

20 **20**

YEAR IN REVIEW



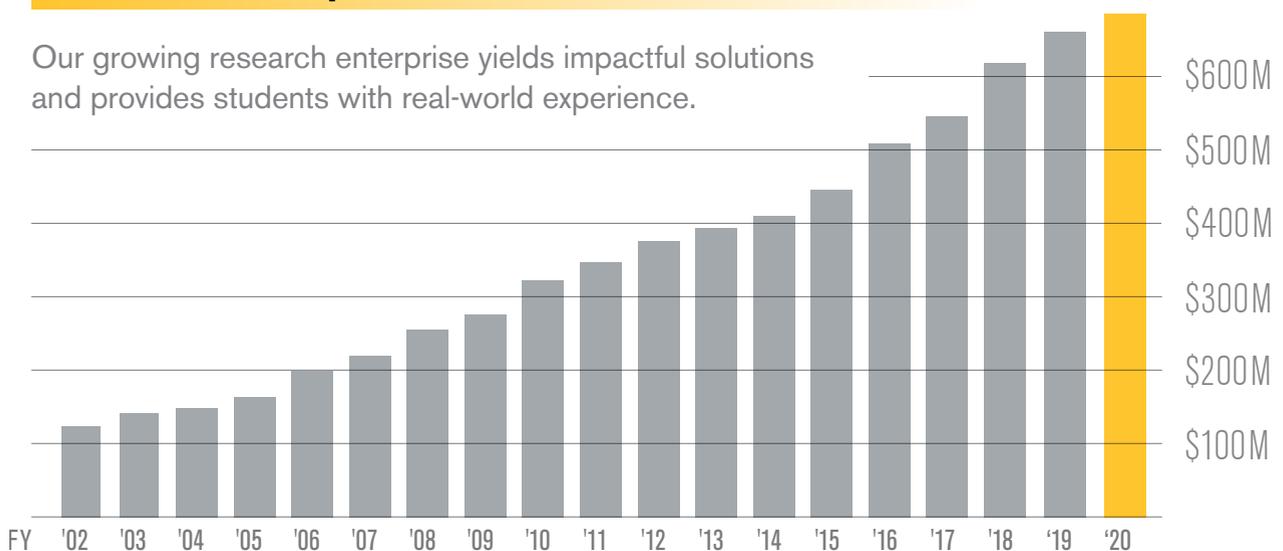
# Knowledge Enterprise excellence

The ASU Knowledge Enterprise advances research, innovation, strategic partnerships, entrepreneurship and international development at the most innovative university in the nation.

## ASU research expenditures

**\$660M** estimated

Our growing research enterprise yields impactful solutions and provides students with real-world experience.



**#1**  
in the U.S. for  
innovation



ASU ahead of MIT and Stanford  
- U.S. News & World Report  
6 years, 2016-2021

**Top 1% of  
institutions of  
higher education  
worldwide**

-Center for World University Rankings

**#12 among  
universities  
worldwide for  
U.S. patents  
issued**

-National Academy of Inventors and  
Intellectual Property Owners Association

## Rankings by research expenditures

Source: National Science Foundation HERD Survey 2019

#1

**Transdisciplinary research**, ahead of MIT, Johns Hopkins University and Northwestern

#1

**Anthropology**, ahead of Harvard, Stanford and University of Michigan

#1

**Geological and earth sciences**, ahead of MIT, Texas A&M and Virginia Tech

#3

**NASA-funded expenditures**, ahead of Stanford, UCLA and Georgia Tech

#4

**Social sciences**, ahead of Berkeley, UCLA and Cornell

#5

**Political science and government**, ahead of Duke, Tufts and Penn State

#5

**Business and management**, ahead of the University of Chicago, Duke and Columbia

#6

**Total research expenditures** among institutions without a medical school

#8

**Communications and communication technologies**, ahead of Columbia, Rutgers and the University of Utah

#10

**HHS (including NIH) -funded expenditures** among universities without a medical school, ahead of Princeton, Carnegie Mellon and Georgia Tech

**ASU  
Innovations  
FY20**

**306  
inventions  
disclosed**

**135  
patents  
secured**

**19  
startup  
companies  
launched**

**56  
licenses  
and  
options  
executed**



# Igniting discovery

**to conquer COVID-19**

As the novel coronavirus swept across the globe in early 2020, hundreds of ASU researchers, faculty, staff and students mobilized to apply their expertise, skills and tools toward a singular goal: **stopping the spread of COVID-19** and helping humanity recover from its destruction.

