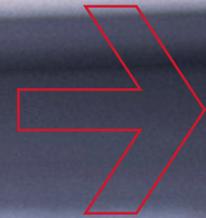


# *INNOVATION*

*IN OVERDRIVE*

IOWA STATE UNIVERSITY  
OF SCIENCE AND TECHNOLOGY





I'd like for you to read *Innovation in Overdrive* in two ways—as both a message of recent progress and as a perennial statement of how we meet our land-grant university commitment to Iowa and the world.

The times we live in test us. They show us what we're made of. I believe they have clarified and strengthened our purpose and mission.

"Science With Practice," emblazoned on our university seal, inspired a new level of awe in 2020 and 2021. To have witnessed our faculty and staff's determination to make an impact on people's lives in the midst of an unpredictable worldwide crisis, is to understand how we refused to let the pandemic become a lost opportunity for creativity.

I want to share with you a snapshot of our recent innovation as the triumph of ingenuity over uncertainty.

That's what defines *Innovation in Overdrive* at Iowa State. We identify the issues and opportunities. We think boldly. We bring together our expertise and our partners. Then we get to work.

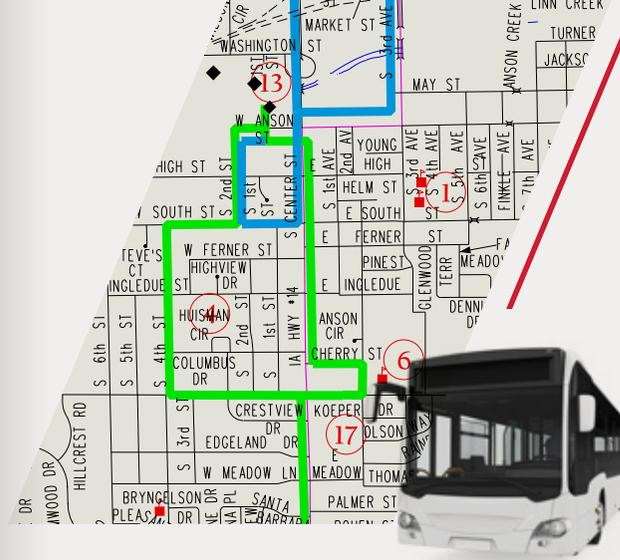
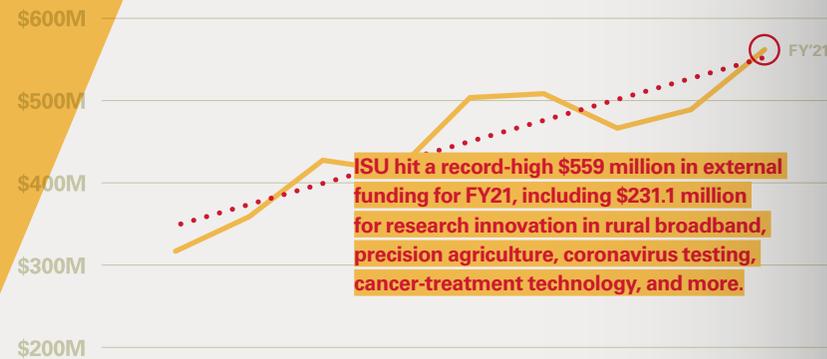


—Wendy Wintersteen, *Iowa State University President*

INNOVATION  
IN OVERDRIVE

# For the Betterment of Lives

**IOWA STATE IS INNOVATING, CREATING,  
AND COMMUNICATING TO MAKE LIVES  
BETTER—HEALTHIER, FULLER, MORE POSITIVE,  
MORE CAPABLE OF PROBLEM-SOLVING, MORE  
ACTION-ORIENTED—IN IOWA AND BEYOND.**

