ASU Knowledge Enterprise

Arizona State University

2023 highlights

Changing the way the world solves problems

At Arizona State University's Knowledge Enterprise, we solve problems through research and innovation to help shape a better future.

This was a milestone year in ASU history. We partnered with NASA to launch the Psyche mission on a six-year journey to a metal-rich asteroid. We established the Southwest Advanced Prototyping (SWAP) Hub as part of the Microelectronics Commons, funded by the CHIPS and Science Act. We are on the cusp of launching a School of Medicine and Advanced Medical Engineering to improve the health of all Arizonans. Our research growth rate is among the fastest in the nation and continues to rise — ASU is among the top 4% of all U.S. universities for research expenditures, according to the latest National Science Foundation data.

All of this is made possible by people. Our culture of innovation and inclusion draws pioneering researchers, highly qualified staff and exemplary students from all 50 states and more than 157 nations. I hope you enjoy reading about their impact throughout 2023.

Sally C. Morton
Executive vice president
ASU Knowledge Enterprise

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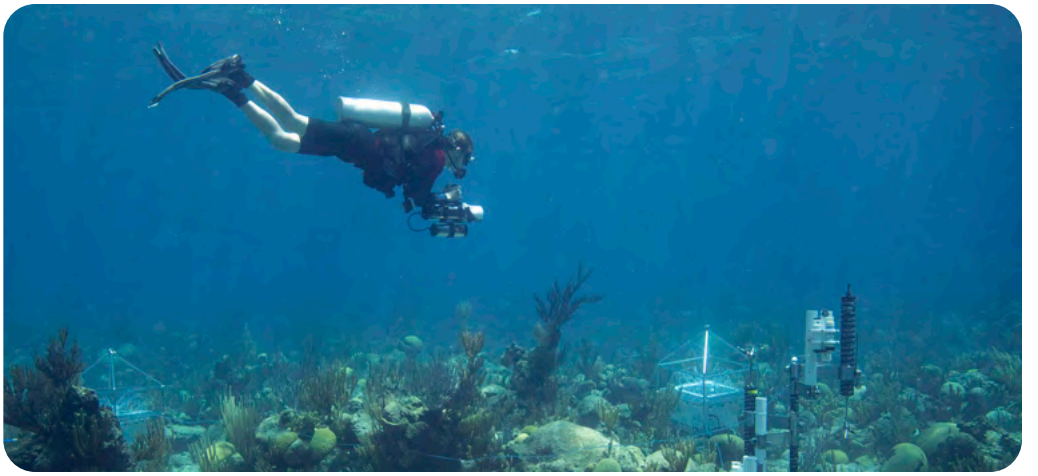


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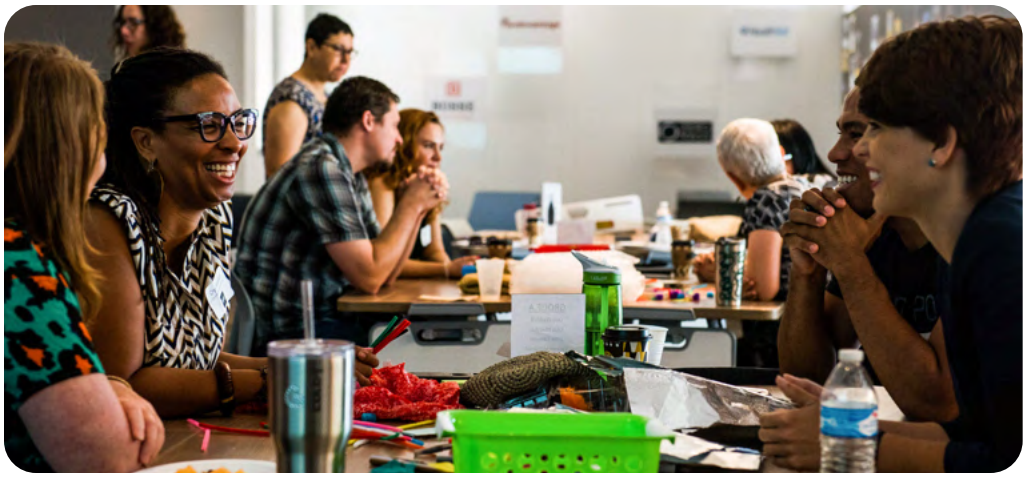
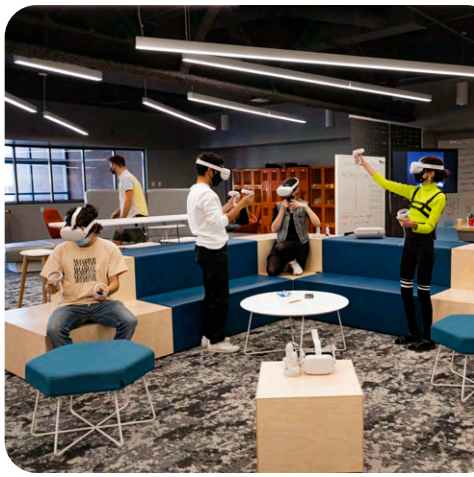
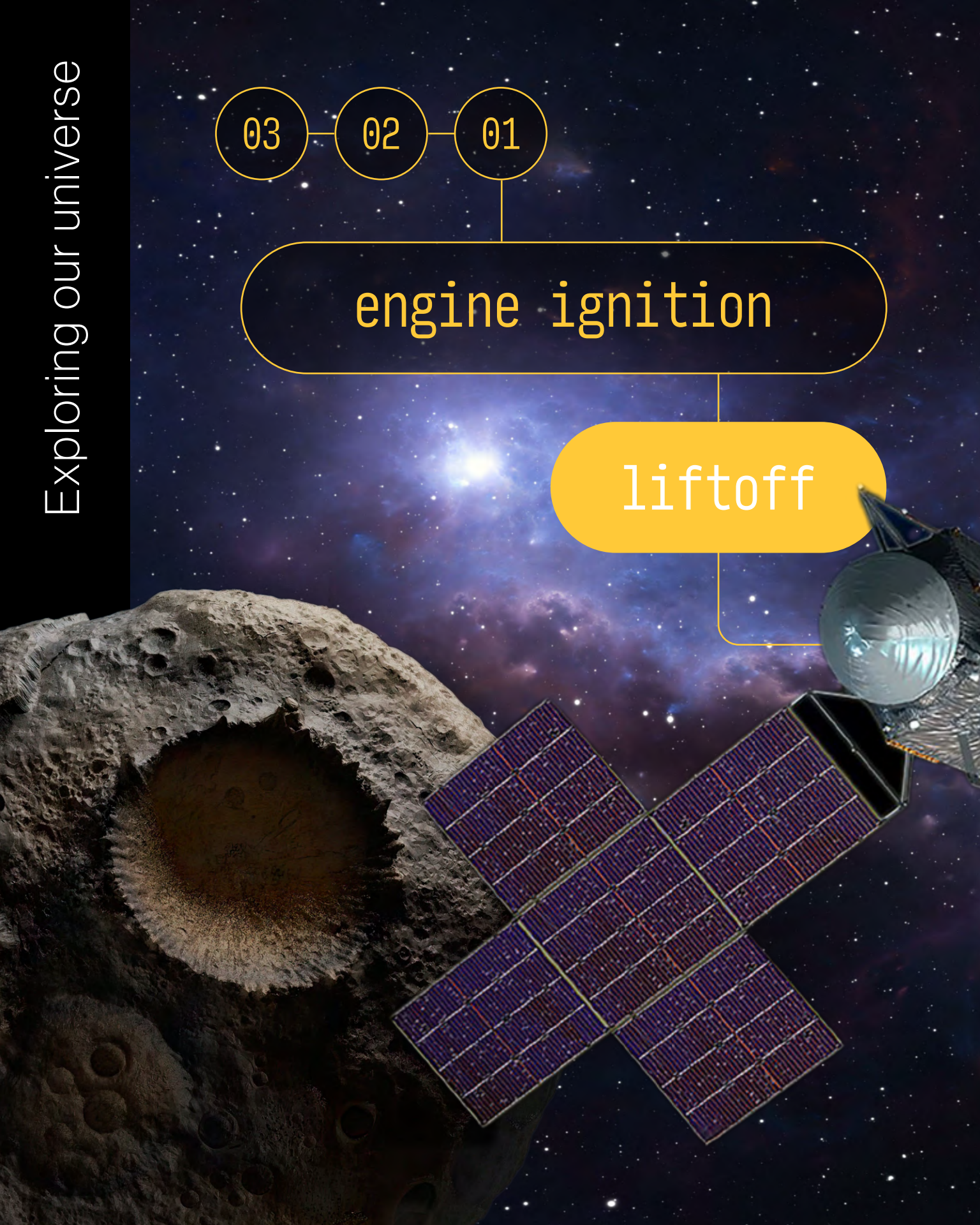
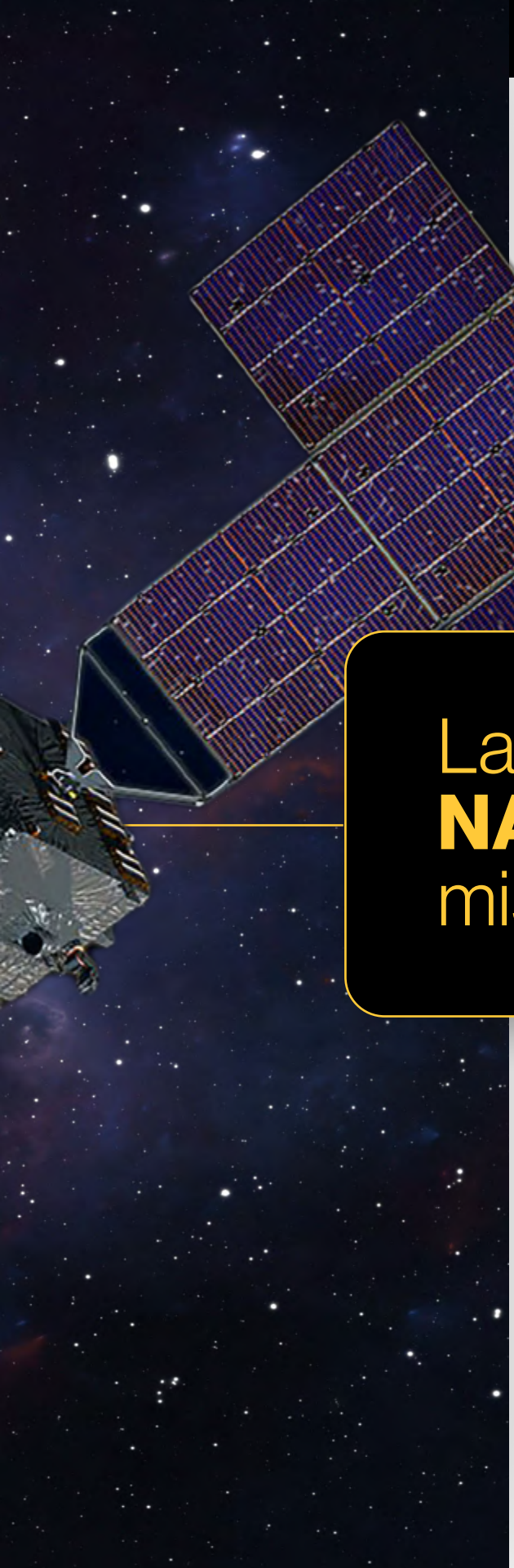




