

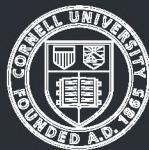
periodiCALS

THE MAGAZINE OF CORNELL UNIVERSITY'S COLLEGE OF AGRICULTURE AND LIFE SCIENCES

VOL. 8 • ISSUE 1 • 2018

A NEW LENS ON HEALTH

*Innovations that
improve how we feel,
eat, move and live*



Cornell University





inside

[VOLUME 8 | ISSUE 1 | 2018]

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ON THE COVER: Connor Lapresi '18 explores virtual reality in the Virtual Embodiment Lab directed by Andrea Stevenson Won, assistant professor in the Department of Communication. Photo: Sasha Israel. A simulated landscape is superimposed on the goggles.

LEFT: When it comes to measuring photosynthesis, green is not all that counts. Ying Sun, assistant professor of geospatial sciences in the School of Integrative Plant Science, is using a NASA satellite to measure photosynthesis in high resolution at the global scale, advancing how we measure plant health and its impact on food production and atmospheric carbon dioxide. Sun and her research team, including postdoctoral researcher Christine Yao-Yun Chang, at left, are verifying the satellite measurements by comparing the readings with ground-based measurements taken in research fields near our Musgrave Research Farm in Aurora, New York.

Photo: Matt Hayes

dean's message



Photo: Sasha Israel

Springtime on campus, which brings increased light, warmth and a sense of renewal, is a perfect opportunity to celebrate health and well-being—the theme of this issue.

At Cornell CALS, we define health and well-being broadly in terms of our research—exploring not only human health but also that of our environment, our food, our economy and our ecosystems. Our approach relies on integration of our discoveries with our classroom teaching and our community engagement strategies.

In this issue of periodiCALS, you'll read about the life-changing and innovative research we're doing to impact the health of people, communities and natural systems.

For example, the more than one million Americans living with Type 1 diabetes—many of whom are children—may benefit from a device developed by Cornell researcher Minglin Ma to revolutionize the management of this disease that has no cure. Meanwhile, research from a new lab in the Department of Natural Resources will combat the woolly adelgid, a deadly insect threatening the health of New York's 700-year-old eastern hemlock trees.

My own area of expertise, food science, can offer clear paths to preserving good health, including helping us understand how certain foods may positively affect us. But research on the human gut presents significant challenges. As food moves through the body and interacts with trillions of human

and bacterial cells, the environment constantly changes, creating variables that are currently outside of our control. The solution is to use research models, created to mimic our intestinal layers, to identify those variables and to achieve desirable results. CALS food scientist Alireza Abbaspourrad is working to further develop these models—called “gut-on-a-chip”—to assess how much of a given nutrient in the food we eat is actually available for our bodies to use.

It's worth noting that much of the work featured in this issue is coming out of the farms, fields and laboratories of some of the newest members of our CALS faculty, hired within the past three to five years. Their expertise and collaborative spirit are helping CALS pursue next-generation breakthroughs in areas focused on social, physical and economic well-being.

The goal of improving human health and well-being through our research, teaching and outreach inspires us at CALS, just as I hope the stories in this issue will inspire your sense of renewal and commitment to the college.

Thank you for your support and interest in CALS—and here's to *your* good health and well-being.

A handwritten signature in black ink, appearing to read "Kathryn J. Boor".

Kathryn J. Boor

Ronald P. Lynch Dean of the
College of Agriculture and Life Sciences

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"It's really amazing how many Cornell connections can be found by just turning over a few stones."

—Andy Cox '07

I am a 2007 CALS graduate with a degree in communication, and I now work in the wine industry with E&J Gallo. I was astonished to discover that one of the first head winemakers at Gallo (after Julio Gallo himself) was Charles Crawford, a fellow Cornell alumnus! After earning his master's degree at Cornell in 1941, Crawford answered an ad for a winemaker-chemist job with Gallo. It was the start of a very lengthy career, and in many ways he transformed winemaking at the company during a period of rapid growth and expansion.

Personally, I have Cornell to thank for sparking an interest in the wine industry as a career path, and I was very delighted to receive the recent periodiCALS issue and its stories about Cornell's contributions to the industry. It's really amazing how many Cornell connections can be found by just turning over a few stones.

—Andy Cox '07

This magazine is a treasure! Every time I receive one, I rush to read it from cover to cover. Every issue prompts a feeling of pride in the institution. The latest issue, with its article on the grape and wine industry, was especially meaningful for a couple of reasons: first, I live in Trumansburg, in the heart of the Finger Lakes wine region; and second, as a new CALS graduate in 1958, I worked as a fertilizer salesman and had Konstantin Frank as one of my customers.

During the ensuing year, I learned a great deal from him about grape production. He always took time to visit with me when I stopped to see him, and I developed a profound respect for the man. Regrettably, I soon learned that fertilizer sales was not my cup of tea, and spent the next four years as an agricultural extension agent in Genesee County, NY, followed by 20 years as a commercial farmer. Subsequently, I returned to Cornell, where I was employed in the Department of Plant Breeding and Genetics for 25 years.

During that time I developed a great camaraderie with many members of the faculty, and a profound respect for their research and teaching accomplishments. It was so heartening to read about the amazing work being conducted under the direction of specific individual faculty members, several of whom are personally known to me.

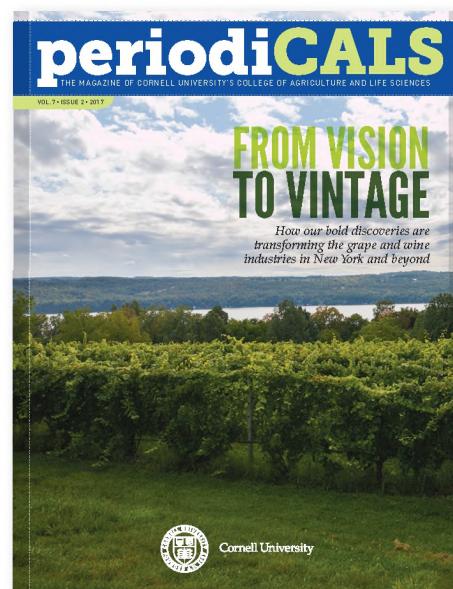
Long story short, a hearty "Thank you" to all who are involved in putting together this wonderful magazine, which helps all of us to stay connected. What a gift!

—Don K. Shardlow '58

I just finished reading the current issue of periodiCALS, and wanted to let you know how much I enjoyed it. A great issue! I particularly liked the faculty research profiles, "Then and Now." I wouldn't mind seeing that become a regular feature.

Thanks for the good work!

—Doug Grover, MAT '70



We want to hear from you!

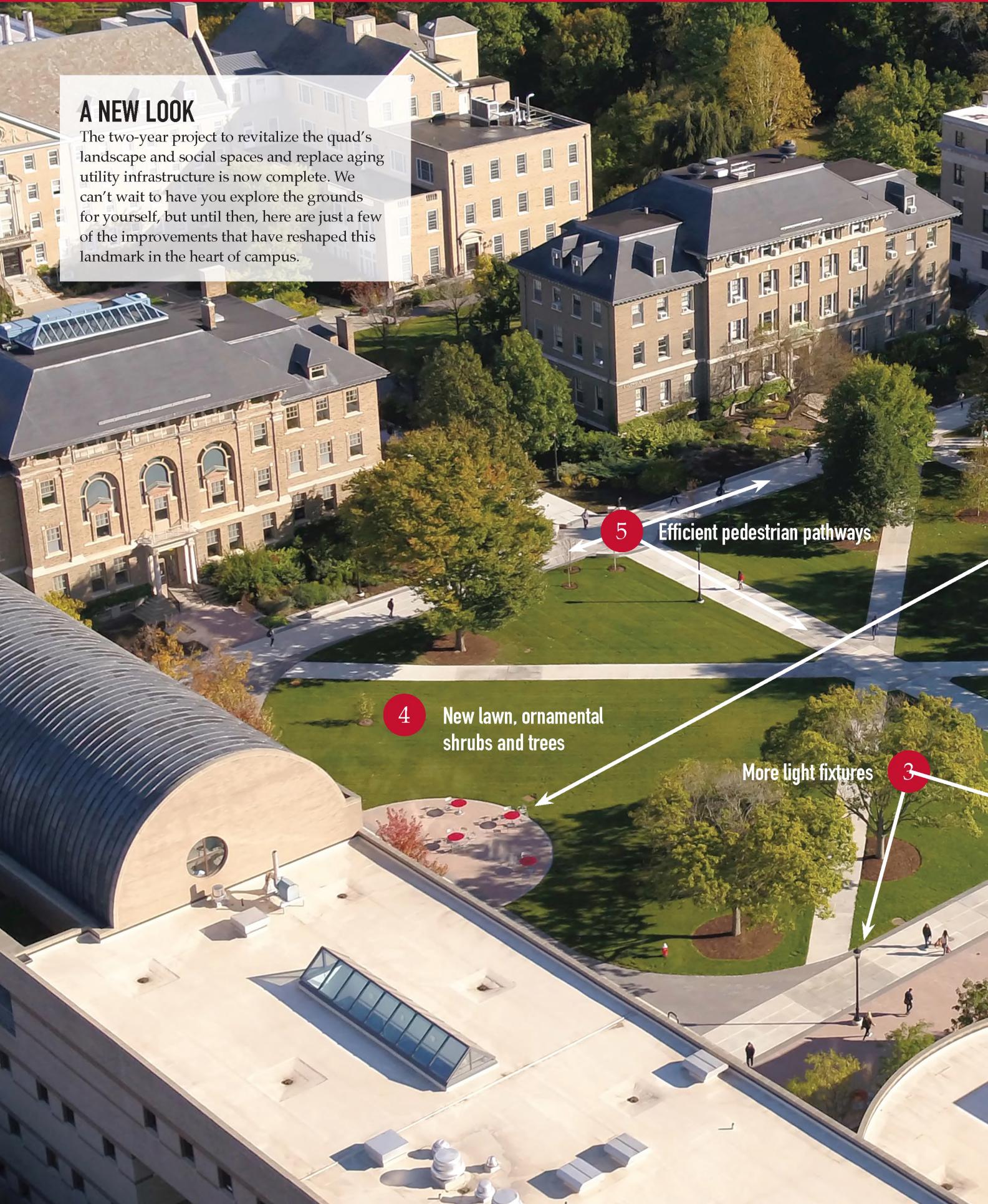
Connect with us on social media or send story ideas to the editor at calsnews@cornell.edu.