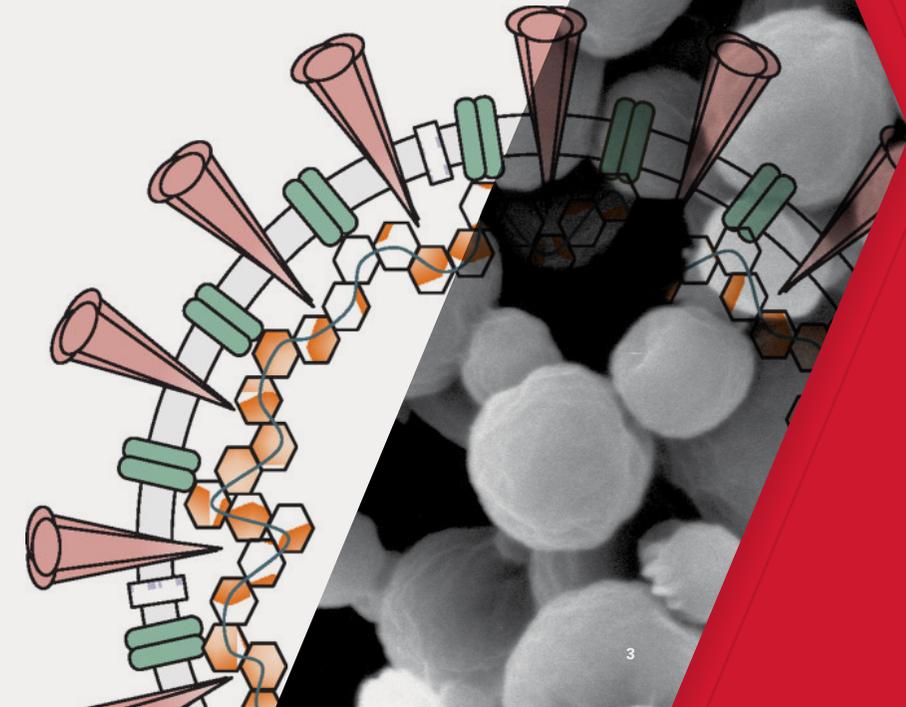


## DECIPHERING DATA, ENHANCING LOCAL LIVING

Solid data is the backbone of solid local action. Iowa State is helping Iowa towns translate their community-level data into action through the Data Science for the Public Good program. The program links the advancement of data science, student learning, and real-world application through ISU Extension and Outreach. The team's work improved transportation access to vulnerable populations in Marshalltown, increasing ridership 11%—progress that led to state and federal recognition for highest ridership increases among rural transit providers.

## CREATING A BETTER VACCINE

A \$2 million federal grant is fast-tracking efforts of researchers in ISU's nationally recognized Nanovaccine Institute to create a new kind of no-needle COVID-19 vaccine. The goal is an inhalable nanovaccine that requires only one dose and is easier for health care providers to store and administer.



INNOVATION  
IN OVERDRIVE

## For the Betterment of Lives

### HOME SWEET 3D HOME IN RURAL IOWA

ISU researchers are applying 3D printing technology to rural Iowa's housing challenges. They are taking an innovative approach to come up with faster, cheaper solutions to the lack of quality, affordable housing in rural communities. Quality housing would be a big step in helping to maintain and grow the state's small towns and rural areas. With a \$1.4 million state grant, the ISU team will work with a local contractor on a development site in Hamburg (pop. 1,214). The team also will partner with Iowa Central Community College on developing curriculum to train future workers in advanced home construction.



Photo courtesy of Alquist3D

For the third time in five years, ISU was recognized nationally for its support of innovation and entrepreneurship across Iowa:

- 2021 Association of Public and Land-grant Universities (APLU) Innovation and Economic Prosperity Place Award
- 2020 APLU Innovation and Economic Prosperity Innovation Award
- 2017 APLU Innovation and Economic Prosperity Talent Award

### HELPING SMALL TOWNS TAKE ACTION ON HOUSING NEEDS

The importance of access to safe, affordable housing that meets Iowans' lifestyle needs is top of mind. ISU Community and Economic Development Extension and Outreach accelerated its Rural Housing Readiness Assessment program, with more than 100 leaders from nearly 40 communities completing training to help them evaluate local housing concerns. The state provides grants to communities that complete the program, helping them get on a path to improve quality, accessibility, and affordability of housing. Initial successes include:

- Ida Grove cleaned up an abandoned mobile home park, replatted the lot for single-family homes, and partnered with a hometown manufactured housing company to build two spec homes on the site.
- The town of Manning annexed land to provide more housing and created an informational toolbox for homebuilders.
- Keokuk worked with ISU specialists to lay the foundation for a registry and inspections program for rentals, vacant lots, and commercial buildings.