Exploring our universe





Launching the **first NASA deep-space** mission led by ASU

The Psyche mission is the first ever to study a metal-rich asteroid and aims to help scientists learn more about the formation of rocky bodies in our solar system

Launched in October, the Psyche spacecraft will travel 2.2 billion miles from NASA's Kennedy Space Center in Florida to a metal-rich asteroid in the far reaches of the main asteroid belt between Mars and Jupiter. Trailing a blue glow from its thrusters and powered by a pair of massive solar arrays, the orbiter will use its payload of science instruments to learn more about the asteroid Psyche.

Ascent timeline

T = 0:00:00	Liftoff from Cape Canaveral
T + 0:01:09	Max Q
T + 0:02:28	Side booster separation
T + 0:03:55	MECO and core stage separation
T + 0:04:04	2nd stage engine start (SES-1)
T + 0:04:24	Fairing jettison
T + 0:08:26	2nd stage engine cutoff (SECO-1)
T + 0:54:00	Escape burn start (SES-2)
T + 0:56:12	Escape burn cutoff (SECO-2)
T + 1:02:24	Psyche separation

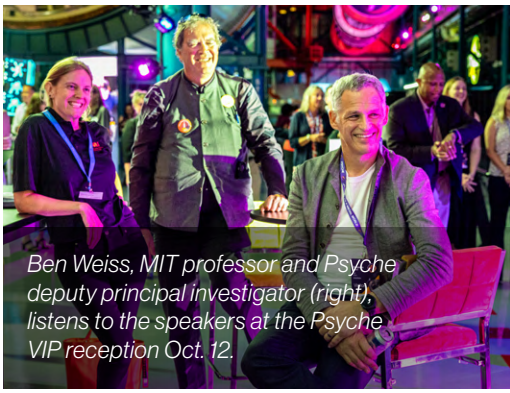
“I am excited to see the treasure trove of science Psyche will unlock as NASA’s first mission to a metal world. By studying asteroid Psyche, we hope to better understand our universe and our place in it, especially regarding the mysterious and impossible-to-reach metal core of our own home planet, Earth."

Nicola Fox, associate administrator for the Science Mission Directorate at NASA Headquarters in Washington, D.C.

On its historic voyage of scientific discovery, the spacecraft will begin exploring the asteroid that scientists think may be the partial core of a planetesimal, the building block of an early planet, composed of a mixture of rock and iron-nickel metal. Because humans cannot drill to Earth’s core 1,800 miles below the surface – or the cores of the other rocky planets – visiting Psyche could provide a one-of-a-kind window into the violent history of collisions and accumulation of matter that created planets like our own. The voyage also represents the first time ever that scientists will explore a world made not of rock or ice, but rich in metal.

Lindy Elkins-Tanton, Foundation and Regents Professor for Arizona State University’s School of Earth and Space Exploration and vice president of the ASU Interplanetary Initiative, serves as the mission’s principal investigator.

The Psyche spacecraft is now heading toward Mars, swinging by the Red Planet in May 2026 and using its gravity as a slingshot toward the asteroid, arriving in August 2029. Afterward, the spacecraft will spend about two years orbiting the asteroid, studying it with a variety of instruments.

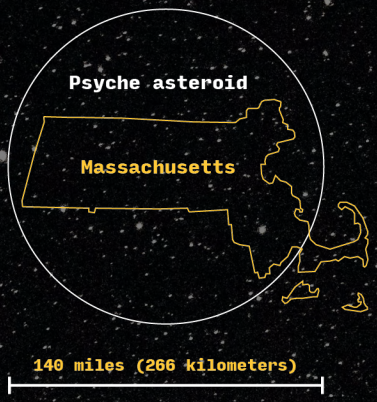


Ben Weiss, MIT professor and Psyche deputy principal investigator (right), listens to the speakers at the Psyche VIP reception Oct. 12.

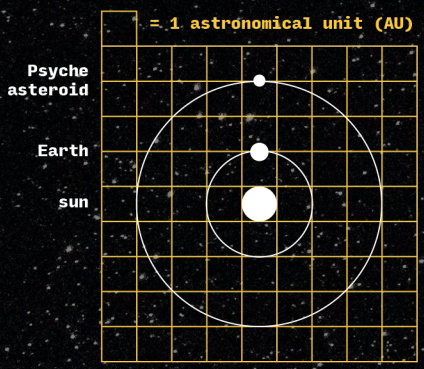
The asteroid Psyche has long been a curious enigma. First spotted in 1852 by Italian astronomer Annibale de Gasparis, who named it for the goddess of the soul in ancient

Psyche specs

Dimensions
173 x 144 x 117 mi (279 x 232 x 189 km)
Diameter
140 mi (226 km) if shown as a perfect sphere
Density
Estimated 3,400 to 4,100 kg/m³
Surface area
64,000 mi² (165,800 km²)



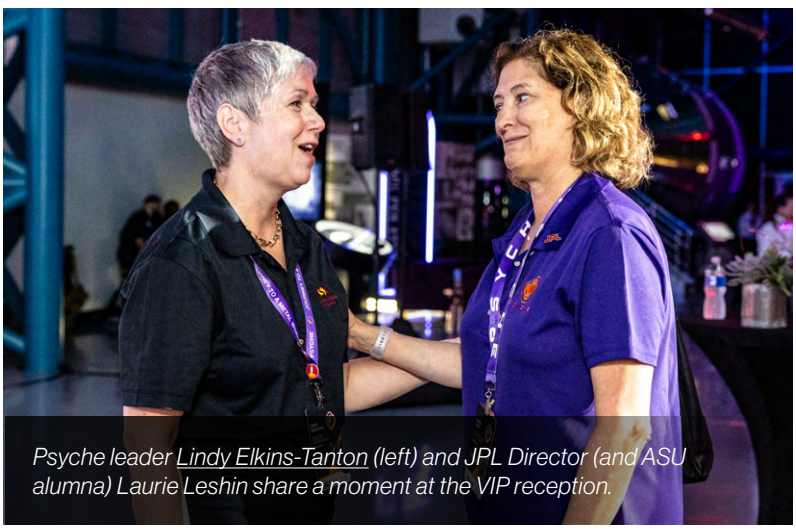
If Psyche were a perfect sphere, it would have a diameter of 140 miles (266 kilometers) or about the length of Massachusetts (leaving out Cape Cod). It is estimated to have a surface area of about 64,000 square miles or approximately 165,800 square kilometers.



