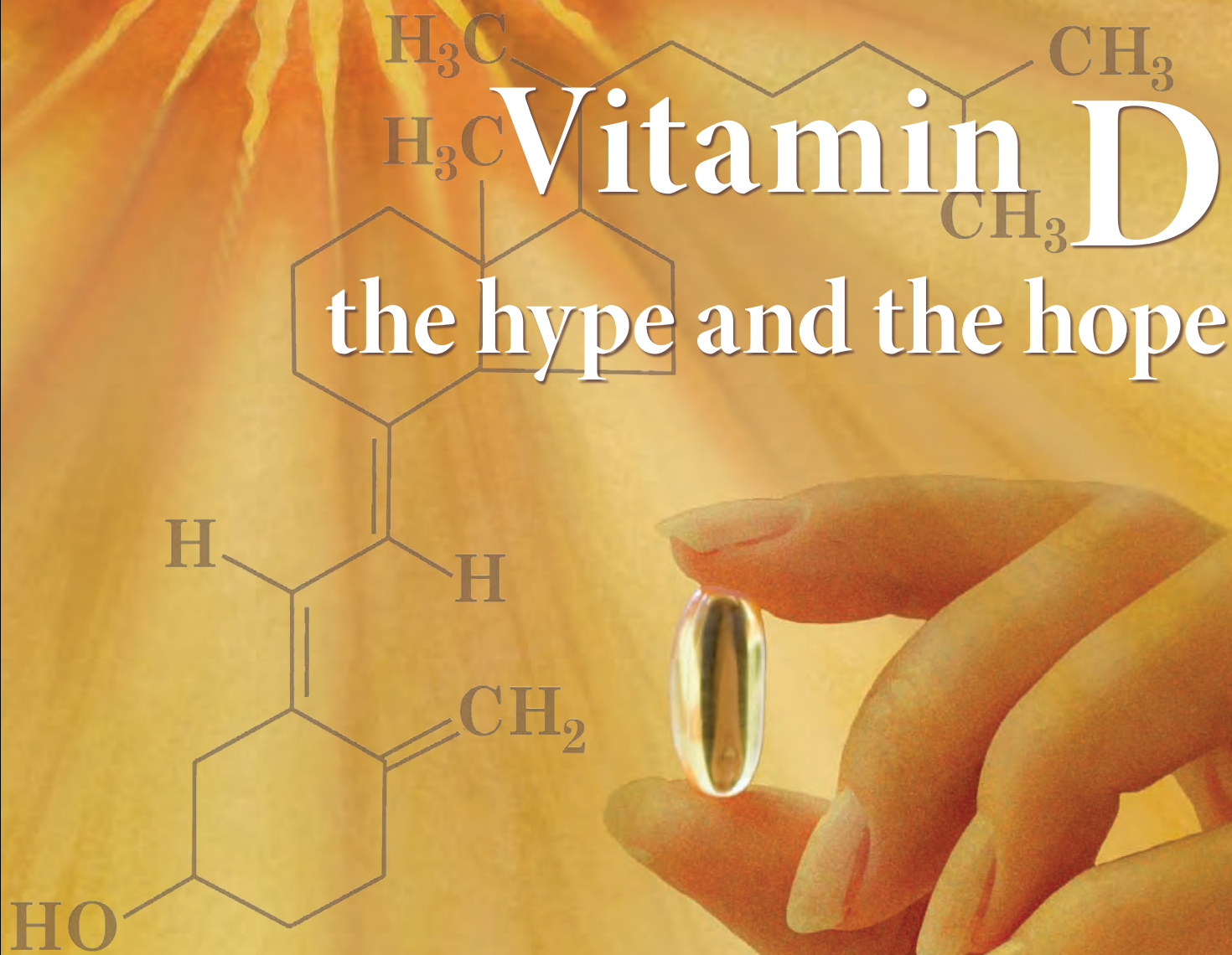


grow

Wisconsin's Magazine for the Life Sciences • Fall 2012

food & agriculture • environment • energy • health



College of Agricultural & Life Sciences
UNIVERSITY OF WISCONSIN-MADISON

FARMING AND CLIMATE CHALLENGES • HUNTING 101 • THE MYSTERY OF BACTERIA





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Wisconsin's Magazine for the Life Sciences

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It's the latest, greatest wonder vitamin—and the research behind it has deep roots at CALS. What do we know about vitamin D, and what benefits can we expect from it in the future?

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For Wisconsin farmers dealing with wild swings in weather, adaptation is the key.

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A six-story sculpture by Norie Sato
graces the atrium of the new Biochemical
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PHOTO BY ROBIN DAVIES,
BIOCHEMISTRY MEDIA LAB

Dean Kate VandenBosch

Our Signature Foods—and CALS



Wisconsinites aren't called Cheeseheads for nothing. But consider, too, our deep love of brats fresh from the grill and a gooey ice cream sundae for dessert.

These foods are nothing less than the taste of Wisconsin—a taste that is acclaimed around the world. We here at CALS can take particular pride in that. A big part of our job has been to develop those foods to their full potential, sharing what we learn in our campus labs and production plants with industry, students and other stakeholders around the globe. When you savor the rich flavor of a Wisconsin artisan cheese or sausage, or a scoop of Babcock Hall ice cream, as a CALS grad you also appreciate the sophisticated science behind it.

Often a cheese, ice cream or sausage maker will come to us with little more than a dream. Our meat and dairy scientists will work with that producer from the recipe stage through production and countless revisions, testing on small batches. Other industry professionals rely on CALS experts for

These foods are nothing less than the taste of Wisconsin

everything from continuing education in production to the latest information on food safety.

Yet our current campus dairy research and production facilities date back to the 1950s, and our meat and muscle lab to the 1930s. While we have done a spectacular job with renovations and workarounds, the time has come when we simply need new facilities in order to maintain leadership in the field. People come to us for guidance, to learn the best from the best, and our facilities need to reflect that. If we don't act now, Wisconsin risks falling behind.

The good news is that businesses, legislators, your fellow alumni and other stakeholders recognize this need and are committed to addressing it. Efforts to raise private funds for new dairy and meat facilities are well under way, with donations to be matched by the state. Enough funds have been raised from donations so far for both projects to have garnered approval by the UW Board of Regents.

I invite you to learn more about these exciting projects at the websites below. And please know that when you "share the wonderful," in the spirit of our new campus-wide giving initiative, your gifts to the CALS Annual Fund will go toward meeting our most critical needs—including our work in advancing Wisconsin's signature foods. We thank you most sincerely for your help.

Dairy and cheese: www.cdr.wisc.edu/building

Meat: <http://meatandmore.wisc.edu/>

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Volume 6, Issue 1
Fall 2012

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On Henry Mall

News from around the college

The Inner Lives of Cows

Bacteria found in cow rumens could be harnessed to process biofuel

What do biofuels look like on the Wisconsin landscape? Some might think of corn or switchgrass. But what about that herd of cows?

What you can't see might fool you. Cows are walking natural biodigesters, says CALS bacteriology professor Garret Suen. Their rumens are filled with rich bacterial communities that break down the cellulose found in feed into nutrients usable by the animal.

"The cow is arguably one of the most efficient cellulose degraders around, and the main reason why is that we've domesticated them to be that way through selection," Suen explains. "What I argue is that we didn't just domesticate the cow, we domesticated their microbes."

Efficiently breaking down cellulose into simpler usable materials—a key challenge in biofuel production—is a feat naturally performed primarily by microbes. "A cow couldn't exist without its bacteria, because it has no way on its own to break down the plants that it eats," he says.

Suen, a researcher with the Wisconsin Bioenergy Initiative, is exploring the workings of the ruminant system in the hope of harnessing its power for industrial applications. He's focusing on three strains of bacteria in the rumen that use different strategies to degrade cellulose. Drawing upon his background in both computational biology and genomics, Suen is using next-generation sequencing to hone in on the individual genes, enzymes and other proteins used by each and how they work together.

"Understanding the different ways that nature has come up with to degrade recalcitrant plant material will be very useful," he says.



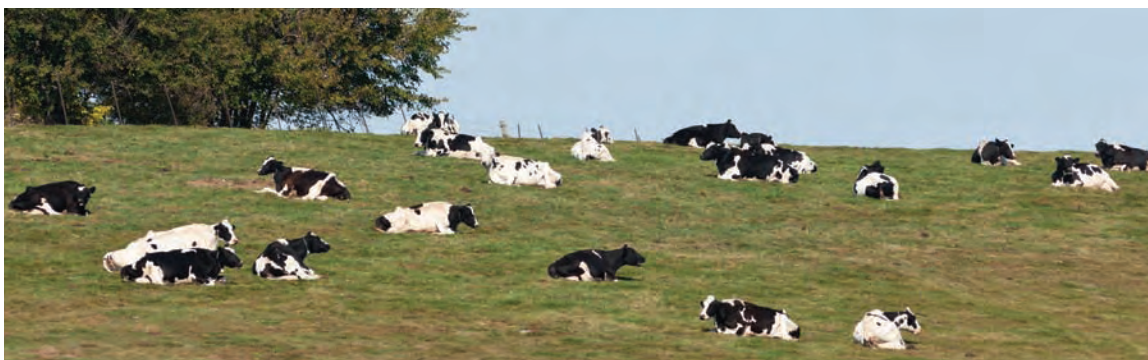
PHOTO BY MATT WISNIEWSKI

To date, Suen's research group has identified some sets of genes they believe are involved, including some interesting surprises that he isn't quite ready to share. He recently received a five-year, \$750,000 early career award from the U.S. Department of Energy to advance the project. Suen hopes the work could ultimately extend even beyond bioenergy.

"Understanding how the microbes are breaking down these plant biomasses doesn't only impact biofuels. It also has implications for areas like improving digestibility of feed and nutrient yield for the cow—which could directly affect everything from milk production to feed costs to beef quality," he says.

—JILL SAKAI

Garret Suen uses an anaerobic chamber to study ruminal bacteria, particularly their ability to degrade cellulose and ferment ethanol.



Learn Among the Trees

A hands-on program takes wannabe foresters to the scene of their future profession

PHOTOS BY NICOLE MILLER MS'06 AND SEVIE KENYON BS'80 MS'06



Students examine a sample from a tree trunk core to assess the tree's health—and, right, look up to refine their birding skills.

It may sound unlikely. Certainly it sounds idyllic. But there's a university course where professors may interrupt class to watch sturgeon swim by, and where lectures may be delivered from the bottom of soil pits or gathered around a campfire.

It's Forestry Summer Camp, a three-week course offered by the forest and wildlife ecology department at CALS' Kemp Natural Resources Station near Minocqua. The camp, which takes place every other year, introduces students to the information and skills they need to assess a forest's natural resources—and also gives them ample opportunities to practice those skills in the field.

"It helps us get an idea of forestry and what it entails to see if it's a good fit for what we want to do in the future," says CALS junior Kelsey Egelhoff, who attended camp along with 26 other students this summer.

The department's idea is to have new forestry majors take the course as early as possible. "It's meant to provide new students with the excitement, the motivation and the context they need to do well in their remaining courses," says forest and wildlife ecology professor Eric Kruger, one of the camp's three coordinators.



Early on, students are divided into groups of four and assigned 250-acre tracts of land, called "compartments," in the nearby Northern Highland American Legion State Forest to survey over the coming weeks. But even just the first step—setting up a compartment's research plots—

is no small matter.

Egelhoff estimates that her group walked for eight hours one day, guided by GPS, to mark their plots with red-flagged stakes—and they only got halfway done. "But even if it's hard work, just being outside and getting to enjoy it all is really nice," says Egelhoff, who hopes to go to graduate school and study redwoods in California.

Next the groups use modern tools and techniques to assess the birds, reptiles, amphibians, mammals, soils, woody debris, shrubs and trees on their plots, gathering data for a summary of their compartments and a final research project.

"One unique feature of our camp is that we have students explore the data that they collect and answer specific questions that are pertinent to their interests," says Kruger.

The camp experience, he adds, has value beyond motivating students.

"I would guess that most employers have been through similar camps in their lives and fully appreciate the importance of these camps for the development of young professionals," Kruger says.

—NICOLE MILLER MS'06

“Red Barns” Go Green

Sustainable farms need sustainable buildings—and a CALS professor provides an option

Lofty red barns may be Wisconsin icons, but the real workhorse structure in agriculture today is the post-frame building. You can't drive very far down a rural road without spotting one being used to house livestock, store and repair equipment, shelter hay or myriad other uses. Virtually every new structure on a modern farm gets built this way, and with good reason. Post-frame buildings are versatile, easy to assemble and affordable.

And now they're becoming more sustainable, thanks to a “Green Frame” building system being developed by Dave Bohnhoff, a CALS professor of biological systems engineering.

Unlike traditional post-frame construction, Bohnhoff's system isn't based on preservative-treated wooden posts embedded into the ground. He uses non-treated wooden “I-posts” affixed to precast concrete piers. The I-posts are sandwiches of dimension lumber and laminated-strand lumber that are structurally and thermally more efficient than timber posts. Another sustainability feature relates to how the frame parts go together. The frame members that tie and brace the vertical posts and roof trusses have reinforced, deep notches at the ends that mate with adjoining pieces. This makes assembly easier, safer and more accurate. It also makes it easy to disassemble and reuse the components when a building outlives its usefulness as the farm enterprise grows and evolves.

Will all of those non-standard parts drive up the cost? Not at all, says Bohnhoff. The beams, connecting pieces and concrete piers can be fabricated on site using materials available in most lumberyards, tools found in any farm shop and basic construction skills.