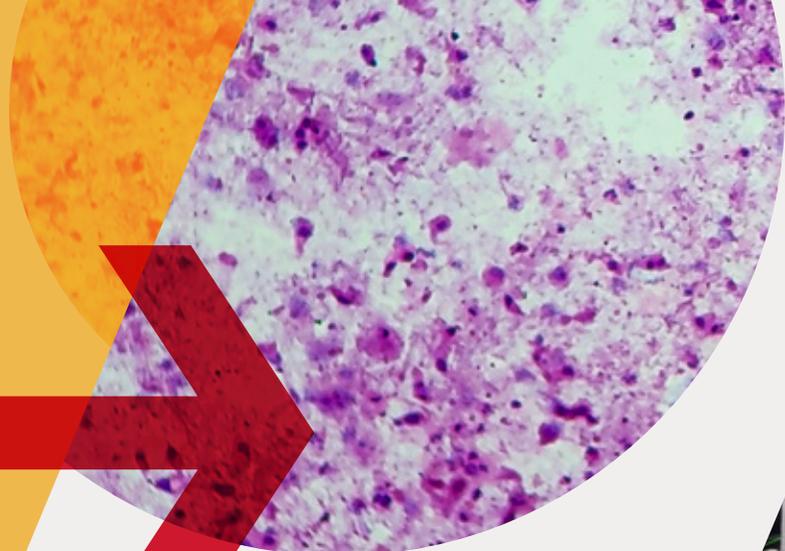


INNOVATION  
IN OVERDRIVE

**For the  
Betterment  
of Lives**

#### **PRECISION MEDICINE TARGETS IMPROVED BLADDER CANCER TREATMENT**

An innovative new technique could allow doctors to tailor bladder cancer therapies without the need for invasive surgery. Using a urine sample from a patient, ISU researchers create an organoid—an artificially grown cell mass that grows and behaves like a tumor. Researchers can then test various treatments on the cell mass, providing data that medical professionals can use to devise a more effective, personalized treatment plan. ISU is working with Mayo Clinic on clinical trials, and with an Iowa-based company to test the new method in dogs. An ISU faculty startup company, 3D Health Solutions, is exploring commercialization of the new techniques to improve both human and animal medicine.



# ¡Magnífico!



Magnifique!

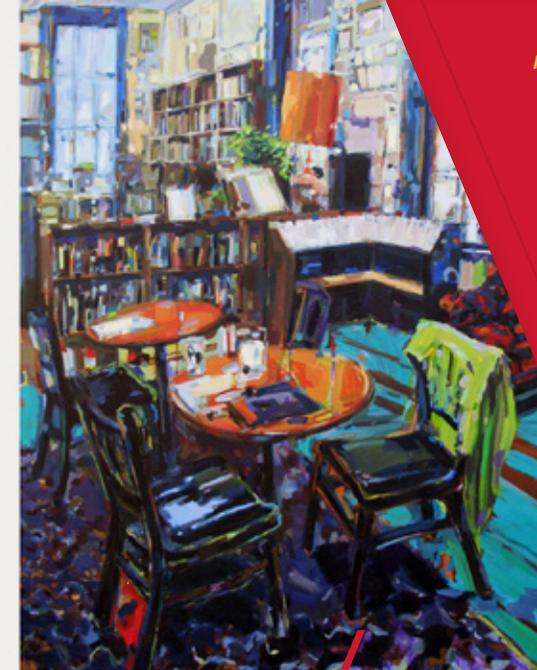
#### **LEARN A NEW LANGUAGE, LESSEN ALZHEIMER'S IMPACT**

Now you have even more incentive to learn French, Spanish, Mandarin, or any other language. Faculty member John Grundy and collaborators discovered that the symptoms of Alzheimer's disease are halted by up to five years in people who fluently speak more than one language. The innovative insight could mean greater quality of life for those with the disease and lift the burden on caregivers. Magnifique! ¡Magnífico! Magnificent!

Magnificent!

#### **ART REVEALS WHAT'S GOOD IN COMMUNITIES**

With every stroke of her paint brush, Jennifer Drinkwater is illuminating the best in Iowa. The faculty member and extension and outreach specialist created the "What's Good Project," documenting the positives of Iowa people and communities and celebrating meaningful stories. Her interviews and artwork portray the good, beautiful, or striking scenes that the residents see and experience. It's one way to demonstrate how art can help build and shape community.



IOWA STATE ANNUALLY DELIVERS A \$3.4 BILLION IMPACT TO IOWA'S ECONOMY, AND ITS ACTIVITIES SUPPORT ONE OUT OF EVERY 49 IOWA JOBS. EVERY DAY, ISU DELIVERS RESEARCH-BASED EDUCATION AND RESOURCES DIRECTLY TO IOWANS IN ALL 99 COUNTIES.