Psyche follows an orbit in the outer part of the main asteroid belt, at an average distance from the sun of 3 astronomical units (AU); Earth oribits at 1 AU.

Greek mythology, it was just the 16th asteroid to be discovered.

The mission's cameras will offer the first close-up look at Psyche, revealing surface features that cannot be observed from Earth. A magnetometer aboard the spacecraft will search for signs of an ancient magnetic field, perhaps similar to the one powered by Earth's core. And a gamma-ray spectrometer will detect high-energy gamma rays and neutrons, particles that contain information about the composition and distribution of metal and rock across Psyche's landscape. Finally, the spacecraft's radio antenna will be used to map the asteroid's gravity field to detect differences in density in the asteroid, which could shed light on its origin.



Psyche leader Lindy Elkins-Tanton (left) and JPL Director (and ASU alumna) Laurie Leshin share a moment at the VIP reception.

Lindy Elkins-Tanton explains what we can learn from Psyche.

Space mission updates

This artist's concept shows the OSIRIS-REx spacecraft contacting the asteroid Bennu with its Touch-And-Go Sample Arm Mechanism, or TAGSAM. Image by NASA Goddard Space Flight Center

MISSION TYPE
Sample return

DESTINATION
Asteroid Bennu

SAMPLE DELIVERED
Sept. 24, 2023

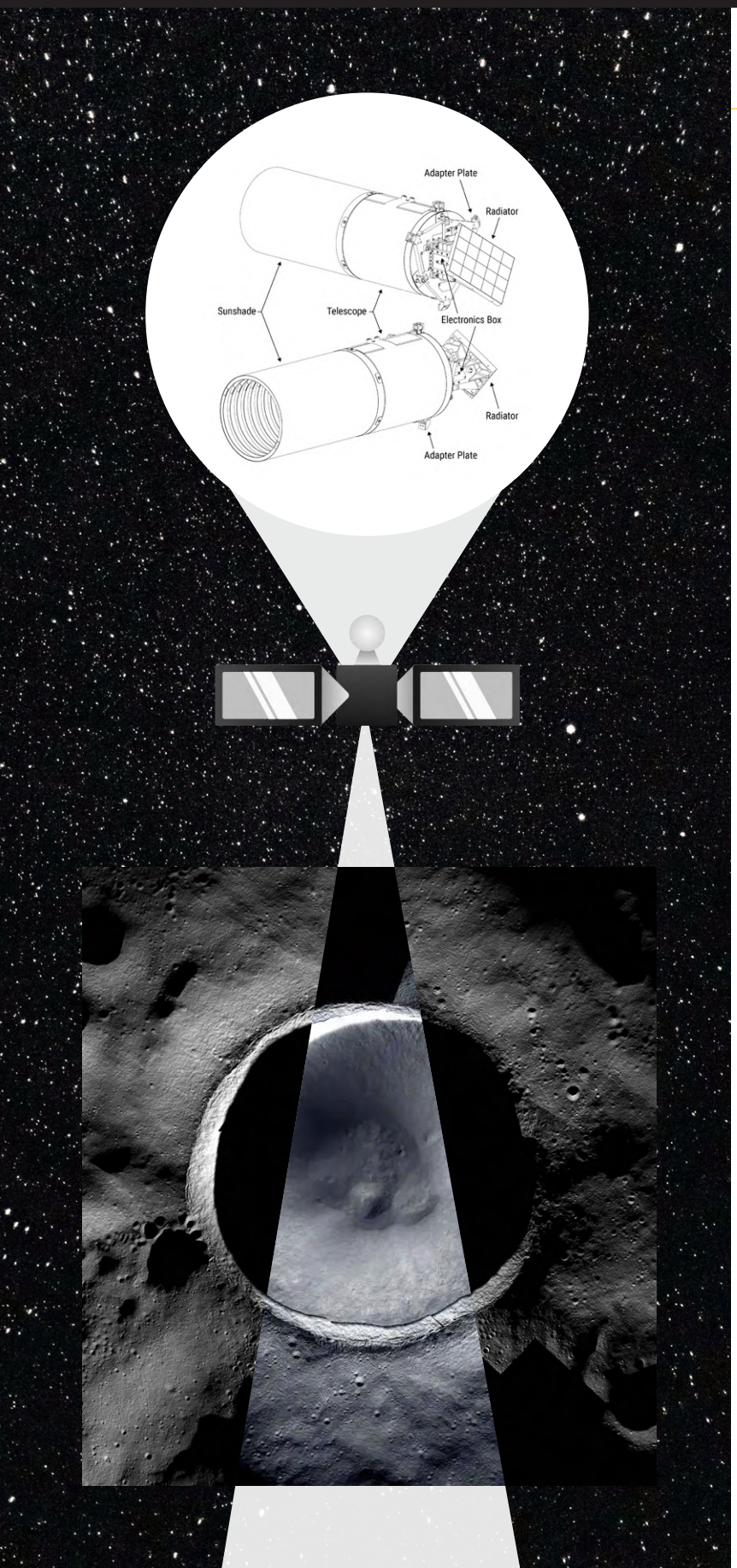
OBJECTIVE
Collect asteroid sample and deliver it to Earth

Discovering the origins of the solar system

With an ASU-built instrument aboard, NASA's OSIRIS-REx spacecraft delivered safely to Earth a sample of the asteroid Bennu, which may hold clues about the origin of life. Bennu contains rocks that date to the earliest epoch of the solar system, and the mission delivered samples of these "fossils" that date back 4 billion years.

Beyond scientific discovery, there's another reason NASA keeps a close eye on Bennu. It has an orbit around the sun that crosses Earth's orbit, posing a small risk it could collide with our planet in the coming centuries. Among the "near-Earth objects" (including comets) that NASA tracks, Bennu tops the list of potentially hazardous space rocks.

The OSIRIS-REx spacecraft carried a number of important scientific instruments, including OTES, the OSIRIS-REx Thermal Emission Spectrometer, the first space instrument built entirely on the ASU campus. OTES was used to map Bennu's mineralogy and surface temperature, data that helped mission scientists choose a site to collect a surface sample to return to Earth.



Space mission updates

A look inside the moon's secret places

Until now, the moon's darkest craters that never see sunlight remained shrouded in mystery for scientists. The ASU designed and led ShadowCam, a powerful science camera that is 200 times more sensitive to light than previous lunar cameras, has now lit up a crater's pockets hidden in permanent darkness.

As part of a collaboration between NASA and the Korea Aerospace Research Institute, ShadowCam was mounted on the Korean spacecraft Danuri and gave scientists their first detailed glimpse of permanently shadowed regions of the moon. The images are helping NASA plan future surface exploration targets before astronauts are scheduled to touch down nearby during the Artemis III mission in 2025.

Some scientists think there may be deposits of water, or even methane and ammonia, in these mysterious craters. If so, these materials would potentially be useful for future human presence on the moon and may also provide important clues to the past billion years of our solar system.