—BOB MITCHELL BS'76

PHOTO BY SEVIE KENYON BS'80 MS'06



Dave Bohnhoff designed this “hot box” to test the thermal efficiency of his Green Frame buildings .

A New Way to Bucky

Tired of ice cream? Not a chance. But if you're looking for a cold, milk-based coffee drink, consider Babcock Hall's latest creation. Buckyccino, available at the Babcock Hall Dairy Store and other campus outlets, comes in coffee and mocha—and in taste tests, UW students, faculty and staff preferred it 9 to 1 over Starbucks' Frappuccino.

PHOTO BY WOLFGANG HOTELMANN BS'75 MS'79



classAct

Shelbi Jentz

“Slow” Learner



Shelbi Jentz knew that CALS would open her eyes to new ideas, but she didn't think a whole new way of eating would be one of them.

“I've always been interested in human health and the environment, but as a high schooler I had a hard time connecting the two,” says Jentz. “After coming to Madison and reading up on the Slow Food movement, I realized that the two are intricately connected.”

Jentz got involved with Slow Food UW–Madison, the campus branch of a global grassroots organization with supporters in more than 150 countries. Founded some 20 years ago in Italy, Slow Food's mission is to counter the rise of fast food by supporting locally grown food and accompanying traditions.

Slow Food–UW offers a wide range of activities. During the school year the group prepares and serves weekly lunches and dinners as well as fruit and vegetable baskets using produce from local farms and small wholesalers. Slow Food UW also conducts service projects year-round, including planting gardens and cooking weekly meals with kids in the Boys and Girls Club in south Madison.

“We're teaching kids how to eat healthy and are supporting a better future for their bodies and their community—environmentally, economically and socially,” says Jentz, who helped submit a successful Wisconsin Idea Fellowship grant to expand the program. “It's great to know that my weekly fun break from homework is making a difference!”

Jentz graduates in December with a degree in community and environmental sociology, but she'll continue to work with young people through Slow Food; she'd like to add children with disabilities to the program, inspired in part by a younger brother with autism. Her plans include earning a master's degree in public health and then going for her big dream: to start a business on her family's farm in Platteville that would combine operating a café and organic farming with raising animals (particularly horses) for use in therapy and a day camp where “people, especially those with disabilities, can learn to grow and cook for themselves and others in the community.”

Learn more at slowfooduw.org

Shelbi Jentz spent the summer interning at a restaurant specializing in homegrown lunches and teas on Inisheer Island, Ireland. There she learned how to grow food and run a small business.

HONORED with this year's CALS Honorary Recognition Award: **Robert B. and Carol Janice Black** of Columbus, **Roger A. Cliff** of Verona, and **Karl S. Klessig** of Cleveland. The CALS Distinguished Alumni Award went to **Martin E. Burkhardt** of Wausau, and **Kenneth H. Shapiro**, professor emeritus of agricultural and applied economics, received the CALS Distinguished Service Award.

NAMED Fellows of the Wisconsin Academy of Sciences, Arts and Letters: rural author and professor emeritus **Jerry Apps BS'55 MS'57 PhD'67**, genetics and agronomy professor **Molly Jahn** and life sciences communication professor **Dietram Scheufele**, for their “lifelong commitment to intellectual discourse and public service.”

HONORED with the 2013 Award for Exemplary Contributions to Education from the American Society for Biochemistry and Molecular Biology, **James Ntambi**, professor of biochemistry and nutritional sciences.

FIRST PATENT AWARDED to the CALS-based **Great Lakes Bioenergy Research Center** (GLBRC), for a heat-tolerant enzyme capable of breaking down the plant walls of cellulosic biomass for biofuel production. The technology is based on research conducted at Middleton-based C5–6 Technologies, one of the GLBRC's industry partners.



AWARDED top prizes, two teams from the CALS Food Science Club, in a national collegiate food product development contest sponsored by Disney. First prize went to

the team behind Peanut Butter Jamsicles, a popsicle version of a peanut butter and jelly sandwich. Second prize went to the creators of Pit Stop, a smoothie made of purple fruit and vegetable juices and Greek yogurt.

Number Crunching 100 YEARS OF MARSHFIELD AGRICULTURAL RESEARCH

STATION. The Marshfield ARS marked its centennial this past summer with a joint celebration with longtime partner, the USDA Agricultural Research Service. The August 16 event



featured a dedication ceremony for a new USDA lab facility and tours of new barns, a milking parlor and feeding and animal health facilities.

how birds find their way

It's a great biological mystery—how millions of migratory birds make epic journeys between their breeding and wintering grounds every year, rarely losing their way.

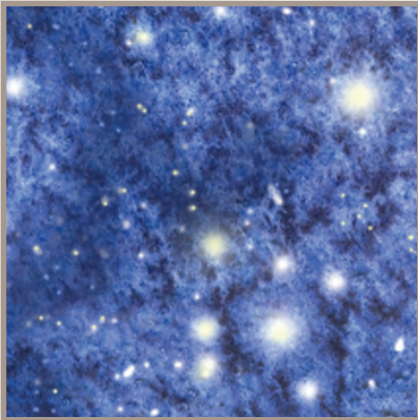


They actually use some of the same tools we do—but theirs are inborn. “Migratory birds and humans need at least a map and a compass to find their way—a map for route and distance, and a compass to stay on course,” notes Stan Temple, an emeritus professor of forest and wildlife ecology.

“Many young migratory birds are born with an innate map that gives them direction and distance to travel during migration,” says Temple. This is evident from the many young birds that make their first migration without their parents. They get a sense of direction—their compass—from environmental cues.

Other birds, such as the young of swans, cranes and some other large birds, are born with the instinct to migrate but learn a migratory route from their parents during their first migration.

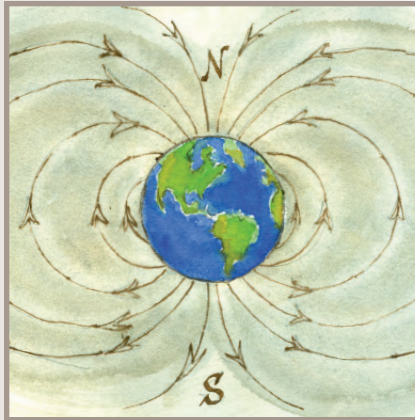
“We have strong evidence of celestial cues, the earth’s magnetic fields and other environmental cues,” says Temple. “Birds use the most accurate navigational cues available at the time, often the sun and stars. When skies are overcast, birds may fall back on geomagnetic cues.”



Celestial Navigation

Birds can get a mind-boggling wealth of information from the positions of the sun and stars—patterns that constantly are changing throughout the day, throughout the seasons and from northern to southern hemispheres.

Human sea-goers use a clock, a compass, maps and a sextant to navigate by stars and sun. (The clock is essential.) Avian travelers are equipped with several internal clocks and a genetically programmed map.



Geomagnetic Navigation

Migratory birds can use the earth’s magnetic field as a compass. The earth’s magnetism is strongest at the poles and progressively weaker toward the equator. Birds may identify north-south directions by sensing differences in the strength of the earth’s magnetic field. Very recent studies have identified a region of the migrating bird’s brain that can detect magnetism.



Geographic Mapping/Landmarks

Birds learn to use landmarks—such as mountain ranges, shorelines and large lakes—from their first migration. Landmarks are most useful as a bird gets close to its destination.

TEXT BY CORLISS KARASOV
ILLUSTRATION BY DIANE DOERING

Five things everyone should know about . . .

The Tension Zone

By David Mladenoff

1 | You will not suddenly develop migraines upon entry. Rather, a “tension zone” describes a geographic area that marks a change from one type of vegetation to another, with species from both areas intermingling in that zone.

2 | There’s a pronounced tension zone in Wisconsin. It stretches in a loose S-shape from Burnett County in the north all across the state, ending in Racine County in the south. Wisconsin’s tension zone marks the crossover between the Northern Mixed Forest—closely related to the forests of northeastern Minnesota, northern Michigan, southern Ontario, and New England—and the Southern Broadleaf Forest, which is more like forests you’d see in Ohio and Indiana. In the tension zone you’ll find plants and animals representing both of these forest types. Before the landscape in the south was developed and converted to farms, you would have seen primarily open oak savanna with forest and prairie.

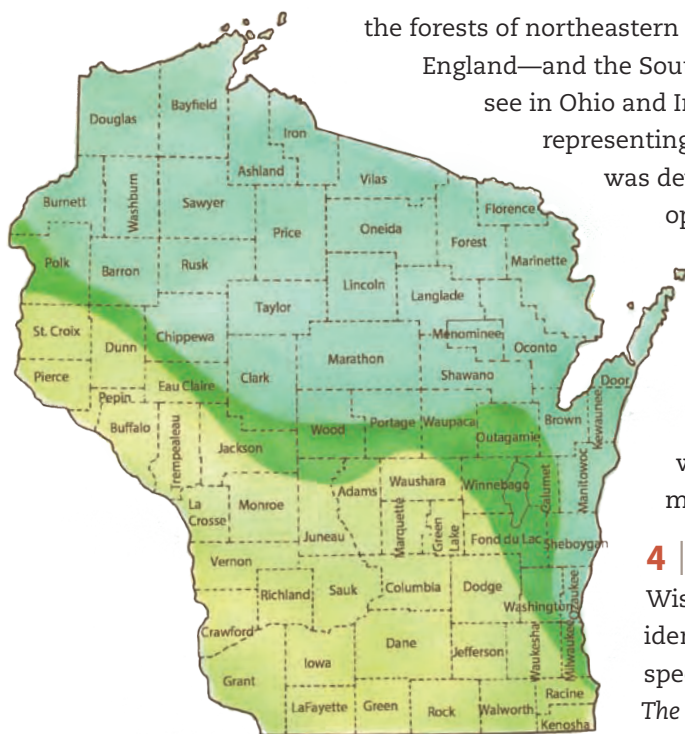
3 | It’s mostly about climate. The tension zone is marked by a climatic gradient, with cooler, moister conditions to the north and relatively warmer, drier conditions to the south. Up to the 1800s, these southern conditions were more favorable to higher populations of Native Americans—and they were a greater cause of fire, both purposeful and accidental. This maintained more open conditions in the south.

4 | It’s a fruitful area for research. John Curtis, a famous Wisconsin plant ecologist, and his graduate students in the 1950s identified the tension zone as a place where relatively more plant species had their northern and southern range limits. His book, *The Vegetation of Wisconsin* (1959), talks about this and includes a map of the number of species reaching their limits in each county.

Today, researchers are again very interested in the tension zone because of changes in land use that have endangered some native plant species. Also, with climate warming, the area is of interest to both climate scientists and plant ecologists, who are looking at how the tension zone is and will be moving north—and its potential effects on ecosystems.

5 | You’ll know you’re in the tension zone when you’re heading north and ... oaks that are dominant in southern Wisconsin, such as Bur, black and white, meet up abruptly with red and white pine as well as paper birch and tamarack swamps that are more characteristic of the north. Shagbark drops out completely and bitternut hickory becomes much less common. You’ll start seeing some birds that are absent or relatively uncommon in the south: common loon, ruffed grouse, osprey, common raven, white-throated sparrow and purple finch. You’ll also encounter northern mammals: snowshoe hare, porcupine, red squirrel, black bear and timber wolf.

David Mladenoff is the Beers–Bascom Professor in Conservation in the Department of Forestry and Wildlife Ecology



QATAR



More water for the desert—and beyond

Qatar's reserves of oil and natural gas make it one of the richest countries in the world—except when it comes to water. The desert nation is notably low on water, and what little it has often is salty.

So when CALS biological systems engineering professor Krishnapuram “KG” Karthikeyan was offered the chance to spend two and a half years at Carnegie Mellon University's Qatar campus in Doha evaluating innovative water treatment techniques and helping to establish an environmental sciences program, he jumped at the opportunity.

“In Wisconsin, my focus has mostly been on water quality issues. There, where water is scarce, I could focus on water quantity and how to make the best use of existing resources,” says Karthikeyan, who returned to Madison this fall.

Desalinating water so that it can be used for drinking and irrigation usually requires expensive equipment and a lot of energy. Karthikeyan's research—conducted in partnership with UW–Madison civil and environmental engineering professor Marc Anderson and others—focuses on capacitive deionization (CDI), an emerging method of removing salts and minerals from water by applying an electric field between carbon electrodes. The latest generation of CDI technology that Karthikeyan and Anderson's group tested proved efficient for use in desalination and capable of reducing operational costs—in fact, it can easily be

coupled with a solar energy source, a readily available commodity in Qatar. Karthikeyan believes the new technology could lead to the development of low-cost, energy-efficient inland desalination systems—a leap that would have implications well beyond Qatar.

“Not all arid countries are rich like Qatar,” notes Karthikeyan. “They don't have the money to desalinate water from the Persian Gulf or other sources. You have to keep pushing the envelope looking for low-cost, low-energy methods.”

While in Qatar, Karthikeyan also began exploring the long-term effects of using treated wastewater for growing crops, research he will continue in Madison in collaboration with CALS soil science professor Joel Pedersen. “Water reuse is going to be of growing importance universally,” says Karthikeyan. “It's already an issue in the southwestern United States and in southern California—and it will become more important in Wisconsin as well.”

Karthikeyan also took water issues into the classroom, where he taught non-science students—mostly business, computer science and information technology majors—how the environment, engineering and society are related.

“Getting non-science majors excited about topics like water management is important,” Karthikeyan says. “Linking water and food production helped them see an economically important connection. With climate change issues at the forefront, these topics are very timely, and as future entrepreneurs, these business students will play a significant role in their future companies and raise awareness among their colleagues.”