INNOVATION IN OVERDRIVE

# For the Success of Livelihoods



ISU Office of Innovation Commercialization reported 47 license and option agreements executed on ISU technologies, 22 with Iowa companies.



## MAKING INFRASTRUCTURE MORE EFFICIENT

Many links in the U.S. supply chain broke during the pandemic. An Iowa State faculty team collaborated with industry organizations to propose innovative ways in which that supply chain can be reconnected or made entirely new for the future. In their report, Mike Crum and colleagues suggest more innovation around transportation to reign in supply chain costs and recommend creation of a federal Office of Supply Chain to facilitate stronger collaboration between the public and private sectors.

Fifteen new companies and 26 pre-incubator firms joined the Iowa State University Research Park in FY21. Currently, the ISU Research Park is home to 119 companies, research centers, and affiliates employing 2,433 people.



## INVENTING SENSORS ON THE CELLULAR LEVEL

If you're testing and creating cell therapies for cancer, autoimmune diseases, or urinary tract problems, you're going to need a lot of cells to work with. Producing those cells is tedious, time consuming, and costly work for scientists in the \$150 billion industry. Enter Skroot Laboratory, Inc., an Iowa State startup spun off from faculty research. The company created sensor kits that automate cell growth monitoring and data collection in bioreactors, removing the need for hundreds of hours of manual work and speeding the process toward new answers for recalcitrant health problems.

INNOVATION IN OVERDRIVE

### For the Success of Livelihoods

#### TOUGHER, LESS BRITTLE MAGNETS ATTRACT ATTENTION

A magnet valued for its many uses in extremely high or low temperatures is now 70% stronger, thanks to researchers at the Critical Materials Institute. The institute is a U.S. Department of Energy Innovation Hub led by the Ames Laboratory on the Iowa State campus. Samarium-cobalt magnets are indispensable for the aerospace, automotive, food, manufacturing, and other industries but have been susceptible to fractures or chipping during their manufacture. A public-private partnership with the Electron Energy

Corporation created an optimized, less brittle product. For its innovation, the Ames Laboratory's Critical Materials Institute was honored with a 2021 R&D 100 Award, recognizing exceptional new products or processes developed and introduced into the marketplace. Operated by Iowa State University, Ames Laboratory is a U.S. Department of Energy Office of Science National Laboratory that in 2022 will observe its 75th year of creating innovative materials, technologies, and energy solutions to address global problems.



Top 100 worldwide universities granted U.S. patents in 2020 (#65)—the only Iowa school on the list.

#### BREAKING THE MOLD TO BUILD IOWA'S WORKFORCE

ISU's Center for Industrial Research and Service (CIRAS) partnered with Delaware County leaders to pilot the Iowa Workforce Innovation Network. The program breaks the mold of traditional workforce by working with community leaders to plan building the regional STEM talent pipeline, trying innovative job attraction and retention efforts, and exploring the role of automated systems. In 2021, CIRAS expanded the program to other communities and businesses around Iowa.



#### THINKING OUTSIDE THE BOX TO IMPROVE POULTRY SAFETY

The challenge of eradicating salmonella in poultry production is a long-standing frustration for poultry farmers. ISU researchers discovered an innovative approach to fight the disease-causing bacteria and their antimicrobial resistance in poultry. Testing a commonly used high blood pressure drug as a model approach, they found the treatment shows promise for stimulating birds' abilities to fight the infection on their own, solving the problem at its source. The new strategy opens new doors on developing more effective approaches to minimize and even eliminate salmonella and other harmful bacteria in poultry production.



A 2021 MacArthur Fellow ("genius grant") was awarded to Dr. Lisa Schulte Moore for her groundbreaking research toward more resilient, sustainable agriculture.

INNOVATION  
IN OVERDRIVE

# For the Resilience of a Changing World

ISU ranks in the Top 30 of *Washington Monthly's* 2021 National University Rankings (#27), measuring contributions to the public good—the only public university in Iowa.



