

grow

Wisconsin's Magazine for the Life Sciences • Summer 2016

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

Breeding *for* Flavor

Scientists work with farmers and chefs to improve the taste and variety of organic fruits and vegetables



College of Agricultural & Life Sciences
UNIVERSITY OF WISCONSIN-MADISON

ISLAND OF GIANT MICE • IMPROVING TECH TRANSFER • THE DEBUT OF CALS-MADE WINE



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Wisconsin's Magazine for the Life Sciences

16 Breeding for Flavor

A new collaboration called "Seed to Kitchen" brings CALS plant breeders together with farmers and chefs to help develop tasty fruits and vegetables for organic growing systems.

By Erik Ness

22 The Island of Giant Mice

Enormous rodents on a remote South Atlantic island may hold the key to a genetic mystery. Genetics professor Bret Payseur and his collaborators are on the case.

By Adam Hinterthuer

28 To Market, to Market

A campus-wide program called Discovery to Product is helping researchers become entrepreneurs. Here we present some shining examples from CALS.

By Caroline Schneider MS'11

Departments**4 In Vivo**

By Dean Kate VandenBosch

5 On Henry Mall

Sowing seeds of community in northern Wisconsin

Improving the road from farm to market

More sustainable feedstock for ethanol

Assessing the biological impacts of nanotech

Student-created quaffs of summer

Alpha Gamma Rho celebrates 100

Undergrads gain experience in commodity trading

Class Act: Kate Griswold

Five things everyone should know about pulses

14 Living Science

Dietram Scheufele, a professor of life sciences communication, serves on a national committee examining the risks and benefits of CRISPR in editing the human genome.

34 Working Life

In the Field: A look at alumni from the CALS Master Meat Crafter program

Catch up with Andrea Garber BS'92 PhD'99

Give: Feeding a hunger for food systems study

39 Final Exam**On the Cover:**

Beautiful produce serves science in the Seed to Kitchen project.

Story on page 16. *Photo by Sevie Kenyon BS'80 MS'06*

Summer serenity: The boathouse at the CALS-based Kemp Natural Resources Station. Kemp is offering a number of fun, educational activities this summer; learn about them at kemp.wisc.edu/outreach/events/. For more upcoming Ag Research Station activities, see page 37.

PHOTO BY SEVIE KENYON BS'80 MS'06

Dean Kate VandenBosch

Strengthening Our Global Engagement



“The boundaries of the university are the boundaries of the state.” That belief has broadened since the inception of the Wisconsin Idea early last century. The boundaries of the university are now the boundaries of the world—and no college embodies this more than CALS.

CALS faculty members conduct research in some 80 countries around the globe. Their work includes everything from increasing vitamin A content in local produce and breeding hardy crop varieties for challenging climates to economic development and opening new markets for Wisconsin products. Their activities have resulted in a multitude of discoveries that benefit CALS, Wisconsin and communities around the world.

But could we be doing even better? That question was considered when we embarked on our CALS strategic planning effort, and it was answered with a resounding “Yes!” What followed was a thoughtful, committee-led process that included a wide range of voices from within and outside of the college. In a final report the committee stated that “renewed investment in international activities will produce excellence in CALS scholarship and teaching, advance the college’s strategic planning goals, have a significant impact on our stakeholders and generate a substantial return on investment.”

“CALS faculty members conduct research in some 80 countries around the globe.”

In order to achieve optimal results from that investment, they deemed that a faculty-led International Programs unit is needed—something CALS has not had for about a half-dozen years. Faculty leadership is essential, the committee said, to “reach the threshold level of coordination and expertise required to win large international research and training grants such as those recently awarded to our peer institutions.”

Enter Sundaram Gunasekaran (*photo left*), a professor of biological systems engineering who has been selected to serve as faculty director of CALS International Programs. Gunasekaran—or “Guna,” as he is widely known—is brimming with ideas and enthusiasm about his new role. This past spring he held a number of “listening and learning” sessions welcoming all CALS faculty, staff and partners to discuss their international work and how a robust re-envisioning of CALS International Programs could help them better pursue it.

“My vision for CALS International Programs is for it to become among the leaders in the nation’s land-grant colleges for international engagement—and for it to effect positive change in global agricultural and life sciences enterprises through research, education and outreach,” Gunasekaran says. “CALS is among the very best land-grant colleges in the nation. Thus it is very appropriate that we envision an international program of a similar stature.”

We’ll be hearing more about CALS’ “new and improved” International Programs in the coming months, including here in *Grow* magazine. In the meantime, on behalf of the CALS community on campus and around the world, I’d like to extend a warm welcome to Guna in his exciting new role.



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On Henry Mall

News from around the college

The Greenhouse as Public Classroom

A CALS grad student sows seeds of community in northern Wisconsin

Just as some seeds yield tomatoes, carrots and lettuce, others grow community and partnership.

In a greenhouse in the northern Wisconsin town of Park Falls, all of those seeds are taking root with the help of CALS horticulture graduate student Michael Geiger, horticulture professor Sara Patterson and a team of dedicated local leaders.

“The greenhouse has opened doors to making healthier food choices, to education about gardening in local schools—and it’s given the university a presence in Park Falls,” says Geiger, who grew up in Arbor Vitae, some 50 miles away.

Geiger’s involvement with the Flambeau River Community Growing Center started four years ago when a friend in the area approached him for advice. Her group was seeking funding for a greenhouse project, and Geiger teamed with Patterson to identify possible revenue sources. They developed a proposal for the Ira and Ineva Reilly Baldwin Wisconsin Idea Endowment at UW–Madison.

By fall 2013, construction had begun on a 25-by-50-foot vail-style greenhouse, built by community volunteers on a vacant lot donated by Flambeau River Papers just north of the mill. Plans call for the facility to eventually be heated with waste steam from the mill.

The Flambeau River Community Growing Center has gained popularity with community members and school groups interested in learning about plants and gardening. “It’s a greenhouse, but it’s also a classroom,” says Geiger.

Learners include children from the Chequamegon School District, who start seeds in the greenhouse and nurture seedlings until they can be transplanted to their own school gardens. Area 4–H groups grow plants and tend them in raised beds just outside the greenhouse. Master Gardener classes are held at the facility, and community workshops have included such topics as square-foot and container gardening as well as hydroponics. Kids have been delighted with sessions on soil testing and painting their own flowerpots.



PHOTO COURTESY OF MICHAEL GEIGER

“It’s clearly a benefit to build a connection between UW–Madison and the community, for the community itself—people from ages 3 to 90—and for the local schools,” Patterson says.

Community leaders and institutions have joined to fuel the center’s success. Its chief executive officer, Tony Thier, recently retired from Flambeau River Papers; UW–Extension has provided valuable educational and technical support; and volunteer opportunities draw professionals from various companies in the area. Park Falls attorney Janet Marvin helped the center gain nonprofit status last fall.

Thier says the center provides needed education for area residents. “It’s been very beneficial,” he says. “When I got involved, it really became a passion. I wanted to learn more about gardening and increase my skill. We try to involve the whole community.”

Geiger says the project has helped him in his academic career as he learned about project planning, gave presentations about the center at two national academic conferences and writes scholarly articles about his work there.

“I’ve been able to see this process through from an idea to reality,” says Geiger. “It’s been really rewarding.”

Michael Geiger (right) in the greenhouse at a hydroponic salad table workshop. The greenhouse features in-floor radiant heating and custom growing tables made of locally purchased white cedar and built by volunteers.

—DENNIS CHAPTMAN

The Road from Farm to Market

CALS researchers are working to more efficiently and sustainably get products from growers to consumers

Tara Roberts-Turner, a founding farmer and business manager of the Wisconsin Food Hub Cooperative, loads fresh produce onto a truck bound for Chicago.

Consumer demand for regionally produced food is on the rise. But transportation and distribution logistics for mid-size shippers, distributors and farmers can be tricky. These supply chain partners are looking for ways to more efficiently move products from Wisconsin's farms to markets, while upholding many of their customers' sustainability values.

That's where the CALS-based Center for Integrated Agricultural Systems (CIAS) comes in. CIAS is working with university and private-sector partners to bring regionally grown food to urban markets while growing rural economies and addressing the environmental impacts of food freight.

"When people think of local food, they think of

Consumers tend to believe that food is more sustainable if it travels a short distance from farm to table. However, a USDA study found that compared to direct markets, the large truckloads and logistical efficiencies found in the conventional food system sometimes use less fuel per food item transported.

Helping mid-size farmers move full truckloads of their products into wholesale markets is one way to build a more resilient regional economy. However, farmers face numerous challenges when shifting from direct to wholesale marketing. Product aggregation is one major hurdle, as wholesale public markets for assembling farmers' wares have largely disappeared from the landscape.

The Wisconsin Food Hub Cooperative (WFHC), founded in 2012, helps fill that gap by providing sales, marketing and logistical support for its 37 farmer-owners, with sales of \$1.7 million in 2015 and anticipated sales of \$2.5 million in 2016.

CIAS helped WFHC implement retail product quality specifications and food safety requirements. Access to CALS expertise in those areas has made a big difference for their business, according to WFHC development director Sarah Lloyd.

"Most retail outlets require growers to obtain voluntary food safety certifications," says Lloyd. "The help we've received in working through this maze of regulations has been critical."

According to Miller, much more work is needed to help Wisconsin growers move their products into regional metro markets. CIAS is investigating fair trade strategies to provide equitable compensation for farmers. The center is working closely with city, county and regional partners to increase food processing and related food systems economic development in southern Wisconsin. CIAS

is also researching more sustainable truck fleets using alternative fuels, hybrid electric engines and day cabs.

"We can gain efficiencies across the food system, at the farm level and in the way we move food to markets," says Miller. "Ultimately we want to make it easier for consumers to support Wisconsin farmers."

—CRIS CARUSI



PHOTO COURTESY OF TARA ROBERTS-TURNER

farmers markets and community-supported agriculture," says Michelle Miller BS'83, associate director of programs for CIAS. "While these direct markets are the gold standard for connecting us with the people who grow our food, they don't address the need to get more high-quality regional products into grocery stores, restaurants and schools."

More Sustainable Feedstock for Ethanol

Perennial crop yields can compete with corn stover, study suggests

PHOTO BY MATTHEW WISNIEWSKI/UW-MADISON WEI

A six-year Great Lakes Bioenergy Research Center (GLBRC) study on the viability of different bioenergy feedstocks recently demonstrated that perennial cropping systems such as switchgrass, giant miscanthus, poplar, native grasses and prairie can yield as much biomass as corn stover.

The study is significant for addressing one of the biofuel industry's biggest questions: Can environmentally beneficial crops produce enough biomass to make their conversion to ethanol efficient and economical?

Since 2008, research scientists Gregg Sanford and Gary Oates, based in the lab of CALS agronomy professor Randy Jackson, have worked with colleagues at Michigan State University (MSU) to cultivate more than 80 acres of crops with the potential to become feedstocks for so-called "second-generation" biofuels, that is, biofuels derived from non-food crops or the non-food portion of plants. They've grown these crops at the CALS-based Arlington Agricultural Research Station and at MSU's Kellogg Biological Station.

"We understand annual systems really well, but little research has been done on the yield of perennial cropping systems as they get established and begin to produce, or after farmland has been converted to a perennial system," says Oates.

To find out basic information about how well certain crops produce biomass, Sanford and Oates tested the crops across two criteria: diversity of species, and whether a crop grows perennially (continuously, year after year) or annually (needing to be replanted each year).

Highly productive corn stover has thus far been the main feedstock for second-generation biofuels. And yet perennial cropping systems, which are better equipped to build soil quality, reduce runoff, and minimize greenhouse gas release into the atmosphere, confer more environmental benefits.



Corn, when grain is included, proved to be most productive over the first six-year period of the study at the Wisconsin site, but giant miscanthus, switchgrass, poplar and native grasses were not far behind. At the MSU site, where soil is less fertile, miscanthus actually produced the same amount of biomass as corn (grain included) in the experiment, with poplar and switchgrass within range.

"All of this means that, at large scales and on various soils, these crops are competitive with corn, the current dominant feedstock for ethanol," Sanford says.

Now in the midst of the study's eighth year, Sanford says the study will continue for the foreseeable future.

"We know that perennial systems can prevent negative impacts such as soil erosion and nitrate leaching, and that they also provide habitat for native species that provide beneficial ecosystem services," Sanford says. "But there are still a lot of questions we want to answer about soil processes and properties—questions that take many years to answer."

Researcher Gregg Sanford stands before a plot of giant miscanthus at Arlington.

—MARK E. GRIFFIN

Safer Nanotech

A CALS researcher is investigating the biological impacts of nanomaterials



PHOTO BY SEVIE KENTON BS'80 MS'06

Soil science professor Joel Pedersen studies the biological impacts of nanomaterials, including how these materials interact with cell membranes.

Although so tiny they are invisible, it's easy to see that nanomaterials are becoming a big thing. There are odor-fighting socks and antibacterial dishrags impregnated with silver nanoparticles. Nano-sized titanium dioxide can be found in a long list of food and consumer products, including salad dressing, cake frosting, toothpaste and sunscreen. The vibrantly colored screen of the Kindle Fire can be attributed to quantum dots, a.k.a. nano-scale crystals of semiconductors such as cadmium selenide. And the list goes on.

Nanomaterials are tiny by definition, measuring between 1 and 100 nanometers along one or more dimension. (By comparison, a human hair is approximately 100,000 nanometers in width.) At this scale, they possess unique physical and chemical properties that make them useful for a wide array of applications, including consumer products, environmental remediation and medicine. Yet there are many unanswered questions about their safety.

