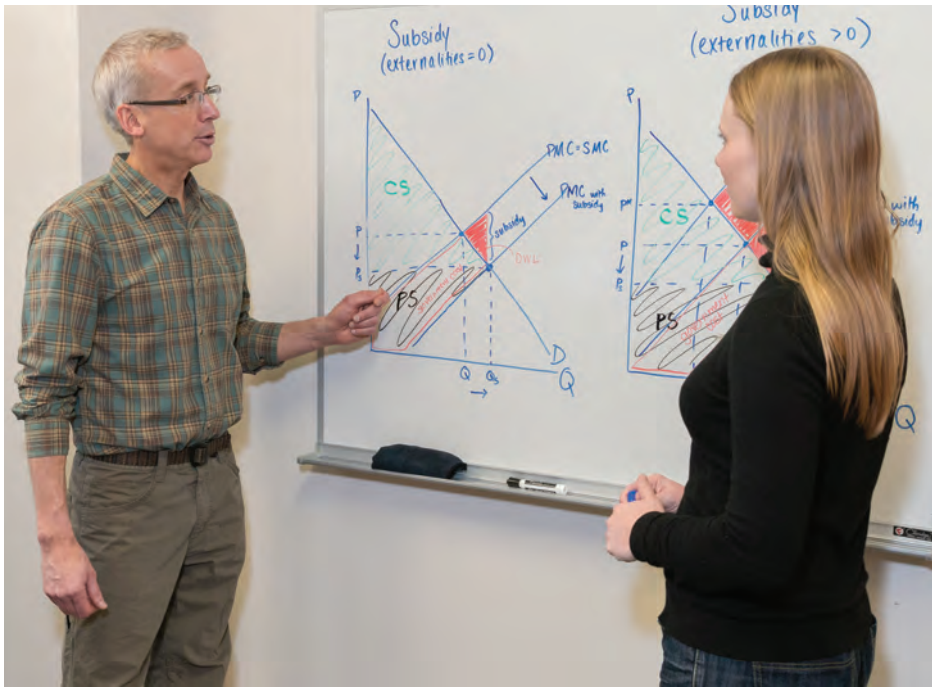
A major part of the class is learning rigorous statistical analysis, using an open-source program called R. "R is a statistical program language that I had never heard of before, but now I use it daily," says Morris, over at Con Ed. "It's been a huge tool for me."

REDA is a "terminal" master's degree, which is meant to prepare students for their careers rather than serve as a stepping-stone for a Ph.D. That limitation doesn't seem to bother grads.

"I was looking to go down the public policy route, but I was not convinced of the value of spending two years on the degree," says Justin Margolies MA'16, now an analyst at Wisconsin Energy Conservation Corp. in Madison. "I realized that REDA would be a better, more focused route."

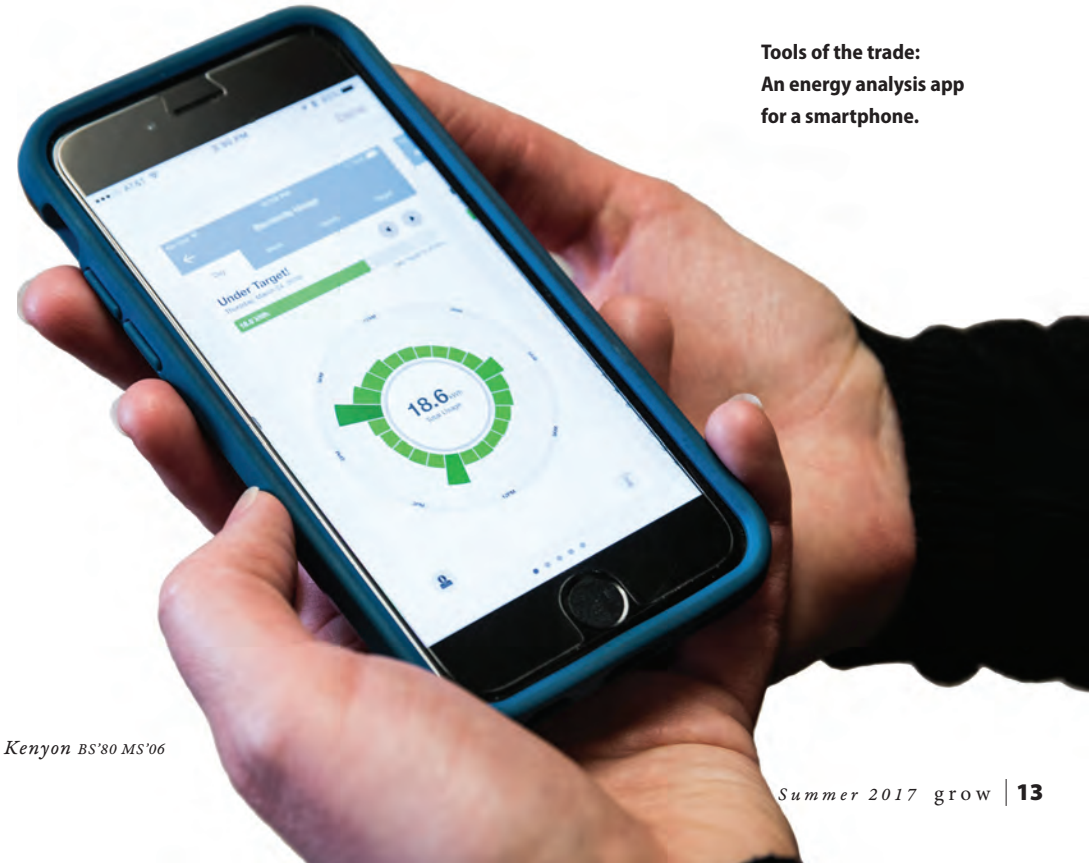
The one-year master's program is particularly attractive to people with "green" values, says program coordinator Bethany Glinsmann MS'11: "Some states and utilities are starting to pay attention to climate change and reducing their carbon footprint, but they need to make hard choices: 'Given our limited set of resources, we want to be sure we are spending money in the most efficient manner.' And that's where program evaluation comes in. Did it work? Or could they find a way to spend those dollars in a more effective way?"

By applying statistical analysis of human behavior to energy—a field previously dominated by engineers and technology—REDA offers a more realistic and insightful way to assess the success or failure of demand reduction programs, says Margolies.



"The energy industry was historically built by engineers, and they used engineering algorithms to estimate the available savings from technology—say, installing an LED or a new air-conditioning unit—but were a little weak on verifying the savings," says Margolies. "They did not take into account the behavioral element. People may not use the technology, or it may not be installed correctly. Those are the questions we are now equipped to answer."

—David Tenenbaum



Tools of the trade: An energy analysis app for a smartphone.

Photos by Sevie Kenyon BS'80 MS'06

DEMOCRATIC REPUBLIC of the CONGO

Unintended consequences

For Dominic Parker, a professor of agricultural and applied economics, a research foray into mining practices in Africa dug up some unexpected findings.

Parker wanted to study effects that recent U.S. legislation might have on "conflict minerals"—raw materials from parts of the world where conflict affects their mining and trading—from the Democratic Republic of the Congo (DRC), a large nation in central Africa that has experienced decades of war and corruption.

In 2010, Congress passed the Dodd–Frank Act, aimed at making significant changes to financial regulation. Tucked into the complex legislation is Section 1502, which requires manufacturers to do due diligence on the sources of minerals used in the production of electronics, including transparent reporting of whether their purchase of minerals might be financing warlords or militia groups in the DRC.

Parker set out to study the consequences that Section 1502 might have in places far removed from Washington, D.C. What he found, in collaboration with CALS colleagues Jeremy Foltz and David Elsea, and with fellow researcher Bryan Vadheim, is that the legislation has had a ripple effect with ramifications for violence and health in the DRC. Their work has been published in the *Journal of the Association of Environmental and Resource Economists* and the *Journal of Law and Economics*.

Tin, tungsten and tantalum—known as the "three Ts" of conflict minerals—are linchpins in the production of everyday electronic goods, including smartphones and laptops. But they are typically harvested in areas where government rule is limited or altogether absent. In this vacuum, militia groups form and instill a crude type of order.

Rather than put their reputations at risk, many corporations simply chose to source their minerals elsewhere. As they pulled out of the DRC, mining became a less lucrative industry—so militia groups started to relocate, becoming more desperate and inflicting more violence and predation upon civilians.

At the same time, the domestic government of the DRC banned noncorporate mining—work that is usually done with pickaxes and shovels, often called "artisanal" mining. In many parts of the DRC, this type of hard labor represents the "only game in town" in terms of employment, according to Parker.

Empirical evidence also suggests that Dodd–Frank, combined with the domestic regulations, has had dire effects on family health. The infant mortality rate in areas surrounding mines nearly doubled in the years following what Parker describes as a "one-two punch" of legislation.

"What we think happened was that this big economic disruption reduced access to health care, either because services and facilities were less accessible or because families didn't have the income any longer to get the health care they needed," says Parker.

The future of the industry is uncertain, as is the long-term viability of Dodd–Frank itself. In 2016, the European Union passed its own form of regulation that promotes responsible sourcing. Untangling the effects of these laws isn't as easy as simply repealing them.

"There are layers of different policies and regulations in place, so the governance of conflict minerals is now extensive and quite complex," says Parker.