## Filling the critical need for testing

Testing is crucial to identify and isolate infected individuals, but labs have struggled to keep up with the massive demand. With unprecedented speed, ASU's Biodesign Institute shifted its capabilities to **create a clinically approved and certified COVID-19 testing lab in a mere two weeks.**

The Biodesign Institute was poised to make the rapid shift as researchers adapted automated diagnostic technology originally developed to detect radiation exposure to a new target: coronavirus genetic markers.

The institute also produced **the Western United States' first FDA-approved [saliva-based COVID-19 test](#)**, with results typically delivered within 48 hours. The saliva test was a game-changer for several reasons. It is less invasive and uncomfortable for participants than nasopharyngeal (NP) swabs. It is safer for testing staff, because NP swabs often cause participants to cough or sneeze. Because of this, testing staff need less hard-to-find PPE.

Biodesign's high-throughput, robotic system has run thousands of samples a day, greatly increasing Arizona's COVID-19 local testing capabilities and providing results quickly. The institute brought in a clinical pathologist to make sure the lab met strict regulatory standards, all while operating under extremely demanding conditions.

A photograph of three laboratory workers in a clinical setting. They are wearing blue gowns, teal face masks, and safety glasses. One worker in the foreground is wearing a white lab coat and green gloves, and is interacting with a computer monitor. The background shows a laboratory environment with glass partitions and equipment.

By the end of December, the **ASU Biodesign Clinical Testing Laboratory** had processed nearly

**500,000**  
COVID-19 tests.

## Donation catalyzes COVID-19 response

In March, the Virginia G. Piper Charitable Trust provided \$2 million in emergency grants to support ASU's COVID-19 response efforts. The funding vastly increased the university's ability to test critical workers, assemble test kits for health care providers and manufacture personal protective equipment. The early investment enabled teams to mobilize at breakneck speed to become the first in the U.S. to offer public saliva testing at scale.



**ASU and ADHS  
provide free  
COVID-19 tests  
to anyone in  
the state.**

## Providing free testing across Arizona

Initially, ASU partnered with local organizations to provide tests to essential workers and underserved populations before expanding its saliva test network to include university students and employees. In early July, ASU established a \$30 million partnership with the Arizona Department of Health Services to launch hundreds of testing sites, offering free COVID-19 tests to anyone in the state.



## Taking COVID-19 testing to the next level

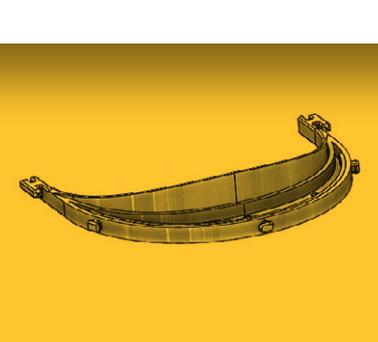
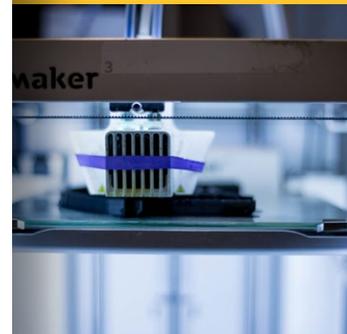
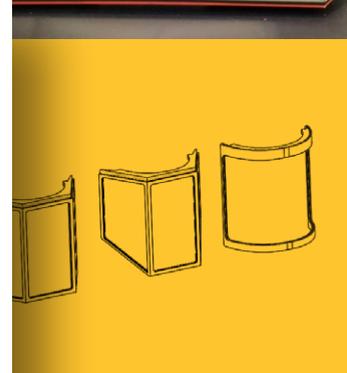
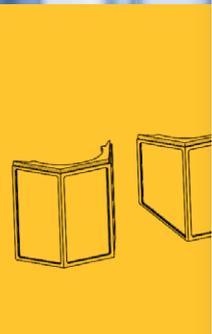
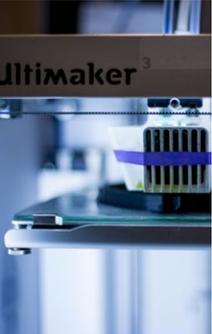
ASU researchers are now developing a new, portable, saliva-based COVID-19 test that will **deliver results in as little as 20 minutes**. Through this point-of-need test, users will be able to easily provide a saliva sample on a computer chip that will quickly detect whether the virus is present. The new rapid saliva test offers the best of two worlds: the speed of existing antigen tests and the greater accuracy of PCR-based RNA tests.