"We don't know a lot about the toxicity of nanomaterials, and we have much to learn about the potential risks associated with the release of these materials into the environment," says Joel Pedersen,

Rothermel Bascom Professor of Soil Science at CALS.

Pedersen is part of a collaborative, multidisciplinary research team exploring these unknowns as part of the UW-Madison-based Center for Sustainable Nanotechnology, which was founded in 2012 with support from the National Science Foundation. Center scientists are working to understand how nanomaterials interact with living systems and the environment, with the practical goal of developing the insights needed to start creating nanomaterials that are designed to be more environmentally benign. This includes re-engineering them to make them safer, if needed.

With expertise in chemistry, biology and engineering, Pedersen is in charge of the Center's efforts to develop laboratory models to assess the biological impacts of nanomaterials. While he has done some experiments in zebrafish, Pedersen's work

for the Center focuses on innovative, non-biological approaches, including creating "artificial cell surfaces" in the lab.

"Our intent is to get down to the molecular level," Pedersen explains. "What are the rules that govern how these materials interact with biological systems? In particular, how do these particles interact with cell membranes?"

One way Pedersen's group makes artificial cell surfaces is by depositing lipid vesicles on a special quartz crystal sensor until the vesicles spontaneously rupture and then fuse to form a lipid bilayer—the basic structure of a cell membrane—on the sensor's surface.

When electricity is applied to the sensor, it causes the system to vibrate at a particular frequency. Next, Pedersen's team applies nanomaterials to the artificial cell surface. The sensor can detect subtle changes in the frequency of the vibration, yielding clues about the interaction between the material and the membrane.

By combining the results of this approach with others, Pedersen is finding that some nanoparticles, by virtue of their unique physical and chemical



Some tools of the trade: The blue box is a quartz crystal microbalance with dissipation monitoring—QCM-D for short—with a close-up (in tweezers) of a QCM-D sensor. This extremely sensitive instrument allows scientists to measure on the order of 1 nanogram per square centimeter—about the equivalent, Pedersen says, of measuring 13–14 ants on a football field.

This cell membrane-disrupting behavior is a concern for the health of humans and animals. And while Pedersen's team hasn't observed this behavior in models of bacterial cell surfaces, there are other, broader concerns about the impacts of nanomaterials on microbial communities in the environment.

"Eukaryotes are our main focus, but there is some concern that nanomaterials in the environment can alter microbial community compositions. At present, we don't know to what extent such changes could be problematic," says Pedersen.

The information gained from Pedersen's research will help inform the work of other scientists in the Center for Sustainable Nanotechnology who focus on tweaking nanoparticles to make them safer.

"Ultimately, the goal is to redesign nanomaterials to minimize their adverse effects, or find better ways to embed them in materials so they aren't released into the environment," Pedersen says.

—MAIA PUJARA

properties, seem to be able to extract lipids from the cell surface.

"Our results are consistent with the idea that these nanoparticles are grabbing lipids out of the membrane and acquiring a lipid coating when they come in contact with a cell," explains Pedersen.

Student-Created Quaffs

THIS SUMMER SEES THE LAUNCH of a new beer and wine designed and produced with the help of students enrolled in two CALS-based programs.

The wine, Red Fusion, was produced through the Campus Craft Winery, a collaboration between the Fermentation Sciences Program and Wollersheim Winery. Students enrolled in FS375, a course taught by food science professor Jim Steele and enologist Nick Smith, were responsible for not just producing the wine, but also naming the product and developing the label. The project yielded 230 cases of wine this year, and Steele hopes to up that number to over 1,000 cases next year. Proceeds will help support the food science department's wine-related outreach, instruction and research efforts.

The beer, S'Wheat Caroline, was produced through the Campus Craft Brewery, a collaboration between the Fermentation Sciences Program and the Wisconsin Brewing Company. Developed by students Daniel Deveney (mechanical engineering), Jenna Fantle BS'16 (food science) and Eric Kretsch (microbiology), the American wheat ale was declared the winning brew among a field of student-crafted competitors by a panel of expert judges. This is the second beer released through this collaboration. Inaugural Red, released in May 2015, has been very successful in the marketplace.

Both beverages are available at Union South and Memorial Union. Additionally, the beers are available on tap and in retail stores statewide. Due to the relatively low volume of product available, beyond campus Red Fusion is available for purchase only at Wollersheim Winery.



Dairy Dash Embodies the Spirit of Alpha Gamma Rho

A fun run with a serious mission has become a signature event for an agricultural fraternity marking 100 years of service

The Dairy Dash, held in honor of the late John Klossner (inset), embodies Alpha Gamma Rho's spirit of community service.

This is one race where cows are welcome—or, rather, people dressed in cow suits.

In just three years, the Dairy Dash has become a campus institution that imbues health and fun times with a serious purpose. The event is held in honor of John Klossner, a CALS sophomore who died of a head trauma following an accident at the 2013 Wisconsin State Fair. All proceeds from the 5K run are donated to the Brain Injury Association.

“John was a gregarious soul who always enjoyed a good laugh. He made friends easily. People naturally gravitated toward him,” recalls his older sister, Kristin Klossner.

the past three years, some 300 people have turned up to raise money for the Brain Injury Association and honor Klossner's spirited and giving life. The bovine attire donned by some runners celebrates Klossner's passion for cows.

Alpha Gamma Rho has been a fixture on campus since April 29, 1916, and to date has had some 1,650 young men as members. The fraternity has been home to some of the top agriculture students on campus—students who continually step up to volunteer and advance agriculture.

One example is the Competitive Edge, an event founded more than 40 years ago to help incoming

students and their parents become acquainted with campus and learn about the opportunities available at CALS. The Competitive Edge and other Alpha Gamma Rho scholarship events award some \$20,000 in scholarships each year. That number should grow as the fraternity embarks on a \$1 million fundraising campaign to expand its educational endowment.

To celebrate the fraternity's rich history and bright future, more than 375 members and their guests—traveling from 24 states and Canada—gathered at the Madison Concourse Hotel in Madison this past April to renew their collective vision for the future.

Meanwhile, current members of Alpha Gamma Rho have added a deep and mean-

ingful chapter in their history with the establishment of the Dairy Dash.

“After losing John, I learned how close of a family the agriculture industry is,” says Kristin Klossner. “I think he is with us every time we are at the Dairy Dash. We love what the AGR brothers have done and continue to do. The Dairy Dash helps to bring people together.”

—SEAN J. HAMNER AND COREY A. GEIGER

Klossner was making his mark at UW–Madison, in particular through his service as a member of Alpha Gamma Rho, the largest social-professional agricultural fraternity on campus. Now marking 100 years at UW–Madison, Alpha Gamma Rho promotes academics along with providing leadership and networking opportunities and fostering fellowship among its members.

Nothing embodies Alpha Gamma Rho's mission more than the Dairy Dash, which members conceived of and run in Klossner's honor. Each May over



The Futures Market—and Students' Futures

Undergrad experience with commodity trading translates into jobs

Using real-world commodity-trading software and armed with simulated trading experience in agricultural markets, a number of CALS students are finding paths to jobs after graduation.

“We prepare students by providing the knowledge of the trading software used by professionals and an understanding of how these sometimes-volatile markets work in real time,” says Sheldon Du, a professor of agricultural and applied economics.

Du says that the market for agricultural business management majors is promising—and students' experience with professional software platforms and hands-on simulated commodity trading makes them more attractive job candidates.

Du has taught his spring undergraduate class, Commodity Markets, since 2012. His students learn about economic concepts related to commodity futures and options contracts, pricing mechanisms, and principles and techniques for using derivatives to hedge price risk. They also learn about commodity trading, wherein futures contracts of commodities—such as grains, dairy products and energy—are bought and sold through organized exchanges to generate returns or to manage price risks.

Last year, Du—with the enthusiastic backing of his department—received a grant from UW–Madison's Educational Innovation initiative to expand the class experience to include an optional 10 weeks of training during the following fall on technical analysis using X_TRADER® software, a professional trading platform that was donated to CALS in 2014 by Trading Technologies International, Inc. The school has since migrated to Trading Technologies' new TT® platform, which became commercially available in 2015.

Students can also go on to compete in the CME Group Trading Challenge, a simulated trading competition that pits hundreds of college teams from around the world against one another as they make real-time commodity trading decisions. Du's students participated in the event in 2015 and then again this year.

Competing in the challenge requires students to use electronic trading software to execute trades on the CME Globex trading platform, offering students

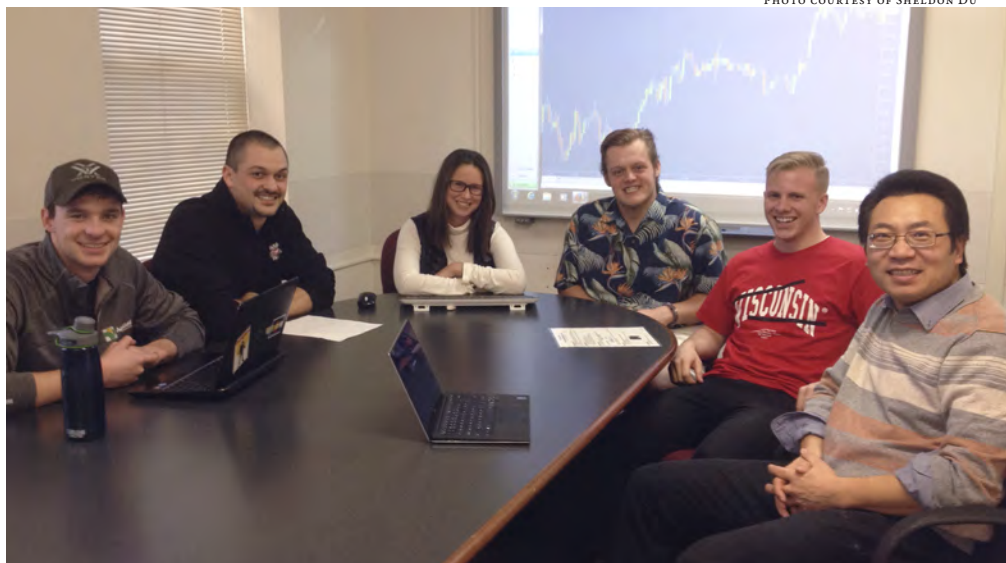


PHOTO COURTESY OF SHELDON DU

added experience with real-world tools and techniques. This spring, seven UW–Madison students on two teams took part in the competition.

Andrew Berger BS'15, who was on one of two trading teams last year, went on to become a risk analyst for Henning and Carey Technologies in Chicago after graduating.

“The fundamental knowledge that I gained about futures and options contracts, hedging techniques and financial market analysis prepared me well for the interview,” says Berger, who returned to campus this spring to speak to Du's students.

Brad Jaeger BS'16, a fresh grad who landed a job as a grain merchandiser at Wisconsin's Country Visions Cooperative, says his two years of competing in the challenge, plus the academic grounding he received, were instrumental in launching his career.

“We learned fundamental analysis, and although we never advanced in the trading competition, we received a lot of great live trading experience,” says Jaeger, who led a team this year.

Exposing students to the theory of commodity markets, along with practical trading situations and tools, helps them get a taste for the profession and the experience to impress prospective employers, says Du.

“I am always looking for ways to increase the trading component, which is important for students' understanding of the markets,” Du says. “It's also important for their professional futures.”

—DENNIS CHAPMAN

Students in the 2016 CME Group Trading Challenge included (left to right) Jackson Remer, Brad Jaeger, Carly Edge, Cory Epprecht and Sam Seid, with agricultural and applied economics professor Sheldon Du (far right).

classAct

Kate Griswold

Training to Make a Difference



PHOTO COURTESY OF KATE GRISWOLD

People have around 40 productive years during adulthood to make a positive impact on the world, according to Howard G. Buffett in his book, *40 Chances: Finding Hope in a Hungry World*.

It's a concept that Kate Griswold BS'16, who graduated in May with a degree in life sciences communication, is keenly aware of.

Griswold was among 40 college students nationwide selected in 2012 to participate in the nonprofit Agriculture Future of America's 40 Chances Fellows program. The goal of the four-year program, funded by the Howard G. Buffett Foundation's 40 Chances awareness

campaign, is to prepare young people to

address global agriculture- and food-related challenges.

"I'm passionate about international food security and transparency in the American agricultural system," says Griswold. "Thanks to my experiences, I feel excited and ready to go out into the workforce and help contribute to the conversations—and solutions—related to these important topics."

Griswold and her cohort participated in leadership conferences, agricultural institutes, career mentoring sessions and professional development workshops. The program culminated in a two-and-a-half-week international experience—which, for Griswold and eight other students, meant going to Bolivia.

Guided by native Bolivians, the students visited processing plants and production facilities as well as farmers in various regions. Two of the country's main crops are soybeans and quinoa, a small, gluten-free grain that is highly nutritious and growing in popularity worldwide. But according to Griswold, "Bolivia, which is one of the biggest producers of quinoa, is still one of the poorest countries in South America."

A key lesson, Griswold says, is that education alone is not enough to change the standard of living and way of life in other cultures.

"The fact that there isn't an easy fix to get people out of poverty is something I've learned to appreciate a lot more," says Griswold. "I now have a much better understanding of the time it takes to implement change and the trust that needs to be built with the local people in order to do so."

As a fresh graduate, Griswold is using the first of her 40 chances by joining John Deere as a marketing representative.

—MATT OLSON

HONORED by **President Barack Obama** with the U.S. government's highest recognition for early-career scientists, biochemist **David Pagliarini**, director of metabolism at UW's Morgridge Institute for Research. The Presidential Early Career Award for Scientists and Engineers was awarded to Pagliarini for his work focusing on the composition and function of mitochondria.