—DENISE THORNTON



PHOTO COURTESY KRISHNAPURAM KARTHIKEYAN

This commercial farm near Doha has an advanced irrigation system using water from a conventional desalination process—one that Karthikeyan seeks to improve upon in terms of energy efficiency and cost.

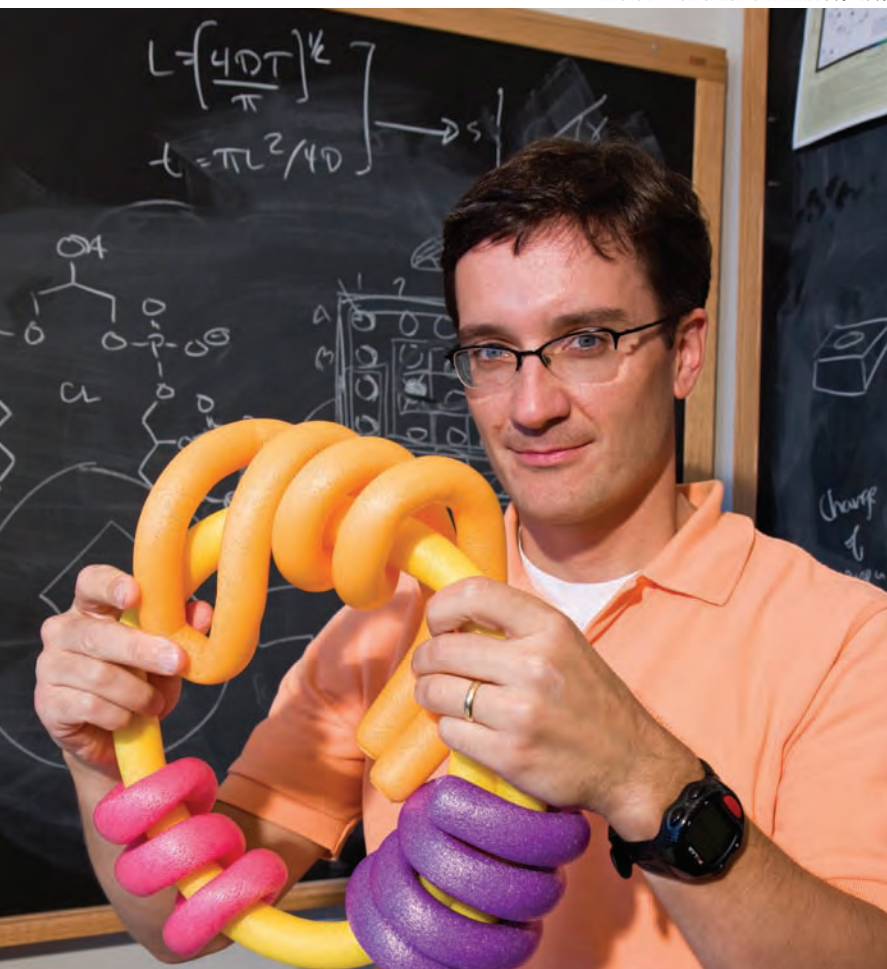
Below: Only a bit of green grows in a Qatar desert.



The Secret Lives of Bacteria

Doug Weibel has a seemingly endless list of questions about bacteria, and he is using all tools at his disposal—and creating some new ones—to find the answers

PHOTO BY WOLFGANG HOFFMANN BS'75 MS'79



CONSIDERING HOW WELL STUDIED THEY ARE, SOME LARGE GAPS remain in our scientific understanding of bacteria. For instance, we don't yet know how bacterial chromosomes are separated into daughter cells during cell division or how their complicated chemical language really works. Using techniques from a broad spectrum of fields—including biochemistry, genetics, materials science and engineering—biochemistry professor Doug Weibel is designing advanced microtools and novel experimental setups to answer, for the first time, persisting questions about these surprisingly complex microorganisms. Through this basic work, he's finding novel antibiotics and other interesting drug candidates.

Why are there still so many major unknowns about bacteria? How can that be?

The issue with bacteria is they are so small. By comparison, eukaryotic cells are enormous! For a calibration point, a human hair is about 100 microns in diameter. That's about the thickness of a piece of scotch tape. And a eukaryote—when it's spread on a surface—is maybe 40 microns in diameter. But the bacteria we look at are about one micron long, and their short axis is just several hundred nanometers. Until recently it was very difficult to look at them under a microscope and see anything useful going on inside the cell. Fortunately, there's been a revolution in optical microscopy techniques over the last five years, and now we can see inside them with pretty good resolution.

How has our understanding about these microorganisms grown in recent years?

Historically, bacteria have always been thought of in the context of the way that we studied them: as individuals. They were always freely suspended in liquid nutrients and were dilute enough so that they never made physical contact with each other. But it's pretty clear now that many bacteria in the ecosystem exist in tight-knit communities.

And during certain developmental stages, bacterial cells will display collective dynamics, where they are no longer acting as individual cells—as little one-bit processors—but are actually making collective decisions. In these cases, they are communicating and acting more like a multicellular organism—as something a lot more sophisticated than we've ever really appreciated.

Tell me more about this collective behavior.

A lot of people know that bacteria swim in solution, but they also swim in groups on surfaces. This collective movement on surfaces is called swarming.

As the bacterial community moves across a surface, the cells mix—and this mixing ensures that all of the cells get nutrients and growth factors to continue replicating. Swarming allows the cells to grow explosively and to colonize whatever niche they're provided with.

What are you trying to learn about swarming in your lab?

We're trying to figure out two things. One has to do with behavior: How does the motion of individual cells on a small scale lead to the pattern formation—the continuous mixing—of the swarm on a large scale? The other question is really the biochemistry of how it works. How do cells sense the surface and then change their morphology to interact with it?

This work should tell us some basic rules about how cells sense things outside of themselves—from fluids to surfaces to other cells. I think this is super interesting.

Can you describe one of the microtools you've developed to study bacteria?

Sure, but let me give you some more context first. In addition to studying the physical interactions between bacteria during swarming, we're also interested in the role that chemical communication plays

reporter protein when it receives that signal. You put these bacteria into various regions of the waffle and let them grow into biofilms. The walls physically constrain the cells, but they permit the free diffusion of small molecules. So the chemicals just diffuse through the waffle and then we measure and quantify the level of activation of the signal-receiving biofilm at different length scales away from the signal-sending biofilm.

We've used this waffle tool to determine that biofilms can eavesdrop on each other when they're within about one centimeter. One interesting thing we found is that the chemical signals from one biofilm really don't seem to have a substantial effect on nearby biofilms. That was a little bit surprising to us! The signal had a slight effect on growth rates, but it really had no obvious effect on community structure.

So what does that tell us? Mainly that we have a really incomplete understanding of chemical signaling in bacteria. There's a lot left to learn.

“Many bacteria in the ecosystem exist in tight-knit communities.”

in the development of swarms. And swarming is just an early stage of biofilm development, so we are also interested in biofilms, which are basically bacterial communities that are firmly attached to surfaces.

One question that's been in the field for a long time is, what is the length scale over which these chemical signals can be propagated? That is, if you have a swarm or a small early-stage biofilm that's secreting signals, how far away does another biofilm have to be before it can no longer eavesdrop? To answer this question we created a microtool that we call the waffle.


The waffle?

You know how waffles have those little squares, right? Well, instead of the waffle being bread, the waffle in our case is made out of a special gel, and we can control the size of the cubes in the waffle and the thickness of the walls between them.

Using this tool we can grow biofilms that are spatially confined from each other. So you can take an organism that's engineered to send a signal and then another organism that's engineered to produce green fluorescent protein or some other measurable

Are there long-term applications for this work?

Eventually we want to look for small molecules that can disrupt the ability of bacteria to differentiate into the swarming phenotype, as well as molecules that promote this behavior. We'll use these as research tools to study swarming in more depth in the lab, but you can imagine that small molecules that can disrupt bacterial swarming could have a biomedical use. They could be new antibiotics.

And, actually, we already have some really cool compounds, and we're working with the Wisconsin Alumni Research Foundation to patent some of them. We found most of them through high-throughput screening, using the UW-Madison Keck Laboratory for Biological Imaging's library of approximately 80,000 unique small molecules. Big pharma does this kind of stuff all of the time. They screen huge libraries of millions of compounds against a target, usually a well-validated target. The difference is we're studying targets that nobody has worked with before. There just aren't that many people in academia screening small molecules against certain classes of cell biological proteins. And we've found quite a few promising antibiotic compounds this way. 



VITAMIN D—the hype

It's the “miracle vitamin” that was discovered by a CALS-trained researcher—and our scientists have been prominent in exploring it ever since.

What have we learned about the true benefits of vitamin D and its promise?

By Nicole Miller MS'06

TWENTY-FIVE THOUSAND YEARS ago, our Paleolithic ancestors got plenty of sun. Scantly draped in animal hides, they spent their days roaming outdoors, hunting and gathering food. With so much sun exposure, they made a lot of vitamin D, the “sun vitamin,” through their skin—around 10,000 units per day, biologists estimate.

Today, with lifestyles that keep us indoors and in vehicles, we don't get out in the sun nearly as much. And when we do, we often slather ourselves in sunscreen to avoid skin cancer—a protective measure that unfortunately also blocks production of vitamin D. Although we get vitamin D from our food, primarily through fatty fish and fortified milk, yogurt and cereal, there's been growing concern over the past decade that we aren't getting enough, and that we may be

missing out on a number of the vitamin's health benefits that we're just starting to understand.

And if newspaper headlines are to be believed, we could be missing quite a lot. Week after week, articles are published touting vitamin D's protective role in a wide range of diseases and ailments—cardiovascular disease, hypertension, cancers of the colon, breast and prostate, cold and flu, asthma, autism, depression, osteoporosis, arthritis, neurodegenerative disease, multiple sclerosis, type I diabetes—and even longevity. But don't count on all of these studies panning out, warns CALS biochemist Hector DeLuca. DeLuca should know—he's a globally recognized authority on vitamin D whose six decades of research laid the groundwork for much of what we know and are discovering about it today.

and the hope

PHOTO BY WOLFGANG HOFFMANN BS'75 MS'79



Hector DeLuca holding one of his latest creations, “2MD,” a vitamin D-based compound for dialysis patients. DeLuca has received more than 1,500 patents—and they’ve earned more than \$500 million in royalties, says the Wisconsin Alumni Research Foundation.

“I’m really worried about how much attention vitamin D has received lately because we did this with vitamin E many years ago—where vitamin E was going to cure all kinds of things and of course it didn’t—and it’s completely off the radar screen now,” DeLuca says. “I don’t want that to happen to vitamin D because there are many places where it’s really effective.”

So what are vitamin D’s health benefits, and what do we need to do to

maximize them? Both are huge questions in the scientific and medical fields. At this point, only one thing is certain: vitamin D is essential for strong bones. Beyond that, the jury is out because we don’t have the large, randomized human clinical trials required to make those calls—yet.

Nevertheless, there have been a significant number of promising *in vitro* and animal studies over the years, enough to convince many vitamin D

researchers to increase their own doses. And when the U.S. Institute of Medicine in 2010 raised the Recommended Dietary Allowance for vitamin D from 400 to 600 units per day for adults—taking into consideration only the vitamin’s impact on bone health—it didn’t sit well with many members of the vitamin D research community who think the recommended intake should be considerably higher.

“Many people thought that was



In 1923 CALS biochemist Harry Steenbock figured out how to biofortify food with vitamin D by exposing it to ultraviolet light, a discovery that led to the almost complete eradication of rickets.

Steenbock's request, DeLuca stayed on to run his lab. "Steenbock was nearing retirement and wasn't physically well, so he asked if I would stay after my Ph.D. and direct the research in his lab," says DeLuca. The offer turned into a faculty position in 1959.

"At the time there was a lot we didn't know about vitamin D and how it makes better bones," says DeLuca. "I thought, 'Why don't we try to figure out how it works, and maybe we'll learn how certain diseases take place?' That was my motivation."

And figure it out he did. By administering radioactive vitamin D to animals and then following its path through their bodies, DeLuca discovered that the vitamin D we get from the sun and through our diets isn't the biologically active form of the compound. In fact, to become activated, it must undergo two sequential changes. First,

it's converted in the liver to calcidiol (25-hydroxyvitamin D₃), which is the predominant form that circulates in the blood. Second, this circulating form is converted in the kidneys to calcitriol (1,25-dihydroxyvitamin D₃), a steroid hormone.

DeLuca patented these discoveries in 1971, and by 1974 had defined the vitamin D endocrine system—how the body's organs use vitamin D to maintain steady calcium levels in the blood. When levels drop too low, the kidney produces more calcitriol, signaling to the small intestine to increase calcium absorption from food and to the bones to disperse some of their mineral stores.

Interest in vitamin D grew after this groundbreaking discovery, and a number of labs joined the race to understand the hormone's mode of action in the body. Two groups—DeLuca's and one that included Wes Pike—solved the puzzle at essentially the same time in

absolutely absurd—that people should actually be taking anywhere from 2,000 to 4,000 units a day," says Wes Pike, another CALS vitamin D researcher who is internationally respected for his work. "But the committee didn't take any risks. They discounted all the other things that people believe higher amounts of vitamin D could be beneficial for—muscle function, a healthy immune system, combating cancer and so much more. And some of those things are real, it's just that there's no strong clinical evidence for them yet."

Fortunately, there soon will be a lot more solid evidence about vitamin D's health impacts—on heart disease, stroke, cancer and more—thanks to a large clinical trial that's gearing up at the Institute of Medicine's request. As scientists, doctors and the public wait for answers, CALS researchers are working in parallel, leading an equally important effort to shine a light on vitamin D's mode of action inside the body and to

explore and understand new vitamin D-based treatments for disease—as they have for almost a century.