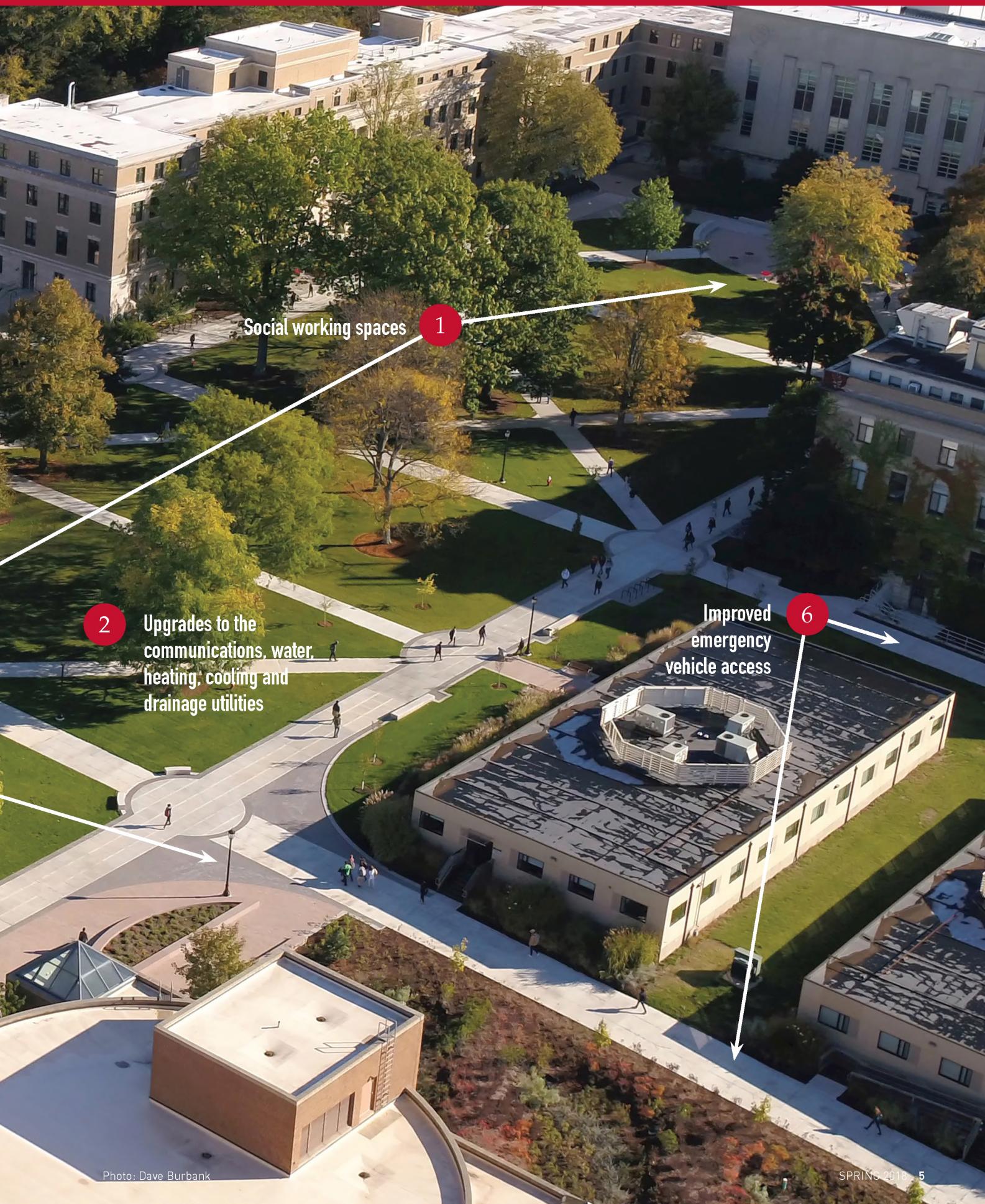
Letters may be edited for length and clarity.

around the quad

A NEW LOOK

The two-year project to revitalize the quad's landscape and social spaces and replace aging utility infrastructure is now complete. We can't wait to have you explore the grounds for yourself, but until then, here are just a few of the improvements that have reshaped this landmark in the heart of campus.







REMOVABLE IMPLANT MAY CONTROL TYPE 1 DIABETES

Device provides alternative to insulin therapy

Daily insulin injections are literally a matter of life and death for the more than 1 million Americans who live with type 1 diabetes. While there is no cure, our researchers have developed a device that could revolutionize management of the disease.

In Type 1 diabetes, insulin-producing pancreatic cell clusters (islets) are destroyed by the body's immune system. A research team led by Minglin Ma, assistant professor in the Department of Biological and Environmental Engineering, has devised an ingenious method for implanting hundreds of thousands of islet cells into a patient. They are protected by a thin hydrogel coating and, more importantly, the coated cells are attached to a polymer thread—which the group has dubbed TRAFFIC (Thread-Reinforced Alginate Fiber For Islets enCapsulation)—and can be removed or replaced easily when they have outlived their usefulness.

The ability to remove the transplant is key because of the potential of tumors forming when stem cell-derived, insulin-producing cells—the most promising cell source for type 1 diabetes cell therapies—are used.

"When they fail or die, they need to come out," Ma said. "You don't want to put something in the body that you can't take out. With our method, that's not a problem."

LAB LAUNCHES DEFENSE AGAINST INVASIVE PEST

Hemlock woolly adelgid threatens eastern forests

Eastern hemlock trees are among the oldest trees in New York, with some more than 700 years old. The trees often occupy shady, north-facing slopes and stream banks and help maintain erosion

control and water quality. Shade from the trees cools streams that are home to many of New York's freshwater fish, including brook trout.

But a tiny pest is putting these majestic trees in peril. Hemlock woolly adelgids, invasive insects native to the Pacific Northwest and East Asia, feed on young twigs and cause buds to die and needles to dry out and drop prematurely.

A new \$1.2 million lab, partly funded

CLIMATE CHANGE GARDEN OFFERS A LENS INTO THE FUTURE

Demonstration garden fast-forwards the impact of increased rain, temperature

Raised beds at our Cornell Botanic Gardens are providing a living illustration of how future temperature conditions may affect plants.

"Climate change is one of the biggest challenges we're facing," said Sonja Skelly, director of education at the botanic gardens. "For the general public, climate change is something they hear about, but it can be out of sight, out of mind."

The Climate Change Demonstration Garden features flowers as well as vegetable and grain plants grown in the present climate. Nearby, a controlled-environment high tunnel approximates upstate New York temperatures predicted for the 2050s. By that time, the average temperature may increase by more than 6 degrees Fahrenheit. The number of days with temperatures rising above 90 degrees could increase, with a greater frequency and duration of heat waves. And the region will likely receive increases in annual rainfall and experience more intense-precipitation events.

"Essentially we're using plants as a lens into the future," Skelly said. "Plants are good communicators of what we can expect to see, and these plants may have an impact on our visitors who see them."



The Climate Change Demonstration Garden.

by the New York State Department of Environmental Conservation, will research and rear biological controls to slow the spread of hemlock woolly adelgids. Previous research has shown that Laricobius nigrinus beetles and silver flies, which both only prey on the pests, are effective biocontrol agents in the Pacific Northwest. The Cornell lab is researching how effective these predators will be on adelgids on the East Coast.



\$35 MILLION IN NEW FUNDING SUPPORTS CASSAVA DEVELOPMENT IN AFRICA

Grant expands efforts to deliver improved varieties for farmers

Cassava is vital to the food security of millions of Africans who eat some form of the root crop daily. Although cassava breeders are making progress, they face significant challenges in developing disease-resistant varieties that also increase yield and respond to the needs of smallholder farmers and processors. We are expanding international efforts to deliver improved varieties of cassava to smallholder farmers in sub-

Saharan Africa with \$35 million in new funding from the Bill & Melinda Gates Foundation and UK aid in the United Kingdom.

"This grant funds a second five-year phase that will allow us to build on previous work and focus on getting improved varieties into farmers' fields," said Ronnie Coffman, international plant breeder and director of International Programs-CALS, who leads the project.

Compared with other major staples like maize, rice and wheat, cassava has undergone few advances in productivity and yield over the last 50 years. During Phase 1 of the Next Generation Cassava Breeding project, researchers shortened the breeding cycle for new cassava varieties by improving flowering and using genomic selection.

"Our focus for the next five years will be to translate this research into breeding practices to increase impact," said Chiedozie Egesi, NextGen project director and adjunct professor of plant breeding and genetics at Cornell, who is based at the International Institute of Tropical Agriculture (IITA) in Nigeria. A key goal in Phase 2 will be to identify traits preferred by farmers and end users and incorporate them into new cassava lines.

"Breeders must be able to more quickly develop cassava varieties that resist diseases, are climate resilient, and meet the needs of end users and consumers," said Egesi.

Strengthening the capacity of national breeding programs will be critical in achieving self-sustaining breeding systems in sub-Saharan Africa. Over the next five years, NextGen researchers will continue to train the next generation of sub-Saharan African cassava breeders in modern plant breeding techniques like genomic selection and improved breeding methods.

\$9.4 MILLION NIH GRANT FUNDS CHRONIC FATIGUE SYNDROME CENTER

Cornell is one of three institutions nationwide to receive funding

Imagine living with debilitating fatigue that is not helped by rest. Along with prolonged and unexplained fatigue following mild physical exertion, you also experience body pain, headaches, trouble thinking clearly and difficulty sleeping.

That is the daily struggle for the more than one million people in the U.S. who suffer from myalgic encephalomyelitis/chronic fatigue syndrome (ME/CFS). Yet despite its prevalence, causes and effective treatments for the disease remain a mystery. The Cornell Myalgic Encephalomyelitis/Chronic Fatigue Syndrome Collaborative Research Center—established in the fall with a nearly \$9.4 million grant from the National Institutes of Health—is studying ways to remedy that situation.