AWARDED Rockefeller University's Lewis Thomas Prize for Writing about Science, evolutionary biologist **Sean Carroll**, in recognition of a body of work that includes several critically acclaimed books. The honor is bestowed upon "the rare individual who bridges the worlds of science and the humanities."

RECOGNIZED with a 2016 Entrepreneurial Achievement Award, distinguished alumnus **Christopher Salm BS'76** (Meat and Animal Sciences) for his outstanding accomplishments in entrepreneurial pursuits. Salm co-founded Salm Partners LLC, a meat production company that serves as an industry leader in developing and implementing new technology systems for meat processing.

NAMED the recipient of the nation's first endowed chair focusing on plant breeding for organic crops, agronomist **William Tracy**. The chair is supported by a \$1 million endowment from Organic Valley and Clif Bar & Company and a matching \$1 million gift from UW alumni **John and Tashia Morgridge**.

APPOINTED director of CALS International Programs, **Sundaram Gunasekaran**, a professor of biological systems engineering. Gunasekaran is charged with building upon and strengthening CALS' already robust presence and research activities around the world.

HONORED with a UW Distinguished Teaching Award, geneticist **Ahna Skop**. Skop received the Chancellor's Inclusive Excellence Award for her leadership, over the course of more than a decade, in advocating for student diversity and inclusiveness at UW–Madison.

Number Crunching 5.11 MILLION LAYING HENS



were tallied in Wisconsin in 2014, according to the 2015 Wisconsin Agricultural Statistics report. They laid an average of 284 eggs each, for a total of 1.45 billion eggs produced. The report is produced by the USDA and the Wisconsin Department of Agriculture, Trade and Consumer Protection. For more fun ag facts, view the report at: <http://go.wisc.edu/agstats2015>.

Five things everyone should know about . . .

Pulses

By Irwin Goldman

1 | You've eaten them without knowing it. If the word “pulse” as a food leaves you flummoxed, fear not. The word pulse comes from the Latin word “puls,” which means thick soup or potage. No doubt you've enjoyed dried beans, lentils and peas in a soup or stew. Pulses are the edible dried seeds of certain plants in the legume family. Soybeans, peanuts, fresh peas and fresh beans are legumes but not considered pulse crops. Some lesser-known pulses like adzuki bean and cowpea play critical roles in diets around the world. Many pulses are economically accessible and important contributors to food security.

2 | They're very nutritious. Pulses contain between 20 and 25 percent protein by weight—twice the amount you'll find in quinoa and wheat—and next to no fat. Around the world, they are a key source of protein for people who don't eat meat or who don't have regular access to meat. Pulses need less water than other crops, which adds to their appeal and value in areas where water is scarce.

3 | Pulse crops have other environmental benefits as well. As members of the legume family, pulses are capable of taking nitrogen from the air and putting it back in the soil in a form available to plants. This makes legumes a critical part of any crop rotation and contributes significantly to sustainable farming. Pulses are grown worldwide but are particularly well adapted to cool climates such as Canada and northern states in the U.S.



4 | We're learning a lot about pulses from a recently sequenced genome. Adzuki bean was domesticated 12,000 years ago in China and is one of the most important pulses grown in Asia. There it is known as the “weight loss bean” because of its low calorie and fat content and high levels of protein. A recent genome sequencing collaboration among scientists in India and China revealed that genes for fat were expressed in much higher levels in soybean than in adzuki bean, while genes for starch were expressed at greater levels in adzuki bean. Their findings suggest that humans selected for diversified legumes in their diet—some that would provide oil and others that would provide starch.

5 | It's their year! The 68th UN General Assembly declared 2016 the International Year of Pulses, so now is the time to eat and learn. Events taking place all around the world focus on everything from cooking pulses (sample recipes: fava bean puree, carrot and yellow split pea soup) to growing them and incorporating them into school lunches. Learn more at www.fao.org/pulses-2016/en/.

Irwin Goldman is a professor and chair of the Department of Horticulture.

CRISPR: The Promise and the Peril

Dietram Scheufele serves on a national committee examining the risks and benefits of human genome editing technology.

Interview by Joan Fischer

DIETRAM SCHEUFELE, a CALS professor of life sciences communication, serves on a national panel examining the implications of human genome editing.

The committee, appointed late last year by the National Academies of Sciences, Engineering and Medicine, is examining the clinical, ethical, legal and social implications of the emerging technology. Genome editing holds great medical promise but also poses risks of off-target genetic alterations and raises fears it could irrevocably alter the human germline.

Led by UW–Madison law professor Alta Charo and MIT biologist Richard Hynes, the committee will specifically advise on questions about how risks should be quantified and whether some aspects of the technology should or should not go forward.

The ability to “edit” genes to target genetic defects became a much more plausible process with the advent of a technology called CRISPR (an acronym for Clustered Regularly Interspaced Short Palindromic Repeats), which can be used to precisely target and cut portions of a DNA sequence.

Controversy arose last year when a Chinese scientific team used CRISPR genome editing on non-viable human embryos. The experiment produced a number of “off-target events” that altered unintended parts of the genome.

Scheufele has published extensively in the areas of public opinion, political communication and public attitudes toward emerging technologies, including nanotechnology, synthetic biology, stem cell research, nuclear energy, and genetically modified organisms. Web of Science lists Scheufele’s publications among the 1 percent most-cited articles in the fields of general social science and plant and animal science. Scheufele also serves on two other committees for the National Academies of Sciences, Engineering and Medicine: a committee on “The Science of Science Communication: A Research Agenda,” and the Division on Earth and Life Studies (DELS) Advisory Committee.

What’s the focus of your panel?

The committee that I serve on deals with human gene editing research and its potential applications. That includes potential future uses that could alter the human germline, which means that edited genes would be passed on to subsequent generations as part of the human gene pool.

But of course there are a lot of applications of gene editing techniques in agriculture and the life sciences, with the attempts to use genetically modified male mosquitoes to combat the spread of the Zika virus being just one recent example.

What are the potential dangers?

Identifying potential problems or concerns is part of the committee’s charge, and our report will work very carefully through both the scientific complexities of the technology as well as ethical, regulatory or political challenges that might emerge. Many of these challenges are focused on specific applications, such as germline editing. Once germline alterations are introduced into the human population, some have argued, they might be difficult to reverse and to contain within a single community or even country.

In many ways, the benefits are much more clear-cut, especially when it comes to helping parents whose genome puts their biological children at risk of inheriting certain diseases. Many patient advocacy groups are especially excited about the potential for medical breakthroughs in this arena.

What is the charge of your study committee? Are there specific deliverables, and what is the timeline?

The National Academies gave the committee a fairly detailed Statement of Task that can be found on our committee’s web page [link provided below]. In short, we will examine the state of the science of human gene editing as well as the ethical, legal and social implications of its applications in biomedical research and medicine.

Our work actually follows a pretty tight timeline that includes a number of additional meetings and information-gathering sessions. Most of the committee deliberations are open to the public and webcast by the National Academies. Once complete, the draft report will be vetted in a very stringent review procedure. There also have been and will continue to be numerous opportunities for formal public input, including on the draft report. If everything goes according to plan, the report will be released in fall 2016.



Dietram Scheufele

PHOTO BY SEVIE KENTON BS '80 MS '06

also led to regular engagements with policy communities in Wisconsin and in Washington, DC. When I co-chaired the National Academies' Roundtable on Public Interfaces of the Life Sciences, for instance, I worked with bench scientists, social scientists and practitioners to build a better dialogue about emerging technologies between scientists and the public.

What role will you play on it as a communication scientist? What expertise do you bring to the table?

Human gene editing shares a number of characteristics with other recent scientific breakthroughs. One of them is an extremely fast bench-to-bedside transition. In other words, the time it takes to translate basic research into clinical or even market applications is shorter than it has been in the past. New gene editing technologies such as CRISPR provide us with faster, cheaper and more accurate tools for gene editing. But that also means that we as a society must have many of the ethical, legal and social debates surrounding gene editing at the same time that we are developing potential applications.

That is why more and more scientists are calling for what Alan Leshner, former CEO of the American Association for the Advancement of Science, has described as an “honest, bidirectional dialogue” between the scientific community and the public. Interestingly, the 21st Century Nanotechnology Research and Development Act of 2003 legislatively mandated public engagement through “regular and ongoing public discussions.” So the idea is not new, and researchers in the Department of Life Science Communication (LSC) at CALS were in fact involved in two long-term NSF center grants examining the societal impacts of nanotechnology and ways of building a better public dialogue. As a result, much of the research teaching we are doing here in the department focuses on how to best facilitate communication about emerging science among all relevant stakeholders in society.

What experiences from past science communication efforts inform your thinking about how best to communicate about gene editing?


Much of our work in LSC over the last few years has examined emerging areas of science that are surrounded by public opinion dynamics similar to what we might see for gene editing. This research has included work on public opinion on embryonic stem cell research, and also research on how non-expert audiences make sense of the risks and benefits of genetically modified organisms. Our research program has

What aspects of gene editing seem to confuse or frighten people the most?

We just collected two representative national surveys, tapping people's views on synthetic biology, gene editing and other scientific breakthroughs. And our findings show that concerns about overstepping moral boundaries with potential applications of gene editing in humans and “blurring lines between God and man,” as the question was phrased, are definitely on people's minds when thinking about this new technology. In LSC, we will continue to track public attitudes, especially surrounding the societal, ethical and regulatory questions that arise from applications of gene editing.

Obviously people are already reporting, writing, thinking and talking about CRISPR. Do you have any immediate recommendations for how to communicate about this subject?

It will be particularly important to keep two things in mind. First, this is an exciting area for science, but many of the questions and debates surrounding human gene editing will focus on ethical, moral or political rather than scientific questions. And we as scientists should be prepared to engage in those discussions, making sure that they are based on the best available science.

Second, having an honest dialogue among different stakeholders will require a conversation that is—at least in part—about values. And scientists will have to resist the intuitive urge to try and convince others by offering more scientific facts. Our own research and that of many colleagues has shown that the same scientific information will be interpreted very differently by audiences with different value systems. The same science, in other words, means different things to different people. And public reactions to many potential applications of gene editing will be no exception. 

Learn more about the panel at <http://nationalacademies.org/gene-editing/consensus-study/about>



Breeding

CALS scientists are breeding new varieties of produce that not only are delicious, but also will thrive in organic growing systems. And in a new collaboration called “Seed to Kitchen,” they’re partnering with chefs and farmers to help determine what works best.

BY ERIK NESS

for Flavor

ON A STICKY WEEKDAY MORNING in August, a new restaurant called Estrellón (“big star” in Spanish) is humming with advanced prep and wine deliveries. All wood and tile and Mediterranean white behind a glass exterior, the Spanish-style eatery is the fourth venture of Madison culinary star Tory Miller. Opening is just three days away, and everything is crisp and shiny and poised.

But in the dining room, the culinary focus is already years beyond this marquee event. This morning is largely about creating the perfect tomato. Graduate students from UW–Madison working on a new program called the Seed to Kitchen Collaborative have set the table with large sheets of white paper and pens. At each place setting are a dozen small plastic cups of tomatoes, diced as if for a taco bar. Each container is coded.

Chef Miller takes a seat with colleagues Jonny Hunter of the Underground Food Collective and Dan Bonanno of A Pig in a Fur Coat. The chefs are here to lend their high-end taste buds to science, and they start to banter about tomato flavor. What are the key elements? How important are they relative to each other?

Despite their intense culinary dedication, these men rarely just sit down and eat tomatoes with a critical frame of mind. “I learned a lot about taste through this project,” says Hunter. “I really started thinking about how I defined flavor in my own head and how I experience it.”

This particular tasting was held last summer. And there have been many others like it over the past few years with Miller, Hunter, Bonanno and Eric Benedict BS’04, of Café Hollander.

The sessions are organized by Julie Dawson, a CALS/UW–Extension professor of horticulture who heads the Seed to Kitchen Collaborative (formerly called the Chef–Farmer–Plant Breeder Collaborative). Her plant breeding team from CALS will note the flavors and characteristics most valuable to the chefs. Triangulating this with feedback from select farmers, plant breeders will get one step closer to the perfect tomato. But not just any tomato: One bred for Upper Midwest organic growing conditions, with flavor vetted by some of our most discerning palates.

“We wanted to finally find a good red, round slicer, and tomatoes that look and taste like heirlooms but aren’t as finicky to grow,” says Dawson at the August tasting, referring to the tomato of her dreams. “We’re still not at the point where we have, for this environment, really exceptional flavor and optimal production characteristics.”

Nationwide, the tomato has played a symbolic role in a widespread reevaluation of our food system. The pale, hard supermarket tomatoes of January have been exhibit A in discussions about low-wage labor and food miles. Seasonally grown heirloom tomatoes have helped us understand how good food can be with a little attention to detail.

But that’s just the tip of the market basket, because Dawson’s project seeks to strengthen a middle ground—an Upper Midwest ground, actually—in the food system. With chefs, farmers and breeders working together, your organic vegetables should get tastier, hardier, more abundant and more local where these collaborations exist.

Julie Dawson DECIDED SHE WANTED TO BE

a farmer at age 8. By her senior year in high school she was hooked on plant breeding and working in the Cornell University lab of Molly Jahn—now a professor of agronomy at CALS—on a project developing heat tolerance in beans. Dawson stayed at Cornell for college and continued to work for Jahn and Margaret Smith, a corn breeder who was working with the Iroquois to resurrect traditional breeds. By the time she finished college, Dawson had a strong background in both plant breeding and participatory research. During her graduate education at Washington State University she began breeding wheat for organic systems. As a postdoc in France, she started working on participatory breeding with bakers and farmers, focusing on organic and artisanal grains.