THE STORY OF VITAMIN D is largely a CALS story. It was identified by biochemist Elmer McCollum, who discovered vitamins A and B as a young faculty member at CALS before joining Johns Hopkins University, where in 1921 he found a substance that cured the bone-softening disease rickets—and named it vitamin D, as it was then the fourth vitamin known to science. In 1923 CALS biochemist Harry Steenbock figured out how to biofortify food with vitamin D by exposing it to ultraviolet light, a discovery that led to the almost complete eradication of rickets by the mid-1940s.

As his last graduate student, Steenbock in 1951 brought on Hector DeLuca, a promising young chemist from the University of Colorado. At

the late 1980s, deciphering the genetic sequence of the receptor molecule for the vitamin D hormone in rats and humans, respectively. It turned out to be an intracellular receptor that, when bound to calcitriol, enters the nucleus and alters gene expression.

"The medical impact of all of this work was enormous. All of the vitamin D-resistant diseases came into focus," says DeLuca. "Some were due to defects in the enzyme that makes the vitamin D hormone. Others were due to defects in the vitamin D receptor." DeLuca's early findings alone led to treatments for vitamin D-resistant rickets, hypoparathyroidism, renal osteodystrophy, drug-induced bone disease and osteoporosis using synthetic calcitriol.

Even before the receptor was cloned, researchers had begun to examine its distribution in the body's tissues. They found it, as expected, in the intestine, bone and kidney, where it plays a role in the vitamin D endocrine system. But its presence in so many other tissues—including breast, colon, lung, ovary, prostate, parathyroid, the pancreas' insulin-producing cells and some immune cells—came as a huge surprise, giving scientists their first clue that vitamin D likely plays a much broader role in human health. "That's when we realized vitamin D has other biological actions in the body," says DeLuca.

When DeLuca discovered the active hormone form of vitamin D in 1970, he also found more than two dozen other very similar-looking molecules in the body. Although all of these metabolites turned out to be inactive, DeLuca was struck by an idea: to try to build vitamin D-like compounds, or analogs, that could be therapeutically useful.

While the vitamin D hormone itself can be—and is—used to treat a number of diseases, it has severe side effects that limit how much can be administered. That's because calcitriol levels are tightly regulated by the body. No matter how

much vitamin D you get through sun exposure and diet (within reason, of course), the amount of active vitamin D hormone in your system stays about the same. But when patients are given the hormone directly, it bypasses this regulation and tends to increase blood calcium levels, a dangerous condition known

DeLuca is always looking

for the next best thing—

the new analog that changes

the shape of the vitamin D

receptor to give it even more

desirable properties.

as hypercalcemia. But analogs, DeLuca figured, could possibly get around this problem if ones could be found that maximize vitamin D's effect on desired tissues while minimizing its effect on the small intestine and bone—and thereby reducing hypercalcemia. So, in addition to basic research, DeLuca launched a program to synthesize novel vitamin D analogs and test their properties.

The program has been a stunning success. Over the years, DeLuca's lab has synthesized more than 800 unique vitamin D hormone analogs, some of them exquisitely tissue-specific. Of his analogs, several have become pharmaceuticals that have impacted the lives of millions of people suffering from osteoporosis, vitamin D-resistant rickets

and bone diseases associated with kidney failure. In the latter case, the top two drugs on the market—Zemplar and Hectoral—are DeLuca's. They replace the vitamin D hormone the patient's kidneys can no longer make, but with significantly less hypercalcemia.

"These drugs serve almost half a million people on dialysis," says Paul Kellerman, a nephrologist with the UW-Madison School of Medicine and Public Health and medical director for Wisconsin Dialysis. "And when you take into consideration other people with late-stage kidney disease, you are talking about a patient population that's probably over a million that needs these medications."

DeLuca is always looking for the next best thing—the new analog that, because of its slightly altered shape, changes the vitamin D receptor's conformation to give it even more desirable properties. He believes he may have a new one for dialysis patients he's calling "2MD." The compound is a top prospect for Deltanoid Pharmaceuticals, a company DeLuca co-founded in 2000 with his fellow biochemistry professor and wife, Margaret Clagett-Dame, to help develop promising analogs to the point where large pharmaceutical companies will take over. "Each of these compounds for dialysis patients has been an improvement on the one before it—doing a better job of controlling parathyroid hormone production without raising serum calcium," he says. "That's the game we're playing with analogs."

Through the Wisconsin Alumni Research Foundation (WARF), DeLuca has filed and received more than 1,500 patents on his analogs and other inventions. WARF estimates these patents have earned more than \$500 million in royalties over the past 30 years, much of which has gone to fuel UW-Madison's research engine.

Interestingly, WARF's very incep-

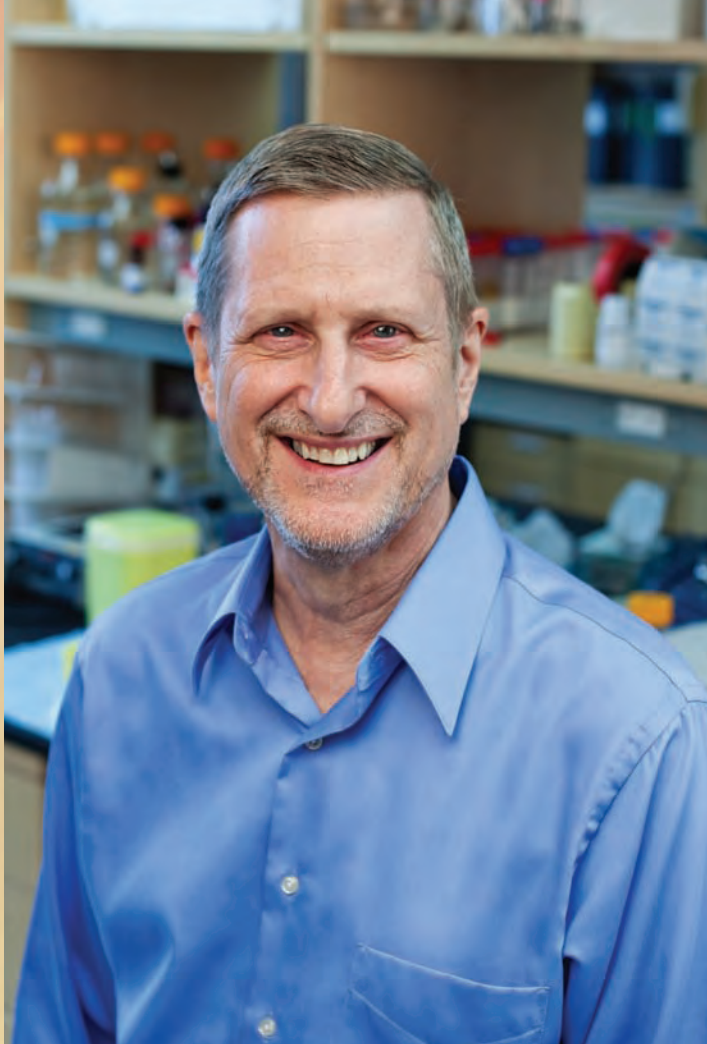


PHOTO BY WOLFGANG HOFFMANN BS'75 MS'79

Biochemistry professor Wes Pike literally “wrote the book” on vitamin D—and in his lab he focuses on how the vitamin D receptor regulates gene expression.

“At my age, I’m more interested in the medical applications, so that’s the direction my lab has taken,” he says. “Wes is taking the next step at the molecular level.”

ONE COULD say that Wes Pike wrote the book on vitamin D. It’s true—literally. The third edition of *Vitamin D*, a 2,000-plus-page textbook he co-edited, came out last year. Within the field, Pike’s expertise focuses on how the vitamin D receptor regulates gene

expression. Since joining CALS in 2001, he’s established a respected, highly productive lab that interacts regularly with DeLuca’s group.

“We have common research meetings every week and we’ve worked on a number of projects together over the years,” says Pike. “It’s a really good collaboration because without understanding how the basic hormone affects gene regulation, we can’t possibly understand the nuances through which Hector’s analogs work.”

This regulation fascinates Pike because it orchestrates all of vitamin D’s various biological effects in the body. His goal is to understand its intricacies. “We’re interested in where the vitamin D receptor binds to DNA, how it binds and how it actually regulates transcription—what activator proteins and other protein complexes it recruits,” he says. While the vitamin D receptor is believed to regulate around 200 genes, Pike focuses his attention on a key few—those he believes have the greatest therapeutic promise.

One of his targets is the vitamin D receptor gene itself. Without receptors, cells can’t respond to vitamin D. Pike would like to find a way to turn the gene on—or dial it up—where it’s needed. “If we could take a tissue and upregulate the receptor, then we could increase the tissue’s sensitivity to existing levels of the vitamin D hormone. That’s a good thing. That’s a therapeutic possibility,” he says.

Pike also is interested in the RANKL gene, and he’s not the only one. The gene’s protein, also called RANKL, promotes bone resorption and is associated with osteoporosis and weak bones. Pharmaceutical giant Amgen developed an antibody against the RANKL protein—which binds and neutralizes its activity—to treat osteoporosis in post-menopausal women. The drug, known as denosumab, is sold under the trade name Prolia for this purpose, and it also has been approved to prevent fractures caused by cancers that have spread to the bone. Prolia works wonders in preventing bone loss, but there can be problems with antibody treatments.

That’s because many proteins have multiple effects in the body, good and bad. The RANKL protein, for instance, is known to help boost immune function—but the antibody wipes out that activity, too. And a single antibody treatment can last for months. “Once it’s in you, you can’t change anything for four months,” says Pike, who is exploring an alternative treatment approach. If he can learn enough about how the vitamin D receptor regulates RANKL’s expression, he believes he may be able to turn off the RANKL gene specifically where it’s not wanted.

“So rather than allow the cells to make RANKL and then shut the protein down on a global scale—on a total body scale—we want to find a way to shut the gene down at its transcriptional roots, so to speak, in a cell-selective way.

tion rests on CALS’ vitamin D research. Harry Steenbock conceived of founding it as the nation’s first university technology transfer office to collect, invest and distribute money earned through research-based discovery. WARF’s first licensing agreement with Quaker Oats in 1927 led to the fortification of breakfast cereals with vitamin D.

DeLuca, although he formally retired last year at age 81, still has an active lab employing five scientists who synthesize new vitamin D analogs under his direction. He also continues to study vitamin D’s role in immune disease and is screening for analogs that could help protect insulin-producing islet cells—or islet cell transplants—in patients with type I diabetes. “I think type I diabetes is an area where vitamin D can really help,” he says.

About a decade ago, DeLuca was instrumental in recruiting Wes Pike to the UW–Madison campus, a move calculated to ensure the department’s continued leadership in basic vitamin D research.

We want to turn it down in the skeleton, but not in the immune cells,” says Pike.

To that end, Pike recently set up a sophisticated system to quickly screen for analogs and other compounds that fit the bill. A positive hit could yield a next-generation drug more targeted than Prolia. He’s also found some cell-specific differences in the DNA binding sites that the vitamin D receptor uses to regulate the RANKL gene—information that also could be leveraged in a therapeutic intervention.

AS SCIENTISTS AT CALS and around the globe work to unlock the molecular secrets of vitamin D and develop promising new therapeutic compounds and approaches, a massive clinical trial is under way that should be able to answer—definitively—many of the medical establishment’s most

pressing questions about the vitamin’s role in human health and disease. The study, known by the acronym VITAL, will track the health outcomes of 20,000 older men and women for five years as they take either vitamin D (2,000 units per day), fish oil, both supplements or a placebo. The study was designed to monitor for heart disease, stroke and cancers—particularly cancers of the colon, breast and prostate—but the investigators also plan to watch for effects on diabetes, high blood pressure, bone density, vision, memory loss, depression, autoimmune diseases and other conditions.

“In 10 years we’ll know an awful lot more,” says Pike. “I think some of these health effects will be borne out, and by then we’ll have figured out the mechanisms that make vitamin D protective.”


In the meantime, DeLuca offers this advice: “My message is to be sure you get plenty of vitamin D so that you’re vitamin D normal—not deficient—because vitamin D deficiency causes a lot of problems.”

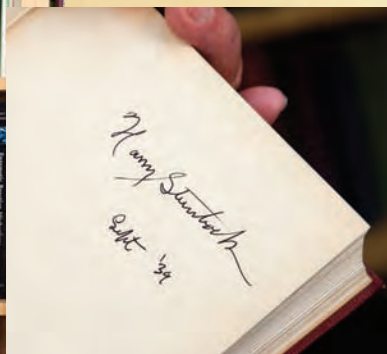
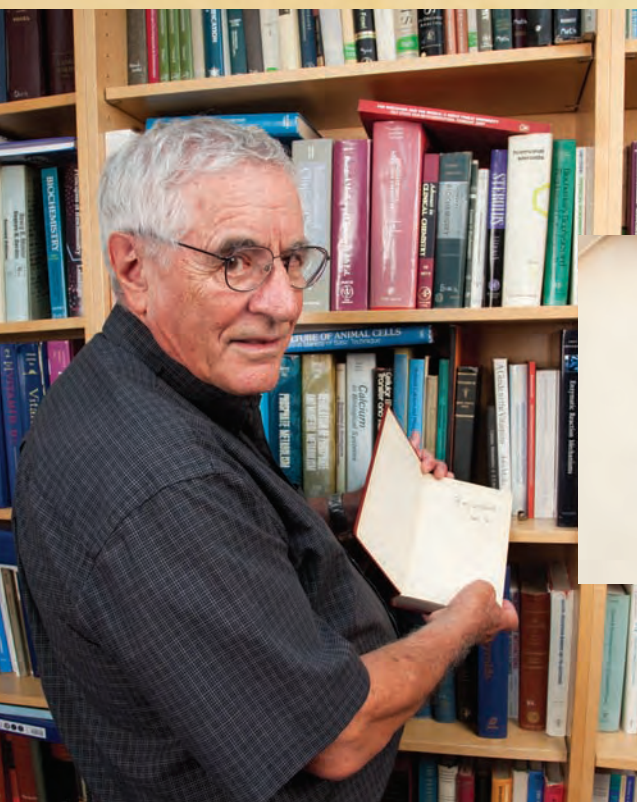
Officially, deficiency

A massive clinical trial is under way that should be able to answer, definitively, many of the most pressing questions about vitamin D’s role in human health and disease.

is defined as having less than 20 nanograms per milliliter (ng/mL) of calcidiol, the circulating form of vitamin D, in the blood. But there’s a lot of debate about where the bar should be set, with many calling for levels of 30 or 40 ng/mL as the lower limit. But there’s no need for healthy people to run out and get tested. Just be sure you get your 600 units of vitamin D per day—and don’t be afraid to get a little extra.