Though his past work has focused elsewhere, such as in studying land trusts, Parker acknowledges this chapter of his career is likely far from over. Early this year he was interviewed twice on the BBC World News. And in March he was invited to testify at a Washington, D.C. hearing about conflict minerals held by the Senate Foreign Relations Subcommittee on Africa and Global Health Policy. Though that hearing was postponed, it is clear that policy changes are being considered.

"The wheels are in motion now, and the health of vulnerable populations is at stake," Parker says.

—Ben Vincent

Dominic Parker (right) with colleague in the Democratic Republic of the Congo.

Artisanal gold miners in Kamituga, DRC.

ICELAND

"Interwoven tapestry" of lakes and land

Photo courtesy of Claudio Gratton

Swarms of midges rise out of a lake in northern Iceland in such enormous numbers every spring and summer that they can impair breathing and darken the sky, giving the lake its name—Myvatn, or "midge lake."

CALS entomology professor Claudio Gratton and other ecologists are trying to understand why the midge population can fluctuate by 100,000-fold across a decade, and what impact these massive swarms have on the surrounding landscape. It's becoming clear that the billions of midges falling on land fertilize and alter the vegetation on the lakeside, but the causes behind such large fluctuations in the insects' population remain a mystery.

Gratton's research aims to better understand lake-dominated environments, including those of Wisconsin.

Lake Myvatn sits at the edge of the Arctic Circle, where the sun barely sets from May to August. The ecosystem is extreme yet simple; a relatively small number of species, like the midges, dominate. This bare-bones environment is perfect for exploring complex interactions within ecosystems.

In 2006, when Gratton first saw the huge numbers of midges rising out of the lake and dying on land, he thought of them as a living transfer of nutrients from water to shore. Gratton calculated that the midges were the nutritional equivalent of scattering a half-million Big Macs around the edge of the lake, which is about the size of Lake Mendota in Madison. He wondered how the lakeside responded to this nutritional glut.

To test how the midges alter the landscape, Gratton's laboratory set up experimental plots in the vegetation around the lake. In some, they added dead midges; in others, they used netting to exclude them.

Over the years, Gratton's team saw that where they added midges, grasses flourished. Normally starved of nutrients in the poor soil and outcompeted by heartier plants, the grasses took off in response to the influx of rotting-midge fertilizer. The research explained why grass grew in some areas and withered in others.

"Only by understanding the linkage between midges and grass can you explain this pattern in nature," says Gratton. "The lake is causing that to happen." Gratton was originally introduced to Lake Myvatn by colleague Tony Ives, a professor of zoology who has a lifelong connection to the island and researches fluctuations in the midge population.

Local shepherds have long called the grass in midge-infested areas "midge grass"—they harvest the grass and feed it to their flocks. Gratton's work suggests that the shepherds' folklore contained a kernel of truth, and that midges might indirectly nourish the sheep by encouraging more grass growth.

Gratton and colleagues are extending these studies to the lake-filled Wisconsin landscape. Gratton and postdoctoral researcher Mireia Bartrons, now at the University of Vic in Spain, developed a model of how insect emergences from Wisconsin lakes affect lakeside ecosystems. With more than 15,000 lakes and 34 percent of the state lying within 200 meters of a lake or stream, the scientists expect aquatic insects to affect a large share of the state.

Gratton sees ecosystems, whether in Iceland or the American Midwest, as an interwoven tapestry of interactions rather than isolated patches of land or water.

"The character of the land would change without these lakes," says Gratton. "Our landscapes are completely interconnected."

—Eric Hamilton

Photo by Claudio Gratton

Photo by David Hoekman

(Top) Resembling a blanket of fog, midges swarm near Lake Myvatn, Iceland.

(Above) Midges on flowers near the lake.

(Left) Entomologist Claudio Gratton in a swarm of midges.

The "Icing" on the DNA

Xuehua Zhong uses plants to study epigenetics, an exciting new field that is broadening our understanding of how some traits might be passed down from one generation to the next.

Interview by Caroline Schneider MS'11

XUEHUA ZHONG, an assistant professor of genetics, studies epigenetics, a growing area of research focused on how chemical tags on DNA can change the expression of genes. She and her team at the Zhong Lab of Epigenetic Regulation, located at the Wisconsin Institute for Discovery, are especially interested in the modification of genes involved in growth and development, and how epigenetics can be affected by the changing environment.

As evidence for a link between environmental factors and epigenetics grows, so does public interest in the topic as people consider the impact of their lifestyles and diets not only on themselves but also on the next generation. Zhong and her team hold talks for the public about their work and conduct a number of hands-on programs about epigenetics for undergraduate and K-12 students, including a summer science camp for local high school students, a field trip for middle-schoolers, a youth apprenticeship program in her lab and a "tabletop exploration station" about how lifestyle choices can affect gene expression. Zhong hopes opportunities such as these will raise interest in and encourage the next generation to study this rapidly growing field.

What is epigenetics?

It's a very interesting question, I would say. The definition of epigenetics has been really challenging over the years because there are different concepts of epigenetics. Most people accept the definition that epigenetics is modifications on the genetic material, the DNA, that changes expression of the underlying genes. I like to say that epigenetics is like a Christmas decoration. You decorate the DNA in a different way, and then the expression of genes is different.

I would also use another comparison: If you think about a cake, the base of the cake is the DNA, the genes. Then the epigenetics is the frosting, the decoration on the cake. And the nice thing about that is if you don't like the frosting, you can remove it. You can redecorate it differently, and it looks like a different cake.

Can epigenetics be passed on from one generation to the next?

This is another reason why epigenetics is so debatable—the question of inheritance. The modification on top of DNA has been well accepted, but whether it's heritable is still being debated. Some modifications are very transient and unstable. But some of the modification, for example, methylation—the process of adding methyl groups to the DNA molecule—is fairly stable and can be inherited by the next generation. That is called transgenerational inheritance.

We talk a lot about how your diet, your exercise and your environment have a huge impact on you, obviously, but can also impact your children and even grandchildren through transgenerational inheritance. There are cases from World War II of women who lived through famine, and even 20 years later when they were leading a healthier life, those women tended to have children with more diseases and stress throughout life.

How is this inheritance being studied?

It's very challenging to study transgenerational inheritance in humans. We're talking about 60, 70 or 80 years for each generation. But in plants, it's been very clear that certain epigenetic patterns can be transgenerationally inherited. For example, the Wisconsin cold can induce modifications of genes that can then be inherited. This is an area we are very interested in—environmentally induced epigenetic modifications and to what extent these modifications are transmitted to the next generation.

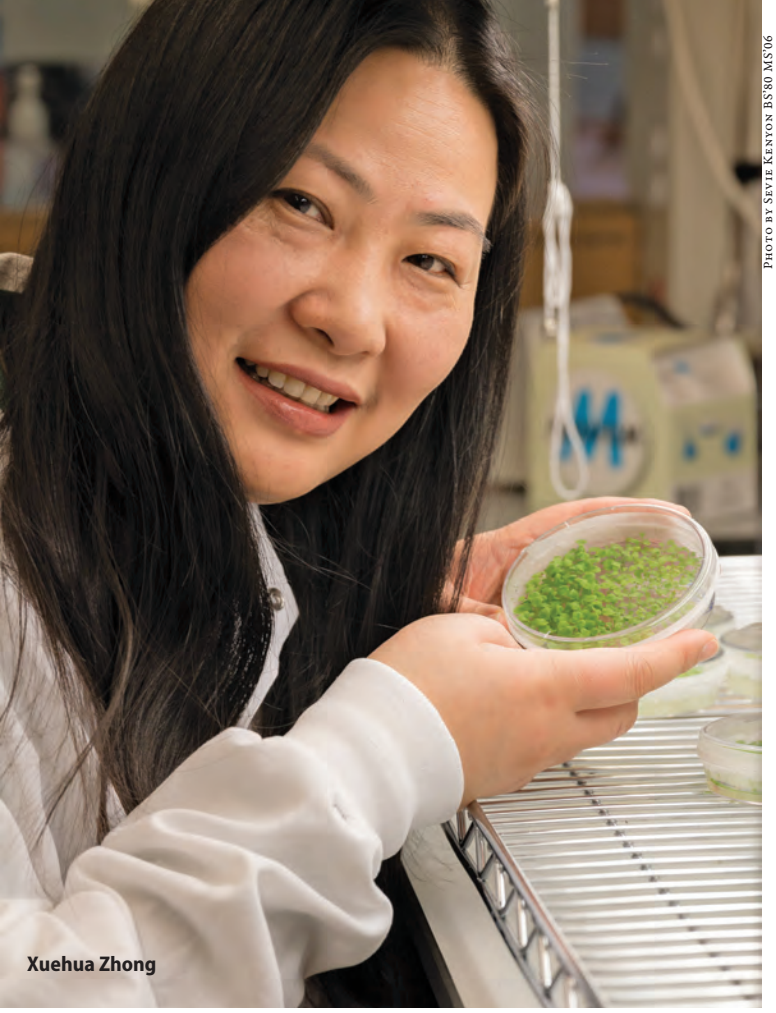


Photo by Sevie Kenyon BS'80 MS'06

Xuehua Zhong

What plant do you use to study inherited epigenetics?
Currently we are primarily utilizing a flowering plant called *Arabidopsis thaliana*, or thale cress. It's a model system that is widely used. We use it because it has a small genome, and because most of our studies are done at the whole genome scale, it's cheaper than other model systems. Also, the generations are very short, only eight weeks. You can look at six generations in just a year. We've also started to extend our work to rice and maize through other collaborations on campus.