"Understanding the biological basis of the illness is essential to develop therapies that will allow those who are now trapped in their beds and homes to resume active lives," said Maureen Hanson, the Liberty Hyde Bailey Professor in the Department of Molecular Biology and Genetics, who directs the center.

"The ultimate goal of all this is to find the fundamental disruptions, so that we can discover treatments to mitigate those disruptions and restore people to health," she said.



Professors Maureen Hanson and Andrew Grimson inspect a high-throughput DNA sequencer in the Biotechnology Resource Center.

AMANDA RODEWALD

Garvin Professor in the Department of Natural Resources and Director of Conservation Science at the Cornell Lab of Ornithology

Biodiversity continues to be lost at alarming rates. Do you have any hope that this trend might be reversed?

I do have hope. One of the challenges we have faced is that science is not always applied in the right places at the right times to help guide conservation. We are changing that by working more closely with partners who practice on-the-ground conservation. When we co-create research and solutions, they are more effective. Scientists also are doing a much better job framing how biodiversity and a healthy environment support human health and well-being. This broad framing draws in new partners—including from the private sector—and has the potential to unlock a lot of resources and capital that can be used to achieve conservation. If you look over history, when people come together to tackle a problem, we usually get positive results.

What keeps you motivated when there is so much negative news surrounding conservation efforts?

I have always had a deep concern for the environment. As a scientist, I am dedicated to finding ways I can contribute to keeping the world healthy. A healthy planet supports biodiversity, ecosystem services, human health and well-being—pretty much everything. My motivation comes from a belief that we can make changes and that better science, innovation and engagement will result in positive outcomes.

On a personal side, I find it incredibly thrilling. Conservation as a field is becoming more and more interdisciplinary. It's not just ecologists working to find solutions: We are collaborating with colleagues in business, economics and other social sciences to find solutions. Cornell makes it easy to connect with colleagues across campus and disciplines, and CALS does a great job of bringing faculty together in a useful and informative way. It's a really intellectually stimulating environment and set of questions to grapple with. I'm always learning; I'm always curious.

What led you to become a scientist?

Growing up in Schenectady, I spent most of my time outside in the alleys, up in the trees and, strangely, even riding imaginary horses around the neighborhood. My interest in conservation grew out of a love of being outdoors. In college I had many interests and thought I might be a writer or environmental lawyer—I was all over the place. Then I met a friend in a backpacking club who was majoring in forestry, and I was like, ‘Wow, you can do that?’

Now that I am a scientist, I can't think of anything else I'd rather do. There are so many great experiences I've had working in the field. I love being surrounded by trees with light coming through the forest canopy and seeing mountains in the distance. All those things are really meaningful to me. The coffee-growing regions in the northern Andes have always

wowed me. There's something about the intersection of the people and the environment that makes it incredibly moving.

What major challenges do you see in terms of conservation decline?

There are many drivers of loss of biodiversity, but habitat loss and environmental degradation remain the top threats. Climate change is certainly another huge concern, but we can't lose sight that we need to stop the habitat destruction that is happening right now. We need to find better ways to incentivize pro-environment choices across all sectors of society.

Is there anything people do that really drives you crazy from a conservation perspective?

When people fail to see the links between the issues that they care about and the environment, that gets to me. Whether it's national security or immigration or strong economy or public health, all of these things are grounded in a healthy environment. An unhealthy environment exacerbates challenges we face in those other areas. Conservation and environmental protection aren't going to be at the top of everyone's list, and I get that; that's OK. We can care about different issues, but we still need to see the connections among them.

Do you have advice for people who want to make changes to their own lifestyle to help support conservation but don't know where to start?

Don't let the “best” be the enemy of the “good.” Any small change is something. Whether it's keeping your cat inside, or buying shade-grown coffee when you can, just making small, positive changes is important. Even voting for politicians who support environmental protection, or supporting conservation organizations, all of those are fairly simple ways to contribute.



Amanda Rodewald conducts bird and conservation research with students and colleagues in 14 countries: Belize, Canada, Chile, Colombia, Costa Rica, Ecuador, Guatemala, Honduras, Jamaica, Mexico, Nicaragua, Panama, Peru and the United States.

Her surprising ability: “I have an uncanny talent for finding four-leaf clovers.”

CALS in quotes

"There needs to be much more work on fungicides and their role in bee declines. People are not looking in all the places they probably should."

—**Scott McArt**, assistant professor in the Department of Entomology, in *The Guardian* describing his research linking fungicides and bee health.

"There is nothing icky about it. Plants don't care whether they get light from the sun or the lamps. It's the same thing."

—**Neil Mattson**, associate professor in the School of Integrative Plant Science, in *The New York Times* on the palatability of eating plants grown in a basement hydroponic farm.

"Minis had been a really hard sell because they don't fit a lot of people's concepts of what a good squash should be. For a lot of vegetables, runty is bad."

—**Michael Mazourek**, associate professor in the School of Integrative Plant Science, in *Bon Appétit* on how the honeynut squash he bred overcame people's preferences for larger vegetables.

"It makes these butterflies look like moths, which is pathetically embarrassing for them."

—**Robert Reed**, associate professor in the Department of Ecology and Evolutionary Biology, in *The Atlantic* about his research showing that butterfly wing colors and patterns are controlled by single master genes.

"Once a tree is infected, the best we can do is try to prevent it from being spread. Unfortunately, it's a death sentence for that tree."

—**Karen Snover-Clift**, director of the Cornell University Plant Disease Diagnostic Clinic, in the *New York Daily News* on how an outbreak of the deadly fungus oak wilt threatens oak trees in the state.

"Plastic is a triple whammy for increasing coral infections. It abrades and cuts open the skin of the coral and then can convey pathogenic microorganisms and shades and cuts off water flow."

—**Drew Harvell**, professor in the Department of Ecology and Evolutionary Biology, in *Motherboard* on how plastic trash in the ocean conveys disease to coral reefs.

"It's not helping food safety. If you want to trace food-borne illness, it needs to be done by public health departments, and it needs to include food history."

—**Martin Wiedmann**, professor in the Department of Food Science, in *The New York Times* about the rise of a website that allows users to post reports of food poisoning without verification from trained food safety experts.

"Today's students are more idealistic and want to change the world for the better. What better way to positively impact the world than to address issues of food security, water availability, environmental pollution and energy consumption?"

—**Marvin Pritts**, professor in the School of Integrative Plant Science, in *USA Today* about how agriculture programs produce global problem-solvers.

We have an optimistic view of human ingenuity and resilience and infrastructure and what we're trying to do is not scare people but to be realistic about what the risks look like in the future."

—**Toby Ault**, assistant professor in the Department of Earth and Atmospheric Sciences, in *Newsweek* discussing the odds of a mega-drought occurring in the western and southwestern United States.





SPOTLIGHT ON HEALTH

On the heels of a particularly buggy flu season, we're welcoming spring with health on our minds. Investigating the wide array of research being conducted on campus has inspired us to take a broad view of the subject, exploring it not only as human physical well-being but also the health of our environment, our food, our economy and ecosystems.

The stories that captured our attention highlight a range of issues that have been propelling our researchers and dig into some novel approaches to improving health. From using virtual reality for addressing chronic pain to examining what tree swallows can teach us about stress, our scientists are often driven to look for answers in unlikely places. But whatever their methods, they all share one overarching goal: to boost the well-being of people and communities near and far.

We hope these stories will spark thoughtful conversations about what it means to be healthy, as well as to live in a healthy society. Maybe this spring you'll even be inspired, as we are, to visit a local farm, try a new food or beverage, and take time out to watch the birds.

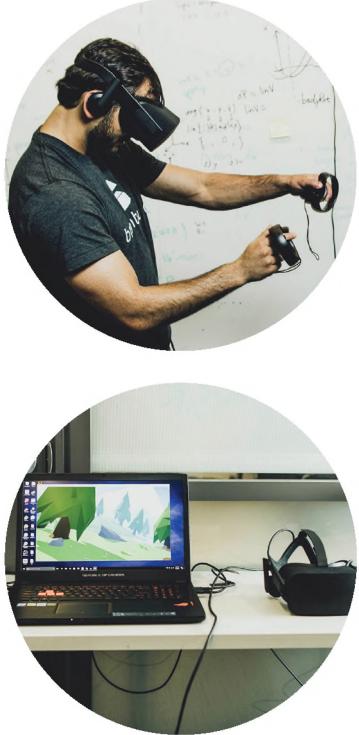
A NEW LENS

Relieving real pain
in a virtual world



Andrea Stevenson Won,
assistant professor
in the Department of
Communication, in the
Virtual Embodiment Lab.

Photos, this spread: Sasha Israel. Previous spread [left to right]: Top row: Jamie Johnson; Sasha Israel; Getty Images; Sasha Israel[2]. Second row: Matt Hayes; Sasha Israel[3]. Third row: Getty Images; Matt Hayes; Sasha Israel. Fourth row: Sasha Israel; Connor Taff; Kathryn Berry. Fifth row: Sasha Israel; Matt Hayes



Top: Connor Lapresi '18 explores virtual reality in the Virtual Embodiment Lab. **Bottom:** Virtual reality equipment in Won's lab.

"For better or worse, our experiences change us."

—Andrea Stevenson Won,
assistant professor in the
Department of Communication

We've all enjoyed losing ourselves in a good book, but what if the story could change our lived experience? It may sound like science fiction, yet Andrea Stevenson Won uses a similar concept to study how immersing people in virtual reality (VR) can treat real-life pain.

VR offers tantalizing hope as a way to relieve the anguish of physical and mental stress. For those dealing with acute pain, it can form a distraction for the mind. And for those suffering from trauma, it helps relive triggering situations in a supported way.

Won, assistant professor in the Department of Communication, directs the Virtual Embodiment Lab, exploring how physical and social interactions in mediated environments affect people's perceptions. "I'm interested in the idea that you can transform your movements—see yourself doing something other than what you're actually doing in real life—and this could help relieve chronic and acute pain," said Won.