## Addressing the state's critical PPE shortage

As a shortage of personal protective equipment threatened health care providers working hard to save lives, ASU ramped up efforts to design, produce and distribute critically needed PPE and other medical supplies. The Biodesign Institute teamed up with ASU's student-led Luminosity Lab, which created an [online platform to link university and community resources](#) such as 3D printers and sewing machines with medical providers in need of personal protective equipment. The network quickly partnered with a number of organizations — Banner Health, Equality Health, Dignity Health, HonorHealth and Arizona Academy of Family Physicians, among others — to get their equipment needs registered and underway. For hospitals sterilizing and reusing equipment to shore up supplies, ASU researchers developed a variety of options to make sterilization fast, effective and affordable.



## Students' fog-free mask wins international competition

[A team from ASU's student-led Luminosity Lab](#) won the XPRIZE Next-Gen Mask Challenge to redesign the face masks used to prevent the spread of COVID-19 by making them more comfortable, functional and affordable. **The team beat nearly 1,000 entries from 70 countries to earn the top spot** and win a \$500,000 prize. In addition, the team will be connected to rapid manufacturing opportunities in the U.S. to accelerate production of their new mask design.

# Helping the community navigate COVID-19

“For Peoria, our mom-and-pops and small retailers are our bread and butter. We were able to get an assessment of who was hardest hit, and it was a list of family-owned businesses that had been in business 20 or 30 years and their sales just dropped immediately. But ASU has been phenomenal and has pivoted so quickly to the current needs of what’s going on.”

— **Amber Costa**, Peoria Economic  
Development Services Department

## Revealing high number of undetected COVID-19 cases

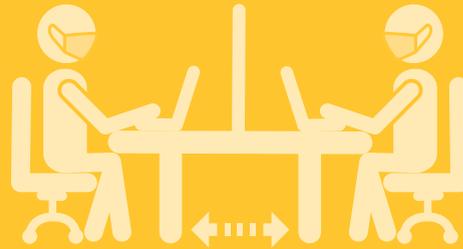
A [seroprevalence study](#) in September found that COVID-19 cases in Maricopa County are three to four times higher than testing efforts indicated. The study, a joint effort by Maricopa County Department of Public Health, Mayo Clinic and ASU, tested blood samples for COVID-19 antibodies from a representative population of

the county. The antibody results revealed that **an estimated 10.7% of residents – approximately 470,000 people – had likely been infected with the SARS-CoV-2 virus** at the time of the study. The study provided critical insights for the county health department to better understand and project how many Maricopa County residents may have already been infected with the SARS-CoV-2 virus.



## Stepping up to help small businesses during the pandemic crisis

[Peoria Forward](#), an Edson E+I Institute initiative, sprang into action to help small-business owners whose livelihoods were threatened by the COVID-19 crisis. Peoria Forward created a task force with several city departments and community organizations that met daily to discuss actions to aid local businesses and surveyed local business owners about their needs. As a result, the team helped distribute 200 banners to independent restaurants advertising that they offered pickup or delivery to customers during the shutdown.



## Guiding employers on safely returning employees to the workplace

As businesses reopened or expanded from a skeletal crew during the COVID-19 pandemic, a pressing question remained: How to safely return employees to the workplace? ASU's College of Health Solutions and the World Economic Forum, with support from The Rockefeller Foundation, provided the very latest information through the [COVID-19 Diagnostics Commons](#). The interactive hub for the global community provides up-to-date information about testing options and a place to share knowledge and practices for safely returning and keeping employees in the workplace.

ASU's Corporate Engagement and Strategic Partnerships also aided businesses through a suite of services, offering expert-driven business solutions on how to safely reopen in accordance with health and safety best practices and Centers for Disease Control and Prevention guidelines; implement procedures, protocols and continued monitoring to protect employee health; utilize software solutions to help limit or eliminate close contact during checkout and ordering; manage supply chains by creating short-term and long-term demand-supply synchronization strategies; and more.

“Knowledge is power, and the COVID-19 Diagnostics Commons is designed to give companies around the world **the power to leverage data** from their peers and bring their employees back to the workplace more safely and effectively.”

— **Mara Aspinall**, founder of Health Catalysts Group and professor of practice at ASU's College of Health Solutions