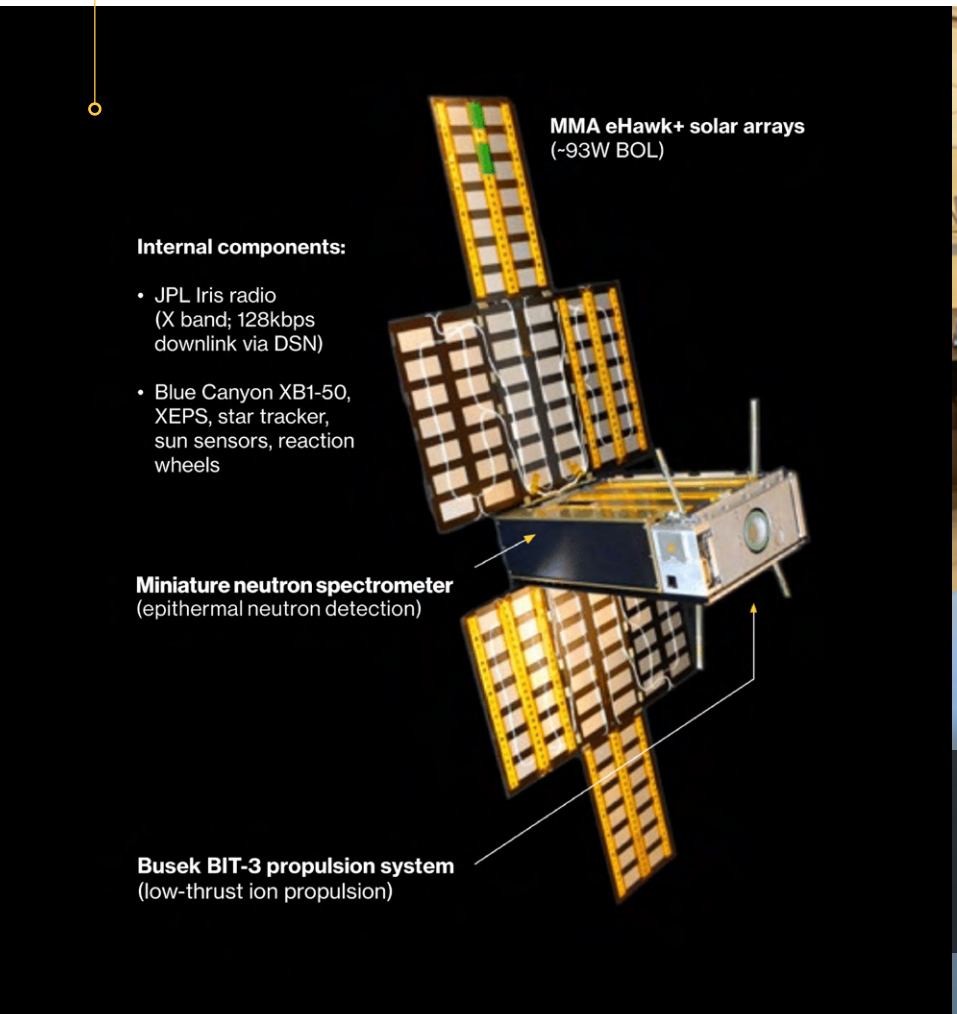
Left: Shackleton Crater near the moon's south pole is shrouded in permanent darkness. ShadowCam has given scientists their first look at what's inside.

Detecting water and ice on the moon

A shoebox-sized spacecraft designed and built at ASU entered orbit around the moon and successfully demonstrated that its neutron spectrometer can detect water and ice at the lunar surface.

During a lunar flyby, the Lunar Polar Hydrogen Mapper (LunaH-Map) CubeSat's neutron spectrometer collected nearly three hours of data from the moon's surface from a distance of about 800 miles. After the neutron spectrometer collected the data, challenges with LunaH-Map's thruster valve prevented it from adjusting course to achieve its planned orbit across the moon's south pole to map hydrogen enrichments (indicators of water-ice).

"We are thrilled that the LunaH-Map team was able to use this opportunity to demonstrate the capability of its neutron spectrometer in flight, even though the mission could not be completed as planned. SIMPLEx missions are inherently risky, as they are designed to test the bounds of what can be achieved with lower-cost missions," says Lori Glaze, Director of the Planetary Science Division at NASA Headquarters in Washington, D.C.



Mechanical engineers Joe DuBois and Nathaniel Struebel (AZ Space Technologies) inspect the LunaH-Map spacecraft's star tracker while ASU principal investigator Craig Hardgrove observes.


CHARTING A COURSE FOR
ARIZONA'S SPACE INDUSTRY
SURFACE
BAT
STATION 1
STATION 2
TRANSMITTING
COMMAND

Building upon its already strong aerospace and defense ecosystem, Arizona is ready to assume an even greater role in the global new space economy. ASU hosted the first Arizona Space Summit in 2023, convening industry, academia and policymakers from Arizona and beyond to engage in a dialogue to accomplish the following goals:

- Highlight the business environment, infrastructure, talent pool and innovation happening in Arizona that is driving the space sector's growth today.
- Identify strategic opportunities for Arizona to become an even stronger global player in the space sector.
- Spur further coordination among Arizona stakeholders to advance opportunities.

Arizona is home to top engineering and space companies, including Boeing, Honeywell Aerospace and Northrop Grumman. In fact, Arizona is the fifth-largest employer in aerospace and defense manufacturing, with more than 1,250 companies contributing to its supply chain.

The summit highlighted many ways in which the state is building on its achievements to drive the space sector to new heights. Here are a few key takeaways:

Workforce

All three of Arizona's public universities — ASU, Northern Arizona University and the University of Arizona — excel in space science. They participate in mission integration, launch and operations and provide their students with hands-on training in these areas. Thus, student experiences go beyond capstone projects and include internships, apprenticeship programs and co-ops, embedding them in teams that are working on real-world projects.

Innovation and collaboration

Arizona is a leader in many technology sectors that support the aerospace industry today and is on the cutting edge of technologies that will be critical to the industry tomorrow, such as quantum science and quantum communications.

Economic development

Industry leaders with operations in the state include Lockheed Martin, Boeing, Honeywell Aerospace, Virgin Galactic, World View Enterprises, Phantom Space, Paragon and General Dynamics Mission Systems.

ASU Space Collective

The university launched the ASU Space Collective, a coalition of organizations seeking to leverage space assets across ASU and Arizona to advance the global space economy, in 2023. Six organizations have joined the coalition already:

Lunasonde, a space age mapmaker, is the first company to offer subsurface data from orbit.

Crow Industries designs, develops and deploys advanced technologies to collect data in extreme environments on and off our planet.

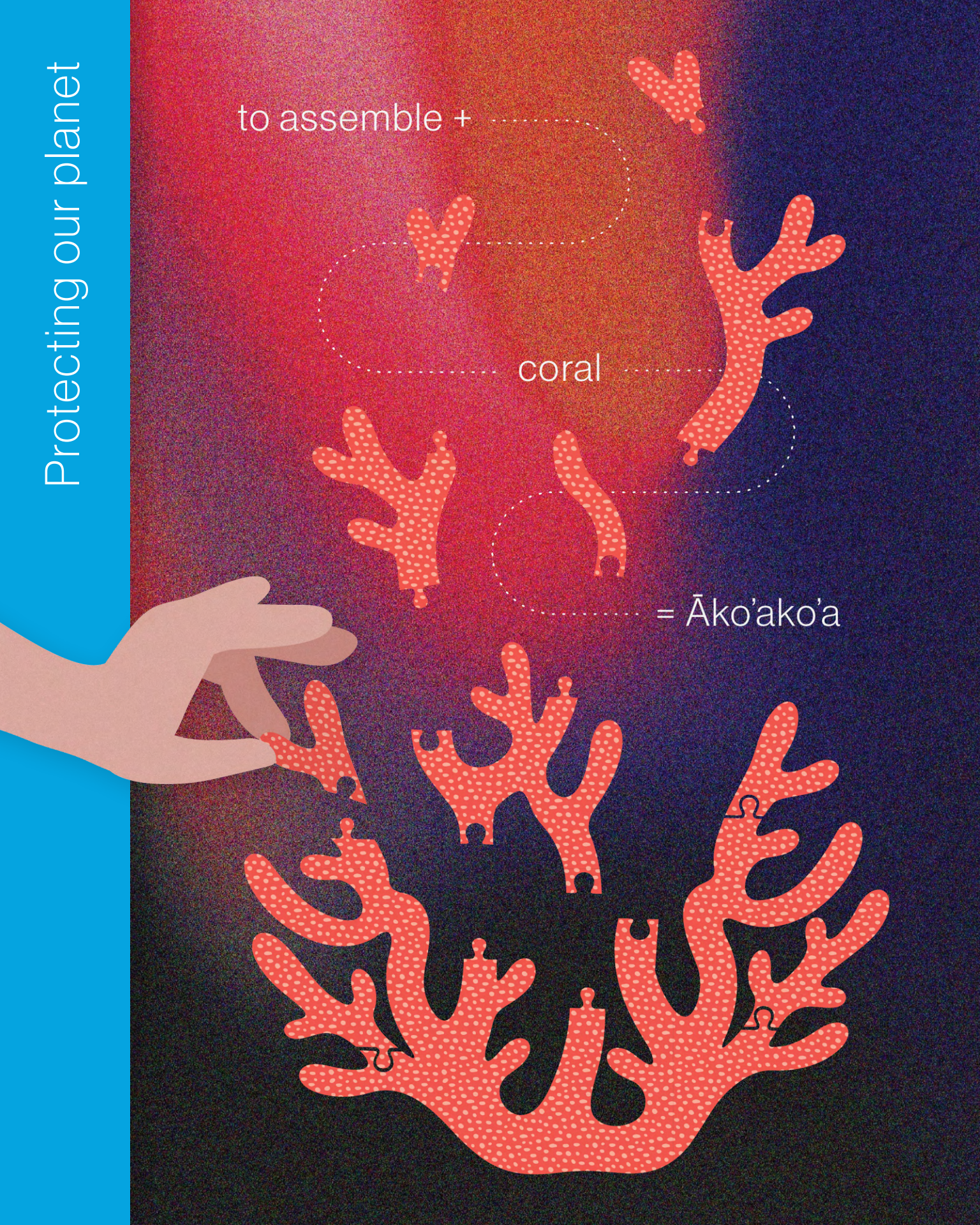
AstroForge mines asteroids to extract valuable minerals in space at a lower cost and smaller carbon footprint than the current terrestrial methods.