## EMPLOYING ROBOTS TO CARE FOR CROPS

Iowa's agriculture-based economy relies on producing healthy, abundant crop yields. So when climate trends put crops at risk with more common droughts, Iowa State researchers took action. Employing an innovative robotic system that roves the lab to water plants, the research team meticulously monitors plant adaptability in various drought conditions by collecting measurements through the robot's on-board sensors. Insights from this research provide a glimpse into the future for Iowa's most vital crops—corn and soybeans. A future made possible by the cross-disciplinary teamwork of Iowa State's researchers—robotic and human alike.

Cross-disciplinary collaboration is the heartbeat of ongoing innovation at Iowa State. For this project, faculty in agricultural and biosystems engineering, as well as genetics, development, and cell biology, partnered to design and build the robot.



**IOWA STATE INNOVATES FOR A BETTER GLOBAL ENVIRONMENT—ADDRESSING GLOBAL CHANGES AND CHALLENGES LINKED TO PROTECTING AND IMPROVING OUR NATURAL RESOURCES.**

## SIMULATING ANIMAL EXPERIENCE UNDER RISING TEMPS



Which animals are more vulnerable to climate change? Iowa State scientists created models that simulate how difficult it is for various species to regulate body temperature. A study of birds in the Mojave Desert explained that the number of species in that region have declined because they struggled to adapt to increasing temperatures. Using computer simulations like these, scientists and conservationists can monitor other animal populations to gauge how quickly to execute mitigation strategies as regional temperatures shift.

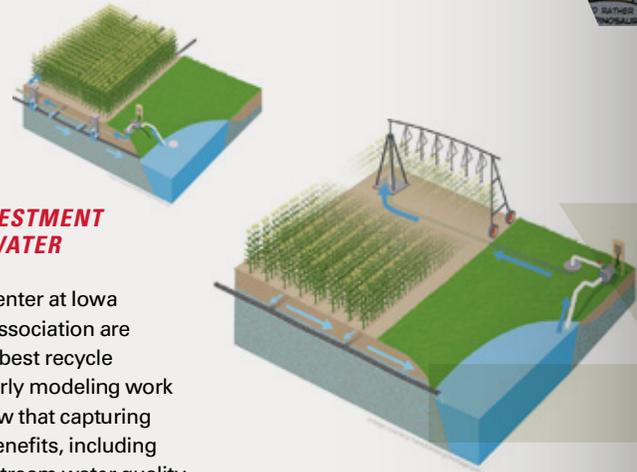
INNOVATION  
IN OVERDRIVE

## For the Resilience of a Changing World

### PROVING RETURN ON INVESTMENT OF RECYCLING RUN-OFF WATER

The Iowa Nutrient Research Center at Iowa State and the Iowa Soybean Association are partnering to research how to best recycle agricultural drainage water. Early modeling work and data from Iowa farms show that capturing drainage water has multiple benefits, including significantly improving downstream water quality and increasing crop yield, especially in dry years. The researchers developed an online tool to help landowners decide where and how to best use drain water recycling systems on their own farms.

**ISU was a 2020–21 top producer of Fulbright Scholars, the flagship U.S. international education program in which faculty teach, study, and contribute innovation solutions to global problems.**



### CREATING COMIC BOOK CURRICULA FOR STEM STUDENTS

A comic book can be an innovative—and effective—method to deliver environmental education to young readers. With illustration help from a well-known Marvel artist, an Iowa State team created a comic called *Mosquitoes SUCK!* to illustrate the vital role each organism has in an ecosystem. Art, science, and education combine to illustrate—literally—important environmental and sustainability issues for the world. The comic book has been distributed to locations across the globe, including in “Science in a Bag” kits distributed at libraries and summer STEM camps in Wisconsin.

### GOING SOLAR JUST GOT EASIER—WITH AI EXPERTISE

ISU research in artificial intelligence is making it easier for consumers to imagine what it looks like to power their homes with the sun. As solar power becomes more accessible and affordable, ISU researchers are developing AI solutions that optimize residential solar installations. The efforts are key to developing the first digital online marketplace where homeowners can tailor customized, energy-specific solar solutions for their homes. The result: A dramatic drop in the nonhardware costs of going solar. Good for the environment, good for online business.