# Advancing research to increase wellness and save lives



## Filling critical gaps in home health care after hospitalization

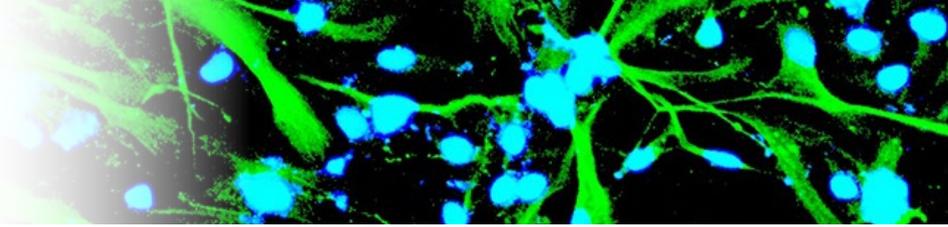
Being discharged from the hospital can be a risky time for patients who may struggle with everything from understanding their medical condition to accessing health resources they need to recover. A [new ASU startup](#) has emerged from the Edson College of Nursing and Health Innovation to meet this critical health care need. The startup, Navi Concierge Nurses, creates a marketplace **connecting nurses to people in need of medical guidance and support** after a hospital stay or outpatient surgery, or for families seeking additional help for aging loved ones. The goal is to fill the gap left when patients don't qualify for home health care but still need professional help.

## Taking a bite out of food waste

The U.S. wastes 133 billion pounds of food or roughly 30% of the total available food supply annually at the consumer and retail level, according to an [ASU College of Health Solutions study](#). Every time people throw away food, it's money down the drain. In fact, a four-person family loses about \$1,500 a year on wasted food, according to the USDA. What's bad for the wallet is also bad for the environment. Food waste that ends up in landfills produces a large amount of methane, a powerful greenhouse gas. An ASU College of Health Solutions researcher piloted a unique study that reveals educating consumers can be an answer to reducing the problem. Participants were trained to properly collect, weigh and report food waste from their household each week. They were also asked to review educational materials such as podcasts, infographics and videos from a specially designed open-access "Waste Watchers" website. The intervention succeeded with **more than 50 participating households reducing their food waste by nearly 28% over five weeks.**

**Americans could fill 730 college football stadiums with the amount of food they waste each year.**





## Microbes fine-tune body weight

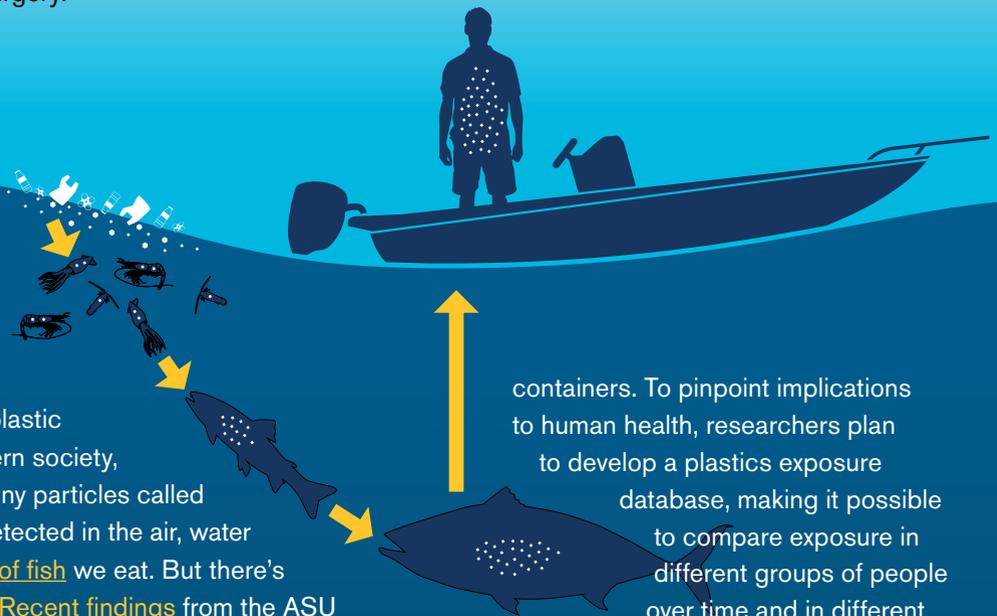
Already considered a global epidemic, obesity continues to rise, affecting over 40% of the U.S. population, according to the Centers for Disease Control. With health care costs approaching \$316 billion dollars annually in the U.S., understanding how to treat obesity will result in a healthier population and help reduce runaway medical costs. Researchers at Biodesign are exploring new therapies that use the body's complex colonies of gut microbes to micromanage weight. [In a recent study](#), they increased our understanding of the changes to the composition of gut bacteria following gastric bypass surgery. The work offers **new hope that obesity may one day be managed through noninvasive therapy, such as a customized probiotic**, reducing the need for costly and risky surgery.