Can you explain what you've learned about plant aging in your work?
We have been finding that one epigenetic complex in particular is very important to make sure that a plant senesces, or ages, at the right time. Early senescence can reduce yields, so if we can find a way to delay senescence we can hopefully increase productivity. And that's exactly what we see. If we get rid of the complex we've found, senescence is significantly delayed.

While we often talk about how delaying aging is good, the opposite can be true, too. Here in Wisconsin, we have relatively short windows for growing plants. If we can promote senescence, we can maybe shorten the plants' growing season to better fit our weather patterns.

Now we are trying to understand the mechanism behind these changes because only when we know the mechanism can we really manipulate the system. Ideally, we will be able to manipulate things both ways by fine-tuning the epigenetics to different levels. It's not all or nothing—it's kind of an art.

How can your work help address concerns about climate change?
Heat and drought will make the areas that can grow plants limited and challenging in the future. This is a big motivation for us. We want to know what kind of epigenetic modifications happen in response to heat and drought—how strongly, uniformly, stably and rapidly do these modifications happen? Also, is this inheritable? If we treat a plant with heat and collect its seeds, will the next generation "remember" that past experience? Can that memory help the plant?

Why is it difficult to study the influence of environmental factors on epigenetics?
In the lab, it's simple because we can control each factor and use one kind of stress. But in the real world, you are going to have multiple factors, and how they crosstalk is very complicated. Heat is associated with drought, and there may be long, dark nights and short days as well. I am interested in finding the epigenetic complexes responding to all of these factors. Ideally I want to combine all this information to establish an environmental epigenetic regulatory network. And if there is one key complex responding to all kinds of factors, that can be our target.

Is there a way to do very targeted epigenetic work?
One area we are getting into is epigenome editing (also named epigenome engineering) using a modified CRISPR–dCas9 system that others are using for genomic editing. This lets us target the genes involved in aging, let's say, and then change only those few genes we have identified to be important. We can put a modification only in that place or on those genes. It's more efficient.

Using CRISPR–dCas9, the epigenetic changes hopefully will be stable. That's a question right now because we haven't gotten to that step yet, but I hope that's true. Ideally once we have the modification on there, it should stay and do its job.

How are epigenetic studies being used beyond the lab?
I am most interested in how epigenetics can be applied to horticulture and agriculture, but many people are interested in epigenetics for drug discovery. In human medicine, there is already a drug used clinically called azacitidine, which is used to treat a bone marrow disorder called myelodysplastic syndrome and works by blocking the methylation of DNA. This is still a huge, growing area, and whether lab findings can be used in the field or in practice is a million-dollar question. We need efforts to take the discovery from the lab into the field. Making that connection is important and challenging work in all areas of research.

candid camera

You might spot a buck, a bear or a bevy of otters. How an extensive trail camera project called Snapshot Wisconsin is engaging state residents in citizen science—and may lead to better wildlife management.

by Erik Ness

Trail camera photos of wildlife provided by Snapshot Wisconsin, Wisconsin Department of Natural Resources


Bobcat


Beaver


Black bears

At first there is nothing—windblown leaves maybe, or the quicksilver skitter of a squirrel. I can't identify the source of the movement, and settle back expectantly because soon, I know, there will be more chances.

Huddled in the twilit hour I am hunting, expecting the common whitetail deer—but hopeful for more elusive game. Where there are deer there could be a wolf, right? A bear? Either would make the wait worthwhile. Or perhaps something I've never seen, like the elusive fisher?

Some time passes before I see the princely buck, so hale and burnished brown that my gaze lingers long in pure appreciation. His neck and shoulders are heftier than even the regal eight-point crown suggests. I've seen a lot of deer already, but he has presented broadside, at perfect range. My finger hesitates as I savor the action. And finally I decide, yes, this is a keeper.


Elk

I shift in my perch and refocus. Yes, there is the heart. My finger flexes. And I click on the heart icon. Subject 4988060, a Dane County buck snapped last November, is now in my favorites folder.

My hunting perch, you may now realize, is my customary recliner, and I'm using my laptop to spy on the wildlife of Wisconsin while dinner warms. In 20 minutes I'll go through a few hundred of the millions of photos already collected by Snapshot Wisconsin, a growing network of trail cameras.

By now everybody's seen trail cam photos. Maybe you or someone you know already uses them to scout deer, or just to see what's on your land when you're not looking.

Certainly someone's emailed you a photo or short video, or they've shown up in your social media feeds. Those are the special shots, curated, viral. Snapshot Wisconsin is the raw feed, and therein lies the fun. Because here you can get your wildlife fix and be a scientist, too. Identifying these animals contributes to a cutting-edge effort that may fundamentally change the way we study wildlife.

"It's like having 350 people out there in the woods day and night recording everything they see," says Jennifer Stenglein MS'13 PhD'14, a research scientist with the Wisconsin Department of Natural Resources (DNR) who directs Snapshot Wisconsin. "That's amazing data that we've never really had before."

And 350 is just for starters. The goal is four cameras in every township in Wisconsin. Stenglein will be happy if they can reach at least 3,000 cameras. "We are, I believe, going to have one of the best data sets in the world," she says.

Wolves

At 10:40 every morning

a NASA satellite flies over Wisconsin and snaps a series of pictures. The photographs measure many things, including a day-by-day record of how green the landscape is, which in turn gives us an idea of how well the plants are doing. The data has been collected for years—one of the satellites, Terra, has been in orbit since 1999—and offers an ever-lengthening perspective on the American landscape.

Satellite photos are now commonplace, but for most people remote sensing data is an abstraction. Woody Turner, program manager for NASA's Ecological Forecasting, is always working to make that data matter to as many Americans as possible. "It's really important to be able not only to understand what's happening in your backyard or your woodlot but also to put it in the broader context," he says. "The satellite brings in the broader context."

In 2012 NASA announced it wanted to fund a project connecting its data with state agencies and university researchers. These are regular customers, but now there was a twist: NASA wanted a project that also used trail cameras and citizen scientists.

Phil Townsend, a professor of forest and wildlife ecology at CALS, had wanted to connect trail cams and remote sensing data for years, and he quickly called his professor colleague Ben Zuckerberg to brainstorm the citizen science angle. Then they reached out to Karl Martin BS'91, then the DNR's forestry and wildlife research chief, who knew camera prices were dropping and was also thinking about how to use them to improve research techniques. Martin also had access to a rich store of potential volunteers.

With all the ingredients NASA was looking for, the Wisconsin team won a pilot grant to install 80 cameras. It was an opportunity to improve wildlife research and put big data to work in the natural world. It even seemed like a promising tool for youth engagement—a partial antidote to nature deficit disorder. "It's a very good example of cross-disciplinary, cross-agency teamwork," says Martin, now the interim dean and director for UW–Extension Cooperative Extension. "This is how you leverage the Wisconsin Idea."

Almost as soon as it began, state budget woes put the project on ice. In a curious twist, a raging national debate over gun control led to record sales of guns and ammunition. These sales are federally taxed, and a portion is returned to the states via the Pittman–Robertson Act for natural resource projects. With a secure funding stream, Snapshot Wisconsin began in earnest.

While the technology has been available for years, the ambitious scale remains a challenge. Educators and tribes can install cameras throughout the state, but cameras for private land are being rolled out gradually. Racine, Vernon and Dodge counties recently joined Iowa, Iron, Jackson, Manitowoc, Sawyer and Waupaca. At last count 417 volunteers were operating 607 cameras that have taken more than 8 million photos.

"The logistics are a big part of it," says Townsend. "The scale that we're doing this at has never been done before." But scale is also the payback. Townsend is interested in phenology—the cycling of the landscape from brown to green and back again. Factors ranging from climate change to land use change can influence phenology. The Snapshot cameras are programmed to take an image at 10:40 a.m. every day, in sync with the satellite, providing a much richer data profile for that precise location.

Meanwhile the motion trap captures the phenological patterns of the animals. "Animals respond differently to their environment," says Townsend. When they give birth, when and where they feed, when they're out and about and when they're in hiding all change, and we understand only a fraction of the whys. Bringing landscape data together with animal data may answer a lot of outstanding questions.

"Wildlife research every now and then gets transformed by technology," notes Tim Van Deelen, a professor of forest and wildlife ecology. Radio telemetry revolutionized wildlife study in the '70s, but it also took a while before researchers were able to put that information to use.

"That's where we are with camera data," Van Deelen says. "We're in that lag phase where we are figuring out how to be efficient with the use of that data. I'm betting that as cool as things are right now, they're going to get cooler as analytic techniques develop. I think there is a lot of basic biology that is going to come clear because underlying Snapshot Wisconsin is a very robust sampling scheme."