**In 2021, ISU launched the first artificial intelligence graduate program in Iowa. Now working professionals and others can take their education in the emerging sector of AI to the next level—a master’s degree that prepares them for high-demand careers applying AI.**



INNOVATION  
IN OVERDRIVE

# For the Mindset of Tomorrow's Innovators

**INNOVATE AT IOWA STATE IS OUR RALLYING CRY FOR DEFINING A MINDSET AND WORLDVIEW FOR STUDENTS WHO WANT TO THINK AND ACT BEYOND THE TRADITIONAL BOUNDARIES OF EDUCATION. IOWA STATE IS PREPARING IOWA'S FUTURE-READY WORKFORCE, WITH 57% OF ITS GRADUATES EARNING STEM DEGREES.**

**INNOVATE** at  
Iowa  
State

## STUDENT INNOVATION CENTER WELCOMES PEOPLE AND IDEAS

The one-of-a-kind Student Innovation Center is a five-level dream factory designed to foster innovation and facilitate collaboration by erasing the barriers among disciplines. Now fully open to students, you'll find hands-on materials labs, office and workshop space for student clubs, and more R&D equipment than you can imagine within the high-tech walls.

**ISU ranks in the Top 50 Best for Student Engagement, Wall Street Journal/Times Higher Education Rankings.**



INNOVATION  
IN OVERDRIVE

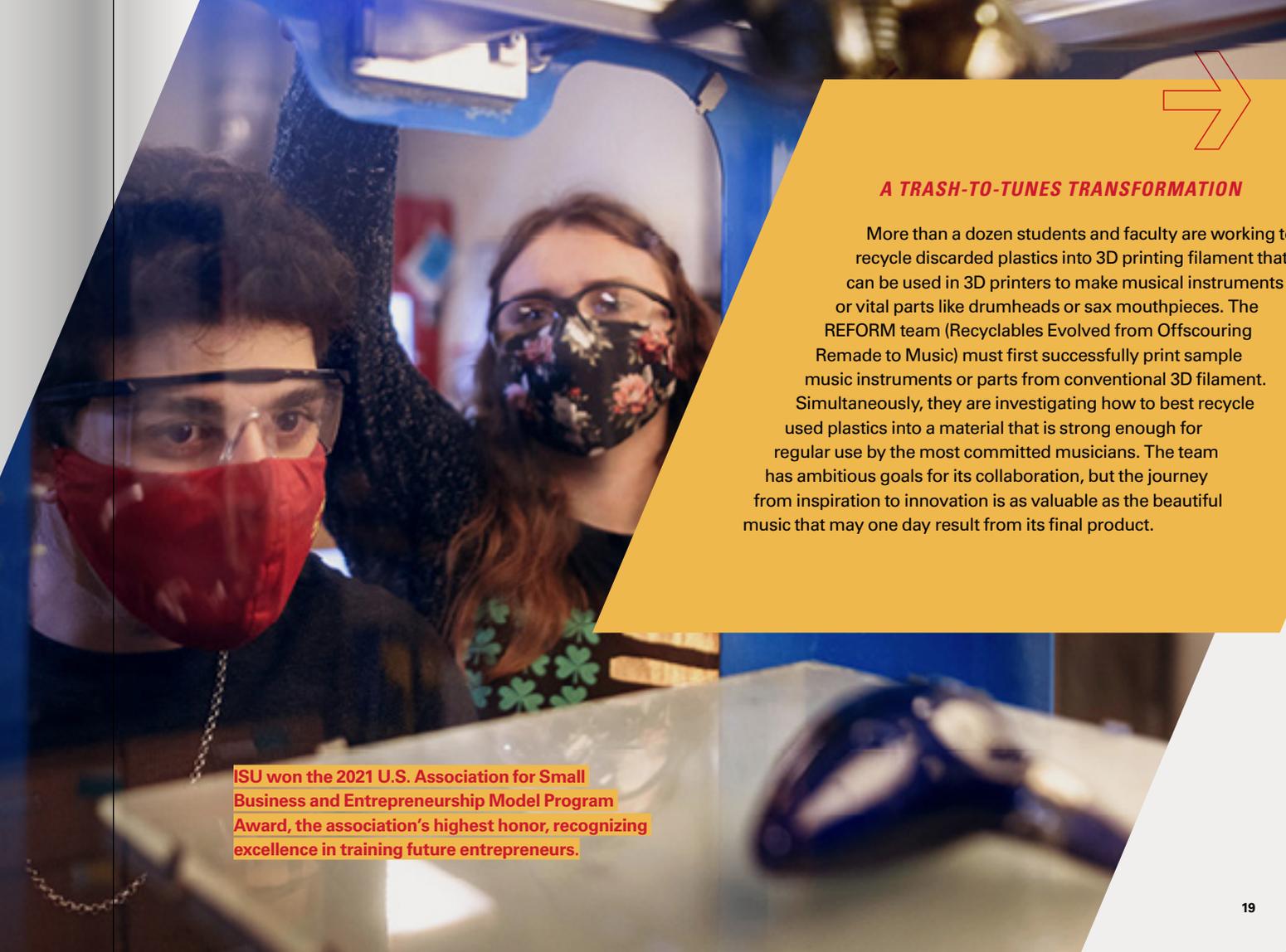
## For the Mindset of Tomorrow's Innovators