## Boosting the accuracy and potential of gene-editing tools

The revolutionary gene editing tool CRISPR offers hope that deadly inherited diseases will one day be corrected. But this promise of regenerative, personalized medicine also holds a peril: CRISPR may not edit in the right place (so-called off-target gene effects) or may not be efficient (successful editing may only be achieved about 10% of the time for every available cell target). But an ASU cell bioengineer, whose goal is to get at the heart of the causes of neurodegenerative diseases like Alzheimer's, used a [new update to the CRISPR base editing technology](#) to vastly outperform previous efforts. Proof-of-concept shows **genes implicated in Alzheimer's disease can be accurately edited with 90% efficiency in human stem cells**.

## Tracking plastic pollution inside the human body

Plastic pollution is literally getting under our skin. As plastic became ubiquitous in modern society, plastic pollution, including tiny particles called microplastics, have been detected in the air, water and in [many of the species of fish](#) we eat. But there's a new chapter to the story: [Recent findings](#) from the ASU Biodesign Center for Environmental Health Engineering reveal that microplastics are accumulating inside the human body. Researchers examined 47 samples of human tissue taken from the liver, spleen, lungs and kidneys – and in every sample, researchers found traces of Bisphenol A (better known as BPA), a chemical that's often used in plastic food



containers. To pinpoint implications to human health, researchers plan to develop a plastics exposure database, making it possible to compare exposure in different groups of people over time and in different locations. Researchers also plan to conduct epidemiology studies to examine potential health risks posed by non-biodegradable plastics in human tissues.

# Launching the Julie Ann Wrigley Global Futures Laboratory

ASU launched a laboratory dedicated to developing innovative solutions to our planetary crises that is advancing at a scale unparalleled by any other university or research entity. Committed to **protecting the future habitability of the planet and enhancing the quality of life for future generations**, [Julie Ann Wrigley Global Futures Laboratory](#) is designed on the scale of a national laboratory and led by world-renowned Earth scientist, Peter Schlosser. ASU President Michael M. Crow calls the laboratory “a medical school for the Earth.” GFL will encompass

the new College of Global Futures and three unique schools — the School of Sustainability, the School for the Future of Innovation in Society and the new School of Complex Adaptive Systems. It will also serve as a major research institute — with centers focused on such pressing issues as water and urban sustainability and the future of agriculture — significantly enhanced by and integrated with global partnerships.



The laboratory will be housed in the new Interdisciplinary Science and Technology Building 7 on the Tempe campus, scheduled to open in December 2021. The high-performance research facility will foster an interdisciplinary approach to knowledge generation and leading-edge research across more than a dozen intellectual focal areas. It will serve as a hub for more than 550 faculty and scholars across all ASU campuses and disciplines, as well as for more than 1,300 students within the College of Global Futures.

# Fueling **entrepreneurial success** for future generations

A quintessential entrepreneur's legacy lives on with the newly formed **J. Orin Edson Entrepreneurship + Innovation Institute at ASU.**

Fueling entrepreneurial success for generations to come, the renamed institute houses the [Edson Student Entrepreneur Initiative](#), which empowers students to transform their ideas into viable ventures. To date, the initiative has supported 297 student-led ventures and provided nearly \$3 million in funding. These ventures have filed more than 40 patents and raised more than \$52 million in external funding. In addition, the institute's community programs support a wide range of local entrepreneurs as well as a national youth entrepreneurship program.

The institute also houses the Edson Training and Development Network, established from an endowed gift from the Edson family in 2018 to accelerate innovative talent and increase capacity to train Edson entrepreneurs through an expanded network, enhanced curriculum to augment and complement academic curriculum, and on-demand programming.

J. Orin Edson was a successful entrepreneur and philanthropist who gave generously to help ASU students pursue their dreams and obtain real-world experiences before his death in 2019 at the age of 87. By his 20s, he was building boats through



a small company that he built into Bayliner Marine Corp., which was the largest manufacturer of luxury boats when he sold the company in 1986. He went on to buy a majority interest in Westport Yachts in 1992 and grew it into a successful yacht-building company before selling his shares. Wanting other aspiring entrepreneurs to have similar opportunities for success, he and his wife, Charlene, have donated to programs at ASU since 2005, including an initial gift that created the Edson Student Entrepreneur Initiative. Additional endowed and non-endowed gifts to support entrepreneurship followed. [read more](#)

**To date, the Edson Student Entrepreneur Initiative has supported 297 student-led ventures and provided nearly \$3 million in funding.**

# Advancing **knowledge** across international borders

## ASU Center in Ghana aims to innovate African supply chains

When pandemic panic buying caused everyday necessities like toilet paper and ground beef to disappear from shelves at stores across the country, consumers gained a new appreciation for a robust supply chain. Even without a pandemic, in many places around the world supply chain gaps prevent goods from reaching their intended market and the people who need and rely on them. To ensure global supply chain resilience, ASU partnered with The Kwame Nkrumah University of Science and Technology in Ghana to create the [Center for Applied Research and Innovation in Supply Chain](#) (CARISCA) in Africa.