In September of 2013, barely unpacked in Madison, Dawson found herself traveling with CALS horticulture professor and department chair Irwin Goldman PhD'91 to a conference at the Stone Barns Center for Food & Agriculture north of New York City.

Organized by food impresario Dan Barber, author of *The Third Plate: Field Notes on the Future of Food*, the conference gathered chefs and breeders from across the country to talk about flavor. Barber knew what could happen when chefs and breeders talked because he was already working with Dawson's graduate advisor at Washington State, wheat breeder Stephen S. Jones.

In the 1950s, as grocery stores replaced corner markets and California's Central Valley replaced truck gardens, the vegetable market began to value

sizes and shapes that were more easily processed and packed. That a tomato could be picked early in Florida and ripen during the boxcar ride to Illinois was more important than how it tasted. Pesticides and fertilizers also became more common, buffering differences between farms and providing a more uniform environment. Packing houses and national wholesalers dominated the market, and vegetable breeding followed.

Breeders have at their disposal a huge variety of natural traits—things like color, sugar content and hardness. Over the course of decades they can enhance or inhibit these traits. But the more traits they try to control, the more complex the breeding. And flavor has been neglected over the last few decades in favor of traits that benefit what has become our conventional food system. "Breeders were targeting a different kind of agricultural system," explains Dawson.

Barber wanted to reverse that trend, to connect farmers and plant breeders and chefs. It appealed to Dawson's sense of where food should be going. "Breeding for standard shapes and sizes and shipping ability doesn't mean that breeders aren't interested in flavor," she says. "It just means that the market doesn't make it a priority."

New to Madison, Dawson hadn't met Tory Miller, but they connected at the Stone Barns Center, and together

realized Madison was the perfect place to pursue this focus on flavor: A strong local food movement supporting a dynamic and growing number of farms, world-class chefs, and—through CALS' Plant Breeding and Plant Genetics Program—one of the highest concentrations of public plant breeders in the world.

They decided to get started in the summer of 2014 by growing a collective palette of many varieties of the most common vegetables. Dawson approached the breeders, Miller rallied the chefs, and both reached out to their network of farmers. "The main idea of the project is to get more informal collaboration between farmers and plant breeders and chefs—to get the conversation started," says Dawson. "We can really focus on flavor."

When the chefs ARE DONE TASTING

TOMATOES, they wander over to a table of corn and cucumber. They are magnetized by the different kinds of corn: an Iroquois variety, another type that is curiously blue, and large kernels of a corn called choclo, which is very popular in the Andes.

These are just a few jewels from the collection amassed over four decades by CALS corn breeder Bill Tracy, who works in both conventional and organic sweet corn. Tracy leads the world's



PHOTO BY GERHARD FISCHER

Fine palates choose the best: Horticulture professor Julie Dawson, standing, getting data about the taste and texture of various breeds of tomatoes from (left to right) celebrated chefs Jonny Hunter, Tory Miller and Dan Bonanno. They conducted the tasting at Miller's new restaurant, Estrellón.

Eating their veggies: Members of the public, including these children, were invited to learn about and offer feedback on various breeds of vegetables at an Organic Vegetable Field Day at the West Madison Agricultural Research Station last summer.

largest research program focused on the breeding and genetics of organic sweet corn, with five organically focused cultivars currently on the market. He was recently named the nation's first endowed chair for organic plant breeding, with a \$1 million endowment from Organic Valley and Clif Bar & Company and a matching \$1 million gift from UW alumni John and Tashia Morgridge.

The support gives Tracy more room to get creative, and Dawson is helping to develop potential new markets for his breeds. Despite his focus on sweet corn, Tracy has always suspected there might be interest in corn with more flavor and less sugar. "We know from sweet corn that there are all sorts of flavors and tendencies," Tracy says. From soups to the traditional meat and potato meal, he thinks savory corn deserves a place.

And building from deep Mexican and South American traditions of elotes and choclo corns, Tracy sees vast potential for new varieties. "Corn is one of the most variable species," he says. "For every trait that we work with in corn there is an incredible range of variation."

The chefs went crazy last year when Tracy introduced them to some of the Andean varieties. "Amazing," says Bonanno of A Pig in a Fur Coat. "I want to make a dish like a risotto or a pasta dish or some type of salad. I don't want the sweet on sweet on sweet. I just want the corn flavor. I want savory."

Tracy's modest sampler inspired chefs Hunter and Miller as well, and they started brainstorming potential growers for 2016. If the experiment takes off, the corn could start infiltrating Wisconsin restaurants this summer.

With so much genetic potential, the chefs help focus the breeding process. "Breeding is a craft," Tracy says. "The great chefs—and we have some great ones in Madison—are truly artists. They are fine artists at the same level as a fine arts painter or musician. The creativity

is just mind-boggling."

And there is little question that they understand flavor. "They are able to articulate things that we can't. We might be able to taste the differences, but we can't say why they are different or why one is better than the other. The chefs are able to do that," says Dawson. "And that's useful for the whole food system."

A food system

HAS SO MANY PIECES—chefs, farmers, retailers, processors, consumers—but perhaps the most fundamental unit is the seed. After decades of consolidation in the seed industry and a significant decline in public breeding programs at land grant universities, many sectors of the food movement are turning their attention to seed.

One fortunate consequence of the industry concentration has been to create a market opening for smaller regional and organic seed companies. They, along with a few public breeders, still serve gardeners and market farmers. One goal of the Seed to Kitchen Collaborative is to systematically support breeding for traits that are important for local food systems.

These small companies develop their own breeds, but also adopt interesting varieties from public breeding programs. They have the capacity to target regional seed needs, and are usually okay with seed saving. "It's almost like working with nonprofits because they are really interested in working with the community," says Dawson.

After Adrienne Shelton MS'12 completed her PhD in 2014—she studied sweet corn breeding under Bill Tracy—she moved to Vitalis Organic Seeds, where she works with growers to find cultivars best suited for the Northeast. As a graduate student in CALS' Plant



PHOTO BY JOAN FISCHER

Breeding and Plant Genetics program, Shelton was a leader in establishing the Student Organic Seed Symposium, an annual national gathering to offer information and support to young researchers focusing on breeding organic varieties.

"Getting farmers' feedback is critical," says Shelton of the opportunity to work with the Seed to Kitchen Collaborative. "The more locations, the better, especially in organic systems where there is more variation."

The organic movement deserves a lot of credit for the trajectory of new food movements. "Organic growers often have a higher bar for the eating quality of produce because that's what their customers are demanding," Shelton says. "Putting a spotlight not just on the farmers but all the way back to the breeding is helping the eater to recognize that all these pieces have to be in place for you to get this delicious tomato that you're putting on your summer salad."

These kinds of seed companies will also help make local and regional food systems more resilient to climate change. "It's fairly easy to breed for gradual climate change if you are selecting in the target environment, because things change over time," says Dawson. "The most important thing is to have regional testing and regional selection."

Overall, a more vigorous relationship between breeders and farmers promises



PHOTO BY JOAN FISCHER

A team of students led by horticulture professor Julie Dawson (center, in cap) and agronomy professor Bill Tracy (second from left) prepare vegetables for the chefs' tasting. The students conduct a tasting of their own to determine which varieties go on to the chefs.

a larger potential for varieties going forward, Dawson notes. The ultimate goal is to make plant breeding more of a community effort. When chefs and farmers and consumers participate in the selection process, says Dawson, "The varieties that are developed are going to be more relevant for them."

Amy Wallner BS'10, A CALS GRADUATE IN HORTICULTURE AND SOIL SCIENCES, has worked behind both the knife and the tiller. While farming full-time, she spent six months working nights at a Milwaukee farm-to-table restaurant called c. 1880. Now she's the proprietor of Amy's Acre—actually, an acre and a half this year—on the margins of a commercial composting operation in Caledonia, Wisc., south of Milwaukee.

She sells to a co-op and a North Side farmers market, but her restaurant clients—c. 1880, Morel and Braise RSA (also part of the Seed to Kitchen Collaborative)—are integral to her business. Before she orders seed for the next growing season, she'll drop off her catalogs for the chefs to study, returning later for in-depth conversation. "Chefs who want to buy local foods want to have a greater understanding of the whole process," Wallner says. "I just like to sit down and talk about produce with somebody who uses it just as much as I do."

Knowing the ingredients they covet, and what kinds of flavors intrigue them, helps Wallner narrow her crop list. Joining the Seed to Kitchen Collaborative took it further. As a student Wallner had worked in the trial gardens at the West Madison Agricultural Research Station, and now she can truly appreciate the farm value of that research. "I wanted to stay connected to UW," she says.

This will be Wallner's third season as part of the group's trials. In her excitement, the first year she grew more than she could handle. Last year she trialed beets, carrots and tomatoes alongside radicchio and endives. "I took on a smaller number of crops because I wanted to be able to collect more extensive observations," she says.

Wallner hopes getting the breeders involved may lead to strengthening the hardiness of early- and late-season crops. "In the Upper Midwest, that's when you're doing the most gambling with your crops. If we can continue to find things that can push those limits out a little bit ..."

Eric Elderbrock, of Elderberry Hill Farm near Madison, has similar practical concerns: With the region's incredibly variable climate, he's always looking for something that isn't going to require the most perfect growing conditions and is also resistant to disease and insects: "For it to be a realistic thing for me to be able to grow, it has to meet these demands."

When he was growing up, Elderbrock didn't pay much attention to where his food came from. It wasn't until he spent a college semester in Madagascar that he began to realize the relationship between the food and the land around him. For him, the collaboration is a form of continuing education.

"It's helpful to me as a farmer to have a sense of what's possible as far as the breeding side," says Elderbrock. "I love seeing all of the different colors and flavors and textures. It helps keep farming interesting."

As picturesque as these relationships are, the business has to work. High-end cuisine doesn't reflect most daily eating, but these chefs are very committed to helping Wisconsin farmers stay in business and make a good living.

"The chefs always seem to be a couple of years ahead," Elderbrock notes. This year he is continuing to experiment with artichokes, a crop typically associated with dry Mediterranean climates like Spain and California. Chef Dan Bonanno is encouraging the research in part because of his Italian heritage and culinary training, which included a year in Italy. He would be thrilled to find Wisconsin variations on some traditional Italian ingredients like the artichoke.

And sourcing locally also leads to a robust cuisine. "Italy has 20 regions and each region has its own cuisine because they source locally," notes Bonanno.

This past February, A FEW WEEKS BEFORE GROWERS WOULD START their seedlings, the Seed to Kitchen Collaborative gathered to tweak plans for this year's trials.

At L'Etoile, Chef Tory Miller's flagship establishment in Madison, beautiful prints of vegetables adorn the wall. But the tables that day were rearranged in a horseshoe. The distinctive conference

Delicious results: Chefs involved in Seed to Kitchen (including Tory Miller, front left, and Jonny Hunter, back left) serve dishes using the vetted produce at a special event last fall.

seating suppresses the normally refined air. Only the curvature of the bar and its adjacent great wall of bourbon suggested a more sensual approach to food.

After introductions and a quick review of last year's progress, Dawson opens the floor to feedback. The ensuing conversation distills into savory glimpses of market baskets and menu flourishes to come.

They've been talking about running a trial for tomato "terroir"—drawing from the wine enthusiasts' notion that differences in soil can have subtle and profound impacts on flavor. Dawson is a little concerned about logistics, but Miller is persistent: "I think it would be a mistake to not include terroir."

They discuss what they can do for unsung vegetables like rutabaga and parsnip—produce particularly suited for the Wisconsin climate, but generally unloved. They learn about a new trial focusing on geosmin, which produces the earthy flavor of beets.

The chefs wonder aloud if it's possible to preserve the beautiful purple hues of some heirlooms. Dawson regrets to inform them that changing the physical chemistry involved—the pigments are water soluble, and flush easily from the plants—is a little beyond their powers.

They talk about what makes perfect pepper for kitchen processing. Is seedless possible? Dawson smiles wryly and reminds them of the intrinsic challenge of a seedless pepper.

The conversation gets very detailed over potatoes. Researcher Ruth Genger from the UW's Organic Potato Project has about 40 heirloom varieties of potato from the Seed Savers Exchange that will be grown out over the next few years. Chef Bonanno asks a technical question about starch content for gnocchi, and then Chef Miller goes off on French fries.

"I've been working on trying to break the consumers' McDonald's mentality on what a French fry should



PHOTO BY ANDERS GURDA

be," Miller says. The sheer volume is a perfect example of how hard it can be to assemble the pieces of a sustainable and local food system. "We're talking about thousands of pounds of French fries," he says, the other chefs nodding in agreement. "You want to have a local French fry, but at a certain point it's not sustainable or feasible. Or yummy." One recent hitch: a harvest of local spuds were afflicted by hollow heart disease.


Genger's heirloom potato trials have focused on specialty varieties—yellows, reds and blues—but Genger has an alternative: "We have some white potatoes that are pretty good producers organically, but what I tend to hear is that most people don't like white potatoes." The chefs don't seem worried about the difference. "There are some good, white varieties from back in the days when that was what a potato was," Genger continues, making a note. Knowing that the interest is there, she can make sure farmers and chefs have a chance to evaluate some white heirloom potatoes.

It's a short conversation, really, but shows the potential value of having everybody at the table. If the breeder

has the right plant, the farmers have a good growing experience and the chefs approve, perhaps in another couple of years there could be thousands of pounds of locally sourced organic white French-fried potatoes ferrying salt and mayonnaise and ketchup to the taste buds of Wisconsin diners.

"We try to make the project practical," says Dawson. "The food system is so complicated. It feels like this is something we can make a difference with. This can help some farmers now, and in 10 years hopefully it will be helping them even more."

Bill Tracy puts the program in an even bigger context.