Honeybee Robotics is a subsidiary of Blue Origin that builds advanced spacecraft, robotic rovers and other technologies for the exploration of Mars and other planets in deep space.

Howe Industries develops cutting-edge technologies derived from the team's expertise in nuclear technologies, thermal systems and space propulsion for power production and space exploration.

Katalyst Space Technologies upgrades satellites post-launch using in-space servicing, giving operators a second chance to add features that maintain their competitive edge.

Protecting our planet



Turning the tide on our coral reefs

ASU forges connections between science and community to preserve and restore Hawaii's coral reefs and the health of its coastlines

Arizona State University is creating a new $25 million collaboration with a group of core partners to preserve and restore vitality to Hawaii's coral reefs and the health of its coastlines. The community-based effort looks to fuse state-of-the-art science programs with the leadership and cultural knowledge of Hawaii's community partners to enable coastal and reef sustainability for generations to come. Named Āko'ako'a (pronounced ah kō-a kō-a), the effort shares a dual meaning: "to assemble" and "coral."

Alexandra Ordonez Alvarez, a marine biologist with Southern Cross University, collects collects georeferenced reef data with GPS overhead. Photo by Chris Roelfsema

"For decades, our original program focused on diagnosing land and reef problems using high-tech satellite, airborne and field technologies," says Greg Asner, director of ASU's Center for Global Discovery and Conservation Science, a unit of the Julie Ann Wrigley Global Futures Laboratory. "The new program further expands this diagnostic work, but it focuses far more effort on interventions that support Hawaii's communities, both coral and human, as one force."

Āko'ako'a has been made possible with an initial donation of $15 million from the Dorrance family and Dorrance Family Foundation, combined with collaborative funding from U.S. Sen. Brian Schatz's office, the Hawaii Division of Aquatic Resources, the National Oceanic and Atmospheric Administration and ASU. The initiative looks to greatly expand restorative work on coral reefs and coastlines of Hawaii and beyond.

"It is our kuleana to protect and care for what we love, our coral reefs and the species they harbor, and all of Hawaii," said Jacquie and Bennett Dorrance in a joint statement. "Success in saving our reefs relies on 'laulima,' many hands working together. The Dorrance family and the Dorrance Family Foundation hope this investment ignites action and vital funding, and we encourage others to join us in support of this tremendous effort. The time is now."

Asner, a senior Global Futures Scientist, says corals are critical to reef biodiversity and home to millions of marine species, which dot the seafloor with a dizzying array of shapes and sizes. He adds that corals are also the "canary in the coal mine" when it comes to our collective behavior — where corals flourish, land and sea are usually well stewarded.

“The Julie Ann Wrigley Global Futures Laboratory’s mission is to explore pathways into a future that offers opportunities for the coming generations on a healthy planet. We live on a water planet, with 70% of Earth’s surface covered by water and its largest biome residing in the world's oceans, thus it is imperative to include the oceans in a holistic view of the world we strive to live on.”

Peter Schlosser
vice president and vice provost
Global Futures Laboratory

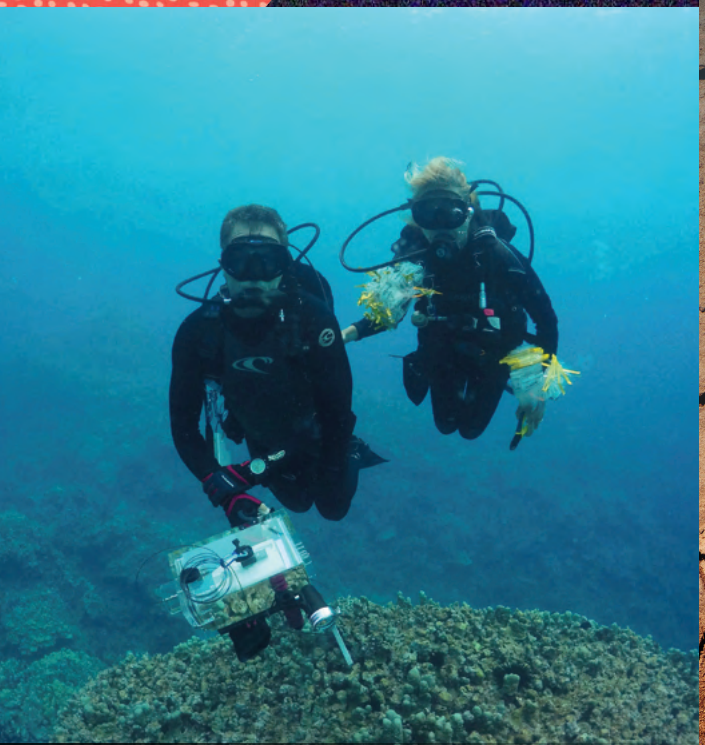
But over the past 50 years, Hawaiian coral communities have undergone an alarming decline due to pollution, climate change and overfishing. Asner’s group has spent the last decade monitoring these impacts, from the land, sea and air; from ocean heat waves to agricultural runoff to the chemistry of the oceans. He says it’s finally time to turn the tide by more deeply connecting human and coral communities for a more resilient future. That notion was seconded by several of Hawaii’s most respected community leaders who are key partners in the initiative.

With major contributions from community leaders, cultural practitioners, ecologists, data scientists and global information systems experts, the initial core focus for restorative work will be on the western side of the Hawaii Island, comprising 120 miles of reef and one of the largest coral communities in the Hawaiian Archipelago. Collectively, the west Hawaii coastline harbors a huge range of human and coral conditions.

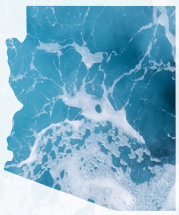
A key part of the collaboration is a new state-of-the-art coral research and propagation facility located at the joint Ridge to Reef Restoration Center in Kailua-Kona. The center is under construction now in partnership with a land restoration organization called Terraformation. The coral facility will be the largest in the world when completed and will become the hub for testing corals for subsequent reef restoration.

“Restoring and enhancing our coral reefs takes a fusion of stewardship, management and high-tech science. Āko'ako'a will be a major example of this blended process for west Hawaii. We are pleased to partner with ASU’s education and research programs in developing and implementing restoration approaches that will benefit communities along the west Hawaii coastline.”

Brian Nelson,
head of the Hawaii Division
of Aquatic Resources



Greg Asner and Robin Martin, associate professor in the School of Ocean Futures, have transformed our understanding of coral reefs.