Supported by a \$15 million USAID investment, the center is home to research initiatives that **reimagine the health and agricultural supply chains that provide food and critical medical supplies to hard-to-reach communities across Africa**. Ongoing projects include designing innovative supply chain courses at Kwame Nkrumah's graduate business school and creating apps to teach supply chain management to small business owners and managers in Ghana.



## Fostering digital literacy around the world

The Peace Corps and Arizona State University have partnered to bring SolarSPELL, a portable, solar-powered library platform, to student communities without access to the internet. The [dissemination of SolarSPELL](#), developed by the School for the Future of Innovation in Society, will provide hundreds of Peace Corps volunteers the training and resources they need to foster digital literacy and community partnerships in countries around the world.

“To Peace Corps volunteers, SolarSPELL is a gift in how it will help volunteers integrate with community partners and school partners.”

— Jody Olsen, director, Peace Corps



# Protecting the public from online threats



## Helping phishing victims avoid taking the bait

In collaboration with PayPal, ASU's Center for Cybersecurity and Digital Forensics led [pioneering research](#) that explored the [full life cycle of phishing attacks](#). Phishing is a cybercrime in which an impostor poses as a legitimate institution and emails, calls or texts an individual to lure them into providing sensitive data, such as personally identifiable information, banking and credit card details, and passwords.

From the launch of a phishing campaign to an account being compromised, researchers tracked nearly 4.8 million victims over a one year period. This groundbreaking research captured valuable data about the success rates of phishing and helped develop a framework for measuring victim traffic and protecting accounts. Recognizing the impact of these findings, **this research won second place in Facebook's Internet Defense Prize Competition and was granted the "Distinguished Paper Award" at the 26th USENIX Security Symposium.**

## Taking action against disinformation

[ASU's Global Security Initiative](#) is helping the U.S. State Department better understand how foreign adversaries use disinformation and propaganda. The project studied ideological techniques (narrative and framing) and operational procedures (mechanisms of amplification) of disinformation and propaganda in Latvia, Sweden and the United Kingdom, providing policymakers with a fuller understanding of the adversarial communication landscape.

The team identified adversarial framing around contentious issues, trained a machine classifier to detect such framing at scale, revealed shifts in messaging strategies, and analyzed anti-democracy narratives. The team also developed **a new feature-driven approach to identify social media accounts who are not who they say they are** to game the system, spread disinformation and support malign influence campaigns.

# Protecting our planet and its inhabitants

## ASU reaches zero greenhouse gas emissions goal 6 years early

Ranked among the most sustainable universities in the world, Arizona State University reached its goal of [zero greenhouse gas emissions](#) from campus operations six years ahead of its planned schedule. ASU achieved the goal set in 2007 in an era of rapid growth in both student population and physical expansion across all ASU campuses. The university accomplished the feat by increasing energy efficiency in both new buildings and campus retrofits; on-site solar generation; renewable energy purchases from large-scale, off-site generation facilities; and purchase of carbon offsets and renewable energy.