### NEW OPPORTUNITIES TO NURTURE BOLD IDEAS

One of the most audacious efforts of 2020–21 was the creation of more than 80 elective innovation programs—lectures, classes, or assignments—all designed to support students' desires to make a difference. In total, these programs garnered nearly 18,300 registered student participants led by nearly 120 faculty and experienced industry executives.

From Flagship Fridays, bringing in industry professionals to share personal stories of innovation, to our 16-week Innovation Sprints, where students team up with industry innovators/faculty to solve specific problems, or the interdisciplinary Innovation Fellows Program, where students become seasoned innovators through networking opportunities and real-world experiences—faculty, students, and business community mentors at Iowa State explored how ideas become reality and problems lead to solutions.

ISU ranks #11 in *The Princeton Review's* top entrepreneurship program ranking of 300 public and private universities.



ISU won the 2021 U.S. Association for Small Business and Entrepreneurship Model Program Award, the association's highest honor, recognizing excellence in training future entrepreneurs.

### A TRASH-TO-TUNES TRANSFORMATION

More than a dozen students and faculty are working to recycle discarded plastics into 3D printing filament that can be used in 3D printers to make musical instruments or vital parts like drumheads or sax mouthpieces. The REFORM team (Recyclables Evolved from Offscouring Remade to Music) must first successfully print sample music instruments or parts from conventional 3D filament. Simultaneously, they are investigating how to best recycle used plastics into a material that is strong enough for regular use by the most committed musicians. The team has ambitious goals for its collaboration, but the journey from inspiration to innovation is as valuable as the beautiful music that may one day result from its final product.

PREVIEW:

# What's Next for Innovate at Iowa State?

EXPECT ACCELERATION OF BIG IDEAS AND BOLD NEW MISSION-ORIENTED STEPS.

Far into the future, ISU students, faculty, and staff will benefit from the impactful giving of 96,000+ donors who made the Forever True for Iowa State fundraising campaign a historic success —surpassing its goal to reach \$1.542 billion.



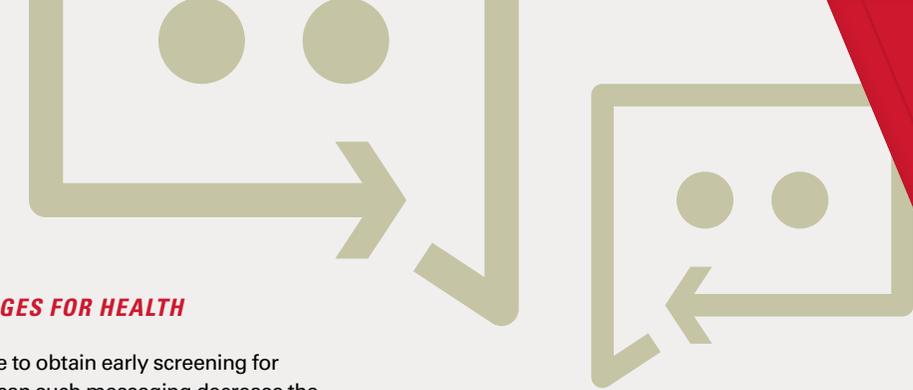
## INVENTING BETTER BROADBAND TECHNOLOGY

Imagine working for a Fortune 500 company from the front porch of your rural Iowa home. What else might be possible, if only rural broadband connectivity were stronger? Enter Iowa State University and its partners who are leading one of four major national programs focused on wireless research to achieve high-capacity, affordable, and accessible rural broadband. With \$8 million in investment from the National Science Foundation, U.S. Department of Agriculture, and others, Iowa State will be developing and enhancing the technologies that lay the foundation for rural broadband infrastructure. The researchers are driven by the opportunity to energize rural areas and to connect people and ideas with jobs that can be performed anywhere, anytime.