"The decisions we make today create the future," Tracy says. "The choices we make about what crops to work in and what traits to work in literally will create the future of agriculture." 

Farmers, gardeners and chefs are welcome to join the Seed to Kitchen Collaborative. You can learn more about project events at <http://go.wisc.edu/seed2kitchen> or email Julie Dawson at dawson@hort.wisc.edu.



the Island of Giant Mice

Gough Island is home to the biggest mice on Earth. Genetics professor Bret Payseur and his team are coming closer to figuring out why.

Enormous rodents on a remote South Atlantic island may hold the key to solving a genetic mystery.

by
Adam
Hinterthuer

Two thousand miles east of the

coast of Argentina, Gough Island rises out of the Atlantic Ocean in an awesome display of ancient volcanic activity. A green carpet of windswept mosses and grasses covers 35 square miles of jagged peaks and steeply sloping valleys. Waterfalls spill out of craggy cliffs and fall hundreds of feet to the sea, which runs uninterrupted for another 1,700 miles before crashing into the tip of South Africa. It is one of the most remote places on our planet.

Four miles west of the University of Wisconsin–Madison campus, the Charmany Instructional Facility is a low-slung labyrinth of concrete hallways lined by bright fluorescent lights and permeated with a smell that is equal parts animal and antiseptic. Part of the UW School of Veterinary Medicine, Charmany is nearly half a world away from Gough Island (pronounced “Goff”). Yet the two locations share a common trait—they both are home to the largest mice on Earth.



In terms of body size and weight, Gough Island mice are twice the size of their mainland cousins, notes Bret Payseur, a geneticist with a joint appointment in CALS and the School of Medicine and Public Health. “The amazing thing about them being twice the size is that they’ve only been on the island a couple of hundred years,” he says. The island’s early rodent settlers were a more moderate-sized strain of *Mus musculus*, house mice stowaways in the holds of sealing ships from Western Europe. But somewhere along the line, Gough Island mice outgrew that ancestry—doubling in size over the course of only a few hundred generations. “That’s incredibly rapid evolutionary change,” Payseur says. “It’s some of the most rapid that I know about.”

Understanding extreme body size on islands could help illuminate the genetic mechanisms underlying human metabolic diseases, notes genetics professor Bret Payseur.

PHOTO BY WOLFGANG HOFFMANN BS'75 MS'79



In the canon of origin stories, however, this tale reads more like a mystery. How did the Gough Island mice get so big so quickly? It could be that a genetic mutation proved so advantageous that huge mice became the norm. Or maybe conditions on the island favored preexisting genetic traits that had lain dormant until the mice became castaways. For the time being, however, the Gough mouse story is transcribed only in A's, T's, C's and G's—the nucleic acids that write genetic code. Payseur hopes to translate that text. What he finds could not only shed light on evolution in action. It could also help illuminate the genetic mechanisms underlying human metabolic diseases like obesity and diabetes.

The Island Rule

While Gough Island mice are unusually large, it isn't unusual for small animals on islands to grow bigger than their mainland counterparts. The phenomenon is often referred to as the "island rule," which states that, in general, small animals tend to get bigger and large

animals tend to get smaller once they've been island castaways for some period of time. There are, of course, exceptions. But from giant Komodo dragons to extinct pygmy mammoths, examples of the island rule run throughout the animal kingdom.

The gigantism effect of this rule seems to be especially pronounced in rodents. Human history is full of daring adventure on the high seas involving fearless mariners and the obligatory stowaways—mice and rats. As a result, the world's islands are full of transplanted rodents. Biologist J. Bristol Foster first posited the island rule in a 1964 paper in the journal *Nature*, titled "The Evolution of Mammals on Islands." In his study, Foster looked at 69 populations of island mice off the coasts of Western Europe and North America. The mice in 60 of those populations were measurably larger than their mainland cousins. Since that study, time and again, scientists find mice and rats on islands that are markedly bigger than genetically similar mainland populations.

This is notable because, in evolution,

random genetic mutations or suddenly shifting environmental conditions can lead a species down a certain path. Which means that chance plays a big role in charting a species' history. "If you 'run the tape' once and go back and run it again," Payseur says, "you would expect different outcomes because of that role of chance." When patterns like the island rule appear in evolution, he says, "People get very excited. It suggests that what underlies the patterns is a common mechanism that would tell us something important about how evolution works."

Payseur's scientific background is anchored in evolutionary biology, and the natural history of species on islands has fascinated him throughout his career. After early work with primates in Madagascar, Payseur realized that, while there is a lot one can do in primate research, keeping captive colonies of lemurs in a lab and breeding the thousands of crosses needed to actually get at answers wasn't one of them. So he turned his attention to mice.

"The great thing about house mice—and I know most people don't think house mice are great—is that the strains or lines of mice that people study in the lab are descended from wild house mice, including the wild mice that often inhabit islands," Payseur says. "So they're kind of cousins evolutionarily and share a lot of the same traits. That means we can use the genetic tools developed for the lab strains of mice to understand what's happening in wild mice."

He's looking to these small creatures to answer some very big questions. "In the very long term, what I would like to answer with this research is, 'What types of genetic changes are responsible for the extreme body size on islands?'" Payseur says. "Are they the same on different islands? Do we see the same genes popping up over and over again, or do organisms take different paths to get big?"



PHOTO © ANDREA ANGEL/ROSS WANLESS

Knowing that he would have the time, money and resources to deal with only a single strain of island mouse at a time, Payseur decided to start with the most extreme example of the island rule that he could find. He turned to colleagues who studied house mice in the field—and every one of them pointed him to Gough Island.

An Incredible Journey

Most researchers simply order mice via catalog, usually from what Payseur calls “the world center for mouse genetics,” the Jackson Laboratory in Maine. A copy of their glossy catalog lets researchers pick trait-specific lines of mice, from body size and coat color to preassigned conditions like immunodeficiency. Then, simply place an order and wait a few days for the mail to arrive. Gough Island mice aren’t in that catalog. Which means that Payseur had to figure out a way to get mice from an incredibly remote island with a grand total of six to eight full-time human residents, all of whom were busy with their year-long stint staffing the South African National Antarctic Programme’s weather station.

The solution came in the form of an unusual and macabre adaptation of behavior in Gough Island mice. In addition to developing bigger bodies in their few hundred years on the island, they have also developed an appetite for bigger food—the chicks of nesting seabirds, which they, quite literally, nibble

to death. Luckily for Payseur, there are quite a few people concerned about those seabirds.

Gough Island is officially a possession of Britain and part of the Dependency of Tristan de Cunha. It is also listed as a World Heritage Site by the United Nations Educational, Scientific and Cultural Organization, which recognizes Gough as a pristine, primarily untouched ecosystem. Its towering cliffs, according to the UNESCO description of the island, “host some of the most important seabird colonies in the world,” from the endangered Tristan albatross to the Atlantic petrel to the Northern Rockhopper penguin. Under such circumstances, a population of non-native, quick-breeding, bird-eating mice is of grave concern—especially to the governments and scientists tasked with preserving the island’s biodiversity.

Peter Ryan, director of the Percy FitzPatrick Institute of African Ornithology at the University of Cape Town, South Africa, says that, especially where petrels and albatrosses are concerned, Gough Island mice are a threat to breeding populations. Ryan has been an honorary conservation officer in the Tristan de Cunha islands since 1989 and has witnessed the decline in seabirds firsthand. When Payseur reached out to him in 2008, Ryan was working with Richard Cuthbert, a scientist at the Royal Society for the Protection of Birds, on a census of sorts to help the British government plan an interven-

**A big body means a big appetite.
Here, a mouse on Gough Island
feasts on a dead seabird chick.**

tion—or, rather, an eradication.

The mice “were easy enough to catch,” Ryan wrote in an email recalling Payseur’s request. “They occur at very high densities and we’d been live-catching lots of mice to estimate their movements and densities and to conduct poison trials to ensure that all were susceptible to the poison bait.” Ironically, in order to study how best to kill them, the researchers had the live traps, food, bedding and other paraphernalia needed to keep the mice alive for study.

The “big issue” Ryan recalls, was shipping them. Eventually, the crew of the *S.A. Agulhas*, a South African Antarctic research vessel, agreed to give the mice a lift, but “Even this was a bit tricky, because we had to convince them that the mice wouldn’t be able to escape.” In the fall of 2008, 50 Gough Island mice boarded a boat and took the return trip to the mainland, specifically Cape Town, South Africa. After a lot of paperwork they were sent to Johannesburg, with inspections and quarantines and mountains of paperwork piling up as they made their way by plane to Europe, then to Chicago and, in a final car ride, to the campus of the University of Wisconsin–Madison, where postdoctoral researcher Melissa Gray was waiting.

That September, Gray had just begun her stint in Payseur’s lab. The idea of working with mice excited her, since, as with Payseur’s initial study of primates in Madagascar, the Channel Island foxes she had been working on promised to be a difficult study organism. When a mentor suggested she reach out to Payseur, Gray says, “It was a perfect connection.” She had a background working on island populations and the genetics of size and “Bret already had this project and nobody to work on it.” Plus, she wouldn’t have to wait long to get going. “I started in Bret’s lab in September,” Gray recalls, “and the mice arrived in late October.”



PHOTO BY WOLFGANG HOFFMANN BS'75 MS'79

Researchers Michelle Parmenter and Mark Nolte weighing the Gough Island mice.

Immediately upon their arrival, the Gough Island mice alleviated any concerns about their suitability as a study subject. “Basically it was a cardboard box with some breathing holes and food stuffed inside,” Gray recalls. But when she opened the box, “It was amazing,” she recalls. Ryan had sent 50 mice off to Wisconsin. Forty-five survived the trip and, even better, they’d managed to produce a couple of litters along the way. They hadn’t even begun their experiment, and already the Payseur Lab was growing a colony of Gough mice. “In a way, we ended up with more than we started with, which is crazy with the amount of stress they were under,” Gray says.

After that initial excitement wore off, the real work began. First, Gray had to randomly breed several sets of mice to ensure that their large size was genetic and not the result of conditions on the island. When those lines came out as big as the wild-born mice, she could turn her attention to creating the first lab-raised line of Gough Island mice, inbreeding some promising strains of mice to create lines that were genetically identical, which makes gene mapping much easier. These mice would then serve as the lab’s breeding colony, slated as mates for lab mice with a mainland heritage.

One way to think about the process—to borrow a metaphor from Mark Nolte, a current postdoctoral researcher in the Payseur Lab—is to imagine two decks of playing cards, one red and the

other blue, where each card is a gene. Each deck represents a chromosome, a long strand of DNA wrapped around proteins that carries genetic instructions from a parent to its offspring. When sexual reproduction occurs, each parent contributes a copy of one of their two chromosomes to their offspring.

Imagine the Gough Island mice as having two blue decks of cards—one deck for each chromosome—and the mainland mice as having two red decks. Their initial mating yields what’s called a “filial generation one,” or an F1 baby mouse with two distinct chromosomes, one with all blue cards and the other with all red cards. But when an F1 mouse mates with another F1 mouse, those decks get shuffled. These “filial generation 2,” or F2 mice, hold the first key to untangling the riddle of the evolution of Gough Island’s giant mice.

Breaking the Code

In a small, windowless room at the Charmany Instructional Facility, doctoral candidate Michelle Parmenter lifts two wriggling brown mice out of separate plastic cages by the base of their tails. One is from a line of laboratory mouse with a lineage that runs, if one looks far enough back, to a population of U.S. house mouse. The other is also a strain of laboratory mouse, although it’s of the lab’s own creation—its Gough Island heritage evident in the way it dwarfs its companion when nestled side by side in Parmenter’s hand.

Parmenter, Nolte and a half-dozen Payseur Lab undergrads spend a large portion of their time taking measurements, plopping each of the 480 mice in the room—increasingly inbred descendants of the original Gough mice—one by one into an empty container of French onion dip and putting it on a scale.

Parmenter has slipped on tough blue “bite gloves” before handling the mice—and one mouse’s attempted nibbles remind her why she needs them. “Okay, you’re trying to bite me,” she announces, putting the critter down. “These bite gloves are good, but they’re only so good.”

A smaller mouse, on the other hand, sits meekly in her palm. Parmenter and Nolte say there are a lot of anecdotal differences in behavior between the Gough line of mice and their mainland counterparts. Gough mice scurble at the corners of their clear plastic cages and frantically scale the grates near their water bottles like monkey bars. The mainland mice spend more time quietly nestled in the shredded paper bedding provided for burrows. When working with the mice, Parmenter and Nolte put them in deep plastic basins, since the Gough mice seem to be strong jumpers and more aggressive. In comparison, says Nolte, “I could work with classical laboratory strains of mice on a level surface and they wouldn’t go anywhere. They wouldn’t even try to escape.”

While they enjoy discussing the potential evolutionary drivers behind some of this observed behavior, what is really exciting to Parmenter and Nolte is what these mice are now telling them at a genetic level.

By crossing mice from Gough and the mainland strain, the Payseur Lab has produced about 1,400 F2 mice. They’ve extracted DNA from each one, sent those samples to a lab for analysis and, in return, received a genomic portrait of each mouse’s DNA. Combing through

Side-by-side comparison:
A Gough Island mouse, left, is much bigger than its U.S. counterpart of the same age and gender (right).



PHOTO BY WOLFGANG HOFFMANN BS/75 MS/79

all of that is a slow process, says Parmenter, but already they are finding hints of the genetic code responsible for their remarkable size.

“Imagine I take the two decks of cards—or ‘chromosomes’—and spread them out, and I can go down each row and say, ‘Oh, there’s a mainland chunk of DNA,’ or ‘Hey, that one came from Gough,” Nolte says. When you do this enough, patterns begin to appear. “If you take your largest mice and spread their decks, you notice that at the same position on the chromosome they all share the same Gough DNA.” When a big enough percentage of large mice show the same chunk of genes at the same position on the genome, Nolte says, it indicates that, somewhere in the region, there is a gene responsible for size.