Pilot studies in collaboration between Won's lab and clinics at Stanford University have shown promising results. But because VR is inherently fun and novel, Won said they need to dig deeper. Her research on chronic pain has previously examined two types of afflictions: complex regional pain syndrome, an uncommon form of chronic pain that typically develops after an injury, surgery, stroke or heart attack but that is out of proportion to the severity of the initial injury; and persistent idiopathic facial pain, a similar condition that occurs in the face.

Both of these maladies could potentially be addressed by giving patients what they would receive under normal conditions: visual feedback on their actions. Using VR, patients can see themselves moving in ways that they can't in real life, and their brains use that feedback to recreate their body image. According to Won, this "bogus" visual feedback can effectively change the way people with chronic conditions, such as neck pain, move. By tricking the brain with virtual experiences, the results could be lasting relief in the real world.

Won has modeled her VR-based approach on V.S. Ramachandran's concept of mirror visual feedback, developed in the mid-1990s to help people cope with phantom limb pain, particularly in cases where they felt an amputated arm or leg was stuck in an uncomfortable position. The reflection of an existing hand or leg was able to fool the patient's brain into thinking that its missing counterpart was moving and, therefore, getting unstuck.

Today, VR treatments for pain intervention as well as for trauma and post-traumatic stress disorder have likewise proven to be successful. Together with increasingly accessible technology and lower price tags, that success has inspired more researchers to explore ways to treat a myriad of conditions.

"For better or worse, our experiences change us," said Won. "As VR becomes a more common experience, there are more opportunities to use the technology to benefit our health."

—JENNIFER SAVRAN KELLY



A tree swallow feeds her young at a nest box in Alaska.

THE SOCIAL NETWORK

How birds are revealing links between connectedness, stress and health

Tree swallows are particularly nosy neighbors. These gregarious songbirds flit from nest to nest, poking around in the cavities of old trees that fellow swallows call home. The most socially active birds tend to sport the brightest feathers, a flashy display of their convivial acumen.

But life for a tree swallow is not one big party. Understanding how individuals deal with stress—and what happens at the biological level when faced with high-stress situations like evading a predator or surviving when food is scarce—is leading to new insights into the links between social connectedness, health and future performance.

"If you look across species, from tree swallows to humans, social bonds are often really good predictors of many aspects of stress resiliency and health," said Maren Vitousek, assistant professor in the Department of Ecology and

Evolutionary Biology. "But we don't yet know whether or how social interactions change the biology of individuals that experience them, in ways that have long-term consequences for their health."

To answer these questions, Vitousek and postdoctoral associate Conor Taff are testing the interactions of tree swallows to see if there's something about their social behavior that influences changes in their biology. Previous research has shown that more socially connected birds are better able to keep reproducing when faced with high-stress situations, and to avoid adverse health events and even mortality. Now the researchers are searching for connections that reveal what's happening at the biological level that influences health and performance, from neuroendocrine function to even gut microbial composition.

The work has tantalizing implications for biological research. In terms of

human health, the findings could help researchers develop biomarkers of social connectedness or stress resistance, or even treatments designed to mimic or reverse these changes.

"The multi-layered social connectedness of humans can be a good predictor of the likelihood someone who is exposed to a major stressor will respond favorably," Vitousek said. Traumatic episodes like natural disasters, terror attacks or war events can result in deleterious long-term effects on health.

"We know these short-term events can have lasting repercussions on human health, but we don't fully understand the mechanism. How tree swallows respond to stress can tell us a lot about our biology; what we learn from this work could have important implications for human health and well-being."

—MATT HAYES



Research associate Joleah Lamb surveys the coral at the Great Barrier Reef in Australia.

TODAY:
11.1 billion plastic items entangled on reefs across the Asia-Pacific region.

IN 2025:
15.7 billion plastic items on coral reefs

UP TO 12.7 MILLION METRIC TONS
of plastic waste are estimated to enter the ocean in a single year

OCEAN PLASTIC PUTS CORAL REEFS IN PERIL

Trash in the marine environment increases the likelihood of coral disease 20-fold

For coral reefs, the threat of climate change and bleaching are bad enough. But an international research group led by our scientists has found that plastic trash—ubiquitous throughout the world's oceans—intensifies disease for coral, adding to reef peril.

"Plastic debris acts like a marine motor home for microbes," said Joleah Lamb, a research associate in the Department of Ecology and Evolutionary Biology. "Plastics make ideal vessels for colonizing microscopic organisms that could trigger disease if they come into contact with corals."

Coral are tiny animals with living tissue that cling to and build upon one another to form "apartments," or reefs. Bacterial pathogens ride aboard the plastics, disturbing delicate coral tissues and their microbiome.

When plastic debris meets coral, the likelihood of disease increases from 4 to 89 percent—a 20-fold change. The scientists estimate that about 11.1 billion plastic items are entangled on reefs across the Asia-Pacific region, and that this will likely increase 40 percent over

the next seven years.

"What's troubling about coral disease is that once the coral tissue loss occurs, it's not coming back," said Lamb. The scientists forecast that by 2025, plastic going into the marine environment will increase to roughly 15.7 billion plastic items on coral reefs, which could lead to skeletal eroding band disease, white syndromes and black band disease.

"Our work shows that plastic pollution is killing corals. Our goal is to focus less on measuring things dying and more on finding solutions," said Drew Harvell, professor in the Department of Ecology and Evolutionary Biology. "While we can't stop the huge impact of global warming on coral health in the short term, this new work should drive policy toward reducing plastic pollution."

Coral reefs are productive habitats in the middle of nutrient-poor waters, Harvell said. Thanks to the symbiotic relationship between corals and their solar-powered algae, "this miracle of construction creates the foundation for the greatest biodiversity in our oceans," she said.

—BLAINE FRIEDLANDER

A close-up photograph of a hand reaching towards a branch of red apples. The hand is positioned on the right side of the frame, with fingers wrapped around a single apple. The branch is covered in green leaves and several other ripe red apples. The background is a soft-focus view of more trees and foliage, suggesting an orchard setting.

SHAKING THE TREE

How our research is
growing the hard cider
industry in New York

Harvesting cider
apples from a Cornell
research orchard.



Gregory Peck, assistant professor of horticulture, conducting research on apple blossoms at Cornell Orchards.

IN NEW YORK:

1,365 FARMS

producing

1.2 BILLION

POUNDS

of apples on

40,000 ACRES

5 MILLION

GALLONS

of hard cider produced annually

\$44 MILLION

contributed in direct economic impacts by cider producers

To say that hard cider has been making a comeback is an understatement. In the U.S. alone, the hard cider market has increased more than ten-fold in the past decade, with sales reaching \$1.5 billion in 2017. And Gregory Peck has been paying attention. Taking advantage of this upward trend, the assistant professor of horticulture has been tapping cider's full potential to grow New York's apple market. Now he's at the forefront of a hard cider renaissance.

"The industry has been booming because cider producers are innovative," Peck said. "Consumers want to experience something different in their food and drinks. Cider has a rich depth of flavor and range of products that appeal to a large and growing consumer base."

Of the more than 800 cider producers in the U.S., nearly 100 are now in New York. That growth is no fluke: the state has an excellent climate and soils for growing flavorful cider apples. As consumption has swelled, business opportunities have bloomed for the state's apple growers, cider producers and people in the agritourism industry. However, they have lacked the necessary research-based information to meet such fast-growing demand, so Peck has been developing both field- and lab-based research that will provide that much-needed guidance.

At LynOaken Farms, a bustling orchard tucked between Buffalo and Rochester and located a few miles from the Lake Ontario shoreline, cider apple trees were planted in 2004 with the goal of using them for cider production at the farm's sister winery. But the family farm owners couldn't find much information on how to grow them.

"Greg wants to see the cider industry advance," said Chris Oakes, production manager at the family farm, which grows 250 acres of apples in addition to other fruits. "He does research right on our farm and shares his data, allowing us to

apply it right away. We're predicting 15 to 20 percent growth per year in cider apple volume over the next four to five years. We've been holding steady at 5 to 10 percent growth, so we're on the cusp of something big."

Apples for hard cider contain up to ten times more tannins than the culinary apples you find in the grocery store. Tannins, a subset of the naturally produced polyphenols in apples, add to cider's mouthfeel, creating a more robust and interesting drinking experience. Peck's lab uses molecular markers to identify the preharvest factors that increase polyphenol development.

While flavor is what consumers notice most, Peck is also exploring ways to increase the quantity of New York grown cider apples, including best practices for fertilizer, crop load and harvest management. He is studying the hard cider supply chain with Cornell Cooperative Extension's Harvest NY team, and working with the U.S. Department of Agriculture to identify potential new cider apple varieties in their collection of 3,500 unique genotypes.

"Our research is narrowing down the list of optimal cider apple varieties for New York," Peck said. "We share what we learn directly with our growers to help them select varieties that will work best for high-quality and flavorful cider."

Steve Selin, orchardist and cider maker at South Hill Cider, is grateful to have someone at Cornell conducting the research and outreach he needs to improve his business. He gained initial confidence to plant his own orchard after visiting a cider apple test plot at Cornell. Having an expert that cideries can turn to for advice helps nurture the entire industry in the state, he said.

"Most of what we know about making cider comes from research done on wine. The work Greg is doing provides us with crucial information we need to take hard cider to a new level," Selin said.

—JENNIFER SAVRAN KELLY



TAKING THE LAB TO THE FIELD

High-throughput phenotyping provides powerful new tool for plant breeders

New technology is changing the game for plant breeders. Before long, drones could become like farmworkers, scouting crops for disease and helping farmers react with the right fungicide or pesticide, before an outbreak of disease spreads out of control.

As DNA sequencing technology has become smarter, faster and cheaper, scientists have benefited from an abundance of genetic information at their disposal. But DNA is not everything. Understanding of phenotypes—the way that the genetic code interacts with the environment to express an organism's actual characteristics—is just as important, but is currently far more difficult and time-consuming to achieve.

This problem of genetic/phenotypic data imbalance is particularly troubling for plant breeders, who are in the business of choosing the best individual organism among a large group of the same species; in other words, the plant with the best phenotypes, or traits.