Bobcat

There are two kinds of Snapshot Wisconsin volunteers. One group maintains cameras—either on their own land or special project cameras on public lands. Sited away from human activity and preferably on a game trail, the cameras operate day and night, snapping three photos in quick succession via a motion trigger. Memory cards and batteries need to be changed at least every three months, and the card uploaded back to Snapshot Wisconsin. Here technology takes over. To avoid any possibility of surveillance, the images on the card are encrypted. After decoding they are uploaded to Microsoft Cognitive Services, where special software removes images that contain humans. Then the image batches are sent back to each camera volunteer, who removes any people pictures the software may have missed.

After this double-check, the images move to me in my armchair via Zooniverse, a citizen science web platform designed by the Adler Planetarium in Chicago. Its goal is to harness our digital enthusiasm for something more than selfies and cat videos. On Zooniverse you can help with research projects that range from finding evidence of water on Mars to transcribing Civil War telegrams.

Why not just let a computer do it? Even in this age of the Watson cognitive computing platform and pervasive facial recognition, the human mind is still the most agile tool available for subtle pattern recognition. "There is no machine that's as good as the human brain when it comes to being able to capture these kinds of images and classify them appropriately," explains Zuckerberg.

Log on to Zooniverse and you'll soon begin to appreciate both the challenge and your gift. The three-photo sequence captures movement. Some images are empty, and if the frame sways, you can tell that wind triggered the snap. But then you find an empty image where just a tiny bit of vegetation moves, and you realize that something has just passed by. Sometimes there's just a blur of color, or—at night—eye gleam. After a while, you begin to recognize places and patterns, to appreciate the different ways that animals use and move across the landscape. Even the boring photos can surprise you. There is one squirrel in Sawyer County who loves to run a steeplechase along a few fallen birch logs. Occasionally this camera catches a deer. But just as I was getting frustrated with what felt like the 99th photo of the same squirrel, I realized the field beyond was crowded with 14 young turkeys.

Citizen science dates back at least as far as the then-nascent Audubon Society's first Christmas bird count in 1900. (Plain folk have been collecting astronomical and meteorological observations for far longer.) In Wisconsin, thousands participate in all kinds of projects, monitoring everything from water quality to bat populations.

Zuckerberg hopes that through Snapshot Wisconsin, biology can join the ranks of such disciplines as meteorology that collect data continuously. "Collecting biological data tends to be very difficult," he explains. State-of-the-art radio tracking can follow only a few individuals. Ecologists want to see how species respond across broad stretches of space and time.

"To me the real value of this is being able to think about animal communities over the course of an entire year," Zuckerberg says. "It's thinking about big-pattern ecology."

Snapshot Wisconsin is in what you might call its giddy start-up phase. There isn't an end product yet, but as the project ramps up, the anecdotal excitement grows. Director Jennifer Stenglein can tell you that there are quite a few porcupines, not so many striped skunks and a fair number of flying squirrels. Also, that we don't capture as many wolves as you might think, and that it can be very hard to tell coyotes from wolves. And, to no one's surprise, there are lots and lots of deer. In fact, 60 percent of the animal photos from Sawyer and Iowa counties have deer.

Which leads to an obvious question: Can Snapshot Wisconsin close the persistent (and politically sticky) gap between hunters and the DNR about deer populations? Nobody is taking bets on that, but the project should upgrade research techniques overall. "The way that the DNR tallies wildlife is highly sporadic," says Townsend. "It's not systematic, it's different among different wildlife species, it's difficult to do and it's expensive to do well."

Stenglein's other major DNR responsibility is care and feeding of the state deer population model, and she sees Snapshot Wisconsin as a dual-use tool. On the one hand, it can contribute to the modeling currently in place,

The DNR's Jennifer Stenglein and CALS' Phil Townsend demonstrate where trail cameras are placed on trees (though for real use they are mounted, not hung). The cameras require a lot of batteries (inset).

Photos by Joan Fischer

providing an index for population size, some idea of overwinter survival, and the fawn-doe ratio. "Cameras can be the best way to get a couple of those deer metrics, we think," she says.

"It might also lead to an entirely different way of understanding the deer population," Stenglein notes. The current model uses data from two observation windows: an August/September survey conducted by the DNR and the public, and the nine-day gun season harvest data. Snapshot would provide many more data points in time.

Two important research projects will help determine the ultimate value of the cameras. Elk reintroduction in Sawyer, Ashland, Bayfield and Jackson counties includes a much higher density of cameras. This will allow scientists to check the validity of the lower-density Snapshot data. And because many of the elk are also collared, traditional telemetry data can also be compared with the camera data. Similar comparisons can be made on another project in Dane, Iowa and Grant counties studying the survival impact of chronic wasting disease. Deer and their predators (coyote and bobcat) are both being collared, and cameras are also planned.

Current deer population models have a strong grasp of general population dynamics, but they are missing crucial landscape factors that we know influence deer. That, says Townsend, is where Snapshot Wisconsin will make the difference. "You are not going to get any one township perfectly, but by sampling enough townships you are going to sample the diversity of land cover and land uses," he explains.

When all of those cameras meet all of that diversity, patterns will emerge. Find a relationship between deer density and vegetation and you can begin to make predictions. "The strength is in numbers," Townsend says. "The remote-sensing data is everywhere. Can we harvest all that information to help make the models better?"

Charged with predicting deer populations, Stenglein usually thinks about lots of deer all at once. But as she's built up Snapshot Wisconsin, a different window on wildlife has opened.

It began when she saw the work of an artist who was using her own trail cam photos for inspiration. Stenglein realized the artist was not painting a generic raccoon, but a very particular raccoon. The artist didn't "know" the raccoon, and was just looking at photos. Yet there was a kind of individual relationship on view. "I realized that so much of this project is actually about the individuals in these photos," Stenglein says. "That's what draws people to this project."

It was easy to imagine the connection landowners might feel for a camera they install and maintain on their property, or even one on public lands that they use. Stenglein gets lots of email from volunteers thrilled the first time they get a fisher or black bear they didn't know they had on their property. Sue Steinmann MS'83 volunteered to place a camera on her scrub oak barrens near Arena "to see if we have bear or bobcats," she says. "I really think we had a wolf come through last winter." Now she'll have more than footprints for proof.

Steinmann and her husband are active in ecological restoration, so they are probably more engaged in natural

Great blue heron

resource issues than most people in Wisconsin. But one of the things being studied by Snapshot Wisconsin is how citizen science can lead to better communication between scientists, resource managers and the public—and how this might lead to better resource management overall.

"When you have folks who are engaged in the process in more depth, and maybe helping to drive some of the questions, or helping to participate in the interpretation of the data, that's where you're starting to see some of these community-level outcomes," says Christine Anhalt-Depies, who is currently pursuing a PhD in wildlife ecology.

Anhalt-Depies is watching the online dynamic among the volunteers—some of whom come from all over the world—and how that evolves. Members of the research team are identified in Zooniverse, and the project also includes a few moderators (you can think of them almost as docents)—volunteers who help new users navigate the learning curve. The chatter is informed and supportive, and while the task might seem rote, it quickly becomes fun.

"I get addicted to doing that and have to stop after a while," admits Sue Johansen BS'94. As a naturalist at Devil's Lake State Park, she monitors three cameras for the park and one Snapshot Wisconsin camera in the West Bluff area. While the cameras began as a new way to engage visitors, they've also found animals—flying squirrels and short-tailed weasels—that no one knew were in the park. "What happens when you're not around?" she says. "It's a different way to connect to the outdoors."

Then there are the "super users." Zooniverse projects tend to develop their own core volunteers, people who process fantastically more images than most people. Some of these people are fully vested in the community aspect, engaging in conversation through message boards. Others remain silent. What are they getting from it, Anhalt-Depies wants to know. Will it translate to engagement in the real world?

"These are not cyborgs out there," Zuckerberg says. "These are people very invested in the research."

It's these modern times that make Snapshot Wisconsin so fascinating.

We are becoming so acclimated to screens, to surveillance, to the omnipresence of cameras. Social networks have always mattered, but they are more visible than ever as we attempt to reap their bumper crops and avoid their vicious undertow. Selfies may be changing our very sense of our place in the world. Science and business are being rapidly remade by our ability to collect big data, and by our struggle to understand it.

Snapshot Wisconsin rides the rebounding ripple effects of all of these phenomena. And yet somehow nature remains at the center of the experience.

I admit: I had my doubts. But I threw both hands up in delight when I scored my first black bear. I was tickled to learn the blob that I had thought might be a wounded turkey turned out to be, literally, a happy family pileup of otters. I laughed longer than I should have when the camera caught a coyote leaving a fecal sample. (Photo bomb.)

In nature there is no substitute for observation. And while the parade of images in Snapshot Wisconsin should not be mistaken for being out there, it's a legitimate supplement, a booster shot against nature deficit disorder.

"If you are going to maintain nature or wild places on this earth as our own numbers grow, I think it's going to be because we care about it," says NASA's Woody Turner. "And to care about something you have to be at least somewhat familiar with it."

Zuckerberg worries that we are increasingly detached from nature—that some children actually view nature as something to fear. Sometimes he listens to his children, ages 9 and 14, on Zooniverse in the next room. They love all the deer pictures but get totally jazzed by the occasional bear.

"I think using technology to allow another experience is what makes this project fun," he says. "This offers a window for kids to become interested and engaged in natural history. I think any way you can do that is going to be a positive experience."

Shaping the Future of Farming

Potted soybean plants growing under greenhouse lights at the Wisconsin Crop Innovation Center.