That strong association, however, isn’t exactly a smoking gun. When the project began, says Payseur, a prevailing thought was that the rapid evolution in Gough Island mice would be the result of mutations in just a couple of key genes. But in a September 2015 paper in the journal *Genetics*, the lab published its first genetic mapping results from the F2 crosses, reporting that 19 different sections of the genome appear to play some role in the rapid and extreme size evolution of Gough Island mice. Each of those 19 sections is comprised of anywhere from 400 to 1,400 genes, which means there is much more work to do.

Right now, the process “is not getting at a specific gene,” says Gray, who was the lead author of the *Genetics* paper. “It’s saying, ‘Okay, this chunk of genome right here somehow corresponds to body size.’ So if you want to tease that apart more, you have to shuffle the deck again. And then shuffle it again.” Keeping your eye on the right card gets difficult. “You really need a lot of samples to get past the noise,” she

says, “and that’s a challenge about a project like this. You need a lot of individuals, and that means a lot of money and a lot of time and a lot of mice.”

The Search for a New Island

As the “giant mice” experiment currently stands, the Payseur Lab will, eventually, uncover specific genes that are responsible for the Gough Island mouse’s astounding size, work that could have implications for research on things like human metabolic diseases or even breeding livestock.

“When you look at domesticated animals, size is one of the most important traits because it’s correlated with characteristics like productivity,” Payseur explains. “There’s a lot of interest in CALS in understanding the genetic basis of size variation—in that context it would help select for increased body size and know what genes confer the response. Maybe there’s a more efficient way to ‘build the animal.’”

But if Payseur is to truly unravel the evolutionary mystery of the island rule, he’s going to not only need more time, money and mice—he’s going to need a new island.

The idea is to run the same experiment with another population of large island mice and see if evolutionary patterns emerge. Do some of the same 19 genetic regions his lab has identified show up in those mice, or did they get bigger through a completely different mechanism?

“It would be nice to choose an island because it has similar ecological conditions to Gough that might have driven the same kind of body size increase,” Payseur muses. “But another consid-

eration is, it would be nice to choose an island where the mice have come from

a different part of the world. I’m in the throes of figuring that out right now.”


Either way, it’s not a decision that will be made quickly. And the project, which is funded in part by the National Institutes of Health, is slated to run for several more years, meaning that large mice will be calling a UW–Madison lab home for a while.

Gray has already moved on from the project, taking a job as a research scientist at Exact Sciences, a Madison-based biotech company. Both Nolte and Parmenter realize that they’ll also head elsewhere in their careers before the full story of the Gough Island mice can be translated. But they admit to hoping that they’re still around when the next cardboard box full of large, wild mice arrives in the lab.

“Just knowing that Bret is pursuing a new island population makes us all giddy,” Nolte says.

Payseur shares their excitement, but he knew when he launched the study that he was signing on for what could end up being a career-long project.

“I think that genetics is the most powerful way to answer evolutionary questions,” he says. But getting at answers can be “more complicated than one might imagine,” Payseur admits. “It would be nice to have a simple explanation, but I tend to be attracted to more complicated projects.”

In one respect at least, things might be finally getting a little less complicated for the Payseur Lab: Wherever they turn next for a population of giant mice, the island in question will be a little less remote than Gough. And the mice involved will be a little smaller. And, just maybe, writing the next chapter of this story will be a little bit easier—aided by a key created from the genome of the largest mice on Earth. 



MARK
COOK

PHOTO BY MICHAEL KIENITZ

TO MARKET, TO MARKET

A new program called Discovery to Product is helping researchers become entrepreneurs

BY CAROLINE SCHNEIDER MS'11

IF YOU'RE FAMILIAR WITH the College of Agricultural and Life Sciences (CALS), you no doubt know all about Stephen Babcock and his test that more than 100 years ago revolutionized the dairy industry by providing an inexpensive, easy way to determine the fat content of milk (thus preventing dishonest farmers from watering it down).

What you might not know is that his great discovery went unpatented. The only money Babcock received for his invention was \$5,000 as part of a Capper Award—given for distinguished service to agriculture—in 1930.

Just years before Babcock received that award, another entrepreneur was hard at work in his lab—and his discovery would break ground not only in science, but also in direct remuneration for the university.

In 1923, Harry Steenbock discovered that irradiating food increased its vitamin D content, thus treating rickets, a disease caused by vitamin D deficiency. After using \$300 of his own money to patent his irradiation technique, Steenbock recognized the value of such patents to the university. He became influential in the formation in 1925 of the Wisconsin Alumni Research Foundation (WARF), a technology transfer office that patents UW–Madison innovations and returns the proceeds back to the university.

Discoveries have continued flowing from CALS, and WARF plays a vital role for researchers wanting to patent and license their ideas. But today's innovators and entrepreneurs have some added help: a new program called Discovery to Product, or D2P for short.

Established in 2013, and co-funded by UW–Madison and WARF, D2P has two main goals: to bring ideas to market through the formation of startup companies, and to serve as an on-campus portal for entrepreneurs looking for help. Together, WARF and D2P form a solid support for researchers looking to move their ideas to market. That was the intent of then-UW provost Paul DeLuca and WARF managing director Carl Gulbrandsen in conceiving of the program.

“The idea of D2P is to make available a set of skills and expertise that was previously unavailable to coach people with entrepreneurial interests,” explains

Leigh Cagan, WARF's chief technology commercialization officer and a D2P board member. “There needed to be a function like that inside the university, and it would be hard for WARF to do that from the outside as a separate entity, which it is.”

D2P gained steam after its initial conception under former UW–Madison chancellor David Ward, and the arrival of Rebecca Blank as chancellor sealed the deal.

“Chancellor Blank, former secretary of the U.S. Department of Commerce, was interested in business and entrepreneurship. D2P really started to move forward when she was hired,” says Mark Cook, a CALS professor of animal sciences. Cook, who holds more than 40 patented technologies, launched the D2P plan and served as interim D2P director and board chair.

With the light green and operational funds from WARF and the University secured, D2P was on its way. But for the program to delve into one of its goals—helping entrepreneurs bring their ideas to market—additional funding was needed.

For that money, Cook and DeLuca put together a proposal for an economic development grant from the University of Wisconsin System. They were awarded \$2.4 million, and the Igniter Fund was born. Because the grant was good only for two years, the search for projects to support with the new funds started right away.

By mid-2014, veteran entrepreneur John Biondi was on board as director, project proposals were coming in and D2P was in business. To date, 25 projects have gone through the Igniter program, which provides funding and



SHAWN
KAEPLER

guidance for projects at what Biondi calls the technical proof of concept stage. Much of the guidance comes from mentors-in-residence, experienced entrepreneurs that walk new innovators down the path to commercialization.

“For Igniter projects, they need to demonstrate that their innovation works, that they’re not just at an early idea stage,” explains Biondi. “Our commitment to those projects is to stay with them from initial engagement until one of three things happen: they become a startup company; they get licensed or we hand them over to WARF for licensing; or we determine this project might not be commercial after all.”

For projects that may not be destined for startup or that need some additional development before going to market, the collaboration between WARF and D2P becomes invaluable. WARF can patent and license discoveries that may not be a good fit for a startup company. They also provide money, called Accelerator funding, for projects that need some more proof of concept. Innovations that may not be ready for Igniter funds, but that are of potential interest to WARF, can apply for these funds to help them move through the earlier stages toward market.

“Some projects receive both Accelerator and Igniter funding,” says Cagan. “Some get funding from one

and not the other. But we work together closely and the programs are being administered with a similar set of goals. We’re delighted by anything that helps grow entrepreneurial skills, companies and employment in this area.”

With support and funding from both WARF and D2P, entrepreneurship on campus is flourishing. While the first batch of Igniter funding has been allocated, Biondi is currently working to secure more funds for the future. In the meantime, he and others involved in the program make it clear that the other aspect of D2P—its mission to become a portal and resource for entrepreneurs on campus—is going strong.

“We want to be the go-to place where entrepreneurs come to ask questions on campus, the starting point for their quest down the entrepreneurial path,” says Biondi.

It’s a tall order, but it’s a goal that all those associated with D2P feel strongly about. Brian Fox, professor and chair of biochemistry at CALS and a D2P advisory board member, echoes Biondi’s thoughts.

“D2P was created to fill an important role on campus,” Fox says. “That is to serve as a hub, a knowledge base for all the types of entrepreneurship that might occur on campus and to provide expertise to help people think about moving from the lab to the market.

That’s a key value of D2P.”

Over the past two years, D2P, in collaboration with WARF, has served as precisely that for the 25 Igniter projects and numerous other entrepreneurs looking for help, expertise and inspiration on their paths from innovation to market. The stories of these four CALS researchers serve to illustrate the program’s value.

REDUCING ANTIBIOTICS IN FOOD ANIMALS

Animal sciences professor Mark Cook, in addition to helping establish D2P, has a long record of innovation and entrepreneurship. His latest endeavor, a product that has the potential to do away with antibiotics in animals used for food, could have huge implications for the animal industry. And as he explains it, the entire innovation was unintentional.

“It was kind of a mistake,” he says with a laugh. “We were trying to make an antibody”—a protein used by the immune system to neutralize pathogens—“that would cause gut inflammation in chickens and be a model for Crohn’s disease or inflammatory bowel disease.”

To do this, Cook’s team vaccinated hens so they would produce a particular antibody that could then be sprayed on

“It’s been a dream of mine to make Wisconsin a centerpiece in this technology,” Cook says.

feed of other chickens. That antibody is supposed to cause inflammation in the chickens that eat the food. The researchers’ model didn’t appear to work. Maybe they had to spark inflammation, give it a little push, they thought. So they infected the birds with a common protozoan disease called coccidia.

“Jordan Sand, who was doing this work, came to me with the results of that experiment and again said, ‘It didn’t work,’” explains Cook. “When I looked at the data, I saw it was just the opposite of what we expected. The antibody had protected the animals against coccidia, the main reason we feed antibiotics to poultry. We knew right away this was big.”

The possibilities of such an innovation—an antibiotic-free method for controlling disease—are huge as consumers demand antibiotic-free food and companies look for ways to accommodate those demands.

With that potential in hand, things moved quickly for Cook and Sand. They filed patents through WARF, collaborated with faculty colleagues and conducted experiments to test other animals and determine the best treatment methods. More research was funded through the WARF Accelerator program, and it became clear that this technology could provide the basis for a startup company.

While Cook didn’t receive funds from D2P to bring the product to market, he and Sand used D2P’s consulting services throughout their work—and continue to do so. Between WARF funding and help from D2P, Cook says starting the current company, Ab E Discovery, has been dramatically different from his previous startup experiences.

“D2P is a game changer,” says Cook. “In other cases, there was no structure on campus to help. When you had a technology that wasn’t going to be licensed, you had to figure out where to

get the money to start a company. There were no resources available, so you did what you could, through trial and error, and hoped. Now with WARF and D2P working together, there’s both technical de-risking and market de-risking.”

The combination of WARF and D2P has certainly paid off for Cook and Sand. They have a team and a CEO, and are now producing product. Interest in the product is immense, Cook says. He’d like to see the company grow and expand—and stay in Wisconsin.

“It’s been a dream of mine to make Wisconsin a centerpiece in this technology,” Cook says. “I’d like to see the structure strong here in Wisconsin, so that even when it’s taken over, it’ll be a Wisconsin company. That’s my hope.”

BETTER CORN FOR BIOFUEL

Corn is a common sight in Wisconsin and the upper Midwest, but it’s actually more of a tropical species. As the growing regions for corn move farther north, a corn hybrid has to flower and mature more quickly to produce crop within a shorter growing season. That flowering time is determined by the genetics of the corn hybrid.

Conversely, delayed flowering is beneficial for other uses of corn. For example, when flowering is delayed, corn can produce more biomass instead of food, and that biomass can then be used as raw material to make biofuel.

The genetics of different hybrids controls their flowering time and, therefore, how useful they are for given purposes or growing regions. Shawn Kaeppler, a professor of agronomy, is working to better understand those genes and how various hybrids can best fit a desired function. Much of his work is done in collaboration with fellow agronomy professor Natalia de Leon.

“We look across different populations and cross plants to produce progeny with different flowering times,”

Kaeppler explains. “Then we use genetic mapping strategies to understand which genes are important for those traits.”

Throughout his work with plant genetics, Kaeppler has taken full advantage of resources for entrepreneurs on campus. He has patents filed or pending, and he has also received Accelerator funds through WARF. For his project looking at the genetics behind flowering time, Kaeppler and graduate student Brett Burdo received Igniter funds from D2P as well. The Igniter program has proven invaluable for Kaeppler and Burdo as they try to place their innovation in the best position for success.

“I found the Igniter program very useful, to go through the process of understanding what it takes to get a product to market,” says Kaeppler. “It also includes funding for some of the steps in the research and for some of the time that’s spent. I can’t fund my graduate student off a federal grant to participate in something like this, so the Igniter funding allowed for correct portioning of funding.”

The end goal of Kaeppler’s project is to develop a transgenic plant as a research model and license the technology, not develop a startup company. His team is currently testing transgenic plants to work up a full package of information that interested companies would use to decide if they should license the technology. For Kaeppler, licensing is the best option since they can avoid trying to compete with big agricultural companies, and the technology will still get out to the market where it’s needed to create change.

“In this area of technology transfer, it is important not only to bring resources back to UW but also to participate in meeting the challenges the world is facing with increasing populations,” says Kaeppler. “Programs like D2P and WARF are critical at this point in time to see the potential of these discoveries realized.”