"Around 2010, when DNA sequencing technology got to a very low price point, the field of plant sciences really began turning its attention to how to solve the problem of collecting a lot of phenotypic data, large volumes of it, at low cost with less labor," said Michael Gore, associate professor of plant breeding and genetics in the School of Integrative Plant Science. "People were trying to figure out how to take the lab to the field."

The result is a method called "high-throughput phenotyping." It refers to almost any approach that gathers and analyzes large amounts of physical data. In plants, it can be everything from crop height to protein expression, spectral reflectance to seed metabolites.

Gore is developing technology that

harnesses the power of this method. He is using aerial drones trained to spot disease across acres of corn, smartphone apps that can tell African farmers what's infecting or infesting their cassava, and ground vehicles that can take the temperature of thousands of cotton plants.

In the cotton project, Gore and his team are looking at transpiration—the water that plants emit in hot temperatures to cool their canopies and prevent heat stress. For more than 50 years, cotton breeders have been selecting for plants with high transpiration rates in hot, arid environments that are heavily irrigated. But with climate change increasing the probability and severity of droughts and freshwater shortages, breeders are now placing more value on plants that use less water, while still being resilient in the heat.

"Canopy temperature is a very time-sensitive phenotype; you often only have a two-hour window to try to robustly phenotype those plants, based on the changing solar angle, air temperature, soil water content and vapor pressure deficit," Gore said. "Imagine having a ground vehicle driving through with an infrared radiometer: it could quickly and precisely measure the canopy temperature of each of those thousands of plants in the field."

While technology cannot replace the more nuanced decision making that breeders and farmers must engage in to ensure crop health, Gore said this new method of phenotyping marks a huge breakthrough in how they approach those decisions.

"We are in an era of rapid change in agriculture," Gore said. "Technology is transforming what we grow and how we grow it, and the result is more nutritious and resilient crops."

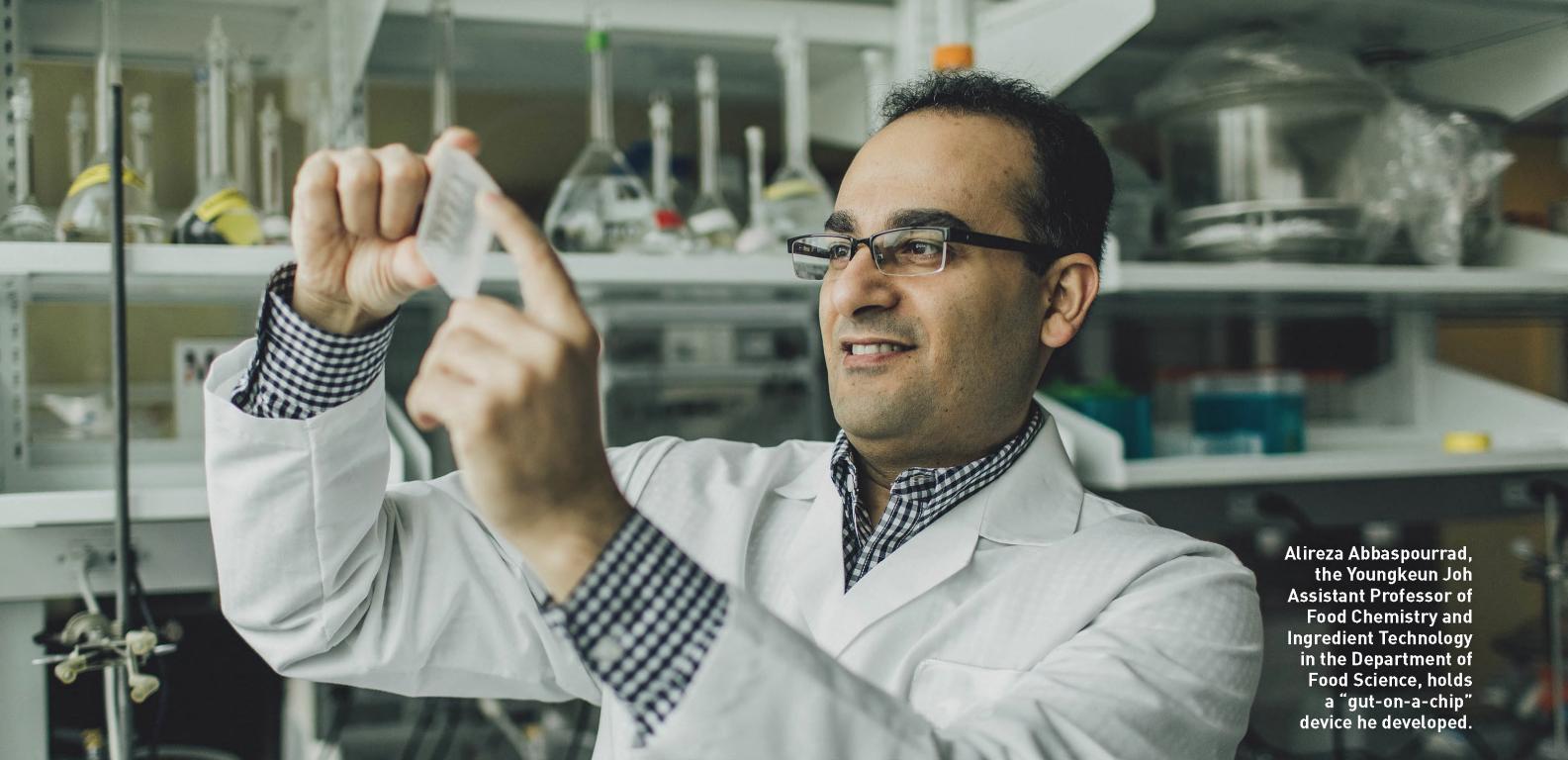
—KRISY GASHLER



Research support specialist Nicholas Kaczmar prepares a drone for takeoff at Musgrave Research Farm.

"We are in an era of rapid change in agriculture."

—Michael Gore,
associate professor of
plant breeding and genetics



Alireza Abbaspourrad, the Youngkeun Joh Assistant Professor of Food Chemistry and Ingredient Technology in the Department of Food Science, holds a “gut-on-a-chip” device he developed.

GUT CHECK

Food scientist works to improve nutrition, understand gastrointestinal disease

The difficulties of conducting research on the human gut are substantial: the presence of trillions of bacterial cells interacting with human cells and each other, constant environmental changes every time food is consumed, and zero chance of conducting trials that control for all those moving parts.

However, gaining a better understanding of how food moves through the body is especially important for helping those with poorly understood gastrointestinal disorders, like Crohn's disease.

One groundbreaking solution, called a “gut-on-a-chip,” involves creating a three-dimensional, microscale model of the human intestinal tract. Composed of biocompatible hydrogels with tunable physicochemical properties, the model recreates the intestinal matrix with villi structures that mimic the mucous-membrane layer of the small intestine. These structures are critical for nutrient absorption.

Alireza Abbaspourrad, the Youngkeun Joh Assistant Professor of Food

Chemistry and Ingredient Technology in the Department of Food Science, has been working for the past year and a half to develop novel approaches to improving the current models. He is one of just a handful of other pathbreaking researchers who are developing similar devices, including John March, professor and chair in the Department of Biological and Environmental Engineering.

“Our hope in the lab is to create healthier, more nutritious foods, and also to help treatment of diseases through understanding ingredients’ effects on intestinal cells and microbiome populations in our gut-on-a-chip model,” Abbaspourrad said.

The device allows researchers to control for variables like nutrients and gut bacteria with tremendous specificity, while using human cell lines, a feat that is impossible with current studies that use lab animals or human trials.

With his model, Abbaspourrad is focused on studying the interactions between multiple strains of bacteria in the gut, assessing toxicity of ingredients and understanding how much of certain

nutrients is actually available for our bodies to uptake, a concept known as bioavailability.

“All of us are becoming more aware and more questioning about how much of a certain ingredient is available for our body to uptake—rather than just how much of it exists in a food,” Abbaspourrad said. “This is the next step in better understanding how certain foods may positively affect our health.”

Abbaspourrad is also using microencapsulation technology to protect and deliver bioactive ingredients to the right parts of the body. For example, people who consume probiotics are trying to get more beneficial bacteria in the large intestine; however, most of the probiotics are destroyed before they can get there.

“We need to bypass the acidic condition of the stomach, deliver those probiotics to the intestine to see their beneficial effects,” he said. “People have tried to work on this; however, this is very challenging and we are trying to address this question using microencapsulation technology.”

—KRISY GASHLER

A photograph showing three farm workers in a field of green leafy vegetables, likely kale. One worker in the foreground is bending over, wearing a blue long-sleeved shirt, blue jeans, and a tan baseball cap with a small yellow logo. They are wearing blue gloves and have a red bucket strapped to their belt. Another worker is visible behind them, and a third is further up the hill. The field is covered with plastic mulch in raised beds. A circular graphic overlays the top right corner of the image.

Farm workers
harvest kale at Main
Street Farms in
Cortland, New York.

BETTING ON THE FARM

Cornell Small Farms Program
supports diversity in agriculture



Photo: Zack Bolton

As Dani Baker looked forward to retirement in 2006, she and her partner David Belding purchased 102 acres on Wellesley Island in the Thousand Islands region of the St. Lawrence River. They were intrigued by the idea of resuscitating a former dairy farm, but they weren't convinced that farming was in their future. Then Baker remembered Belding's childhood dream of being an organic farmer, and a newspaper advertisement for a workshop caught her eye: Building Your Small Farm Dream.

"The course was extremely inspiring," Baker said of the educational opportunity offered by the Cornell Small Farms Program (CSFP). "It propelled us to take the leap."

Today, with the ongoing support of CSFP, Baker and Belding operate Cross Island Farms, producing a range of certified organic meats, eggs, fruits and vegetables, and powering their efforts with sustainable energy.