The new Wisconsin Crop Innovation Center is poised to serve as an exciting incubator for agricultural improvement.

By Terry Devitt

Photos by Jeff Miller/UW–Madison Communications

Thirty-five years ago, when CALS bacteriologist Winston Brill and his colleagues set out to exploit science's newfound ability to manipulate genes to confer new traits on crop plants, the technology was, literally, a shot in the dark.

Working in a facility in Middleton, just west of Madison, Brill and his team blasted plant cells using a gene gun—a device that fired microscopic gold beads laden with DNA.

The idea was to introduce foreign genes that could confer new abilities on the plants that would ultimately be grown from the altered cells. First as Cetus of Madison, Inc., later as Agracetus and still later as a research and development outpost of Monsanto Company, the Middleton lab was, by all accounts, a hub of plant biotechnology innovation.

"Agracetus was the first in the world to engineer soybean, first in the world to engineer cotton, first in the world to field-test a genetically engineered plant," recalls Brill, who was recruited by Cetus to establish the lab in the early 1980s. "Thus, the Madison area and the UW influence led to historically important events."

In December 2016, the $10 million, 100,000-square-foot facility—a warren of labs, greenhouses and growth chambers—was donated to UW–Madison by Monsanto to become the Wisconsin Crop Innovation Center (WCIC).

The hope, according to agronomy professor Shawn Kaeppler BS'87—now WCIC's director—is that the center will add to its string of plant biotechnology achievements as one of just a few public facilities in the country dedicated to plant transformation, where genetically modified plant cells are taken from tissue culture and regenerated into large numbers of complete fertile plants.

The advent of the WCIC "is an unprecedented opportunity to add capabilities and capacity we couldn't afford otherwise," says Kaeppler, an expert on corn. Its acquisition by UW–Madison, he and others note, comes at an opportune time as powerful new techniques in synthetic biology are poised to make the development of plants with new or improved traits much more than a shot in the dark with a gene gun.

WCIC will function very much like a core facility, providing cell culture, phenotyping and plant transformation services for researchers at UW–Madison and other universities. It is also coming online at a time when the need for such resources is acute.

"There is a recognized need nationally," explains agronomy professor Heidi Kaeppler BS'87, an expert in plant transformation who is serving as WCIC's transformation technology director. "There are just a few public facilities around the U.S. and demand is outpacing the abilities of those facilities. It is a bottleneck."

For researchers like bacteriology and agronomy professor Jean-Michel Ané, a member of the WCIC scientific advisory board, the new center means he will be able to devote more time to exploring such things as the genetic interplay that occurs when plants and bacteria collude to draw nutrients from the air through the act of nitrogen fixation.

Nitrogen-fixing plants such as soybean, alfalfa and clover are staples of modern agriculture. They are essential to the crop rotation practices that prevent exhaustion of soil from crops such as corn. Ané and many other scientists have long dreamed of engineering the ability to fix nitrogen into plants like corn to transcend the need for expensive and environmentally harmful chemical fertilizers.

However, engineering complex traits such as nitrogen fixation in plants that don't have that innate ability is a monumental scientific and technological undertaking. To begin with, there are two organisms—the plant and a bacterium—working cooperatively. Each has its own genome, and many different genes from each organism are in play to accommodate the act of drawing life-sustaining nutrients from the air.

To confer that trait on corn, for example, is an exercise far more complicated than tinkering with one or a few genes, notes Ané. "The goal is to create maize that has this association. However, modifying a single gene will not be sufficient," he says. "We modify many genes at a time. There is a lot of trial and error. We need to try many combinations."

Those combinations come about in the lab as scientists alter individual plant cells by adding or subtracting genes of

(Left) WCIC director Shawn Kaeppler amid rows of automated light carts in a climate-controlled incubator room.
(Right) Heidi Kaeppler, director of transformation technology, examines transgenic corn plants sprouting in a rooting box.

interest. Today, scientists can harness new techniques such as CRISPR–Cas9—a fast, cheap and accurate genome editing tool—and potent new cloning technologies that allow scientists to easily assemble multiple DNA fragments and their assorted genes into novel sequences.

Even with potent new tools like CRISPR–Cas9, engineering plants is a big, difficult task. A gene needs to be dropped in the right place on the genome and be in association with the right "promoters," segments of DNA that initiate gene transcription, the first step toward expressing a new gene in an organism. Once plant cells are genetically altered, they must be transformed into large numbers of actual plants for further testing in the lab and, ultimately, the field. It is essential to know, for example, that the new genetic construct is stable, that the new genes are passed from generation to generation, and what effects they may have on plant growth or yield.

The promise of WCIC, Ané believes, will be the opportunity to work through all of those steps more efficiently and cost-effectively, and carry projects from the lab to the field much faster.

"We can focus on really doing science instead of growing plants," Ané says. "We can now make genetic constructs very quickly. Within a month we can make hundreds of constructs. The limiting aspect is plant transformation. However, the scale of transformation we can do at WCIC allows us to think seriously about applying synthetic biology to plants."

Intense hues of magenta and blue emanate from LED grow lights in a climate-controlled incubator room.

To begin with, WCIC is providing plant transformation services for corn, soybean and sorghum, big commercially important crop species. But Shawn Kaeppler envisions WCIC playing a role, as well, with crop plants that have not yet risen to the top of commercial research agendas.

To date, commercial interest has focused primarily on just a handful of traits—insect and herbicide resistance—in a handful of widely planted crops. Uncharted territory, Kaeppler says, exists in the full range of crop plants and their many different traits.

A ready example is switchgrass, a native perennial that is under the microscope at the Great Lakes Bioenergy Research Center (GLBRC), a U.S. Department of Energy-funded multi-institutional research center headquartered on the UW–Madison campus. The grass is seen as a potential feedstock for converting its biomass to liquid fuel. However, efficient conversion of plant materials

A Facility With Deep CALS Roots

Photo by Sevie Kenyon BS'80 MS'06

The name is new, but the Wisconsin Crop Innovation Center (WCIC) holds a prominent place in the young history of agricultural biotechnology. The facility also has long and deep ties to CALS researchers and alumni.

Originally known as Cetus of Madison, Inc., the Middleton facility—owned by the Cetus Corporation of Emeryville, California—opened in 1981 under the direction of CALS bacteriology professor Winston Brill. The Wisconsin Alumni Research Foundation (WARF) played a key funding role in the early days of the company.

Cetus of Madison, Inc. initially focused on evaluating and testing a wide variety of natural rhizobia species to better understand their role in nitrogen fixation and nodulation in legumes, with the hope of someday enabling maize to have that capacity.

As interest in biotechnology grew in the early 1980s, the facility's focus changed to inventing and innovating ways to introduce genes into plants. In 1984, Cetus Corp. sold half of its interest in Cetus of Madison, Inc. to the WR Grace Co.—and thus the company name "Agracetus" was born.

Great discoveries followed. An electric "gene gun" and transformation methods developed at Agracetus revolutionized the plant transformation process. Many plant species were subsequently transformed, including tobacco, peanut, sunflower, soybean, maize, cotton, cranberry, canola, poplar, wheat and rice. CALS researchers Kenneth Raffa, Brent McCown PhD'69 and Elden Stang, as well as WCIC associate director Michael Petersen BS'87 (then still an undergraduate) and Richard Heinzen MS'74, collaborated with Agracetus scientists during that period.

But that wasn't the only significant research taking place. Other studies critical to agricultural improvement focused on cotton fiber quality, transformation process improvements, polymerase chain reaction (PCR) method development, insect and disease resistance and herbicide tolerance. A number of CALS faculty, including Michael Sussman, Richard Amasino and Andrew Bent, were highly involved in consulting with Agracetus in many of these areas.

In 1990, WR Grace Co. acquired full ownership of Agracetus. During the early 1990s, Agracetus ventured into research in DNA vaccines—using an improved "gene gun"—and contracted plant transformation services to others within the industry, including, most notably, the Monsanto Company. Collaborating with biological systems engineering professor Richard Straub PhD'80 (now CALS senior associate dean) and other CALS researchers, the company also worked on producing industrial enzymes in plants.

After successfully generating plants that eventually became commercial products for Monsanto, including Roundup Ready Soybeans and Bollgard Cotton, the facility was acquired by Monsanto in 1996.

Over the next 20 years, Monsanto used the facility as its primary site for soybean and cotton transformation. Other R&D at the site included corn, canola, wheat, rice and alfalfa transformation, gene expression, molecular testing and seed chipping/genotyping.

The site was considered a "center of excellence" for Monsanto due to its highly innovative employees, high throughput transformation capabilities and ability to consistently perform above and beyond expectations.

In July of 2016, Monsanto relocated a number of remote functions back to its St. Louis headquarters in the interest of business consolidation. In the hope that the Middleton facility would continue to work toward the betterment of agriculture, Monsanto the following December donated it to longtime collaborator the University of Wisconsin–Madison, along with University Research Park.

Not surprisingly, given the long history of CALS involvement, agronomy professor Shawn Kaeppler BS'87 was chosen to serve as facility director.

(Left) Associate director Michael Petersen, a CALS alum, has worked at the facility through many changes of management.

(Below) WCIC greenhouse lights glow at dusk.

to energy remains a challenge, and plant genetics will play a big role in refining the traits that will make that possible.