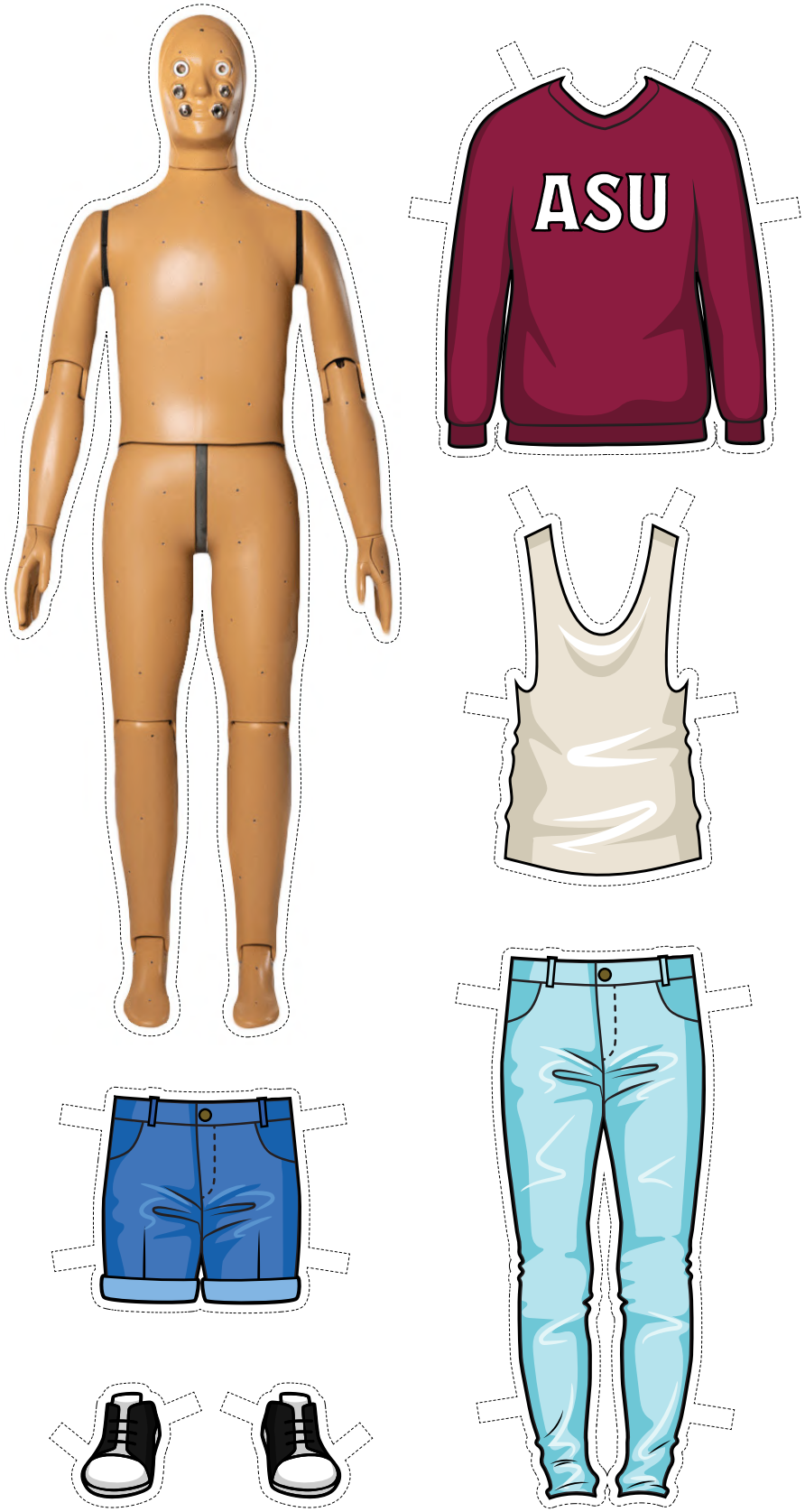
Why oceans are important to Arizona

Life systems on Earth are complex and interconnected in sometimes surprising ways. With every breath we take and drop we drink, life in Arizona is connected to the ocean.

"We are so dependent on climate cycles that are happening in the Pacific," says Susanne Neuer, an oceanographer and founding director of ASU's School of Ocean Futures. "Our storms bring water from the Pacific that has evaporated there. Next time you get drenched in the rain, just think about how this is all water that originally came from the Pacific. In summer, we get the monsoons from the Gulf of Mexico and Gulf of California. Life in the desert, and the supply of water, are really dependent on the ocean."

More than that, the entire globe depends on the ocean in some way or another. That's why ASU's School of Ocean Futures is critical to the overall mission of the Global Futures Laboratory, which aims to ensure a habitable planet and a future in which well-being is attainable for all.

The summer of 2023 was the hottest in history, setting new records for heat-associated deaths in Arizona's most populous Maricopa County. The Arizona Department of Health Services reports there were 2,558 emergency department visits for heat-related illnesses in the state in 2023. Out of every 10,000 emergency department visits this year, 48.7 were due to a heat-related illness.



Associate Professor Konrad Rykaczewski, research scientist Ankit Joshi, ANDI the thermal manikin, Associate Professor Jennifer Vanos and Assistant Professor Ariane Middel in the lab.

Understanding the human body's response to extreme heat

In the coming decades, every region in the U.S. is expected to experience higher temperatures and more intense heat waves. Thousands of people around the country die from heat-related illnesses each year. In Maricopa County alone in 2022 there were 425 heat-related fatalities, a 25% increase from the previous year.

ASU researchers aim to better understand heat stress on the human body and what makes hot weather so deadly. To do so, they've turned to ANDI, the world's first indoor-outdoor breathing, sweating and walking thermal manikin. Around the globe, 10 ANDI manikins currently exist, mostly owned and used by athletic clothing companies for garment testing.

ASU's ANDI is one of only two used by research institutions, and it's the first thermal manikin in existence that can be used outdoors, enabled by a unique internal cooling channel.

Using both ANDI and a heat chamber in which ANDI lives, ASU researchers in the School of Sustainability and School of Arts, Media and Engineering are working together to understand how human bodies are impacted by heat stress and quantify the risk different environments pose to health.

Inside ANDI's current home, ASU's newly developed heat chamber, researchers can simulate heat exposure scenarios from different places around the globe.

Dubbed the "Warm Room," the heat chamber is outfitted with advanced technologies that control the wind, temperature up to 140 degrees Fahrenheit and solar radiation. But in addition to being studied indoors, ASU's ANDI is the only thermal manikin in the world that can be used outside.

ANDI is built with internal cooling channels that circulate cool water throughout its body, which enable it to stay cool enough to withstand extreme heat while measuring complex variables that contribute to our perception of heat in different environments — solar radiation from the sun, infrared radiation from the ground and convection from the surrounding air.

> This research is something that humans can really relate to because we partly experience the world through the changing seasons — documenting how summer and winter temperature varied through time translates to how we understand climate."

Tyler Jones
assistant research professor and fellow, INSTAAR

In the foreground, a researcher holds up an ice core — a cylindrical column of ice drilled from ancient ice sheets. The researchers were stationed in west Antarctica, shown in the background, for their study. Photos by Bradley Markle/University of Colorado Boulder.

Unlocking the mysteries of Earth's past climate to help predict the future

An ASU researcher is among an international team of scientists that has completed the most detailed look yet at the planet's recent climatic history, including seasonal temperatures dating back 11,000 years to the beginning of what is known as the Holocene period.

The study, published recently in Nature, is the very first seasonal temperature record of its kind, from anywhere in the world.

"The goal of the research team was to push the boundaries of what is possible with past climate interpretations, and for us that meant trying to understand climate at the shortest timescales, in this case seasonally, from summer to winter, year-by-year, for many thousands of years," says Tyler Jones, lead author on the study and assistant research professor and fellow at the Institute of Arctic and Alpine Research, or INSTAAR.

Jones teamed up with Joshua Garland, an associate research professor in the Global Security Initiative at Arizona State University, to utilize his expertise in information theory to reexamine ice cores from the West Antarctic ice sheet.

Their highly detailed data on long-term climate patterns of the past provide an important baseline for scientists who study the impacts of human-caused greenhouse gas emissions on our present and future climate. By knowing which planetary cycles occur naturally and why, researchers can better identify the human influence on climate change and its impacts on global temperatures.

12 ASU researchers serve as prominent voices in policy-shaping work on US climate change

The White House released a comprehensive analysis of the impacts of global climate change in the United States in its Fifth National Climate Assessment (NCA5), with key contributions by 12 ASU faculty members. The congressionally mandated, quadrennial report provides Americans comprehensive information on accelerating climate impacts and vulnerabilities in their own regions, along with potential solutions and actions, including policy changes at federal, state and local levels.

One of the most influential chapters, focused on the Southwest, was led by Dave White, associate vice president for research advancement in ASU Knowledge Enterprise and Senior Global Futures Scientist.

> "As shown in the Fifth National Climate Assessment, the Southwest — including Arizona — is taking action on climate change. Governments, nongovernmental organizations, universities and private enterprises are responding to climate impacts with innovative solutions, increasing adaptation and resilience. Climate action offers unparalleled opportunities to improve well-being, benefit the economy and create a more just future for our state and region."
>
> **Dave White**
> associate vice president for research advancement in ASU Knowledge Enterprise and Senior Global Futures Scientist


Laura Brewington


Mikhail Chester


Otakuye Conroy-Ben


Melanie Gall


Margaret Garcia


Zena Grecni


David Hondula


Victoria Keener


Sara Meerow


Jennifer Vanos


Dave White


Abigail York

“We can’t live without the industrial sector, nor can we live with the levels of carbon pollution it creates.”