## PROGRAMMING DIGITAL FIELDS TO TEST REAL-WORLD DECISIONS

The future of artificial intelligence in agriculture envisions plant breeders improving crop varieties in new ways, farmers responding more quickly and effectively to ease stresses on their crops, and natural resources being preserved. ISU is applying innovation to that vision thanks to a \$20 million investment by the National Science Foundation and U.S. Department of Agriculture. The new ISU-led AI Institute for Resilient Agriculture is creating digital copies of individual plants and entire fields, all based on live data collected by drones and robots deployed on real farms. The data and models created from real-world scenarios will help researchers—and ultimately farmers—better plan and predict in-field operations that help ensure food security and environmental challenges are met as global population continues to grow.





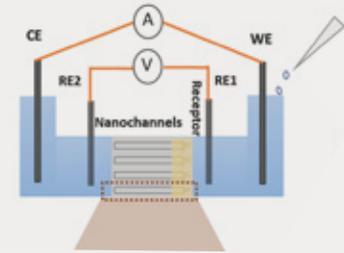
**DESIGNING MORE COMPELLING MESSAGES FOR HEALTH**

How can marketing effectively motivate people to obtain early screening for colon cancer? And when executed effectively, can such messaging decrease the rate of colon cancer for the most at-risk populations? Those are major questions an Iowa State-led research team is investigating after receiving funding from the National Institutes of Health's National Cancer Center. The team of experts in computation, social influence, and health communication will gather data on which, when, and where communication approaches are—or are not—effective. Then they'll develop recommendations about how best to communicate with at-risk audiences to overcome misinformation and promote colon cancer screening.

**More than 120 new companies were jumpstarted by the ISU Startup Factory over the past four years.**

**CREATING TOOLS TO TEST AIR SAFETY EARLIER, QUICKER**

In a matter of years, airports, government buildings, and high traffic venues could be vastly better equipped to detect and respond to airborne contaminants like COVID-19, Ebola, or even toxic agents like anthrax. The leap in public protection will be thanks to Iowa State researchers who are developing a shoebox-sized sensor platform that can detect a range of biological threats in the air. That, in turn, will help officials respond much faster—long before people show signs of infection. The potential is so great, the U.S. Department of Homeland Security is supporting Iowa State's efforts to develop the microscopic technology that is far more portable and flexible than current techniques.



**A FRONTLINE DEFENSE FOR \$32 BILLION ANIMAL INDUSTRY**

Iowa State's Veterinary Diagnostic Laboratory is the front line of defense for protecting thousands of livestock operations and millions of animals, keeping Iowa's \$32.5 billion animal agricultural industry competitive. Its caseload is the largest in the country—more than 100,000 cases in the past year. In 2021, the university broke ground on a construction and renovation project to expand and enhance the lab's capabilities. The new state-of-the-art lab, that is vital to so many Iowa livelihoods, is expected to open in 2023.

**PREVIEW:  
What's Next for Innovate at Iowa State?**





PREVIEW:

**What's Next  
for Innovate at  
Iowa State?**

**Forbes and Statista named ISU one of  
2021's Top 10 Best Employers in Iowa.**

**WHAT'S UP WITH UPCYCLING?**

Researchers at Iowa State University and the U.S. Department of Energy's campus-based Ames Laboratory are organizing a national research epicenter for the rapidly emerging field of plastics upcycling. With a \$12.8 million investment from the U.S. Department of Energy, they're building an Institute for Cooperative Upcycling of Plastics. The team is developing new technologies to efficiently process used plastics and applying innovative discoveries to recover, reuse, recycle, and repurpose those materials.

**A SOLAR FARM AND A SUNNY  
OUTLOOK FOR MISSION-ORIENTED WORK**

Announced in 2021, a partnership between Iowa State and Alliant Energy will lead to the establishment of a solar farm near university livestock and poultry farms south of Ames. The public-private partnership is a significant step in making progress on mutual renewable energy and sustainability goals. The exciting and innovative part of the project will be brainstorming research, extension, education, and training activities on the site—foreseeing great opportunities for ISU students to learn more about renewable energy and demonstrating how solar energy and solar farms can be successfully integrated into rural communities.



**We identify the issues and opportunities.  
We think boldly. We bring together our expertise  
and our partners. Then we get to work."**

—Wendy Wintersteen,  
Iowa State University President



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IOWA STATE UNIVERSITY  
OF SCIENCE AND TECHNOLOGY

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