"WCIC will help lead us to the next generation of crop breeding and plant genetics," explains Kate VandenBosch, the dean of CALS, referencing, broadly, the genetic makeup of the crop plants in play. "Scientific agencies at the federal level have invested a lot in understanding genomes, but we still have a lot of work to do to understand how those genes function."

Indeed, genetic sequencing technologies have advanced to the point where new plant genomes are sequenced with increasing regularity. The genomes of crop plants like watermelon, cucumber, potato, soybean, wheat, corn and many others have been sequenced, but as VandenBosch notes, exploring those sequences to identify the genes that govern plant traits is an unexplored frontier.

Shawn Kaeppler's own research, for example, is a window to both the complexity and opportunity that lurk in the genomes of plants. One of his interests is the complex of genes—involving anywhere from tens to hundreds of genes—that governs the root architecture of corn. Knowing more about the combination of genes that directs the plant to send shoots into the soil, it might one day be possible to engineer a plant that can send its roots deeper into the earth, providing farmers with a hedge against drought.

"Fifty to 70 percent of all maize genes are expressed in roots," Kaeppler says. "Some control processes in all parts of a plant, and some specifically control root development and response to environmental stimuli."

A gene of interest for Kaeppler and his team is one that influences root angle. "Altering root angle even five to 10 degrees can dramatically increase the rate that roots get deep in the soil," as well as how much root biomass a plant lays down at depth, he explains.

Identifying those candidate genes and mutations of those genes means they can be selected and manipulated in the laboratory to generate plants with different root structures. At WCIC, those plants can be grown in quantity, their new qualities studied and, if promising, tested in the field. The goal, of course, is to provide a practical outcome that is useful to growers.

In plant science, numbers matter. The more plants you can grow to test a new genetic combination, the better, as there are so many variables in play.

"In many aspects of science, doing things on a large scale is critical," says biochemistry professor Rick Amasino, an expert on flowering in plants. "To have WCIC in our capability is great. Large-scale transformation opens up a lot of possibilities."

Amasino, who is also a member of WCIC's scientific advisory board, views the center as an important new national resource. Individual labs, he explains, do not have the same capacity.

"This has the potential to be on a scale greater than any other university's," Amasino says. "Individual labs can't generate the hundreds or thousands of transgenic plants needed to fully test certain hypotheses. Labs around the country and, hopefully, around the world can now do experiments they couldn't otherwise do. There are so many opportunities out there."

Photos courtesy of V&V Supremo Foods, Inc.

A Tale of Two Cheeses

How the Center for Dairy Research helped Wisconsin makers of vastly different cheeses improve production and quality—and bring home top honors in international competitions.

By David Tenenbaum

MANY OF THE WORLD'S GREAT CHEESES are made in Wisconsin. It's a fact that begs the question: How do those cheeses get to be great?

A key ingredient is the Center for Dairy Research (CDR), based at CALS and operated with funds from dairy farmers, dairy food manufacturers and processors, and other industry partners. Located within a licensed, operating dairy plant on the UW–Madison campus, its facilities include a cheese pilot plant, a dairy ingredients pilot plant, a sensory lab, an analytical lab and an applications lab, all of which are available to cheesemakers and other dairy manufacturers for trial runs and testing new products. For experienced cheesemakers seeking rigorous additional training, CDR, in partnership with the Wisconsin Milk Marketing Board, offers a three-year program of courses and mentoring leading to certification as a Wisconsin Master Cheesemaker.

CDR's experts boast hundreds of years of combined experience in industry and academia. Those experts have something else in common: Many grew up in the same milieu as the cheesemakers they work with around the state.

We are pleased to present here the success stories of two very different kinds of Wisconsin cheesemakers who availed themselves of CDR's support and expertise.

Oaxaca is the melty cheese in many Mexican dishes, including the mandarin pork chop quesadillas shown here (left and below). You can find this and many other recipes using Oaxaca cheese at www.vvsupremo.com/recipes/.

Mexican Melty

When milk is converted into cheese, science alone takes you only so far, says Tom Dahmen, a second-generation cheesemaker who manages the Chula Vista cheese factory near Browntown, in southwestern Wisconsin.

"I'm a big believer in heavy-duty science, but there is always a bit of magic in making cheese," says Dahmen, who began washing cheesecloths at age 6. Intuition and experience also play a role, he notes.

At Chula Vista, those ingredients are combined to produce a string cheese called Oaxaca (wa-HA-ka), which received the Best in Class award in the Hispanic melting cheese category at the 2016 World Championship Cheese Contest in Madison. The CALS community can take pride in this honor, because CDR helped Chula Vista create the cheese.

Oaxaca is a white, mild-flavored cheese used in many Mexican dishes. The cheese gets its name from the Mexican state where the style originated.

At the Chula Vista plant, named for its beautiful view of Lafayette County dairy farms, people work two shifts making two styles of Mexican cheese.

Chula Vista and V&V Supremo of Chicago were cheesemaking partners for decades. Last September V&V bought the plant, where employment has risen to 80, up from 34 about seven years ago.

Although Chula Vista purchased and sold Oaxaca cheese for several years, "We were never happy with the quality, so we decided to move production in-house," Dahmen says. "I had spent 14 years making a related style, but there were challenges to our 'make,' so we went to CDR. They helped us from the beginning."

Starting in around 2010, Dahmen and Alan Hamann, V&V's senior manager of quality control, began talking with CDR researchers about the details of fat-protein ratios, milk solids, chemistry and pH.

"You have to control all of these factors even as the milk changes subtly from one truckload to the next," says Hamann, who has more than 36 years of experience in the dairy industry.

Once the ideas were collated, they needed to be tested. At Browntown, each test would require 5,000 pounds of milk, Hamann says. Vats at CDR, however, would require only 500 pounds, reducing cost and eliminating errors attributable to running tests with different batches of milk. "At CDR, we could test several variables at once," Hamann says. "Working at CDR drastically cuts your timeline and offers much more control."

When the improved Oaxaca reached the market in 2015, Chula Vista was producing one or two vats per week. Now the company makes that much in a day.

Oaxaca cheese is produced using a procedure similar to that used for fresh mozzarella. Pasteurized milk is set (coagulated) and cut in a stainless-steel vat and then turned into curd slabs that are moved to a cooker-stretcher, a machine where heating and repeated folding links protein molecules, forming the familiar elastic product called string cheese.

The stretched curd is then formed into cylinders by six nozzles, cut to length and packaged for shipment to stores ranging from "mom and pops" to Wal-Mart, says Philip Villasenor, V&V's vice president of manufacturing.

Beyond technical advice, CDR offers business consulting to the dairy industry, says Vic Grassman, CDR's technology commercialization manager. "We help firms develop products and expand," says Grassman. "I help with economic development financing, permits, workforce information and development."

As employment tightens, particularly in rural areas, CDR links manufacturers with existing resources for economic development. "It's not just 'Develop the product and you are on your own,'" Grassman says.

But when you visit Chula Vista, it's all about the cheese. Even though Chula Vista aims for a standardized, pure product, "Every vat is a controlled

experiment," says Dahmen. "We are predicting what is going to happen, and we are pretty accurate, but this is a living system, and unplanned things happen: A pump dies. A cooler dies. People don't show up. But once you start a batch, you have to finish."

Those snafus are familiar to both Chula Vista and CDR, says Dahmen. "The beauty of working with CDR is that they are heavy, heavy on science, but their people have all worked in the industry. They have this blend of science and art that you can only gain from experience. For our Oaxaca cheese, they greatly shortened the timeline to reach the product quality we were looking for."

The collaboration with CDR also served as a rich educational experience for Dahmen. Earlier this year he earned certification as a Wisconsin Master Cheesemaker for Quesadilla and Oaxaca cheeses.

Wisconsin Master Cheesemaker Tom Dahmen, of Chula Vista.

Alpine Goodness

If you walk into Roelli Cheese Haus near Shullsburg in southwest Wisconsin, you'll see plenty of succulent Wisconsin cheeses—but not Little Mountain, the company's champion cheese. It lives behind the counter, with nary a sign.

Little Mountain, described by its maker as a "classic upland style from Switzerland," is not contraband, but Roelli is practically running on empty after a "Best of Show" at the American Cheese Society contest last July. "We feel pretty honored," says company owner Chris Roelli, noting that Little Mountain bested 1,842 other cheeses in the competition.

Although Roelli is a fourth-generation cheesemaker, in creating the recipe and honing the details of microbiology, timing and equipment, he got assistance from CDR. "For us as a small business, tapping the experience at CDR was invaluable," says Roelli. "It accelerated our path to bring this cheese to the market, literally by years."

Little Mountain requires at least seven months of careful aging to achieve its characteristic flavor, texture and rind. Aging occurs in an above-ground "cellar," with cooling pipes along the walls. Forced air would waft microbes, threatening the cheese with spoilage.

Roelli's great-grandfather, Adolph Roelli, immigrated from Altburon, Switzerland to Green County in the early 1900s. "He was a cheesemaker's apprentice in different areas of the Swiss Alps," says Roelli. "He settled here as a farmer and sold milk to a co-op, which offered him a job as head cheesemaker, based on his experience in Switzerland."

Roelli says he's been in and out of cheese factories all his life. "I watched my granddad make commodity cheddar," says Roelli, but the factory closed shortly after Roelli got a cheesemaker's license in 1989. "We weren't able to compete."