**DENISE
NEY**

A DIET TO TREAT DISEASE

Around the world, about 60,000 people are estimated to have phenylketonuria, or PKU. Those with the inherited disorder are unable to process phenylalanine, a compound found in most foods. Treatment used to consist of a limited diet difficult to stomach. Then, about 13 years ago, nutritional sciences professor Denise Ney was approached to help improve that course of treatment.

Dietitians at UW–Madison’s Waisman Center wanted someone to research use of a protein isolated from cheese whey—called glycomacropeptide, or GMP—as a dietary option for people living with PKU. Ney took on the challenge, and with the help of a multidisciplinary team, a new diet com-

position for PKU patients was patented and licensed.

“Mine is not a typical story,” says Ney, who also serves as a D2P advisory board member. “Things happened quickly and I can’t tell you why, other than hard work, a good idea and the right group of people. We’ve had help from many people—including our statistician Murray Clayton, a professor of plant pathology and statistics, and the Center for Dairy Research—which helped with development of the foods and with sensory analysis.”

Being at the right place at the right time had a lot to do with her success thus far, Ney notes. “I’m not sure this could have happened many places in the world other than on this campus because we have all the needed compo-

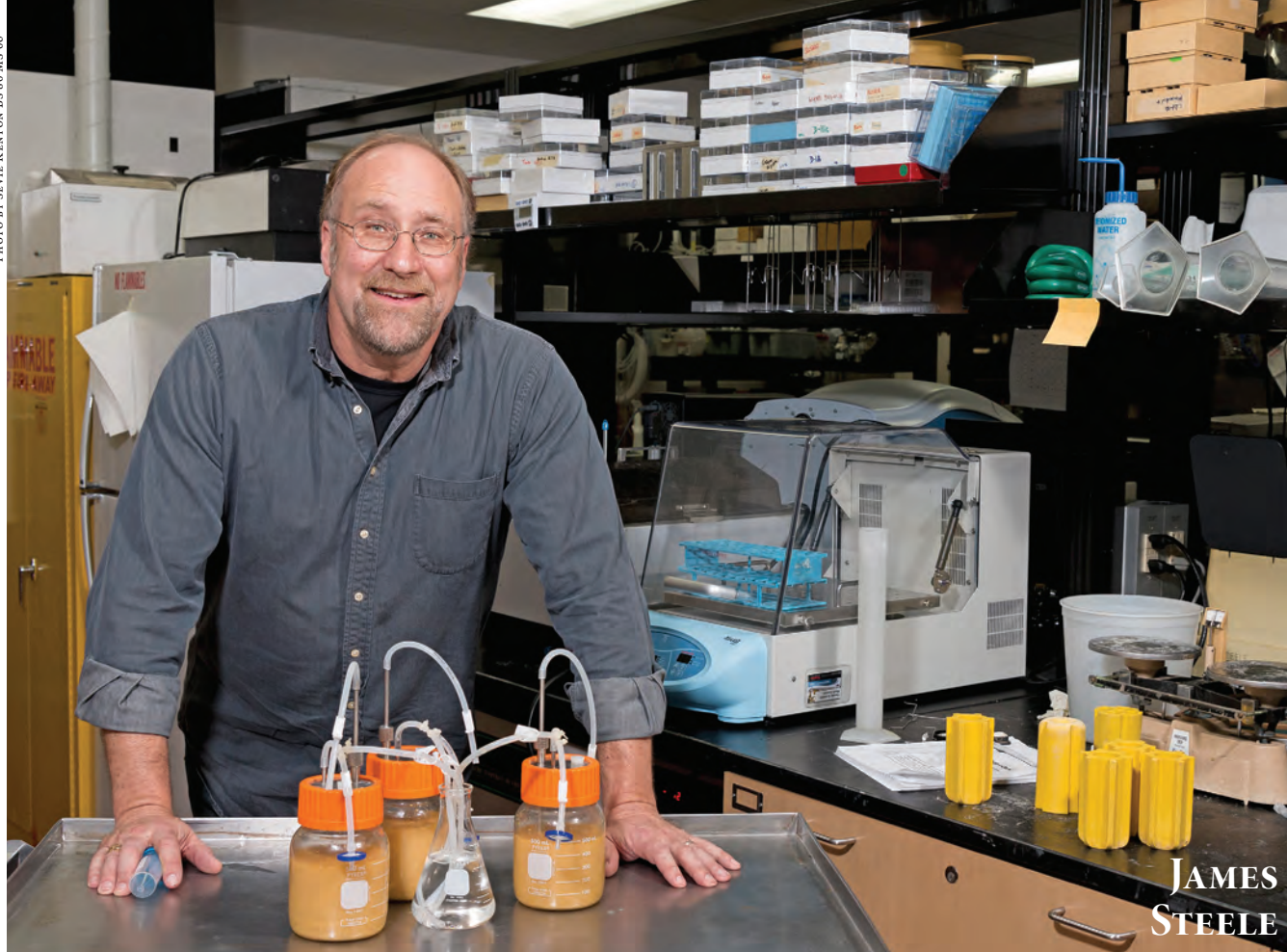
nents—the Waisman Center for care of patients with PKU, the Wisconsin Center for Dairy Research, the clinical research unit at University of Wisconsin Hospitals and Clinics, and faculty with expertise in nutritional sciences and food science,” she says.

Ney is currently wrapping up a major clinical trial of the food formulations, referred to as GMP medical foods, that she and her team developed. In addition to those efforts, the new diet has also shown surprising promise in two other, seemingly unrelated, areas: weight loss and osteoporosis prevention.

“My hypothesis, which has been borne out with the research, is that GMP will improve bone strength and help prevent fractures, which are complications of PKU,” explains Ney. “I have a comprehensive study where I do analysis of bone structure and biomechanical performance, and I also get information about body fat. I observed that all of the mice that were fed GMP, whether they had PKU or not, had less body fat and the bones were bigger and stronger.” Interestingly, the response was greater in female compared with male mice.

To support further research on this new aspect of the project, Ney received Accelerator funds from WARF for a second patent issued in 2015 titled “Use of GMP to Improve Women’s Health.” Ney and her team, including nutritional sciences professor Eric Yen, are excited about the possibilities of food products made with GMP that may help combat obesity and also promote bone health in women.

“There is a huge market for such products,” says Ney. “We go from a considerably small group of PKU patients who can benefit from this to a huge market of women if this pans out. It’s interesting, because I think I’m kind of an unexpected success, an illustration of the untapped potential we have here on campus.”



FEWER ANTIBIOTICS IN ETHANOL PLANTS

Bacteria and the antibiotics used to kill them can cause significant problems in everything from food sources to biofuel. In biofuel production plants, bacteria that produce lactic acid compete with the wanted microbes producing ethanol. At low levels, these bacteria decrease ethanol production. At high levels, they can produce so much lactic acid that it stops fermentation and ethanol production altogether.

The most obvious solution for stopping these lactic acid bacteria would be antibiotics. But as in other industries, antibiotics can cause problems. First, they can be expensive for ethanol producers to purchase and add to their workflow. The second issue is even more problematic.

"A by-product of the ethanol industry is feed," explains James Steele, a professor of food science. "Most of the corn kernel goes toward ethanol and what remains goes to feed. And it's excellent animal feed."

But if antibiotics are introduced into

the ethanol plant, that animal feed by-product can't truly be called antibiotic-free. That's a problem as more and more consumers demand antibiotic-free food sources. But Steele and his colleagues have a solution—a way to block the negative effects of lactic acid bacteria without adding antibiotics.

"We've taken the bacteria that produce lactic acid and re-engineered it to produce ethanol," says Steele. "These new bacteria, then, compete with the lactic acid bacteria and increase ethanol production. Ethanol plants can avoid the use of antibiotics, eliminating that cost and increasing the value of their animal feed by-product."


The bacteria that Steele and his team have genetically engineered can play an enormous role in reducing antibiotic use. But that benefit of their innovation didn't immediately become their selling point. Rather, their marketing message was developed through help from D2P and the Igniter program.

"Learning through D2P completely changed how we position our product and how we interact with the industry," says Steele. And through that work

with D2P, Steele plans to later this year incorporate a company called Lactic Solutions. "D2P has helped us with the finance, the organization, the science, everything. Every aspect of starting a business has been dealt with."

Steele and his collaborators are now working to refine their innovation and ideas for commercialization using Accelerator funds from WARF. Steele's work, supported by both WARF and D2P, is a perfect example of how the entities are working together to successfully bring lab work to the market.

"There is no doubt in my mind that we would not be where we are today without D2P," says Steele. "On top of that you add WARF, and the two together is what really makes it so special. There's nothing else like it at other campuses."

With such a strong partnership campaigning for and supporting entrepreneurship at UW-Madison, CALS' strong history of innovation is poised to endure far into the future, continuing to bring innovations from campus to the world. And that is the embodiment of the Wisconsin Idea. 

in the field



Matthew Bayer



Jennifer Dierkes



Vance Lautsbaugh



Louis E. Muench



Richard Reams

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/

Know a CALS grad whose work should be highlighted in Grow? E-mail us at grow@cals.wisc.edu

Matthew Bayer Class of 2012 • Matthew Bayer is the co-owner of Country Fresh Meats in Weston, Wisconsin, a family-owned and -operated meat processing plant that's been in business since 1982 and has 45 full-time employees. Country Fresh Meats sells products to convenience stores all around Wisconsin and distributes out of state as well. Bayer is a longstanding member of the Wisconsin Association of Meat Processors and currently serves as president of the Wisconsin Beef Council. Despite his many years of experience, Bayer found there was still much to learn in the Master Meat Crafter course. "It's helped me work on efficiency in our process, along with maintaining or increasing the quality of the product," says Bayer. "It's also helped in developing new products and trying different things." Bayer thanks the Master Meat Crafter course for inspiring him to start producing Genoa salami and Sopressata, to name a few examples.

Jennifer Dierkes Class of 2014 • Jennifer Dierkes is the general manager and one of three owners of McDonald's Meats, a market and meat processing facility in Clear Lake, Minnesota. She began her career there in 1990 washing dishes while she was still in high school. "I have been part of helping grow this business from a very small butcher shop with a staff of five to a full-service meat market with 35 employees," she says. Her favorite part of her job is the process of creating

new products and helping staff grow and learn new things, she says—and her experience at CALS has enhanced those efforts: "The Master Meat Crafter course has helped immensely in my work. I learned much more about the science behind what we do every day. When you know that, troubleshooting the problems that arise becomes much easier."

Vance Lautsbaugh Class of 2016 • Vance Lautsbaugh is the production manager at Crescent Meats in Cadott, Wisconsin, where he deals with everything from scheduling day-to-day operations to HACCP/meat inspection, product formulations, employee training and troubleshooting when problems arise. "I enjoy being the manager and that everyone respects my judgment, but my favorite part of my job is making new products and formulations," he says. "Making the best quality products that I can and hearing compliments from the customers when they try them is what drives me."

Lautsbaugh finds that the Master Meat Crafter course helped deepen the knowledge and interests he'd developed as a food science student at UW–River Falls: "This class has helped me in so many ways, but most importantly it has given me more confidence when talking to customers and employees. Because I understand what is happening to the meat at all stages of production, I can explain it and teach others what I know."

Master Meat Crafters

Meet some graduates of a two-year program CALS launched in 2010 to improve and distinguish the production, quality and variety of meats made in Wisconsin and beyond.



Jake Sailer

Ashley Sutterfield

Josh Swart

Kelly Gall Washa

Louis E. Muench Class of 2012 • As the president of Louie's Finer Meats in Cumberland, Wisconsin, Louie Muench has a lot on his plate. Besides being the head sausage maker, Muench oversees and manages all aspects of the business. His favorite area is product development as he has more than 100 kinds of brats. The Master Meat Crafter program increased Muench's networking capability with both suppliers and alumni, which gives him more exposure and support when trying new methods and learning how to expand his business. When he isn't working, Muench enjoys cross-country skiing, hunting and fishing in the north woods.

Richard Reams Class of 2012 • Rick "RJ" Reams owns and operates RJ's Meats & Groceries in Hudson, Wisconsin, working alongside his wife, Anne, and sons Anthony, Aaron and Joe. RJ's is a full-service retail meat market and producer of many varieties of sausage, ham, bacon and salami. While he originally started with fresh meats, Reams now really loves making sausage. The Master Meat Crafter program helped Reams immensely in two ways: it helped educate his staff in food safety and why things are done certain ways, and it got him making Italian salami with wine, a product that is now shipped all over the United States. In his free time, Reams enjoys fishing and learning more about the meat industry.

Jake Sailer Class of 2012 • Jake Sailer co-owns Sailer's Food Market and Meat Processing Inc., in Elmwood, Wisconsin, along with his father and mother and his wife, Leslie. As a fifth-generation meat cutter, Sailer has great expertise in the cured and smoked meats that he produces. He's won numerous awards at state, national and international levels with such products as bacon, hams and smoked beef. The Master Meat Crafter program has given him a better understanding of the science behind meat processing and has allowed him to grow relationships and friendships with others in the industry. When he's not working, Sailer enjoys spending time at a cabin with family and friends, flying an airplane and cutting wood.

Ashley Sutterfield Class of 2016 • Ashley Sutterfield is an associate manager of sales development at Tyson Foods, Inc. in Bentonville, Arkansas. In this role, she manages projects as a liaison between the customer, the Tyson sales team and their internal business units. Sutterfield's favorite moments are when she can translate her scientific knowledge into lay terms for the people she works with. Some of that knowledge came from the Master Meat Crafter program, which Sutterfield says was "invaluable to my career as I developed as a meat scientist and made connections within the industry." In her free time, Sutterfield enjoys traveling, advocating for the tiny house movement and training for Ironman Wisconsin 2016.