Since 2001, CSFP has been providing New York farmers with education and training programs, addressing needs ranging from preparation to enter new markets to support for military veterans looking to enter the industry. Through efforts like on-the-ground teaching, online courses and an e-newsletter that reaches 11,000 people, program staff, together with community educators of Cornell Cooperative Extension (CCE), have been empowering farmers through every stage of small farm business development.

Yet small is relative, according to CSFP director Anu Rangarajan. "It comes down to the community a farmer aligns with and how they perceive their operation," she said. "Many people who take advantage of our programs would be considered mid-size to large. The bottom line is we want to see a vibrant, evolving and growing agriculture."

The 2012 USDA Census of Agriculture highlights a crucial need for this type of growth: the average age of farmers has risen to 58.3.

"At our core, we are an educational organization, but I think it's just as important we provide voices saying that farming is rewarding and doable," said Violet Stone, small farms ▶

Below: The Baskets to Pallets Project teaches farmers how to expand their marketing to wholesale buyers. Right: David Belding and Dani Baker started Cross Island Farms after taking a course from Cornell Small Farms Program.



program coordinator and New York coordinator for the Northeast chapter of Sustainable Agriculture Research and Education (SARE). With support from state and federal organizations, such as the National Institute of Food and Agriculture (NIFA), CSFP is well positioned to do just that.

About ten years ago, CSFP discovered there was a surge of people looking to start farms. With CCE educator colleagues and NIFA's support, they developed the Beginning Farmers Project to offer networking opportunities, courses and trainings. As part of that effort, they produced the "Guide to Farming in New York," a printed guide of practical information such as zoning and labor laws, tax regulations and ways to access land and equipment.

Farmers like Baker and Belding have benefited directly from the program. Not only are CSFP courses designed to help farmers assess their resources and interests at the outset, but the courses help them develop their businesses over time.

Baker and Belding also participated in CSFP's Profit Team Program to set realistic financial goals. For Baker, the most exciting outcome has been an edible forest garden they created in 2012 after taking a two-hour course on permaculture.

"I'm hopeful the forest will bring in new income streams through U-Pick, weddings and workshops—and even an associated nursery," Baker said.

The main way in which CSFP has been taking the pulse of New York farmers and agricultural educators is by means of their Small Farms Summit. Every two years they bring together farmers and educators to ask about their concerns and what opportunities they see.

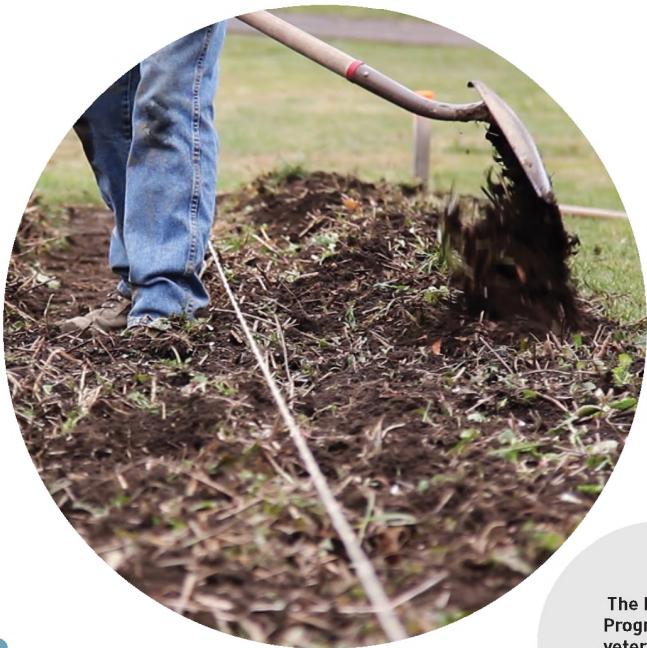
"From our statewide position," Stone said, "we can see trends and concerns emerge in a broader way than local educators who have one-on-one relationships with farmers."

At a 2014 summit, farmers expressed apprehension about declining direct-market sales. For some, intense competition at farmers' markets was

keeping them out, and community supported agriculture (CSA) was losing customers. Farmers' interest in new marketing opportunities led CSFP to create the Baskets to Pallets Project, which teaches farmers how to expand their marketing to scale-appropriate wholesale buyers such as natural food stores, farm cooperatives and food hubs.

"The summits drive our programming, but we also share farmers' comments with legislators, community members and others to make the needs of a dispersed and diverse group of farmers visible," Rangarajan said. "The conferences also help build connections among Cornell, Cornell Cooperative Extension and the community."

In addition to the summits, where farmers and agricultural educators enjoy the opportunity to meet face-to-face, CSFP has created virtual networks to inspire innovation. Currently, 100 organizations participate in their Northeast Beginning Farmer Learning Network—groups who are all committed to supporting the next generation of farmers.



The Farm Ops Program helps veterans enter the agricultural industry.

"I became a soldier to serve my country, and now I've become a farmer to serve my community."

—Nina Saeli, owner of Centurion Farm

FOSTERING DIVERSITY

CSFP recognizes that nurturing the next generation depends on supporting diversity among the farming community.

"Farmers of color and other underserved populations are an audience we want to better serve," Stone said. "We are committed to building these relationships."

With a recent grant from NIFA, they are currently addressing the training needs of Hispanic farmworkers wanting to climb the ladder from labor to management to ownership.

Another traditionally underserved group that came to the program's attention in recent years is military veterans. Veterans often encounter obstacles when considering entry into farming, such as lack of access to specialized resources and lack of funds for farm-related education and training.

Nina Saeli of Centurion Farm, 58 acres of pastures, hardwood forest, riparian forests and wetlands, spent 17 years as a medical service core officer in the U.S. Army and had two spinal surgeries

prior to retiring.

"The most difficult struggle I faced during my transition was feeling like I had lost my sense of purpose," she said. "It wasn't until we made the decision two years ago to start farming that I feel I'm starting to regain it. I became a soldier to serve my country, and now I've become a farmer to serve my community."

After receiving an increasing number of requests for assistance from veterans like Saeli over the last few years, CSFP created the Farm Ops Program. Forging bridges with organizations like the Division of Veterans Affairs and the Department of Labor, they support agriculture training for veterans and have implemented multiple education strategies to engage and train those who want to farm.

"One of the most valuable resources has been going to the workshops sponsored by the local Cornell extension offices," Saeli said. "They haven't just been informative, but also provided many opportunities to network with local farmers."

LOOKING AHEAD

One of the biggest challenges CSFP faces is helping new farmers scale up because each farm is so different. "If we can elevate other people's work to help make connections, that can really move us forward," Rangarajan said. "The grand goal is to highlight the many ways in which New York is an attractive place to land—and stay—for farming."

Looking to the future, she hopes to work with small farm specialists to discover where digital agriculture fits into a small farm context. What technological tools and advances might best support small farms to help them achieve their goals?

For both Rangarajan and Stone, farming is much more than just growing and producing things. It's personal.

Stone grew up in a rural Pennsylvania dairy community. Rangarajan, born in India and raised in Detroit, found her home in agriculture. Both have come to believe that farming plays a crucial role in land stewardship and boosting the ecological health of communities.

"I love my work," said Rangarajan. "My aspiration is to pave the way for anyone who's interested in supporting agriculture. Frankly, I think that the more people who count themselves as farmers, the better."

—JENNIFER SAVRAN KELLY

student life

Sai Kartoori, Shwetha Halappa, Emma Herrity '19 and Nelly Guerra '18 transplant rice in paddy mud at the Indian Institute of Rice Research.



CORNELL'S FIRST INTERNATIONAL COURSE TURNS 50

More than 2,500 students have taken part in IARD6020

Innovative. Eye opening. Worrisome. Incredible. Communal. Inspiring. Educational. Unforgettable.

Those are just some of the ways 40 undergraduate students described their experience in south-central India in January, part of the 50th cohort to travel abroad in our International Agriculture and Rural Development 6020 (IARD6020) class.

A breakthrough when first introduced in 1968 and the first to take students abroad, the class is now Cornell's longest running experiential learning course.

More than 2,500 undergraduate and graduate students and hundreds of faculty from Cornell and partner institutions have taken part in the course run by International Programs in CALS over the last 50 years. They have traveled to places as far flung as Myanmar, Thailand, India, Dominican Republic,

Mexico, Costa Rica, Honduras and Ecuador.

In the fall, in IARD4020, faculty teach concepts the class will experience during the 20-day field trip abroad in January, when they visit in-country agricultural systems, value-added food enterprises, rural development agencies, farms, veterinary services, textile cooperatives and clothing factories.

This year the Cornell undergraduates met up with the cohort of 14 Indian students who took IARD4020 remotely, in addition to joining the class in Ithaca for three weeks in October. In India, they split into four groups to focus on socio-economic and development issues. The cross-cultural experience helps students gain insight into issues of globalization, development and transnationalism.

—LINDA McCANDLESS



Photos, clockwise from top left: Linda McCandless, Olu Roberts, Olu Roberts



Kirsten Kurtz, second from left, along with artists (from left) Patty Chan '18, Shujie Li '17 and Fatma Rekik, MS '17, hold their winning "Three Sisters" painting.

THE ART OF DIRT

Soil painting celebrates essential resource

The soil under our feet may not be top of mind, but it provides the foundation for everything we need to live—and it's disappearing. Since the advent of industrial agriculture, roughly one-third of Earth's arable land has been lost to erosion or pollution. Kirsten Kurtz is on a mission to save this essential resource by turning our attention to its natural beauty.

Kurtz, manager of Cornell's Soil Health Testing Laboratory and a graduate student in the field of natural resources, does this in a profound way: by painting with it.

"You can see how I became inspired," said Kurtz while pulling out soil samples ranging in hue from reddish brown to tan to yellow ochre. "It was being in the lab and seeing all the colors come in."

By mixing soils with water and clear gesso, a liquid binder, she creates unique paints similar to acrylic that retain the quality and texture of the soil. She first began experimenting with soil painting in 2014, and a community event she organized on campus the next year drew hundreds of Cornellians to try their hands at the unique art form.