Photos by Jeff Miller/UW-Madison Communications

Wisconsin Master Cheesemaker Chris Roelli (left and bottom) holds a 15-pound wheel of Little Mountain cheese aging in a storage facility at Roelli Cheese Haus. Once packaged (below), tasty Little Mountain flies off the shelves.

In 2005, unable to stay away from the family business, Roelli returned with "Cheese on Wheels," a cheese plant mounted on an 18-wheeler.

The following year he started an artisanal cheese business in a new factory behind his store on Highway 11 east of Shullsburg, and started to envision a Swiss cheese that would go back to the family's roots. In preparation, he says, "I went around and tasted as much Swiss mountain-style cheese as I could."

Both Emmentaler and Gruyère were already produced nearby, and Roelli mulled a Swiss version of Parmesan before settling on an Appenzeller, a hard-rind cheese flavored with "washes" of brine as it ages.

He approached John Jaeggi, CDR's cheese industry and applications coordinator, with some flavor profiles he was looking for. "I made a couple of batches here as total experiments, and we went to the CDR and made six batches to fine-tune the culture and process," Roelli says.

In Jaeggi, Roelli found a particularly kindred spirit for this project. Jaeggi is a third-generation, Swiss-descended cheesemaker from Green County who, like Roelli, grew up in a cheese family. "If you look at the history of Wisconsin, a lot of cheese factories were family operations and the family was involved in all aspects of the business," Jaeggi says. "The younger generation would start on the bottom floor, cleaning, sanitizing, packaging and working their way up."

The initial conversations with Roelli, Jaeggi says, concerned flavor, texture and equipment. "We talked about aging, culture, the 'make' schedule. Chris came up to CDR and worked in our test vats, looking at cocktails of microbial cultures for different flavor profiles. Once we got close, we went to his plant two or three times to make the cheese, then optimized the make procedure to fit his plant."

The cheese would be aged from seven to 16 months while being washed with a hush-hush recipe of salt, yeast and bacteria. The wash would break down proteins and fat to create the rind and desired flavor.

"Although artisan cheesemakers are pretty open in general, when it comes to world-class cheese, there are still secrets out there," Roelli says.

Holding secrets is a point of pride at CDR. "To be able to draw from the knowledge base at CDR was invaluable," says Roelli, who has earned certification as a Wisconsin Master Cheesemaker. "There is nowhere else you could get that. If John Jaeggi or Mark Johnson [a CDR cheese scientist] asks for help from someone in Europe, they will help. They don't know me, but they know them."

Someday the world's top cheesemakers may start to know Chris Roelli, who has built his future atop his history and the cheese wisdom brought by his great-grandfather from Switzerland. "If you make something really good, people

will find it," Roelli says. "We entered competitions to garner some interest from places where we don't normally get it. You don't have to set the world on fire with advertising."

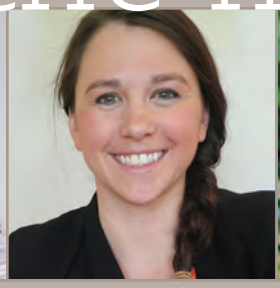
Between the store and the cheese plant, Roelli Cheese Haus has five employees. Chris Roelli also runs a larger business hauling milk from farms.

Demand for Little Mountain exploded after the award in July, Roelli says. "We beat the world champ from last year, and three other American Cheese Society Best of Shows from past years. We have upped production for the end of 2017 as much as we can. I still have a list as long as my right arm wanting the next batch."

in the field


Caitlyn Busche


Mascha Davis


Amy Giffin


Ellya Hillebrand


Bridget Reineking

Caitlyn Busche BS'14 • Caitlyn Busche was drawn to dietetics because of its "relatable nature," she says; she enjoys working in a rare branch of health care where patients can see, feel and understand both the processes and results of treatment plans. At Chicago's Northwestern Medicine, she is able to do just that. There Busche works with oncology patients to improve chemotherapy and radiation-related side effects through dietary modifications. As an undergraduate at CALS, Busche worked as a lab research assistant, which taught her how fascinating and exciting nutrition research could be. These early experiences gave her the foundation in research that has been instrumental in providing evidence-based medical nutrition therapy to her patients in the ever-changing field of oncology nutrition.

Mascha Davis BS'06 • Born in Ukraine, Mascha Davis fled with her family to the United States as a political refugee in 1990. Her family settled in Madison, Wisc. in search of their own American dream. She attended CALS, majoring in nutritional science, and she later earned a master's degree in public health at the University of California, Los Angeles. As a refugee, Davis has always been drawn toward helping impoverished nations, an interest that led her to pursue a career abroad. She worked in Geneva, Switzerland, and in five different African countries, where she focused on programs preventing malnutrition. Today Davis is putting her years of education and experience to great use through her own private dietitian practice, Nomadista Nutrition. There she educates clients on such topics as healthy eating and weight loss. She also is working on a book, *Food Myths*, that will be released at the end of 2017. Davis works part-time as a dietitian for Satellite Healthcare in Los Angeles, and she is a featured health writer for the *Huffington Post*.

Amy Giffin BS'09 • Coming from a family of cheesemakers, it was no surprise that Amy Giffin began her college career in food science. She planned to follow in her family's footsteps, but after a guest dietitian spoke at her freshman-year nutrition class, she had a change of heart. "I realized that I also wanted to apply the science of food and nutrition to help others," says Giffin. Now she manages the menus of students in the Sheboygan Area School District as the school nutrition supervisor. There she has the opportunity to work with students to develop meals that are nutritious and tasty. In her free time Giffin is on a quest to make cooking "fun and fearless" through her nutritional food blog, Eat Right Cook Tonight (eatrightcooktonight.com). Giffin is thankful for the inspiration and education she received at CALS and for the lifelong Badger community that comes with any UW–Madison degree, she says.

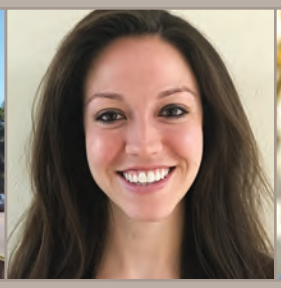
Ellya Hillebrand BS'10 • Elya Hillebrand's path through dietetics led her to a successful career in the military. After earning a bachelor's degree in dietetics from CALS, Elya Hillebrand joined the U.S. Army. During her six years of service, she earned a master's degree in dietetics from Baylor University and held many nutrition-related positions, including, most recently, director of food and nutritional services. In that position Hillebrand discovered her knack for management, and she recently decided to leave the military to pursue a career in food service management.

Bridget Reineking BS'04 • As the global associate director for training and development at BioMarin Pharmaceutical Inc., a California-based biotech company specializing in drugs treating genetically based diseases, Bridget Reineking is responsible for educating the company's global medical affairs team. In this position she ensures that employees are trained as experts in BioMarin's many projects and are able to accurately communicate the company's scientific advancements to the public. During her time at CALS, Reineking gravitated toward positions involving education and development. "It is a beautiful thing to travel down the path of knowledge with an individual," says Reineking. In the midst of a successful career, Reineking looks back and attributes her strong communication and organizational foundation to her time spent at CALS.

Samantha Schmaelzle BS'10 MS'13 • After spending seven years completing both her bachelor's and master's degrees in dietetics and human nutrition at CALS, Samantha Schmaelzle couldn't imagine starting her career anywhere


Samantha Schmaelzle


Patrick Solverson


Bridget Stroup


Michelle Trumpy

Alumni making a difference through Dietetics

else. Numerous internships and research opportunities, including fieldwork in Zambia, opened up countless job opportunities for Schmaelzle after graduation, and ultimately landed her a job with UW Health. As an outpatient clinical dietitian with UW Health's Surgical Weight Management Clinic, Schmaelzle works to educate morbidly obese patients on nutritional needs and lifestyle changes in preparation for bariatric surgery. The long-term, personal work with patients makes their progress and recovery very rewarding, says Schmaelzle. "My patients are my favorite part of my job," she says. "Their motivation, energy, successes and positive changes keep me going every day."

Patrick Solverson BS'09 MS'12 • Could blackberries help cure obesity? Patrick Solverson is on the path to find out. As a researcher with the USDA's Beltsville Human Nutrition Research Center in Maryland, Solverson studies various diets and their effects on human health. Currently his focus is on anthocyanins, compounds found in blue and purple fruits and vegetables, and their potential to curb the effects of high-fat diets. Solverson's passion for dietetics stems from his own struggle with weight as a child. He learned the benefits of nutrition and exercise early on, which changed his life and sparked his interest in this field. "Nutrition is the staple of life every single one of us must address multiple times a day," notes Solverson. "It's unavoidable, powerful, and if harnessed correctly, can be so rewarding." In his free time Solverson enjoys staying fit through sports and weight lifting, and staying current in research by reading science articles with his cat, Allister.

Bridget Stroup BS'11 • Bridget Stroup chose a career in dietetics because of her passion for learning and improving lives. Stroup currently is a registered dietitian earning her Ph.D. in nutritional sciences at CALS while working in the lab of professor Denise Ney. There Stroup's research concerns phenylketonuria, or PKU, a disease that restricts processing of the common amino acid phenylalanine, which is found in protein-rich foods such as meat, dairy and grains. Individuals with PKU have limited food choices and must receive key nutrients from unpleasant-tasting amino acid medical foods that often come with equally unpleasant side effects. Stroup is working to develop and promote an alternative, known as glycomacropeptide (GMP) medical foods. GMP medical foods, made from whey protein, offer a low-phenylalanine, whole protein medical food option that is effective and more palatable. Stroup loves the collaboration and constant educational journey that her research at CALS provides.