When the Institutes of Medicine set vitamin D’s RDA in 2010, it upped the vitamin’s “tolerable upper limit” for adults—the level deemed safe for most people in that group—from 2,000 to 4,000 units per day. “So up to 4,000, you’re okay. If you go above that, you’re taking a risk,” says DeLuca, who currently takes around 3,000 units per day between food and supplements.

Pike, like DeLuca, isn’t waiting for the results of the VITAL study or new government guidelines to up his dose. After reading enough promising research studies, Pike made a decision: “I said I’ll take 4,000 units, just in case.” 



DeLuca treasures a pioneering textbook about vitamins that was given to him and signed by his mentor, Harry Steenbock.

PHOTO BY WOLFGANG HOFFMANN BS'75 MS'79



COPING WITH THE

For Wisconsin farmers dealing with wild swings in weather,

Farmer Kirk Leach standing near the “great divide”—the irrigated versus unirrigated corn on his farm during this year’s scorching summer.

It’s late May, weeks before

southern Wisconsin would be locked into a scorching drought, and Kirk Leach BS’78 is worrying about the weather. The grass around his house is already brittle and yellow. A hose snakes across the driveway, trickling moisture over some sad and thirsty new aspens.

But it’s the corn planted just on the other side of his kitchen garden that troubles him. There are patches—hand-high daggers of green—but there is not enough height, not enough uniformity and just plain not enough of it coming up. “This is the last corn I planted, two weeks ago tomorrow,” he says. “You’d expect a little more growth than that.” He squats above an empty row, probing through three inches of crumbling earth until he unearths a seed, hard and polished as if just spilled from the bag.

Every farmer has an opinion about the weather. Leach remembers when he was young and everything germinated, even seed just thrown on the ground. But in Leach’s mind it’s these little mini droughts—two or three weeks in a row without rain—that have his attention. “Whether that’s significant enough or evidence of climate change I don’t know,” he muses. “Is it because I was a young, carefree 20-year-old like my sons that I didn’t think about it? Whereas now all the responsibility is mine, and so I’m worrying about every time the next rain is going to come?”

Climate

adaptation is the key.

By Erik Ness

(Right) Kirk Leach invested heavily in an irrigation system. “The long and short of it is, we’re ensuring our productivity with irrigation,” he says.

That’s the kind of conundrum that climate change presents to Wisconsin farmers as they’re forced to adapt to wild swings in the weather. Some trust the science, but many have questions, too. They’re all practical scientists with their own, very personal sets of data and research concerns.

The reality is that they’re already adapting to climate change, just as they’ve adjusted to so many other challenges. They’re planting earlier. Schedules for vegetable canneries and cranberry harvest have shifted later to reflect consistently warmer autumns. Even the USDA plant hardiness zone map was updated this year, showing Wisconsin a half-zone warmer than in 1990.

But the forecast calls for a whole lot more, in the way of both opportunity and challenges. The simplest take is that slowly warming temperatures may help boost agricultural production by extending the growing season. But higher temperatures could also reduce corn and soy yields and lead to more pest problems. Higher annual rainfall and more intense storms could mean more soil erosion.

Those broad-brush projections are statistical abstractions for any given farmer. Wherever the weather compass spins, the challenge is to craft a livelihood from sunshine, dirt and water.

The silver lining: a generation of stress in the farm economy has left a population of survivors, farmers who are hungry for information and who are lean and agile enough to act on it. If you have the skill and luck

to bring a harvest to market, prices have been good. But with input costs soaring ever higher, extreme climate events can make farming seem more like placing a bet than following a business plan.

The growing season in Wisconsin

has lengthened by two to three weeks over the last half-century—a big change over a short time. But because spring can be cold and late one year and early the next, some people tend to chalk it up to variability.

Agronomy professor Chris Kucharik BS’92, PhD’97 has no doubt that it’s climate change. Simply put, the earth is like a giant car, and increasing the amount of carbon dioxide is like rolling

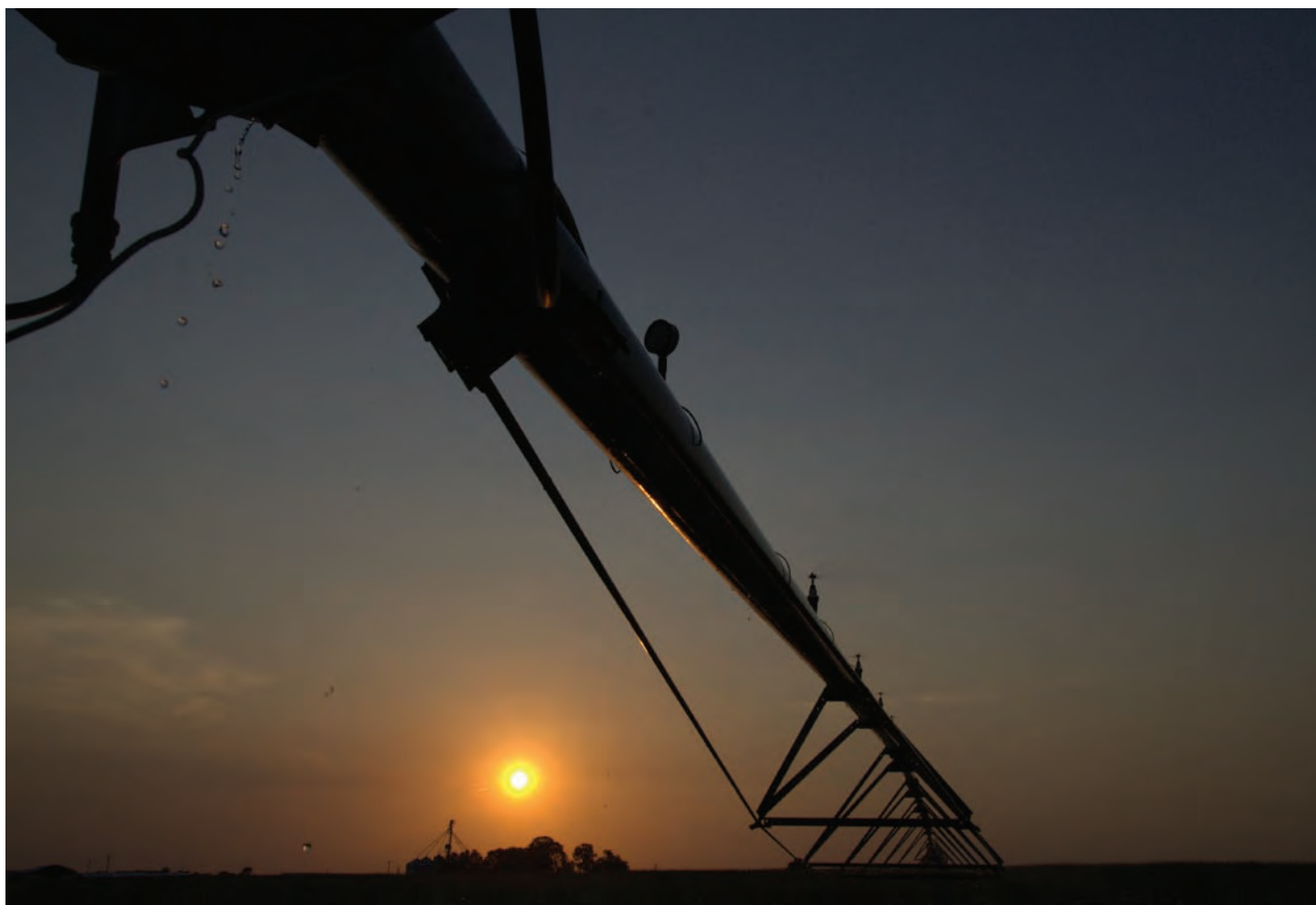
up the car windows on a sunny day. But under the hood is a series of massive mathematical models that attempt to mimic and forecast such fundamental earth forces as wind, temperature, evaporation and photosynthesis.

Early in his career Kucharik spent a few years in the far northern boreal forests of Canada helping to fine-tune these climate models. When he grew dissatisfied with the abstraction, he decided to try something closer to home: fit agriculture into the models. Honing in on local, Midwestern problems, he became one of the state’s foremost experts on climate and agriculture, with a joint appointment in the CALS agronomy department and the Nelson Institute for Environmental Studies.

Kucharik knows better than most how dense the science can get, but he is adamant that evidence for climate change is clear and overwhelming. In fact, he can even show how it’s helped agricultural productivity in some locations in Wisconsin over the last few decades. It’s not easy to tease out, because crop genetics and management practices have significantly improved over the same period. But trends in precipitation and temperature during the



Drought can upset the critical timing between the emergence of corn’s pollen-laden tassels (shown here) and the emergence of its silk, where the pollen is caught and guided into the ovule to become kernels. If the tassel is out before the silk, which can happen during a drought, the amount of time available for complete pollination is reduced along with corn crop yields and quality.



growing season from 1976 to 2006 explain more than a third of the variability in corn and soybean yield trends, he says.

The bad news is that this productivity trend might be hurt by continued warming without adaptive measures. Indeed, for each additional Celsius degree of future warming, corn and soybean yields could potentially decrease. With luck, modest increases in summer precipitation could offset this. Unless, of course, it fails to rain at all.

This general forecast first came in 2007 from the Intergovernmental Panel on Climate Change, the international scientific body that has coordinated the work of thousands of scientists around the world. They projected that without adaptive measures, ag productivity in higher latitudes could decrease by 5 to 20 percent as temperatures climb.

As a co-chair of the ag working group of the Wisconsin Initiative on Climate Change Impacts (WICCI)—a partnership between the University of Wisconsin, the Wisconsin Department

of Natural Resources and an array of other agencies and public and private institutions—Kucharik and his collaborators have been checking these projections for Wisconsin. Without adaptive measures, a 2 degree Celsius increase in maximum monthly average temperatures in July and August could reduce yields by 6 percent for corn and 2 to 4 percent for soybeans. A 4 degree increase could lead to corn and soybean yield losses of 22 to 28 percent and 13 to 24 percent, respectively.

That's a projection over decades, but so much on-farm decision-making is short-term. "If I walk into a room of producers and say that 50 years from now our summer temperature will be on average 3 degrees warmer, so what?" Kucharik asks. "It means nothing. They're worrying about next year.

"I hear a lot of concern," he continues. "But I also hear, on the flip side, that people have been farming for three generations and obviously have been adapting to changes in climate with no significant problems thus far."

Speaking months before the rain stopped and the summer became ruinous for many, Kucharik looks prescient now: "I think the risk is elevated for failure, not only in production but also in economic failure."

Kirk Leach and his brother Kent

farm 1,500 acres scattered south and east of Janesville. Driving around the spread in May, Leach ruminates about his choices this year. For example, the early spring favored weeds; they had to be knocked back before planting. Leach opted to do that by turning the soil with a disc cultivator, at about half the cost of herbicide. He wonders if that cost him precious soil moisture. "Now our fields sit, just waiting on a rain before things start germinating," he says.

Not everywhere, though—he's got 500 acres under irrigation. We drive by the newest rigs, covering 65 acres. The total cost of these center-pivot units will be \$114,000 and their high capacity wells, another \$30,000. That's

Right: Cows struggled (but made it out safely) during severe flooding in Sauk County in 2008. Right, below: Also in Sauk County, a flooded field.

Below: Thawing caused by warm winter weather increases manure runoff from fields—leading to higher phosphorus content in Wisconsin lakes and waterways.

a lot of money, but Leach says it will pay for itself in less than 10 years. It's a hedge against years like this, and it's also allowed him to diversify into higher-margin specialty crops like mint and peas.

"It's a hell of a good aquifer," Leach says of the water beneath the Rock Prairie. But he knows scarcity is relative. What if every field is irrigated and industrial Janesville keeps growing? "Whether there will be an issue someday or not, who knows?"

Sitting in his truck at the edge of a cornfield, Leach grabs a binder filled with Google maps of his fields, each covered with notation.

"Variability," he says. "You're playing a guessing game with that every year." Besides the irrigation, he spends a lot of time tinkering with corn hybrids, and these maps keep track of the 27 varieties he has stretched over 1,000 acres.

"Probably it's my susceptibility to my salesmen," he laughs. Decades of his own experimentation have shown that he generally gets better yields on longer-maturity hybrids. And with seed corn now running around \$300 a bag, he's never satisfied with just last year's winner. "Information is good," he says, more seriously. "You've gotta push the pencil. Every habit you had, you have to constantly question it."