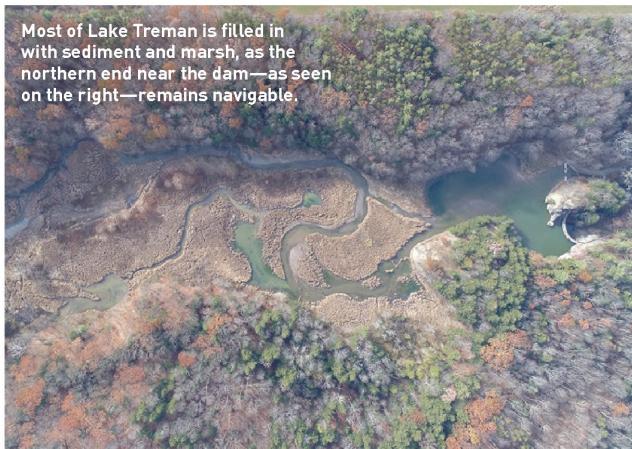
The success of that community gathering inspired the Food and Agriculture Organization of the United Nations to take the concept worldwide. It launched a global soil painting competition in December 2017 with the goal of illustrating soil's

crucial role in sustaining life. For the contest, Kurtz and other artists gathered in the lobby of Mann Library and used the special paints to honor an agricultural practice used by Native American communities. The scene they painted was based on "Ringelreihen," a 1910 work by the German artist Franz von Stuck, which shows three women spinning arm-in-arm.

For their version, the artists added baskets filled with corn, beans and squash. Those crops are the three main agricultural crops—known as the "Three Sisters"—grown for centuries by the Haudenosaunee communities in the Finger Lakes. Their contest entry, which incorporated more than 50 paints formulated from soils from around the world, won first prize in the university category of the global competition.

"Painting with soil is a powerful way to show younger generations that soil is something you can study," said Kurtz, who grew up on a 200-acre organic farm, worked in various wineries and vineyards and has worked with the soil health lab for more than six years. "If we want to feed the world, we're going to need many more soil scientists, and we need to encourage creative people to enter the field. You need creativity to solve many of the challenges we're facing, and being an artist helps."

—CRAIG CRAMER AND JENNIFER SAVRAN KELLY



Photos, from top: Tom Whitlow; Provided; Tom Whitlow

RESTORING BALANCE TO A LAKE IN TRANSITION

Students survey Lake Treman to predict its future

Far above Buttermilk Falls in Ithaca sits a reservoir dam impounding Lake Treman. Hiking trails wend through the area, which for eight decades has slowly accumulated enough sediment to turn the lake into plodding marsh. Sometime in the next thirty years, it will completely fill.

To bring clarity to the future of this historic lake, students in Tom Whitlow's Restoration Ecology class spent the fall semester examining Lake Treman's many components. They collaborated with the New York State Department of Parks and Recreation to develop a plan for managing it.

"We looked at a bunch of nature's different services the area provided," said Tanvi Naidu '17, M.Eng.'18, who collected samples of sediment and analyzed the marsh's methane levels (they are low). "We evaluated it as a wetland and as a lake, and we tried to make predictions. It is definitely not stable in the physical or biological sense."

The students examined biology along trails, inventoried trees and plants, collected water samples and produced a bottom profile of the remaining lake using a canoe equipped with sonar technology to measure water depth. They identified invertebrates and invasive species, collected bacterial samples and compared the area's aerial maps over an 80-year period.

When the Civilian Conservation Corps built Lake Treman in 1930, tributaries flowed into the lake from surrounding farmland. But by 1964, the southern end was becoming noticeably marshy.

The entire southern half of the lake became mostly wetland by 1991—and in 2016, only the northern tip of the lake held navigable water. In a 1938 aerial photograph, Lake Treman encompassed about 16 acres of water. Now the lake has been reduced to 1.9 acres, while the marsh now measures 10.9 acres, according to the students' calculations.

"The field of restoration ecology is relatively young and rapidly evolving. It lacks the coherence of mature disciplines like physics or chemistry," said Whitlow, associate professor in the Horticulture Section of the School of Integrative Plant Science. The field applies environmental theory to solve problems, he said.

Beyond the plants, hydrology and natural systems, students learned about real life. "We worked with many people, and we had to blend a lot of information into a cohesive, comprehensive report," said Samantha Schultz '18. "The big idea of the class was to look at restoration projects from a different viewpoint. Everyone wants simple solutions, one recipe, but in reality, as Dr. Whitlow taught us, problems may have different solutions."

"Answers are very specific for problematic sites," she added. "One solution doesn't fit all."

—BLAINE FRIEDLANDER

in memoriam

The CALS community remembers with gratitude faculty members who recently passed away.

OLAF LARSON

(b. 1910)

Professor emeritus of rural sociology

Larson dedicated his career to increasing people's understanding of low-income rural families, becoming a pioneer in rural sociology research during the Great Depression. In 1954, Larson was among the first members of the Rural Sociological Society, and in the early 1960s he helped organize the first World Congress of Rural Sociology. Larson lived 107 years and had been Cornell's oldest living emeritus professor. He continued to publish throughout his life, including two books after age 100: "Opening Windows Onto Hidden Lives: Women, Country Life, and Early Rural Sociological Research" (2010), with Julie Zimmerman, Ph.D. '97, and his autobiography, "When Horses Pulled the Plow" (2011).

ROY MILLAR, PH.D. '55

(b. 1924)

Professor emeritus of plant pathology

Millar served as a pilot in the Royal Canadian Air Force during World War II before studying plant pathology at the University of Alberta. He earned his Ph.D. from Cornell. Millar's research focused on the physiology of plant disease. He conducted foundational studies on the pathology of forage legumes. During his career at Cornell he served as editor-in-chief of the journal *Phytopathology*, as president of the Northeastern American Phytopathological Society, and was elected a fellow of the society in 1973. Millar was chair of the Department of Plant Pathology at the time of his retirement in 1986.

NATHAN PECK SR. '51, PH.D. '56

(b. 1923)

Professor emeritus of plant and soil science

Peck was born on a fourth-generation family farm in Phelps, New York. He served in the U.S. Army during World War II, after which he studied plant and soil sciences at Cornell. In 1959 he joined Cornell's New York State Agricultural Experiment Station at Geneva, where he conducted research that led to more than 100 publications on soil fertility and plant nutrition to improve yields and quality. In 1989, Peck was honored with a tribute from the New York State Vegetable Growers Association for his scientific contributions to the industry. He also directed the climate station at Geneva, where he enjoyed driving the tractor himself to set up agricultural research plots.

EUGENE MADSEN, M.S. '81, PH.D. '85

(b. 1953)

Professor of microbiology

Madsen was an innovative researcher who advanced basic understanding of environmental microbiology and developed multiple applied processes to remediate polluted sites in New York and elsewhere. His work focused on the role of microorganisms in the cycling of carbon, nutrients and pollutants in natural habitats. Madsen published more than 150 primary research papers and review articles, as well as a widely used textbook, "Environmental Microbiology: From Genomes to Biogeochemistry," based on a course he taught at Cornell. Madsen was a dedicated and caring teacher, who taught undergraduate and graduate courses in environmental science, sustainability, environmental microbiology and science communication.

FROM CALS TO PYEONGCHANG

Meet our alumni who showed off their athletic mastery at the 2018 Winter Olympics in Pyeongchang, South Korea.



BREAKING THE ICE

Four alumnae took home silver medals as members of the Canadian women's Olympic hockey team.

Rebecca Johnston '12 became the first Cornellian to compete in three Olympic Winter games and is the sixth to compete in three or more Olympics. She has earned a medal at each—gold in 2010 and 2014; silver in 2018—tying her with Kevin Freeman '64, who earned silver in equestrian in 1964, 1968 and 1972, for the most medals in school history.

A two-time Olympic medal winner, **Laura Fortino** started playing hockey at age three at the urging of her two older brothers. She was a three-time first-team All-American at Cornell, who as a freshman led all NCAA defensemen in scoring.

Lauriane Rougeau '13, a two-time Olympic medal winner, holds the Cornell career record for best goal differential. Her 89 assists clock in at the tenth most in school history.

Jillian Saulnier '15 and teammate Blayre Turnbull were the first Nova Scotia natives to play on the Canadian women's Olympic hockey team.

ON TRACK

After earning the bronze in bobsled for Team USA in Sochi in 2014, **Jamie Greubel Poser '06** finished in Pyeongchang in fifth place, only hundredths of a second from the podium. Jamie still holds a pair of Cornell track and field records in heptathlon and pentathlon.

In his Olympic debut with Team Canada, **Joshua Kirkpatrick '10** finished 12th in the four-man bobsled. At Cornell, he was a five-time Ivy League Heptagonal champion. He earned individual titles in the indoor pole vault in 2008, and two years later won titles in heptathlon, outdoor long jump and decathlon, while also leading his 4x100 relay team to victory.

MEDAL COUNT

If CALS were a country, our alumni and their four medals would have finished 18th in the medal count.

16 Finland: 6 medals

17 Great Britain: 5 medals

18 CALS: 4 medals

Tied for 19 Australia, Belarus and Slovakia: 3 medals

alumni stories



ALUMNUS NAMED ONE OF AFRICA'S MOST INFLUENTIAL WOMEN

Bostwana-based firm honored for fostering food security

After 22 years in New York City, Michelle Adelman '89 decided to quit climbing the corporate ladder and found her own investment firm—in Botswana.

An eye-opening safari to southern Africa made Adelman realize that her business skills could help provide jobs for Africa's expanding youth population, fill gaps in supply chains and help consumers meet basic needs for food, housing and energy.

In the 6 years since she moved to Africa, Adelman's firm, Accite, has helped build 14,800 square feet of greenhouses, created 100 new entry-level jobs and introduced hydroponic animal feed and plant-based protein food technology to the southern Africa region.

Her work was recognized by CEO Global, which named her Africa's "Most Influential Woman – Business and Professional Services" for 2017. Adelman serves on the CALS Advisory Council, and on the board of directors of the Travel for Impact Fund, Sir Ketumile Masire Foundation and the Botswana Human Resource Development Council.

MANN AWARD FUNDS RESEARCH FOR HIV'S ACHILLES' HEEL

Recognizing the next generation of biochemical, molecular and cell biologists

The scientific struggle against viral scourges includes training cells to recognize invaders before they strike and preventing viruses from entering cells during the early stages of an infection.