Jennifer Granholm
U.S. Secretary of Energy

Learn more about what EPIXC will do.

Clean heat for manufacturing

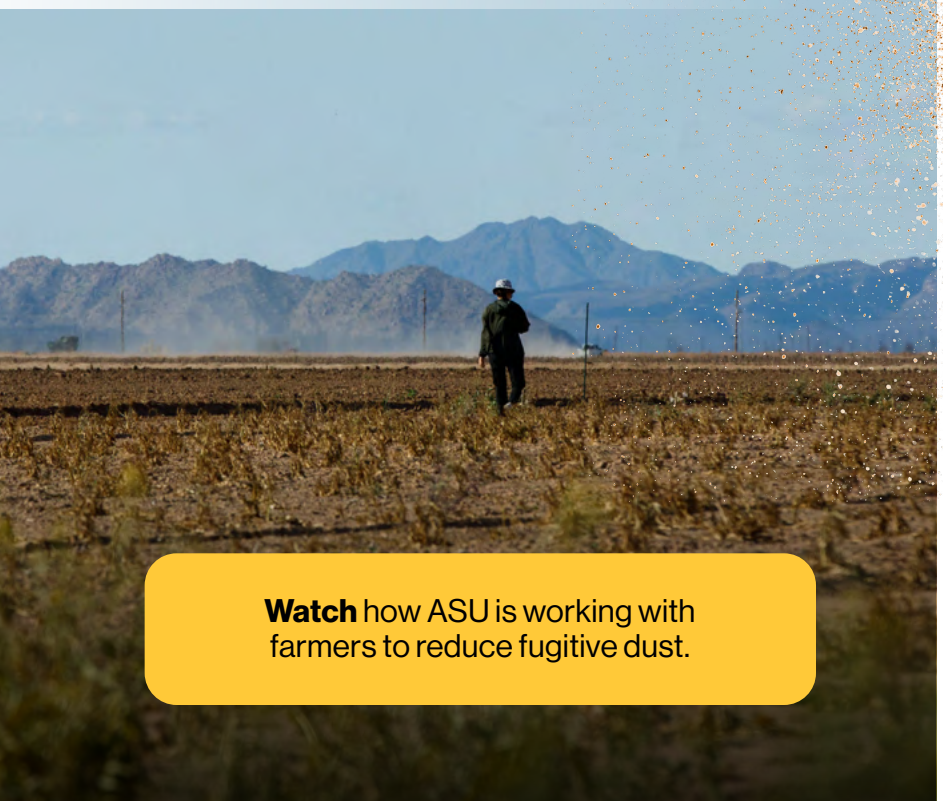
The U.S. Department of Energy selected ASU to establish a new Clean Energy Manufacturing Innovation Institute devoted to reducing greenhouse gas emissions from industrial process heating, the use of thermal energy to produce, treat or alter manufactured goods. The industrial sector currently accounts for more than 30% of U.S. greenhouse gas emissions, and fossil fuel-driven process heating — from pasteurizing milk to melting steel — is the most significant contributor.

The new institute, Electrified Processes for Industry Without Carbon (EPIXC), will support expanded use of clean electricity for the heating used to prepare materials and produce manufactured goods. The end result will be a dramatic reduction of carbon dioxide emissions across industrial sectors, including iron and steel, chemicals, petroleum, food and beverage, forest products, and cement.

Operating as a public-private partnership, EPIXC will conduct innovative research, development, demonstration and deployment of relevant technologies as well as workforce training to meet the growing demand for electric technicians to develop, install and maintain the new equipment. EPIXC joins the DOE’s six other Manufacturing USA institutes, which convene the nation’s brightest minds to solve the country’s toughest manufacturing challenges and move novel electrification processes out of the lab and into the market.

EPIXC is mobilizing a coalition of private companies, national labs, universities, labor unions and community partners to build an industrial sector that is more resilient, efficient and competitive and set the United States on a path to net-zero emissions by 2050.

Biocrust to beat the dust



Watch how ASU is working with farmers to reduce fugitive dust.

Airborne dust is a big problem in Arizona. Strong monsoon winds can pick up loose, dry topsoil and gather it into hazardous dust storms. How do we suppress that dust? The key may lie with the secret web of life hidden in our dirt. Biocrust is a mesh of photosynthetic bacteria that holds down dust like a sticky net. Human activity like agriculture and construction disturbs the biocrust layer, and it can take decades to regrow. A team at ASU's Biodesign Center for Fundamental and Applied Microbiomics hopes to reduce that regrowth time to a year or two. They're growing biocrust in the lab with the aim to plant it in depleted areas. They're also evaluating the best treatment option for each type of soil. The research team studies dust storms, biocrusts, soils and land use practices together as a whole system to find actionable solutions to lessen the severity of dust storms.

Empowering young African leaders with the tools, education and network to succeed

ASU leads a project to bolster leadership and entrepreneurial training across Africa

Africa enjoys an abundance of natural resources — arable land, renewable freshwater, vast mineral wealth and more — but its most valuable asset may be its youth.

By 2030, it's expected that 42 percent of the world's 15–35-year-olds will live in Africa. This growing demographic is inheriting a litany of challenges, both regional and global. Successfully navigating these challenges and charting a thriving future hinge on the development of young leaders and the creation of economic opportunity.

The U.S. Agency for International Development has tapped Arizona State University to help realize that future. Backed by $80 million in funding — the largest USAID award in the university's history — ASU is assembling a coalition to empower Africa's young leaders with the tools, education and network to succeed. Over the next five years, the coalition aims to streamline recruitment, admissions, curriculum and communications of the existing Young African Leaders Initiative through a new, on-continent framework called YALI Africa.

The YALI Africa project will be funded by USAID and implemented by ASU's International Development Initiative, drawing on the unique capabilities of the Thunderbird School of Global Management, Watts College of Public Service and Community Solutions, J. Orin Edson Entrepreneurship + Innovation Institute and EdPlus.

"Essentially, the end goal is a program designed by Africans, led by Africans, supporting Africans," says Stephen Feinson, managing director of the International Development Initiative.

Partnering with ASU are FHI 360, the African Diaspora Network, Geeks Without Frontiers, N50 and CoELIB at Egerton University in Kenya. An African team of experts will implement day-to-day activities across 49 countries in sub-Saharan Africa, operating from four hubs based in Nairobi, Kenya; Dakar, Senegal; Accra, Ghana; and Pretoria, South Africa.

The award follows through on last year's U.S.-Africa Leaders Summit held in Washington, D.C., where the Biden-Harris administration announced new and expanded initiatives to empower African institutions and people. YALI was among the programs the White House renewed its investment in, pledging to invest $100 million over multiple years.

“We are thrilled to be working with Arizona State University as we continue to provide young African leaders, both women and men, the opportunity to have an impact on their communities, their countries and their continent. This new award will ensure that the YALI Regional Leadership Centers will provide the best leadership training opportunities to these amazing young African leaders and will also mean a much richer and more effective engagement with our more than 24,000 YALI alumni.”

Denise O’Toole
acting YALI coordinator for USAID

Entrepreneurship updates

Startups and small businesses are a major driver of Arizona's economy, employing almost half (44.5%) of the state's private workforce, according to the U.S. Small Business Administration.

Sparky joins Abyssinia Bizuneh and Michael Li, both biomedical engineering majors, after they won $40,000 for their entrepreneurial venture Captavate at the spring 2023 Demo Day pitch event at SkySong on April 22.

$332,500
total awards given

77
startups

7
funding tracks

Record-breaking funding at ASU Demo Day fuels student ventures.

In April, 77 startup companies pitched their ideas at Venture Devils Demo Day, the culmination of ASU's Venture Devils program. Part of the J. Orin Edson Entrepreneurship + Innovation Institute, Venture Devils provides support and resources to ASU students, staff, faculty, alumni and community entrepreneurs. At the biannual Demo Day, top ventures engaged with the program to showcase the fruits of their labor and deliver investor-style pitches, perhaps even walking away with significant seed funding, in-kind services or other valuable resources. A total of $332,500 was awarded in seven funding tracks in April — the most ever for the event.

New Chandler incubator open to all community entrepreneurs

ASU has a new entrepreneurship resource in Chandler that is perfectly aligned with the university's charter — open to anybody in the community.