That's an attitude guaranteed to make CALS/UW Extension agronomists Joe Lauer and Shawn Conley BS'96 MS'99 PhD'01 smile. Lauer is the state's leading corn agronomist; Conley specializes in soybeans and small grains. Between them they have 24,000 test plots scattered across the state, maintaining a series of long-running experiments that test planting dates, new hybrids, crop rotations and numerous other management variables.

Lauer acknowledges that this has been a challenging season—as of early August, 20 to 30 percent of the southern

tier of cornfields were barren—but he hews carefully to a long view. "Farmers experience weather variability all the time," he says. Think March was crazy? He has seen farming logs dating from the 1850s that talk about catching grasshoppers in January in the Upper Midwest.

Lauer says a huge part of climate change adaptation is the continuous improvement of genetics being pursued by the public and private sectors. This year alone, 510 varieties of corn are being tested in his trials, including new strains that tout improved drought tolerance. For example, recently developed resistance to the European corn borer helps prevent stalk damage, which allows the plant to better withstand heat extremes. More traits are coming, but it can take seven to 10 years for new varieties to enter production.

Continuing research in crop rotations could improve productivity, decrease inputs and reduce carbon emissions. The research predates his tenure, and he hopes it will continue beyond. "There has to be a public investment into these kinds of projects," says Lauer, noting that industry could not justify the investment. "Who knows what the questions are going to be?"

Farmers, he notes, have 30 or 40 seasons to get it right. And even simple differences in how each farmer responds to the challenges of the season produce a variability that strengthens the farm economy. "Farmers try a lot of different things," Lauer says. "Next year if we can plant in March, there will be more people doing it."

Indeed, Conley planted soybeans on March 29th. Twenty years ago most soybeans weren't planted until the end of May or the first part of June. Now almost half of soybeans are in the ground by mid-May. That's partly due to warming trends, but it also reflects better planting equipment, better genetics and new seed treatments.

But research sealed the deal, showing that earlier planting maximizes yield. Plant after May 8th and you start losing about four-tenths of a bushel per acre per day.

That's the kind of information that growers need to capitalize on. "Growers today are technologically savvy. They are quick to move if they see an opportunity," says Conley. "The challenge is sorting out which technology pays and enhances productivity and which technology doesn't."

Another valuable conclusion: no-till



PHOTO COURTESY HERB GARN, USGS



PHOTO COURTESY SAUK COUNTY DEPT. OF CONSERVATION, PLANNING AND ZONING



techniques for soybean yield comparably to conventional practices. That's important because high commodity prices are tempting cultivation on steeper slopes. Meanwhile, extreme rain events are increasingly common. Unless conservation changes are made, soil erosion rates could double by 2050 compared to 1990. "We need to be able to protect our soil," says Conley.

Indeed, soil health is a critical element of agricultural resilience—the ability to withstand stress. Healthy soils are more productive. They also retain more moisture, generally demand fewer inputs and return more in the way of ecosystem services (waste decomposition, water filtration and other benefits).

It's no wonder that many of the climate change adaptation recommendations from WICCI's ag working group feature a heavy dose of soil conservation.

The almost complete laundry list: expand adoption of currently accepted soil conservation practices; review public policy on soil conservation subsidies; improve measurement and monitoring of soil conservation programs and practices; investigate how bioenergy policies

and changing production practices influence soil conservation; devise new metrics for the sustainability of soil and water resources; research better accounting of the costs and benefits of soil management choices.

But other forms of adaptation might not even take place in the field. For example, heavy rain poses challenges besides erosion. Many of Wisconsin's vegetable crops mature underground—potatoes, carrots, onions—and are vulnerable to damage when soil is saturated. High humidity favors disease develop-

ment, and the overflow of municipal waste systems can flood downstream fields with pathogens.

CALS/UW Extension horticulturist AJ Bussan PhD'97 is investigating potential plant traits to meet these challenges, but he also says that the vegetable industry has created action plans to respond to major rainfall events from a safety and quality perspective. Even simple refinements in storage techniques—particularly temperature and ventilation management—can help overcome damage.



Plague of Pests

If you enjoyed the early earthy morel or the delicate blooming of lilacs ahead of schedule, know this—the dreaded seed corn maggot cometh too. These three harbingers of spring are typically in sync, and remained so this year, all of them three weeks early.

Wisconsin winters offer a huge pest management advantage over more southern climes, where farmers have to manage aggressively for resident insect pests year-round. A little extra heat and a little extra time is a compounding problem. For the onion thrips it can be the difference between a single female breeding 30,000 replacements—or 15 million.

CALS/UW Extension entomologist Russ Groves says the balmy March drew a lot of insects out of hibernation, including the dreaded Colorado potato beetle—also three weeks early.

Meanwhile, non-resident pests arrived ahead of schedule. Farmers have been taught to start looking for the potato leafhopper by the first of June. This year, it arrived by May 10. “Growers are going to have to reset their clocks,” says Groves.

The squash vine borer and squash bugs are just two pests that have established full-time Wisconsin residency in the last 20 years, says Groves. “If that happens with the seed corn maggot, that could really change the pest landscape.”

On a sunny day in early June, Ed

Grygleski’s cranberries are in bloom and the bees are busy. Two semi loads of hives arrived the previous week and already are settled in. Some of his fellow growers weren’t so lucky, and their bees are still in transit from other states.

Grygleski has never gotten bees in May before, but he’s also never seen a cranberry blossom on May 15th. “If I didn’t have all my bees right now I’d be screaming on the phone,” he says. “This is perfect weather for pollination.” The more blossoms the bees visit, the better the harvest.

Grygleski’s relaxed demeanor belies a crazy year. The mild March awoke his plants, but then it got cold again and stayed cold. He struggled for more than a month to protect the early vines—not always successfully.

“You can tell the color’s different, the vines just look sick,” he says, pulling up to a damaged bed. “The buds don’t grow out.” The bed will recover, but he estimates an 80 to 90 percent loss this year.

CALS/UW Extension horticulture professor Rebecca Harbut is still trying to assess the overall damage. She believes that three climate-related events combined to stress the bogs. Last fall was warm and dry, then it snapped cold in December. A mild winter made it difficult to establish the ice

A balmy March drew out some pests early, including the Colorado potato beetle.

that growers use to protect their beds. Finally, March temperatures soared to the 80s, followed by a cold and very dry April. Some growers protected with sprinklers, but very dry air lowered the dew point, making frost more likely. The remaining growers flooded their beds but had to keep them submerged as long as three weeks.

There's more bud damage than usual, and bizarre growth patterns have ensued. "We do not understand what happened," Harbut says. "Clearly the physiology of the plant got confused."

The irony here is that cranberry growers are perhaps better prepared for frost events than anyone, and still they got burned. Now Grygleski has a new automated pump system with 13 wireless probes for bed temperature and soil moisture positioned around the farm. The system will save a lot on energy and water as well as improve response time to frost danger.

"Every fruit crop I work with has been absolutely hammered this year," notes Harbut. One example: the false spring lured Door County cherries into an early bloom, and few blossoms survived the reversal. An estimated 90 to 95 percent of the crop was lost.

Spurred by the challenge, Harbut is now spearheading a research proposal by cranberry researchers across the country who want to figure out how to best adapt to climate change. Industry support is strong. "There has always been a lot of risk in farming," she says. "The last 10 years it's gone up exponentially because of the unpredictability of the weather."

Meanwhile, in London last March—during that unseasonably warm spell in Wisconsin—the independent Commission on Sustainable Agriculture and Climate Change released a report on how to "sustainably intensify agricultural production while reducing

greenhouse gas emissions and other negative environmental impacts." Among its select contributors was just one American, CALS genetics and agronomy professor and former dean, Molly Jahn.

While we're conditioned to look for major technological breakthroughs, Jahn and her colleagues believe the key to climate change adaptation is information: more of it, integrated better and shared freely. "If we're going to better manage our agriculture for this twin purpose of our species' survival and planetary care, we need to have much better ways to keep track of what we're doing in real time and in multiple dimensions," Jahn told a Madison radio host in an interview from London. This means everything from space-based sensors to help predict pest expansion to economic

Grower Ed Grygleski hopes that remote monitoring of cranberry bed temperatures will quicken response to frost dangers.



PHOTO COURTESY ED GRYGLESKI

intelligence to help ease spikes in food prices and shortages.


Locally, information also is the centerpiece of WICCI's recommendations for Wisconsin: learn more, and share it with the ag community. One tool the state currently lacks is the kind of detailed local climate monitoring found in such neighboring states as Iowa, Illinois and Michigan.

"We need to arm ourselves with enough information to help adapt to a future state of the climate and resource availability," says Kucharik.

The politically sensitive nature of climate change doesn't help. "Part of the ag community feels they are being blamed for climate change," Kucharik explains. He particularly understands the concern that there may be more environmental regulation.

Unfortunately, he says, the distrust runs so deep that sometimes producers won't talk to grad students who are trying to understand management decisions. That's a big problem—but one potentially answered with a historic ideal. "I think this all depends on executing the Wisconsin Idea to its fullest," says Kucharik.

"Good, bad or indifferent, politics are part of science today," says Shawn Conley. The challenge, he says, is to be able to talk about it. "Because when it comes down to feeding the 9 billion or so people we're expected to have on the planet in 30 years, I think U.S. growers are going to be vital in doing that. We have to be. And to do that we have to have frank discussions based on science.

"We don't always agree, and that's fine. But we also have to understand that, with the costs now in equipment, inputs and land, the risk has never been greater for a grower to make a lot of money—or to lose the farm." 

Hunting *for* Beginners

BY PRESENTING A FRESH VISION
OF THE SPORT TO NEW AUDIENCES,
A PROGRAM AIMS TO STEM
AN ALARMING DROP IN HUNTERS

By Michelle Wildgen

Photos by Wolfgang Hoffmann BS'75 MS'79

LAST FALL I spent an afternoon near Baraboo sitting in a tree stand across from a woman with a rifle. Perched in another crook was our hunting mentor, Karl Malcolm MS'08 PHD'11, then a CALS doctoral student in forest and wildlife ecology. Malcolm was the organizer of that weekend's Learn to Hunt program, which was the reason I ignored my fear of heights and climbed 15 feet in the air. The woman with the rifle was Kristen Cyffka, a UW–Madison grad student in statistics with an interest in sustainable food. That day would be our chance to shoot a deer—if we saw one. The temperature was unseasonably hot, the deer scarce.

As the sun began to set, the air cooled and the golden light dimmed over the thickets and fields. In the silence, the occasional rustle took on thrilling clarity. This, whispered Malcolm, is the magic hour.

But Cyffka had woken up before 3 a.m. for an earlier hunt, and as the woods grew tranquil, the breeze gentle, I saw her head begin to droop. The rifle remained propped on the armrest of her tree stand. My first instinct was to nudge her with my foot, but then I decided to rouse her in the least startling way I could and instead whispered her name in a soothing murmur. I was learning that you rethink a lot of things when you're out in the woods in the presence of a loaded gun.





The Learn to Hunt program pairs seasoned hunters with novices. Front left, CALS alum Karl Malcolm teaches a beginner the elements of shooting.



KARL MALCOLM has been an avid hunter and angler since his teens, and when he enrolled in the University of Michigan's School of Natural Resources and Environment, he assumed he'd be among fellow hunters.

"I thought I'd meet lots of people with the same feeling I had," says Malcolm, who is now based in New Mexico as a Presidential Management Fellow with the USDA Forest Service. But when he started talking about his love of hunting and fishing, the other students thought hunting was "barbaric and disrespectful to animals, and that it was all about bloodlust," he says. "It didn't at all jibe with my personal experience." As he began to evaluate and articulate his hunting experiences for others, Malcolm found the initial seed for his interest in teaching others to hunt.

Wisconsin's Learn to Hunt (LTH) programs have been around since 1997, inspired by the Wisconsin Student Hunter Program, which CALS forest and wildlife ecology professors Don Rusch and Scott Craven had launched in 1993 to ensure that the department's students gained hands-on experience in hunting and understood its history and

role in conservation. The Wisconsin Department of Natural Resources (DNR) adapted that into LTH programs designed to recruit new hunters, initially focusing on turkey and pheasant before expanding into deer. The LTH program introduces novices to hunting in a controlled manner by pairing them with mentors on a one-to-one basis. After at least four hours of classroom and field instruction in topics like gun safety, ethical shooting and finding and setting up a hunting site, participants and mentors go out into the fields to experience the hunt firsthand.

Most organizers charge nothing for the course. Mentors must have at least five years' experience hunting the chosen animal; they also may apply to serve as organizers of an LTH program. Learners must be at least 10 years old and never have received a hunting license for the species being hunted. On paper, Malcolm has organized his programs as an individual, but in practice help comes not only from the DNR but also from the CALS Department of Forest and Wildlife Ecology, thanks to such hunting mentors as professors Mike Samuel and Tim Van Deelen and engaged students

and alumni like Steve Grodsky MS'10, Dan Storm PhD'11 and Mike Watt BS'07 MS'12.

"Other folks who are interested in putting together similar programs should know they can do it and the DNR will be there to back them up," explains Malcolm.

Now prospective hunters have additional and quite significant support thanks to the Hunters Network of Wisconsin, a joint project between CALS, the DNR and UW-Extension that is dedicated to recruiting more hunters. The effort began with a survey of hunting and conservation organizations conducted by CALS/UW Extension life sciences communication professor Bret Shaw and research associate Beth Ryan, funded with a DNR grant. The survey, which would then inform strategic outreach to mentors and interested non-hunters, identified resources the organizations already used or would like to use more, from assistance in finding interested participants to funds to sponsor LTH events and volunteer education and training.