But what if, having invaded a cell, the

viruses couldn't get back out? If the cell membrane could be coaxed into preventing further infection to the host body?

Yi Wen, a fifth-year doctoral student, is exploring that radical concept. Her innovative approach earned her the 2018 Harry and Samuel Mann Outstanding Graduate Student Award.

Established in 2012 by Thomas Mann '64 and Diann Mann '66, and Cornell parents Jeanne (Mann) Newman and Gary Newman, the annual award recognizes the next generation of biochemical, molecular and cell biologists. The award honors Harry and Samuel Mann, the

LAND GIFT EXPANDS OLD-GROWTH FOREST NATURAL AREA

More than 100 acres of pre-European settlement forest now preserved

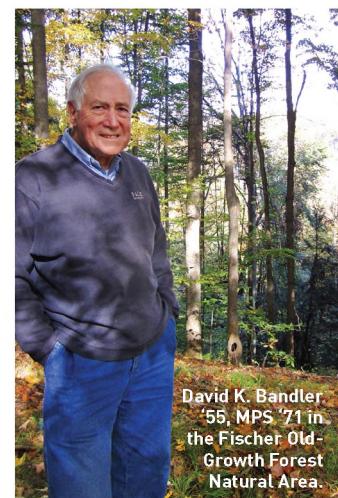
Cornell Botanic Gardens has expanded the Fischer Old-Growth Forest Natural Area in the town of Newfield, New York, with a gift of 42 acres from Lenore and David K. Bandler '55, MPS '71, professor emeritus in the Department of Food Science.

The parcel will be known as the Bandler Family Forest Tract. With the gift, the natural area now preserves more than 100 acres, with almost 30 acres of old-growth forest.

The land is one of the few remaining examples of pre-European settlement forests in the region. The preserve protects a broad variety of habitat types, allowing visitors to understand and study the influences that past land use has had on plant communities and natural plant succession.

The new parcel is the second gift from the Bandler family to enhance the natural area, following a donation of more than 17 acres in 2016.

"When we saw how the Fischer Old-Growth Forest was used to enhance teaching, research and the pleasure of hikers in the Cornell community, we knew that our adjoining land should one day become part of that treasure," said David Bandler. "We have enjoyed this beautiful forest for the past 57 years, and it's time for it to be forever preserved for future generations."



David K. Bandler '55, MPS '71 in the Fischer Old-Growth Forest Natural Area.

children of Russian immigrants and some of the earliest commercial suppliers of biochemicals for life science research.

Since its inception, the award has funded research into health problems like neurodegenerative diseases and the bacteria that cause Legionnaire's disease, as well as fundamental research into cell biology.

"We hope this award will continue to help enable stunning, elegant research such as that of Yi Wen that will allow all of our societies to benefit from the understanding of science," said Thomas Mann, Samuel's son.

Alan Sealls '85 on set during a broadcast for the CBS-affiliate WKRG in Mobile, Alabama.



INTERNET CROWNS ALUMNUS “BEST WEATHERMAN EVER”

Calm, informative style earns Alan Sealls '85 acclaim

It was early September 2017, and Hurricanes Irma, Jose and Katia were all barreling toward the Gulf of Mexico, near where meteorologist Alan Sealls '85 explains the weather for viewers of WKRG, the CBS affiliate in Mobile, Alabama.

Sealls presented the grim forecast in the characteristically calm and informative way he has honed for more than 30 years since he left Ithaca with a degree in atmospheric sciences. On that day, between his on-air forecasts, Sealls posted a weather segment on YouTube.

When Sealls went to bed that night, his video had 60,000 views. When he woke the next morning, he read a surprising email from a colleague: “People on Reddit are going crazy; you’re going viral!”

A Reddit user had posted Sealls’ weather report on the social news aggregation website and declared him the “Best Weatherman Ever.” The post became the top trending item on the site, and by the end of the day, his YouTube clip had 4 million views.

Commenters praised Sealls’ calm, educational presentation, in contrast to the sometimes-dramatic weather reports on other programs.

“I wish I was as good at anything as he is [at] this,” one commenter posted on YouTube.

“I wanted to be a meteorologist when I was young. This guy just reignited those feelings,” posted another.

Sealls has taken the moment very much in stride. “It was amazing that something that I’ve always done, the exact same

way, suddenly went viral. It was a positive thing, because most things that start trending on the internet are, in my opinion, either goofy or silly or somehow embarrassing—things that don’t necessarily have value in the long run. But this is one where people got excited about science, they got excited about learning, so to me, that was a really wonderful thing.”

Sealls has received numerous broadcast awards for his work, including ten regional Emmys and a national award for a series he produced on climate change. He is a fellow of the American Meteorological Society and is serving as the 2018 president of the National Weather Association.

Forecasting weather in the Gulf Coast region requires experience with some of the world’s most devastating conditions. Sealls said his most memorable work was the continuous coverage he did during Hurricane Ivan in 2004 and Hurricane Katrina in 2005, both of which directly hit Mobile. For Ivan, his news station was broadcasting live for six days; for Katrina, they were on for ten days.

“We did take commercial breaks, but it was basically a week straight of doing these extended weather segments, teaching people how the wind will come from a certain way, how they need to board up a certain side of their house,” Sealls said. “I got to use everything I’ve ever learned as a meteorologist, and my work had a real, positive impact on people. I’m really proud of what I do.”

“People got excited about science, they got excited about learning, so to me, that was a really wonderful thing.”

—Alan Sealls '85

end note



Jake Reisch '15, right, co-founded Eversound with Matt Reiners, left, and Devin Jameson '16, center.

MY CORNELL STORY: JAKE REISCH '15

My Cornell story starts, funny enough, as a student at a different institution. I was enrolled at nearby SUNY Cortland when I took off a semester to work on organic farms and sustainable energy systems in Hawaii. While my feeble attempt to build a landscaping business fell through, I developed a new belief: powerful global change is best done through for-profit business models. I came back to the Northeast with this knowledge, eager to make a difference. I transferred to Cornell inspired to drive change through business.

I believe strongly in the power of entrepreneurship as a mechanism for learning. In 2013, when I was a junior at Cornell, I co-founded Party Headphones with my friend Matt Reiners. The company uses wireless headphones to play music at silent discos. That business is still growing, having provided for thousands of events and nearly a million people.

At the time I was building that business, I watched a loved one move into a senior living community. I saw her and many others struggling with hearing loss, and I thought, "Maybe the technology we are developing could help them?" Matt and I quickly learned that hearing loss is a massive problem, especially among people 80 years and older. Less than 20 percent of people who need a hearing aid actually use them, and those with hearing loss are three times more likely to develop dementia, 54 percent more likely to die prematurely and three times more likely to develop depression. By adapting our technology for those in senior communities, we recognized we could dramatically improve their quality of life.

In 2015, I founded Eversound, with Matt and Devin Jameson '16. The company offers hearing technology and engagement services for senior living communities to improve the residents' well-being. The person speaking uses a headset microphone and wireless transmitter to broadcast their voice to everyone

in the room. We also provide tools and services to help activity directors deliver entertaining programs to their residents.

My last semester at Cornell was spent walking into every senior living community within 150 miles of Ithaca, asking people to try our technology. We put together our first prototype to test with the residents at Kendal at Ithaca. After the demonstration, a gentleman came up to us, smiling, and said, "Listen guys, even with my hearing aids, this is the first time I've actually been able to hear what's being said." People just light up when they use our headphones.

We're thrilled this technology is now in use by numerous top assisted living communities, improving well-being for over 40,000 seniors. The results are staggering, with 28 percent increase in engagement and countless stories of residents completely transformed when they can finally hear again. It's amazing to see technology have such a dramatic impact on someone's quality of life.

Cornell's eLab was a huge part of helping us kick off. We received great advice and were connected with people who could take our idea to the next level. Red Bear Angels, an angel group that invests in Cornell University's most promising startups, was one of our first investors. Others were current and emeritus members of the Cornell Board of Trustees. I now serve on the Advisory Council for Entrepreneurship@Cornell. These programs were so critical for the initial success of our companies that I want to give back by helping future student entrepreneurs.

Jake Reisch '15 is co-founder and CEO of Eversound. The company, based in Boston, has provided more than 40,000 older adults with access to personalized hearing technology and engagement services to improve well-being. Reisch and co-founders Devin Jameson '16 and Matt Reiners were named to the 2018 Forbes 30 under 30 list for consumer technology.

WHERE'S THE BUZZ?

Protecting our pollinators

You may find bees to be a real pain but don't swat them too far away—your food depends on them.

About one-third of our edible crops are pollinated by insects, and most of that work is done by our tireless agricultural partners, the bees. These incredible, tiny creatures play an enormous role in growing many of our favorite foods—fruits like apples, strawberries, pumpkins, watermelon and more, plus vegetables, nuts, spices and even coffee.

AROUND THE HIVE

- **20,000 bee species** worldwide.
- **50%** of the **\$170 billion in crop pollination services** globally is due to the managed honeybee—*Apis mellifera*.
- **5,000 flowers** visited by a honeybee on a good day.
- **60 pounds of honey** produced each year by a healthy colony.

SWEET SURVIVAL

95°

Honeybees get through the winter by packing together inside the hive and "shivering" to keep warm. They feed off stores of honey for energy, and their activity keeps the hive at a balmy 95 degrees throughout the winter.

SAVING THE BEES

- **416 bee species** are found in New York. **50+** are known to be in decline, and likely many more are threatened.
- **18 bumblebee species** are native to NY. **16** of those in decline. One—the rusty patched bumblebee—is on the Federal Endangered Species list.
- **42–68% of New York's 100,000 colonies** have died each year since 2010.
- **320 colonies sampled** by our New York State Beekeeper Tech Team in 2017 as we worked with **34 beekeepers** across the state.
- **50 beekeepers are trained each year** by our Cornell University Master Beekeeper Program to manage their colonies in ways that maximize their health and productivity.



Data provided by Scott McArt, assistant professor in the Department of Entomology, and Emma Mullen, extension associate.

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