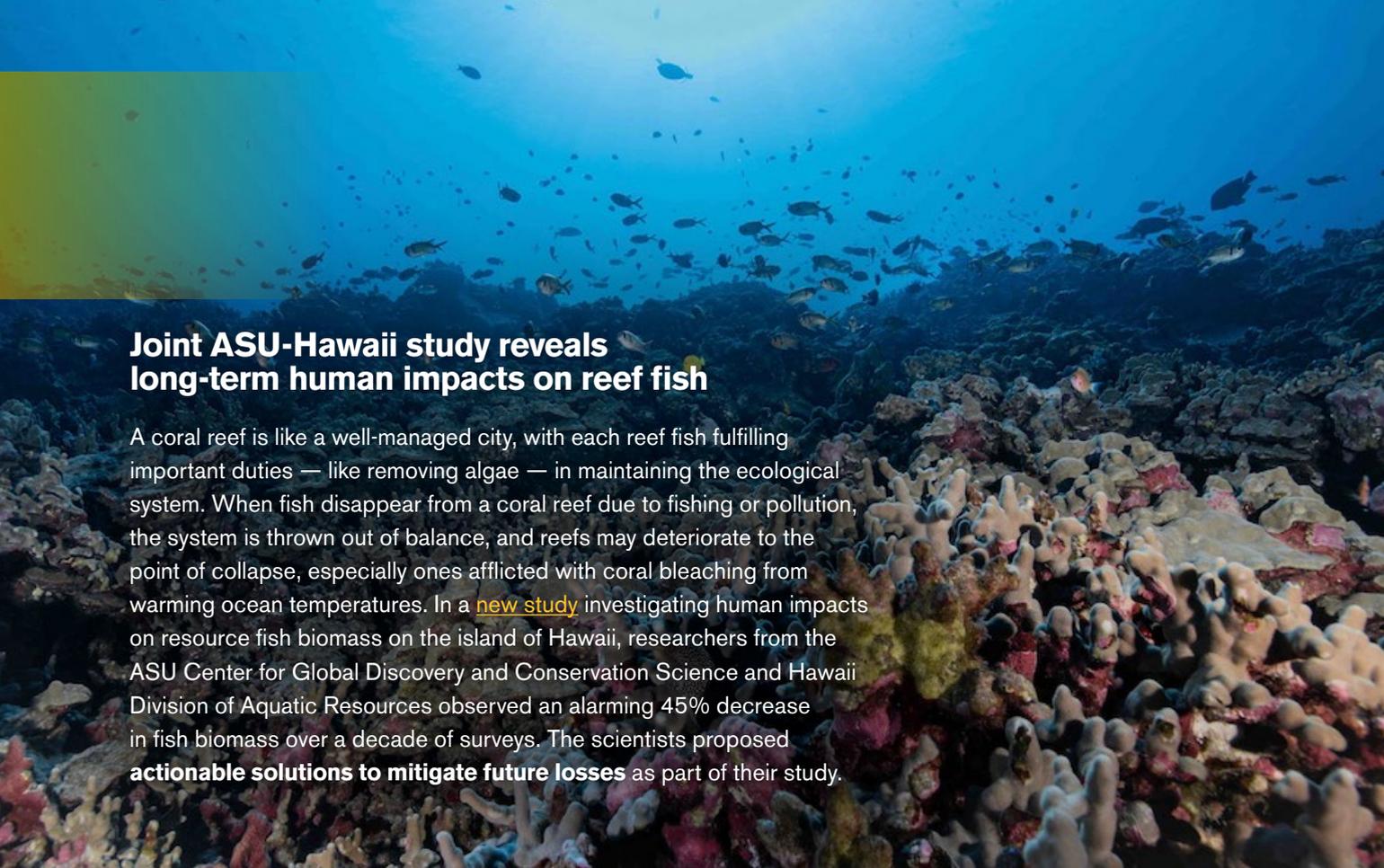
## ASU is one of only nine universities in the world to achieve the STARS Platinum rating.

These actions helped ASU earn the STARS (Sustainability Tracking, Assessment and Rating System) Platinum sustainability rating from the Association for the Advancement of Sustainability in Higher Education. STARS is a framework for colleges and universities to measure their comprehensive sustainability performance. Platinum is the highest certification awarded in the STARS program and ASU is one of only nine universities in the world to achieve the STARS Platinum rating.

## Predicting climate trends and heat waves using data analytics

Predicting extreme weather events such as heat waves, droughts, tornadoes and hurricanes can save lives, and [new research](#) emerging from ASU and Stanford University taps into the power of data analytics to discover the early warning signals. The research quantifies changing temperatures before global warming in the early 20th century and recent heat waves to **reveal the early warning signals for potential catastrophic changes**. Tracking the pre-event signatures, or tipping points, of the increasing frequency and intensity of heat extremes will provide key data for the development of countermeasures to restore climate system resilience.





## Joint ASU-Hawaii study reveals long-term human impacts on reef fish

A coral reef is like a well-managed city, with each reef fish fulfilling important duties — like removing algae — in maintaining the ecological system. When fish disappear from a coral reef due to fishing or pollution, the system is thrown out of balance, and reefs may deteriorate to the point of collapse, especially ones afflicted with coral bleaching from warming ocean temperatures. In a [new study](#) investigating human impacts on resource fish biomass on the island of Hawaii, researchers from the ASU Center for Global Discovery and Conservation Science and Hawaii Division of Aquatic Resources observed an alarming 45% decrease in fish biomass over a decade of surveys. The scientists proposed **actionable solutions to mitigate future losses** as part of their study.