But perhaps even more significant was the survey's focus on hunters'

Spending time immersed and observant in nature, learning and using new skills, and camaraderie with friends and family were among the main things hunters named as drawing them to the sport in a survey conducted by CALS and the DNR.

motivations for taking part in the sport. The top reasons people named for hunting were spending time outdoors, being close to nature, using and sharing skills and knowledge, and camaraderie with friends and family. The Hunters Network hopes to use this insight to make mentoring new hunters more appealing.

There's a compelling reason for all of this outreach. Hunting is an important part of Wisconsin's history and culture. It also has a \$1.4 billion impact on the state's economy and supports some 26,000 jobs, according to the DNR.

Yet Wisconsin has experienced an ongoing decline in hunting in recent years. A study from February 2011 by the DNR and the UW-based Applied Population Laboratory found that the number of gun deer hunting licenses sold to the state's residents dropped 6.5 percent, from 644,991 in 2000 to 602,791 in 2010. The report predicts that by 2030, the number of male gun deer hunters (who make up the bulk of hunters, though the number of female hunters is expected to rise) could drop to 400,000.

Keith Warnke BS'90, the DNR's hunting and shooting sports coordinator, says that could mean a drop of more than 10 percent in license fees, from about \$10.9 million dollars in 2000 (at \$20 per license for 549,505 resident male deer hunters) to \$9.6 million in 2030 (at \$24 per license).

Fewer hunters means less tourism money for rural areas that depend on it. It also means less revenue from excise taxes, explains Van Deelen. The money from federal excise taxes on hunting equipment and ammunition (such as the Federal Aid in Wildlife Restoration law, also known as the Pittman-Robertson Act) returns to states, earmarked for conservation. Van Deelen says most of his research is funded this way.

If license fees and excise tax revenue continue to drop, conservation

budgets will decline as well, Warnke says. That means less emphasis on conservation, habitat management and sustainable forest management practices, and less wetland and prairie restoration.

"Hunters have a direct and participatory connection to their food source, which results in a strong conservation ethic and a high profile for sound natural resources management," says Warnke. "The further our society becomes disconnected from the natural world, the less natural resources conservation will matter."

WARNKE LISTS a number of reasons for the decline. Smaller generations succeed the baby boomers, who tend to stop hunting as they age, and fewer youths take up the sport in an increasingly urban society focused on structured indoor activities. Efforts to expand within the hunting community, such as LTH programs for the children of hunters or opening up hunting licenses to 10- and 11-year-olds, didn't halt the drop.

But a new approach has helped spur a steady rise in LTH participation, from 1,000 LTH participants in 2008 to almost double that—1,940—in 2011. The Hunters Network and DNR have specifically sought to broaden the net to college students, people of color and city dwellers who have grown up with no hunting experience.

One way to interest these groups is through the burgeoning interest in local, ethical food. Malcolm's LTH program, for example, emphasized hunting as a source of sustainable meat, and the majority of participants cited that interest as their reason for being there. Warnke says that while many states are seeking new hunters, he doesn't know of any others that are actively encouraging LTH programs for young adults on college campuses. (To name another



example, Madison Area Technical College plans to offer a four-week adult education course called "Hunting for Sustainability" this fall.) He believes the young adult population with an interest in eating locally is a very fertile source of future hunters. "These folks missed the natural path into hunting through parents, but they certainly have a strong conservation ethic, a strong environmental orientation, and a realization that hunting is a really sustainable way to obtain your protein," Warnke says.

CALS' Bret Shaw agrees. "The kind of people they've been targeting at college events also tend to be interested in local foods and how hunting can be part of the local food movement. An animal that is a wild creature eating natural things—I think that's an appealing part to a lot of folks, at least in terms of how



Author Michelle Wildgen handles a gun for the first time. CALS alum James Neitzel, then a senior, provides an aura of calm.

The students were mostly women ranging from 18 to mid-30s, a mix of undergrad and grad students, professionals and UW faculty, and mostly from non-hunting backgrounds. In other words, we represented a perfect target audience for LTH programs. The mentors were

all male. Many said they'd been hunting since childhood.

James Neitzel BS'12, then a UW senior and member of the Badger Hunting Club, walked me through the mechanics of my borrowed rifle. I had never handled a gun, and for this occasion I'd borrowed a Winchester 30.30, older and different from what most others were using. It lacked a scope, for one thing, and the process of putting on its safety was a terrifying system that involved slowly pulling the trigger on a loaded gun while holding the firing pin down with my thumb. Several times, as I practiced with the unloaded weapon, Neitzel said calmly, "You just shot the gun."

The class zipped along at a surprising clip, considering the gravity of what we were learning to do. Despite the emphasis on gun safety, I was nervous at being surrounded by rifles. The margin for error seemed perilously slim, for I am clumsy enough to require a fairly generous margin of error just to avoid significant injury in my daily, gun-free life. Still, when it was my turn I practiced my slow and steady trigger squeeze, though I couldn't tell if I hit a thing.

After a couple of hours we departed the cornfield for dinner and a discussion about hunting, contrasting the bloody, macho stereotypes with the mentors' explanations of their own experiences, which could be summed up as a passionate commitment to the land, a near-holy experience of being in the quiet of the woods, and gratitude, mixed with sad-

they initially get involved," he says.

This certainly was the case for UW student Kristen Cyffka. When she spoke to a friend who eats only meat that he himself has killed, she "was struck by how reasonable that was, and so I jumped at the opportunity to learn how to gather my own meat."

Malcolm says his students, prior to participating in LTH programs, perceived a number of barriers to the sport, even though they tended to be adults with the wherewithal to pursue hunting if they chose. Perceived barriers included expense, finding a spot, obtaining and using a gun or just what to do with an animal should they shoot one. "In a couple of short sessions, you tear down a lot of barriers in people's minds and show them it's not that mysterious," Malcolm explains.

The process may not be mysterious, but the experience of leaving behind the trappings of daily life in order to sit in the woods silently, and alertly, turns out to be profound. Says Shaw, himself a newcomer to hunting, "It makes you notice the rhythm of nature in a way that's different from walking or hiking through it. There are very few times when you're required to sit still and be present in nature."

The Hunters Network and the DNR are hoping that realizations like this will inspire a love of hunting. Otherwise, Warnke believes we risk a weakened connection to the land and to our food sources, a loss of "an in-depth, almost spiritual connection

with nature," he says.

Many consider hunting integral to wildlife management, a concept articulated most notably by Aldo Leopold, who founded the world's first department of wildlife management at CALS. While conservation managers aim for only a harvestable surplus of other species, the state tries to use longer seasons and antlerless harvests to reduce its overabundant deer population. Van Deelen cautions that "populations have more internal controls than people think," but that those internal controls can range from unpleasant to disruptive (think crop and forest damage or deer-car crashes).

Nevertheless, Van Deelen says, hunters are not a dial that the wildlife manager can easily turn up or down. Other possibilities for reducing deer numbers might include more liberal hunting seasons and allowing more old growth instead of scattered clear-cuts to make land less habitable for deer, but such potential remedies have only been "kicked around in academic circles." For now, hunters remain the primary source of population control and much-needed revenue—both goals the LTH programs may help to meet, hunter by hunter.

THE NIGHT BEFORE the hunt, our class met in a clearing in a farmer's cornfield for a primer in gun usage and safety as well as a little target practice.

Two tables were set up beside a pond, with targets across the water.

Know where your meat comes from:
New hunter Kate Julian shot her first buck with the help of mentor and CALS alum Mike Watt.



ness and pride, for the successful hunt.

Overviews of ethical shots and scouting practices reminded me of just how much there is to learn, but one doesn't need to be a nature lover of long standing to get started. As people spoke it became clear that the motivation for many novices was not their extensive outdoors experience but about following the trail of a meal back to its source.

Certainly this was where my interest lay, and so when discussion and the pop quiz on gun safety concluded, I loaded up a plate of lean venison backstrap (much like tenderloin), nuggets of duck, and fat, chili-flecked elk sausages. The meats all carried the faint flavor of liver, a rich meatiness with a hint of iron and blood, in the best possible way. We chewed gently on our duck breast, careful of shot. Then we made plans with our mentors, to scatter the next morning into the woods of Wisconsin.

The closest my group came to seeing a deer was after dark, when a buck appeared at the edge of a cornfield as we drove away from the site. That sudden appearance after a long absence, Malcolm told us, is the source of those crazed grins in hunting photos that people often interpret as bloodlust—most hunters go out and see no deer at all for 10 sits. When one finally appears, it feels as if some kind of sorcery has finally worked.

Maybe, for another novice, it did work. A buck approached a blind in which sat Kate Julian, a student visiting from Michigan, and her mentor, Mike Watt. The buck stood still, presenting her with a perfect shot.

A smaller group met the next day at the DNR Service Center to help with the butchering of the 150-pound buck, which arrived, field-dressed (its highly perishable organs removed) and packed

with ice, to be hoisted from a tree by its hind legs. I had never met my meat when it was so unprocessed. When I grasped the hide with both hands to pull away the skin, it was not thin and leathery as I'd expected, but thick and furry, like a handful of the fur of a pet. The buck's antlers were roughly textured; its hooves smooth and black. Skinned, its tail was segmented like a rat's. As I worked with knife and hands to help skin the deer, sometimes the loose end of the rope suspending the carcass brushed against my arm, startling me so much that I realized how nervous I really was.

We worked for several hours, transporting large segments of muscle and bone to two tables where other volunteers were cutting them into manageable pieces or grinding them up, sealing meat into plastic bags. As the deer went from whole animal to a leg, hindquarter and backstrap, the process came to feel less outdoorsy and more culinary.

Bret Shaw was there on butchering day, too, and later he described how breaking down a whole animal has enhanced his understanding of meat and which cuts come from where. "It makes it more visceral and intuitive to see it being butchered," he says, and he is right. As I lifted a large, ovoid portion of the deer's haunch, I knew I'd remember that its heavy use and leanness demanded


moisture and slow cooking, but if I were handed an already-cubed package of stew meat it wouldn't seem so clear.

My reward for staying for much of the afternoon was a generous helping of venison: a large piece from the haunch, some backstrap, and a few packages of ground venison. The meat was firm and cool, a clear, uniform garnet almost totally free of fat. My haul seemed both extraordinary—all that

meat, and just for helping!—and yet so finite. Without a plan in place to hunt again, this was all I'd get.

Maybe Cyffka felt that same mix of gratitude and appetite for more. A month or so after our LTH program, she hunted during the November deer season and participated in an LTH pheasant program in Horicon Marsh in the spring (which led to some delicious pheasant fajitas). She hopes to hunt the turkey and deer seasons this fall.

"Overall it was a great experience," she says, regarding her participation in LTH. "I especially liked learning about that entirely different way of looking at food—as something that you can gather with your hands as opposed to pay for in a grocery store. It also changed the way I look at firearms. A whole group of people actually uses these things to provide for their families!"

That October night I sliced the backstrap into medallions, seasoned it with salt and pepper, and seared it quickly in butter. Served with pasta and shiitake mushrooms, flecked with scallion and parsley, the venison tasted a little ferrous and slightly of game, but not of fat, a faint muskiness echoing the mushrooms. The meat was autumnal and a little wild, and if I want to taste it again, which I very much do, I'll have to go out and hunt. 

in the field



Susan Crane



Norval Dvorak



Corey Geiger



Bob Hagenow



Valerie Johnson

In celebration of its 40th anniversary, the Wisconsin Agricultural and Life Sciences Alumni Association (WALSAA) is honoring individuals who have made a difference not only for WALSAA, CALS or Farm and Industry Short Course, but in farms, classrooms, laboratories, businesses and other organizations all around Wisconsin. We are pleased to profile 10 of these extraordinary individuals in this edition of *Grow*. The additional 30 honorees are listed below. You can learn more about them at walsaa.org.

More WALSAA 40 in 40 Impact Award Honorees

Lou Armentano	Gail Janssen (deceased)
LaVerne Ausman	Bruce Jones
Roger Biddick (deceased)	John "Jack" Kaltenberg
Dale Boness	Pete Kappelman
Dale Bruhn	Robert Kauffman
William C. Bruins	Alan Koepke
Robert Bush	Jill Makovec
Tom Crenshaw	Larry Meiller
Rick Daluge	Larry Satter (deceased)
David Dickson (deceased)	Tom Schomisch
Dorothy Farrell	Ronald Schuler
Steve Fronk	George Shook
Keith Hawks	William F. Tracy
Liz Henry	Gale VandeBerg
Daphne Holterman	Thomas Wright

Susan Crane • Crane's career has been marked by a deep belief in education and a passionate commitment to agriculture. Crane and her family run Crane Farms in Burlington, and she also works with We Energies as manager of special projects for wholesale energy and fuels. Crane was appointed by Governor Doyle in 2005 to serve on the Wisconsin State Fair Park Board, and she continues to promote awareness of and support for agriculture through her work with the CALS Board of Visitors and a number of other organizations.

Norval Dvorak BS'43 Agricultural Economics • Since earning his degree in 1943, Dvorak has devoted his life to educating others through his work with a number of committees and organizations, including Packerland Packing Co., Wisconsin/Minnesota Feeder Pig Marketing Cooperative, Midwest Livestock Producers Cooperative, Lake to Lake Dairy Cooperative and the Lakeland Egg Marketing Cooperative. Dvorak, 90, along with his wife, Jean Hird Dvorak, continues to educate people about the importance and value of agriculture. "It was a great time to be in agriculture," he reflects, looking back on his career. "And the opportunities in the years ahead look even more promising."