Michelle Trumpy BS'03 • Michelle (Flatt) Trumpy settled on dietetics as a profession while she was still a teenager. "I was referred to a registered dietitian in high school to improve my own nutrition and quickly realized dietetics would be a great career choice for me," she says. "The mix of science, nutrition and helping people was a perfect fit." After completing an internship and working as a clinical dietitian at UW Hospital, Trumpy earned a master's degree in public health from the University of Minnesota–Twin Cities. As a registered dietitian at the Children's Hospital of Wisconsin, The Emily Program and with two public school districts, Trumpy has done extensive work with children and families. She now serves as the administrative manager at the Dakota County Public Health Department in Minnesota. A recipient of the Recognized Young Dietitian of the Year Award from the Minnesota Dietetic Association in 2011, Trumpy remains an active volunteer for her profession with the Academy for Nutrition and Dietetics, the University of Minnesota School of Public Health and Feeding Matters, a national nonprofit that addresses pediatric feeding disorders.

by Gilliane Davison

About *In the Field*

These alumni represent the depth and breadth of alumni accomplishments. Selections are made by *Grow* staff and are intended to reflect a sample of alumni stories. It is not a ranking or a comprehensive list. To read more about CALS alumni, go to **www.cals.wisc.edu/alumni/**

Catch up with…

Molly Sloan BS'06 Dairy Science/Life Sciences Communication

As a child, Molly Sloan dreamed of one day stepping onto the colorful shavings that cover the floor of the Dane County Coliseum in order to judge dairy cattle at the World Dairy Expo. Her inspiration came from growing up on a small dairy farm in northern Illinois, taking in everything about the business and the animals. From the farm, Sloan took the steps necessary to reach the Expo and make her dreams come true.

After coming to UW–Madison, Sloan quickly got involved in dairy on campus, establishing a network of dairy professionals at CALS. While completing degrees in dairy science and life sciences communication, she was active in such organizations as the Association of Women in Agriculture and the National Agri-Marketing Association. Through dairy judging with her team in the Badger Dairy Club, Sloan refined her judging skills and sharpened her eye for prize cattle.

Sloan's experiences and determination spurred success in both dairy genetics and cattle judging. Judging Ayrshires at the 2016 World Dairy Expo was her second time on the colored shavings she dreamed about as a kid—and it's not likely to be her last.

• How did your time and experiences at CALS help you get to where you are now?

I grew up in northern Illinois, and I knew all along that I wanted to study dairy science. I realized quickly that there was really no other option than CALS, which is world renowned for its dairy science program. I added a second major with agricultural journalism early on and was very involved in extracurricular activities as well as internships with different dairy genetics and reproductive AI [artificial insemination] companies. Through that involvement I was able to meet the industry contacts that I needed to get internships and, ultimately, job opportunities. When I finished college I started with Alta Genetics, and now, as Alta's global training program manager, I travel the world pretty extensively.

• What's it like to judge cattle at the World Dairy Expo?

This has always been a dream of mine. When I came to the University of Wisconsin I knew right away that I wanted to be involved in the dairy judging team. Through intense workouts and practices I was fortunate enough to be part of a very competitive team with exceptional coaching from Dr. Dave Dickson and Ted Halbach. After that, I knew that I wanted to continue this experience if the opportunity arose.

• The World Dairy Expo is considered a bit of a pinnacle for cattle judging. Where do you go from here?

I think you said it best; it really is the pinnacle in this field. I want to keep doing it as long as it's fun. For me, every new show is a great opportunity and experience. I would love to have the opportunity to come back and do another show here on the colored shavings.

—Gilliane Davison

Photo by Sevie Kenyon BS'80 MS'06

Into the Woods with FWE

Photo courtesy of UW-Madison FWE

Regal hemlocks tower overhead, fragile ferns blanket the forest floors and ribbons of sunlight break through the canopy. That may sound like paradise, but for CALS forest and wildlife ecology students, it's a school day—with the forest as a classroom.

Every summer the Department of Forest and Wildlife Ecology (FWE) offers students a weeks-long opportunity to learn among the trees at the CALS-based Kemp Natural Resource Station in Woodruff. In odd-numbered years, a field camp focuses on wildlife ecology. And in even years students can participate in a Forest Resources Practicum, affectionately known as "forestry camp." The three-week course allows young foresters to see what a career in forestry entails while learning essential skills from forestry professionals.

Last summer's forestry camp followed the established tradition. The class is divided into teams of four, and each is assigned a "compartment," a 200-acre tract of rich woodland in the Northern Highland American Legion State Forest. Throughout the course, teams learn all about their plot—essentially, forest ecosystem structure, function, processes and services—by surveying the vegetation, soil, animals and, of course, the trees.

Along the way students develop the knowledge to conduct a comprehensive forest resource assessment. Subject areas include basic field skills, plant identification, GPS & GIS, timber cruising, forest soils, wildlife identification and survey methods and forest habitat classification.

Instructors guide students as they work, visiting individual teams in the woods.

"Field visits often take an hour or two because they become deeper conversations about the history of the forests and the various components of the ecosystem," says professor Volker Radeloff. "Camp days end up being long days!"

All of that work pays off with invaluable experience and a slew of lifelong memories. Student John Joutras recalls the day he and his team got stuck in the middle of the forest during a rainstorm.

"One of my teammates said, 'You know you're a real forester when you're bushwhacking through the woods in the pouring rain.' Sure, that might sound kind of miserable, but it was actually really fun," says Joutras.

Hiking from dawn to dusk would feel like a full day to most, but students refused to stop there. After dinner, activities continued with canoeing, campfires and even more hiking.

During the final week, students summarized their results and conducted a final project based on their own and other teams' data. But the true value of the course can't be quantified through a final project or grade, students say. Rather, forestry camp motivates students and fuels their passion for the outdoors while they build lasting relationships with instructors and, of course, each other.

"The real challenge isn't any individual part but finding a way to tackle it all as a team," says Joutras. "I found that invaluable."

—Gilliane Davison

Interested in supporting this program? You can make a gift to the Department of Forest and Wildlife Ecology Field Camps and Experiences Fund at supportuw.org/giveto/FWEcolFieldCamps.

next**Steps**

VISIT US at **Wisconsin Farm Technology Days**, this year taking place in Kewaunee County **July 11–13** at Ebert Enterprises in Algoma. More info at **wifarmtechnologydays.com/kewaunee/**. Be sure to attend the WALSAA Farm Technology Days Picnic on **Wednesday, July 12**. More info at **walsaa.org**.

GET YOUR FOOTBALL ON at the WALSAA Football Fire-Up! on **Saturday, September 9**. More information available soon at **walsaa.org**

Together, we achieve

GROWING KNOWLEDGE and GROWING SOLUTIONS— from improved practices and technology in agriculture to medications to cure diseases—is what we do at CALS. To help us do that, our students need the guidance of our professors, UW–Extension specialists and other researchers—and the support of donors like you. Please contribute to the CALS Fund and turn student dreams into real-world improvements.

GIVE TODAY

supportuw.org/giveto/CALS

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Take the Final Exam!

Fill out your answers online. Ace our quiz and we'll enter you in a drawing for a gift box of Babcock Hall cheese. Go to: www.cals.wisc.edu/grow/ for more details.

Animal Sciences

1) Which of the following is NOT a key criterion for defining a required nutrient?

a) The nutrient must provide energy
b) The nutrient must be present in the animal
c) When the nutrient is removed from the animal diet, there is disease
d) The nutrient must have a defined biochemical use

Biochemistry

2) Pick the statement about cholesterol that is FALSE:

a) It is the major sterol in animals
b) It contains a fused ring system that is the basic motif for hormones such as testosterone and estradiol
c) It lacks an alkyl (hydrophobic) tail
d) It has a polar head group
e) It is a lipid

Horticulture

3) The trait on which selection is based is referred to as the:

a) Selection differential
b) Selection intensity
c) Selection criterion
d) Selection advantage

Global Health

4) Which of the following is FALSE about agricultural animals and health?

a) Agricultural animals can give rise to health problems for humans
b) Agricultural animals are the likely source of HIV
c) Agricultural workers are exposed to diseases from animals
d) H5N1 *(bird flu)* and H1N1 *(swine flu)* are diseases of recent global health importance
e) None of the above

Wildlife Ecology

5) An animal's energy demands increase as _____ decreases. *(Fill in the blank)*

a) Temperature
b) Surface area-to-volume ratio
c) Activity level
d) Metabolic rate

Last issue: Answers were 1:C; 2:D; 3:D; 4:D; 5:C. Congratulations to food science graduate student Jade McGill, who was randomly selected from 11 people who correctly answered all questions. She wins a Babcock Hall cheese box.

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ROOTY RESEARCH takes place on corn (shown here) and many other plants at the new Wisconsin Crop Innovation Center. Read more about it starting on page 24.

Photo by Jeff Miller/UW–Madison Communications