## Survivors of climate disasters tell their stories

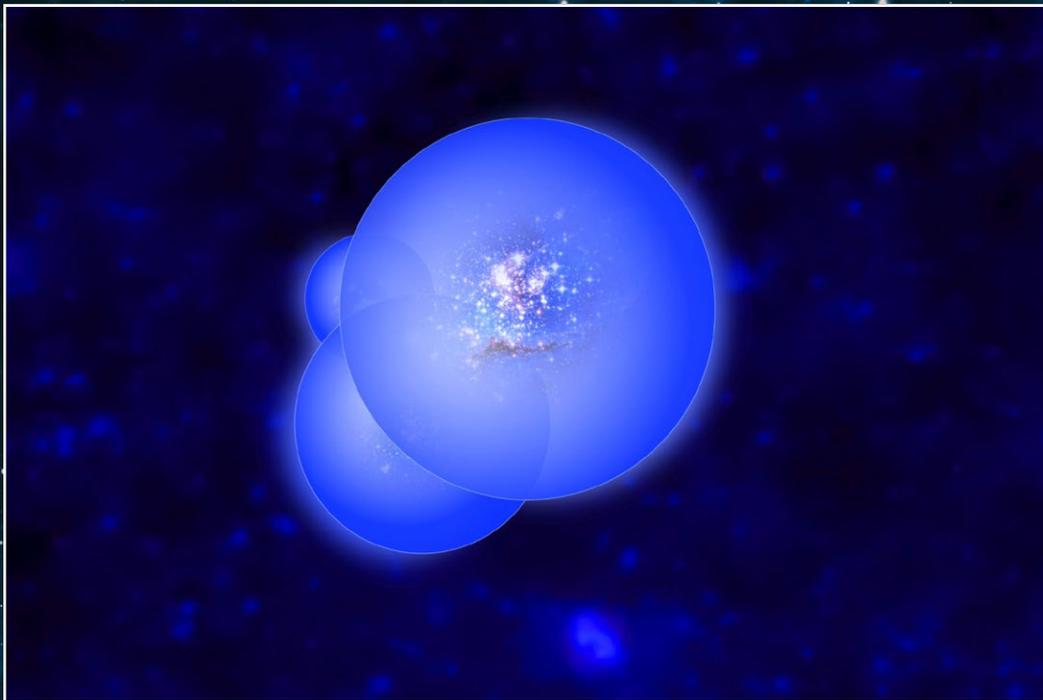
In 2020 alone, the world watched devastating fires rage across Australia, the Amazon rainforest and the West Coast of the U.S. The Atlantic hurricane season proved to be the second most active on record, with three major storms battering the Gulf Coast. Taking a step beyond data and science, Voices from the Future, an initiative from the Julie Ann Wrigley Global Futures Laboratory, chronicled the experiences of more than three dozen survivors of extreme climate disasters across five continents. The [compelling personal narratives](#) have captivated audiences nationwide, from the pages of The New Republic to “Planet Forward,” a series on WNET, a PBS affiliate in New York.

# Venturing into deep space for discovery

## ASU, NASA spy the farthest galaxy group identified to date

An ASU researcher, along with a team of NASA astronomers, made a [breakthrough discovery](#) early this year when they found the farthest galaxy group sighted to date. The collection of three galaxies, dubbed EGS77, harken back to a time when the universe was just 680 million years old, or less than

5% its current 13.8 billion years. More significantly, the astronomers found that EGS77 was part of a sweeping cosmic makeover called reionization, in which light from the first stars cleared the cosmic fog created by hydrogen atoms, clearing the way for light to travel across the cosmos.



## ASU instrument provides ‘eyes’ to search for signs of life on Mars

On July 30, a rocket lifted off from Cape Canaveral, beginning a five month journey to the Red Planet. Aboard that rocket is **NASA’s Mars Perseverance rover**, which is designed to study Mars’ habitability, search for signs of past microbial life, collect and cache samples, and prepare for possible human exploration. Integral to that mission is **Mastcam-Z**, a mast-mounted camera system with zoom capability that will serve as the main “eyes” of the science team back on Earth. Designed by an ASU planetary scientist with the School of Earth and Space Exploration, the panoramic Mastcam-Z will transmit 3D images and videos and photos in up to 11 unique colors for researchers to scour for clues about Mars’ past.

MARS 2020  
PERSEVERANCE

## Hope makes history with ASU-designed instrument

ASU played a small role in history this July as the United Arab Emirates launched an interplanetary mission, a first for an Arab nation. Lifting off aboard a rocket in Tanegashima, Japan, the Al Amal orbiter sped toward Mars to start a two year mission to examine our neighboring planet’s atmosphere. The **Al Amal orbiter** – which means “Hope” in Arabic – carries three instruments, including the **Emirates Mars Infrared Spectrometer (EMIRS)**, an interferometric thermal infrared spectrometer developed by an ASU geologist and geophysicist. Upon arrival at Mars in February 2021, EMIRS will provide a unique view of the lower and middle atmosphere of the planet, measuring the distribution of dust particles and ice clouds while tracking the movement of water vapor and heat.



[research.asu.edu](https://research.asu.edu)