Josh Swart Class of 2016 • As a supervisor in the sausage production kitchen at Usinger's Famous Sausage in Milwaukee, Swart is responsible for setting up the product flow and making sure all production is finished for the day. He started working for a smaller sausage company during summer breaks from school and collected experience and knowledge there before moving to Usinger's. Swart enjoys being able to share the reasons why they do things in a particular way—information he learned by taking the Master Meat Crafters program. In his free time, Swart likes to play bass and listen to music.

Kelly Gall Washa Class of 2016 • Kelly Gall Washa is the owner and operator of Grand Champion Meats in Foley, Minnesota, which processes beef, pork, buffalo, alpaca, deer, elk and other wild game. She is a second-generation meat cutter who is accomplished in both cured and smoked meats, including snack sticks, jerky, summer sausage and Braunschweiger. She is a past president of the Minnesota Association of Meat Processors and enjoys making and maintaining industry connections. When she's not working, Washa loves spending time with her two children and looks forward to training a third generation of meat cutters.

by Jacob Knudtson

Catch up with ...

Andrea Garber BS'92 PhD'99 Nutritional Sciences

As a professor of pediatrics at the University of California, San Francisco, Andrea Garber BS'92 PhD'99 conducted a groundbreaking study concerning a very vulnerable group: patients hospitalized with anorexia nervosa, an eating disorder that often proves fatal. It is most prevalent among teenage girls and young women.

Garber and her team discovered that the standard “refeeding” protocol used in hospitals nationwide—that is, the necessarily careful reintroduction of food to patients who have been starving themselves—was too low in calories and was in fact causing patients to continue losing weight even during longer hospital stays. The phenomenon had been long observed, but Garber’s study, published in 2012 and based on the largest cohort of its kind, was the first to actually prove it.

● **What makes this work so critical?**

Anorexia nervosa is the most deadly psychiatric illness. It has a mortality rate of 5 to 6 percent, which is the highest among all psychiatric diagnoses, and the recovery rates are really low. Studies that are using the absolute best forms of treatment and psychotherapy still show that maybe only 30 percent at the lowest—but at the highest, half—of patients are recovered at one year. So we absolutely need to develop better treatments.

● **What protocols do you think will be more effective?**

In a new five-year study, we are testing a higher-calorie refeeding protocol, starting at 2,000 calories per day and advancing quickly by 200 calories per day. We’ll compare this to a group receiving a lower-calorie protocol, starting at 1,400 calories per day and advancing



slowly by 200 calories every other day. This lower-calorie diet is in fact a little higher than the traditional recommendation to start at 1,200 calories.

● **Why have such low-calorie diets been used with anorexia patients?**

For safety. “Low and slow” refeeding is believed to minimize risk for the refeeding syndrome, which was first documented around the time of World War II. It’s characterized by life-threatening shifts in fluids and electrolytes that can occur when nutrition is reintroduced in starved patients.

At UCSF and our collaborating site at Stanford, we are set up for a high degree of medical management and we can carefully monitor for any signs of refeeding syndrome. The main one is electrolyte shifts, which our physicians check every day and correct as needed with supplements. A key question is, how much medical intervention is needed to keep higher-calorie refeeding safe? That’s important to know before disseminating these protocols to other settings, such as residential treatment facilities.

● **Do these protocols have implications for patients after hospital discharge?**

We’re looking very closely at relapse rates. Forty percent of these young people relapse within one year of their first hospitalization. If higher-calorie refeeding gives us shorter hospital stays, but these kids end up coming right back, then we’ve undone any potential benefit of that shorter stay. While the higher-calorie refeeding seems promising in terms of faster weight gain and shorter hospital stay, there are many unanswered questions about potential long-term benefits, long-term risks and the overall effect on recovery.

—JOAN FISCHER

A growing appetite for food systems

Anyone looking to see exciting growth of a new field should talk with the Department of Community and Environmental Sociology. Since changing its name from Rural Sociology in 2009, the number of undergraduate majors has quadrupled. And a big reason for that rapid growth is the increased visibility of environmental issues in general—and food issues in particular.

“Perhaps as many as half of our undergraduates want to work on local food issues,” says professor and department chair Gary Green. “Some would like to start a community-supported agriculture (CSA) farm, others would like to work for a nonprofit and still others see themselves in food policy positions in the future. In addition, there is growing interest in urban agriculture programs in major cities. We believe we have the potential to make an important contribution to CALS through preparing students to work in this growing field.”

The department is taking a two-pronged approach to meeting this demand. They are raising funds to support one or two graduate student fellowships specifically in the area of food systems research—and they also seek to hire an assistant professor with a focus on food systems. These new positions would serve not only to advance research and outreach in the field, but also to help meet high undergraduate demand for related classes and field opportunities.

“There is a growing interest in CALS in developing a certificate in food systems, and these positions could play a key role in supporting that effort,” notes Green. Three food systems courses now being piloted in CALS, with the participa-



As a CES major, Desire Smith discovered a love for urban ag.

tion of five departments, could serve as the core of a future food systems certificate program.

The department is not a new player in the study of local food systems. Indeed, emeritus professor Jack Kloppenburg, who retired last year, is a nationally renowned pioneer in the field. The loss of Kloppenburg and two other professors with local food systems expertise—Jess Gilbert and Jill Harrison—has left the department less able to continue leading the charge.

“It is critical to recruit new faculty to continue to provide teaching, research and outreach in this area,” notes Green. The position would also enable the department to take advantage of numerous funding opportunities for food systems research.

“We foresee no drop-off of interest in food and agriculture, but rather a long-range increased demand in this area,” Green says.

—JOAN FISCHER

To support these efforts, please visit <http://supportuw.org/giveto/ces/>. For more information, please contact Jodi Wickham at the University of Wisconsin Foundation: jodi.wickham@supportuw.org, tel. (608) 206-6058.

CELEBRATE WISCONSIN AGRICULTURE

at Agricultural Research Station events for the public. Of particular note this year: Hancock's Centennial Celebration on **Thursday, July 28**. Here's a selection to get you started:

Peninsular: Door Co. Master Gardeners Open House, **July 9**. **Arlington:** Organic Field Day, **July 12** and Agronomy/Soils Field Day, **August 31**. **OJ Noer:** UW Grandparents University, **July 21–22** and Turfgrass Association Field Day, **July 26**. **Hancock:** Centennial Celebration and Field Day, **July 28**. **Spooner:** Twilight Garden Tour, **August 16** and Sheep Day, **August 27**. **West Madison:** Horticultural Field Day, **August 20**. More info at ars.wisc.edu/announcements.

VISIT US at **Wisconsin Farm Technology Days**, this year taking place in Walworth County **July 19–21** at Snudden Farms in Lake Geneva. More info at wifarmtechnologydays.com/walworth/. Be sure to attend the WALSAA Farm Technology Days Picnic on **Wednesday, July 20**. More info at walsaa.org.

THE SCIENCE OF SPIDER SILK—“How is spider silk made?” is a question answered by entomologist **P.J. Liesch**, director of the UW Insect Diagnostic Lab, as part of Blue Sky Science, a series of video presentations responding to questions posed by visitors to UW's Discovery Building. You can watch Liesch's explanation at morgridge.org/question/how-is-spider-silk-made/.

GET YOUR FOOTBALL ON at the WALSAA Football Fire-Up! on **Saturday, September 17**. More information available soon at walsaa.org.



CELEBRATE JAMES F. CROW by supporting efforts to establish a named professorship in genetics in his honor at a fundraising event on **Friday, September 23**. More info soon at genetics.wisc.edu/CrowProfessorship.htm

For more information, go to: www.grow.cals.wisc.edu





Together, we achieve

GROUNDBREAKING NEW TOOLS—from medications to cure diseases or hardier plants to help feed the world—are not developed alone. Students at CALS need the guidance of professors and other researchers, the collaboration of fellow students and the support of donors like you. Please contribute to the CALS Annual Fund—and turn student dreams into real-world improvements.

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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.

Agronomy

1) Nitrogen contamination of the groundwater is a major problem in some areas. This is because:

- a) Of the process of demineralization.
- b) Of the process of denitrification.
- c) Nitrogen is highly mobile in the soil.
- d) The cation exchange capacity is unstable.

Agricultural and Applied Economics

2) By 2100, the global mean temperature will rise by:

- a) 0.01–0.04 degree Celsius
- b) 0.1–0.4 degree Celsius
- c) 1–4 degrees Celsius
- d) 10–40 degrees Celsius

Animal Sciences

3) High protein intake can result in what type of elemental toxicity?

- a) Calcium
- b) Amino acid
- c) Nitrogen
- d) Hydrogen
- e) Oxygen

Wisconsin School for Beginning Dairy and Live- stock Farmers

4) What are the "5Cs" of credit that any lender looks for?

- a) Capacity, cash, collateral, conditions, conscience
- b) Character, capacity, collateral, capital, conditions
- c) Character, competence, collateral, capital, cooperation
- d) Competence, capital, capacity, conditions, cooperation

Global Health

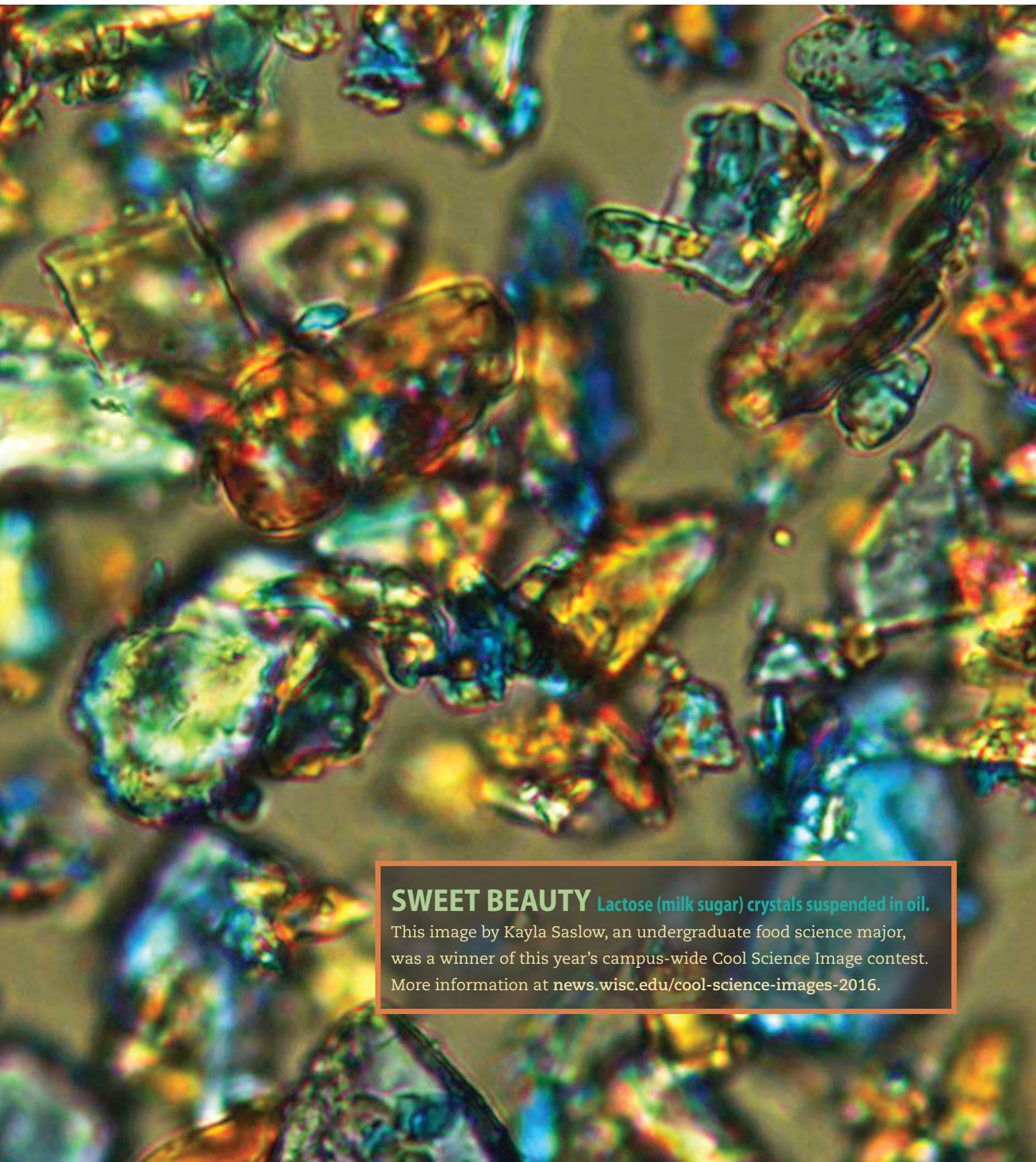
5) Regarding trends in obesity, it was recently announced that:

- a) Rates of obesity worldwide have increased for women but not men.
- b) Rates of obesity worldwide have increased for both men and women.
- c) As a country, India has the highest proportion of the world's obese people.
- d) Nearly 30 percent of the world's population is obese or overweight.
- e) Both b and d are correct.

Last issue: Answers were 1:B; 2:D; 3:C; 4:C; 5:D. Congratulations to Lindsay Haskins Marks BS'06, who was randomly selected from 3 people who correctly answered all questions. She wins a Babcock Hall cheese box.

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SWEET BEAUTY Lactose (milk sugar) crystals suspended in oil.

This image by Kayla Saslow, an undergraduate food science major, was a winner of this year's campus-wide Cool Science Image contest. More information at news.wisc.edu/cool-science-images-2016.