Corey Geiger BS'95 Dairy Science, Agricultural Economics • Geiger is the assistant managing editor of *Hoard's Dairyman*, one of the nation's oldest and most respected dairy publications. A past president of the Wisconsin Holstein Association and the National Dairy Shrine, Geiger

remains active in both organizations along with the Badger Dairy Camp and Young Dairy Leaders Institute, as well as serving as superintendent of the National Collegiate Dairy Cattle Judging Contest. And that's still not all. He's also a devoted member of Alpha Gamma Rho and is active with CALS and the greater agricultural community.

Bob Hagenow BS'85 Dairy Science • After earning his degree, Hagenow worked for the National Brown Swiss Cattle Association for two years before beginning his career with Vita Plus Corporation, where he now works as a sales manager. Hagenow has been an instrumental contributor to Alpha Gamma Rho (Iota Chapter), WALSAA, the CALS Department of Dairy Science and a number of other organizations within CALS. "His involvement is unique and he is always true to his roots of agriculture and becoming a well-rounded individual," says an associate.

Valerie (Breunig) Johnson BS'86 Agricultural Journalism/Agricultural Extension Education • Johnson is the new CEO of Habitat for Humanity of Dane County, where she develops partnerships that build communities and homes. She was previously executive director of the Worldwide Foundation for Credit Unions. Her volunteer work with United Way and on the board of directors for WALSAA and the Wisconsin 4-H Foundation keeps her involved with businesses and industry through many fruitful collaborations and projects. "Valerie bleeds Badger red," says a colleague.

SPECIAL FEATURE: The WALSAA 40 in 40 Impact Awards



Shelly Mayer



Sam Miller



Bernie Staller



Marjorie Stieve



Robert Williams

"She is a tried and true advocate for CALS, its students and its alumni."

Shelly Mayer BS'88 Agricultural Journalism • Mayer is a widely respected authority on dairy industry education. She has operated at the forefront of the industry for the past 15 years through her work with the Professional Dairy Producers of Wisconsin, serving as the organization's executive director since 2001. She's also a full partner with her husband in Mayer Farms. In addition, Mayer serves on the executive committee and as secretary/treasurer for the Center for Food Integrity along with serving her community as a 4-H dairy leader and through a number of activities in her church. Mayer's colleagues describe her as "the heart and soul" of the Professional Dairy Producers of Wisconsin.

Sam Miller BS'84 Agricultural Economics • Miller serves as managing director and group head of agriculture banking for BMO Harris Bank. His agricultural community activities include serving as the vice president of the WALSAA Board of Directors as well as on the CALS Board of Visitors, the Wisconsin Dairy 2020 Council and the Dairy Business Innovation Center. He's also a former chairman of the

American Bankers Association's ag and rural affairs committee. "While it is rare to find great leaders in any industry, Sam Miller's combination of intelligence, insight, knowledge and passion for the dairy industry is both rare and admired by all of agriculture," a colleague notes.

Bernie Staller BS'65 MS'66 Agricultural Education • Staller was an agribusiness instructor and a Future Farmers of America (FFA) advisor at Janesville-Parker High School for 11 years before moving on to the National FFA Foundation, where he has served as assistant executive director and executive director. He's also served as the chief operating officer for both the National FFA Organization and the FFA Foundation. He has been honored with numerous awards highlighting his contributions and commitment to agricultural education. "Many individuals experiencing UW-Madison have been affected by Bernie's involvement whether they realize it or not," says a colleague.

Marjorie Stieve BS'91 Agricultural Journalism • Since graduating from CALS, Stieve has influenced many people through her work at World Dairy Expo, Capital Newspapers and, most recently, as an employee owner

of Vita Plus Corporation, where she serves as marketing services manager. Stieve serves on the boards of directors of WALSAA, WDE Management and Community Support Network. She also has been engaged with the Association of Women in Agriculture, the National Agri-Marketing Association, the Wisconsin 4-H Foundation, Cows on the Concourse and numerous other organizations, events and causes. Colleagues respect Stieve for what they call her "nonstop dedication to agriculture."

Robert Williams BS'76 Agricultural Education, MS'82 Continuing, Adult and Vocational Education • Williams recently celebrated his 40th year with the Wisconsin Department of Agriculture, Trade and Consumer Protection as the county fairs coordinator, where he works to ensure that the County Fair Board and Association has proper judging programs and complies with requirements to continue receiving state aid. Williams has demonstrated the same enthusiasm for WALSAA that he has for education—"a really personal commitment that makes those who interact with him realize that he is sincere and dedicated to the cause," says a colleague.

Catch up with ...

Michelle Moyer BS'05 Genetics, Plant Pathology

SHE'S NEVER SET FOOT IN AFGHANISTAN, but Michelle Moyer is helping farmers there nevertheless. Moyer, who earned her Ph.D. in plant pathology at Cornell University, is now an assistant professor of horticulture at Washington State University, where she also serves as an Extension specialist for viticulture. This put her in a prime position to help U.S. troops being sent to Afghanistan to better understand the significance and cultivation of the country's No. 1 fruit crop: the grape.



● **Why is it important for U.S. troops to know about Afghanistan's grape cultivation?**

Grapes, the leading horticulture crop in Afghanistan, are used predominately for fresh eating and raisin production. Many troops arrive in country during the growing season, so being aware of what they're seeing will help minimize damage. That's critical in establishing rapport with local communities. There are many U.S.-based economic development teams working in Afghanistan to help promote agricultural production, so clearly everyone wants to be on the same page. If other U.S. and international aid agencies are promoting the growth and development of the viticulture industry, it is imperative that military efforts do not hinder it.

● **How does grape cultivation in Afghanistan and in the United States differ?**

The biggest differences are the extent and level of infrastructure. Afghan vineyards often are not arranged in rows. In many cases, vines are trellised on any available structure or grow in a bush form. Irrigation systems are still predominately in the form of ditches, and we highlight the need to be careful when operating machinery through them as it could negatively impact farmland downstream.

Moyer developed a presentation for the national Grape Community of Practice (GCoP), an Extension network of 87 grape production professionals from 31 states and Ontario, Canada. The GCoP is distributing Moyer's presentation to its members at universities and government agencies who are involved in training U.S. troops.

With this work Moyer joins a number of experts in the CALS community who are helping the U.S. military improve agriculture in Afghanistan. For example, CALS serves as a training and "reachback" resource for Wisconsin National Guard agribusiness development troops serving in Afghanistan.

Vineyards growing raisin grapes often have large structures called "kishmish khanas" located in their center. These are drying houses for raisins. Grapes are dried in a similar fashion as tobacco is in Wisconsin: they're hung on various levels inside a dark building with sufficient air circulation. As they dry, the raisins drop to the ground, where they are collected. Unfortunately, khanas also are likely spots for insurgent activity, so we highlight being careful when scouting—for many reasons!—as you could damage produce worth thousands of dollars.

● **What did you learn from the experience of preparing a group for this particular need?**

It really highlighted the global and cultural significance of grape production. In the United States, we tend to focus on wine grape production when we think of grapes. But grapes have so many more uses that are equally vital and are an integral part of a culture's heritage. It was fascinating to learn about this type, style and level of grape production, particularly relating to raisin production in Afghanistan. I am impressed that the U.S. military reaches out to Extension for this education. It highlights that the U.S.'s intention in these types of operations is to help, even if that message gets lost in the political and emotional strains of conflict.



Let CALS provide your holiday cheer. Tree sale takes place Nov. 30–Dec. 2. You can also buy your turkey, ham or prime rib from CALS outlets. See “holiday goodies” below.

SHARE THE WONDERFUL by participating in the all-campus annual campaign—see page 38. You can designate that your gift go to the **CALS Annual Fund**, which allows the College to allocate your support where it is needed most. Your gift in any amount makes a difference!

BUY HOLIDAY GOODIES while benefitting CALS student clubs and organizations:

Thanksgiving Turkey Sale: Turkeys range from 11 to 26 pounds. Place order by **November 10**. Proceeds benefit the Poultry Science Club. More info from CALS’ Ron Kean, rpkean@wisc.edu.

Christmas Trees: Fraser Fir, Balsam Fir, White Pine and wreaths available at the UW Stock Pavilion **Friday, Nov. 30 through Sunday, Dec. 2**. Trees grown locally, proceeds benefit the Forestry Club. More info at labs.russell.wisc.edu/forestryclub/.

Prime Rib Roasts and Ham are offered by Bucky’s Butchery. Last day to order ham: **December 7**. Last call for prime rib: **December 14**. Bucky’s Butchery is the on-campus outlet of the CALS meat lab. More info at wisc.edu, search for “Bucky’s Butchery”—or visit <http://go.wisc.edu/y7399m>.

SEE TRAVEL CHANNEL host Andrew Zimmern reach into a UW dairy cow’s stomach. It may be old hat to many Dairy State residents, but Zimmern shot the piece for his series on “Bizarre Foods.” In addition to getting up close and personal with partially processed fodder, Zimmern interviewed CDR’s Mark Johnson and dairy science grazing specialist Dave Combs about the unique flavor that a pasture diet gives to dairy products. You can see the clip at <http://andrewzimmern.com/2012/07/17/andrew-zimmerns-dirty-job/>.



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

Experiencing the World

Rachel Glab recently spent time on an idyllic Caribbean island, but she wasn’t there to stick her toes in the sand.

Rather, Glab was in Montserrat on bird business—specifically, researching how to protect the Montserrat oriole, a species facing various threats. Glab spent three days on the island interviewing a range of local residents and members of the United Kingdom-based Royal Society for the Protection of Birds. She also performed fieldwork including blood collection and banding, working under the direction of CALS ornithologist and animal sciences professor Mark Berres.

“My goal was to gain experience in data analysis and genetic work, along with developing and conducting interviews to gain broad perspectives on how to protect the oriole—what’s working, what isn’t, and what it really takes to get people together to facilitate positive change for a species,” says Glab.

Travel abroad wasn’t really in the cards for her, at least not for now. Glab, 27, is paying her own way through school. She is a licensed veterinary technician with AAS degrees in both veterinary medicine and laboratory animal medicine, and she has a job taking care of research animals at the UW’s Wisconsin Institutes for Medical Research (WIMR). Her work at WIMR convinced her to get her bachelor’s degree, and she plans to pursue a degree in medicine after graduating.

International travel would have been beyond her means without funding from the CALS Study Abroad Scholarship Fund, which was just renamed the Kenneth H. Shapiro CALS Study Abroad Fund in honor of the recently retired professor of agricultural and applied economics and former associate dean and director of CALS International Programs.



Throughout his career Shapiro greatly expanded CALS research and service partnerships with countries around the world and raised scholarship funds so that all students could participate.

Numerous studies and testimonials confirm the benefits of study abroad, which include developing a globally minded workforce, allowing students to study natural resources not available in the United States and—perhaps most important—offering students a broader, richer experience of the world.

Glab speaks to some of those benefits. “The experience made me look at our country differently, at the way we live and the access we have to things here,” says Glab, noting that people in Montserrat make do with much less. “My interactions with residents and conservationists there were priceless to me. I’ve come back with greater awareness of what we have and what we can do together.”

To help support the Kenneth H. Shapiro CALS Study Abroad Fund, visit: supportuw.org/giveto/shapirostudyabroad

The UW Foundation maintains more than 6,000 gift funds that provide critical resources for the educational and research activities of CALS.



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Biochemistry

1. Which of the following statements about water is FALSE?

- a. Water has a high melting point and boiling point relative to other liquids.
- b. Water acts as a dipole because it has partial positive charges on the hydrogens and partial negative charge on the oxygen.
- c. The hydrogen bonding potential of water is fully satisfied when the oxygen accepts one hydrogen bond and the hydrogens each donate one hydrogen bond, making a total of 3 hydrogen bonds.
- d. Water molecules in the liquid state have on average fewer hydrogen bonds per molecule when in the solid state.
- e. Water is an excellent polar solvent due to its high dielectric constant.

Genetics

2. The backbone of the DNA molecule is formed by:

- a. Amino acids and deoxyribose sugars.
- b. Deoxyribose sugars and phosphates.
- c. Nitrogenous bases and phosphates.
- d. Deoxyribose sugars and amino acids.
- e. Nitrogenous bases and deoxyribose sugars.

Ag and Applied Economics

3. If all other things remain constant, as disposable income of a consumer increases, the percentage of income spent for food decreases according to:

- a. Engel's Law
- b. Say's Law
- c. Law of diminishing demand
- d. None of the above

Wildlife Ecology

4. Aldo Leopold was one of the first persons to advocate:

- a. Establishing nature reserves and refuges to protect wildlife communities.
- b. Managing animal populations by manipulating the habitats that they use.
- c. Passing federal legislation to protect threatened and endangered species.
- d. Managing populations of game species using sustained yield harvesting.

Biological Systems Engineering

5. What is the name of the land area unit established via the Public Land Survey System that is one square mile in size?

- a. A township
- b. A range
- c. Both A and B
- d. A section

LAST ISSUE: Answers were 1: B, 2: C, 3: C, 4: D, 5: D. Congratulations to NaTanya Olson BS'93, who was randomly selected from the two people who correctly answered all questions. She wins a gift certificate to Babcock Hall. (Please note: Questions appeared in different order in the online version of the quiz. These answers correspond to what appeared in the printed magazine.)

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BUSY BEAVERS

left their mark at Kemp Natural Resources Station, where undergraduates gathered this summer for hands-on learning in the forest. Learn more about Kemp at ars.wisc.edu/kemp/—and more about our students on page 6.