The Chandler Endeavor Venture Innovation Incubator, a partnership between ASU's Edson Entrepreneurship + Innovation Institute and the city of Chandler, is a unique model. Typically, incubators require entrepreneurs to apply, and they may or may not be selected to join a cohort of other startups.

The Chandler Endeavor Venture Innovation Incubator invites any entrepreneur in the community to join simply by registering. Then, they can collaborate with peers and get expert advice, according to Tracey Dodenhoff, the new vice president of entrepreneurship and innovation at ASU.

New library to honor senator's legacy

President Joe Biden visited ASU's Tempe campus in September to announce a major federal grant to the state of Arizona to help design and build a new McCain National Library at Arizona State University.

The McCain National Library will honor the life and legacy of the late John McCain, who represented Arizona first as a U.S. representative and then as a longtime U.S. senator and a Republican presidential nominee.

The new 80,000-square-foot national library, to be located north of the university's Tempe campus, will include archives for McCain's papers and materials from his decades of high-profile work in Arizona, Washington, D.C., and around the globe while in office. A visitors center and an Arizona home for the Washington, D.C.-based McCain Institute are among other elements planned for the site, envisioned as a solutions center and gathering spot to learn more about leadership, democracy and national security.

Feeling the Sound

Click here to see and hear how it works

Professor's invention lets violinists feel the sound

A violinist and professor in ASU's School of Arts, Media and Engineering is expanding how people play, learn and perform on instruments. Seth Thorn invented a device called an active shoulder rest to transmit the feel of the violin's sound to a player's upper body. The device serves as a silent metronome, allowing musicians experimenting with digital sound and people with sensory impairments or learning difficulties to feel the music's beat. The active shoulder rest easily integrates into current violin playing because most violinists already use a shoulder rest to ease neck strain. Initially, Thorn made six active shoulder rests by hand with a colleague from the School of Arts, Media and Engineering. In 2022 he began sharing the active shoulder rests with a free musical academy for children in Phoenix. With a $10,000 seed grant from the Herberger Institute for Design and the Arts, the project is expanding and providing 3D-printed active shoulder rest devices to more Greater Phoenix schools.

Saving lives, improving health

Arizona's life expectancy fell 2.5 years in a recent one-year span — from 78.8 to 76.3 years, below the national average. Improving the state's health outcomes is the mission of ASU's new medical school.

"We want industry leaders to engage with us up front, to help us build education programs that graduate the kind of people that can hit the ground running in their companies. We also want community members to tell us what is important to them in the context of their health."

Dr. Sherine Gabriel
executive vice president, ASU Health

ASU launches a different kind of medical school

Innovative academic programs, research and clinical partnerships aim to improve Arizona's health outcomes

Arizona State University is taking an innovative approach to Arizona's significant and growing health care needs through ASU Health, a "learning health ecosystem" designed to accelerate and focus the university's health-related efforts. Central to this effort will be a new medical school, the School of Medicine and Advanced Medical Engineering.

Arizona's vital signs offer a poor prognosis when it comes to health outcomes. The state currently ranks near or in the bottom quartile of many health system performance indicators, including No. 32 overall, No. 44 in access and affordability and No. 41 in prevention and treatment.

Meanwhile, Arizona faces a shortage in almost every health care profession amidst significant turnover for physicians and nurses that is only expected to grow as they reach retirement age. Public health funding is 50% below the national average, and Arizona has fewer hospital beds per 1,000 people than the national average.

"We are focusing our full energy and innovation on improving Arizona's health outcomes," says ASU President Michael M. Crow. "We have an opportunity for change. And over the past 20 years, ASU has shown that we know how to create transformative change, at scale."

The first-of-its-kind medical school will fuse medicine and engineering to create a different kind of health care provider that approaches problems differently and devises innovative solutions. ASU will also launch a new School of Public Health Technology that will leverage artificial intelligence, data science and technology to drive transformational change, as well as a Medical Master's Institute that will help fill the skills gap for learners in a variety of health care fields.

The Health Observatory at ASU, a new research initiative, will serve as an early warning system to help state leaders spot trends and make health-related decisions. It will integrate data from diverse sources across the state to inform real-time decision-making and ensure resources yield the greatest impact.

Clinical partnerships will support the research and academic programs, delivering solutions that improve patient and health care outcomes. This includes expansion of ASU's longstanding alliance with Mayo Clinic, which will continue to grow through the ASU Health Futures Center next to Mayo Clinic's north Phoenix campus and the Discovery Oasis Innovation Zone next to the Mayo Clinic Phoenix Hospital.

Watch ASU President Michael M. Crow discuss the new medical school with Phoenix Mayor Kate Gallego.

Removing ‘forever’ chemicals from drinking water

ASU researchers discover a way to make dangerous PFAS biodegradable — and harmless

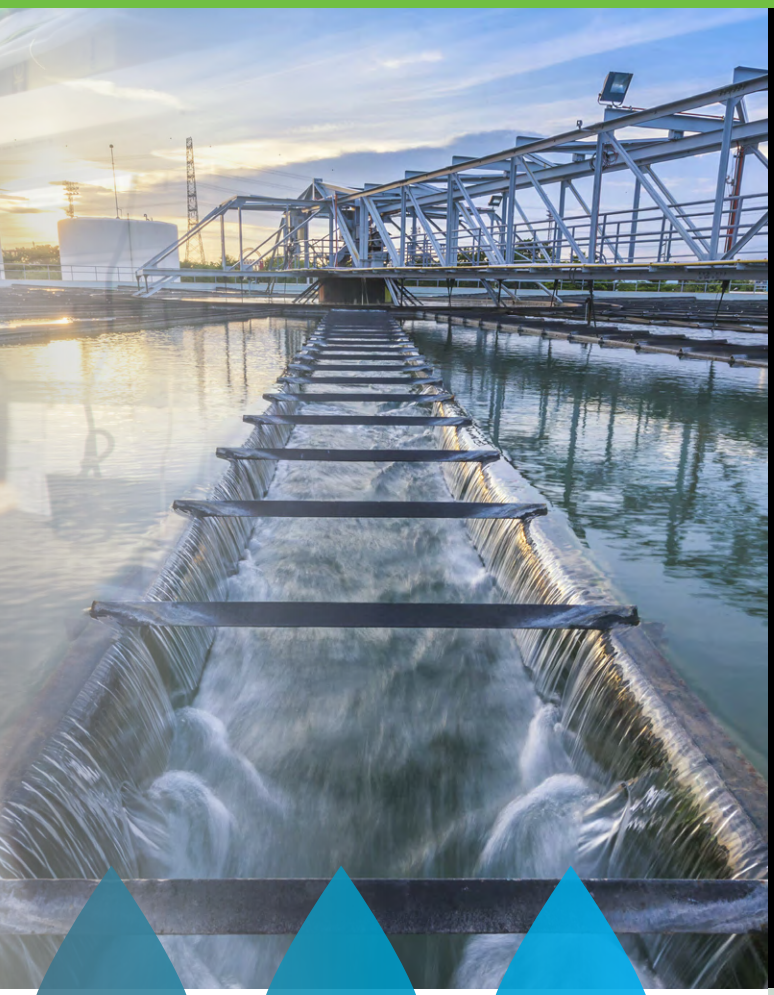
The everyday act of drinking a glass of water from the faucet may be a greater hazard to our health than we imagined.

The Environmental Protection Agency says that perfluoroalkyl and polyfluoroalkyl substances (PFAS) are dangerous, even in amounts so small as to be undetectable in drinking water. The agency has set legal drinking water limits for six of the most studied and toxic PFAS compounds, commonly known as “forever chemicals” due to their stubborn persistence in the environment. The new limits mark the first time in 26 years that the EPA has set legal limits for a contaminant in drinking water.

Municipal utilities will be required to remove the compounds from drinking water, which experts say could cost billions of dollars. For communities with the pollutants, it’s a costly problem to solve.

But researchers at ASU have developed a new method that helps microorganisms destroy PFAS. The technology may prove to be more cost-effective and nonpolluting than alternative technologies. A research team at the Biodesign Swette Center for Environmental Biotechnology has discovered an unorthodox way to break PFAS down — by introducing them to a team of microorganisms that act like PFAS assassins.

After a solid track record of success in the laboratory, it’s time to gear up for future field testing at contaminated sites. The researchers’ next step is to scale up the technology to a larger, real-world configuration and conduct experiments in the lab and then in the field.



Time is of the essence. Data compiled by the Environmental Working Group, a nonprofit advocacy organization, reveals that PFAS lurk in the drinking water of more than 200 million Americans, or more than 60% of the country's population. The compounds may take hundreds or even thousands of years to break down in the environment.

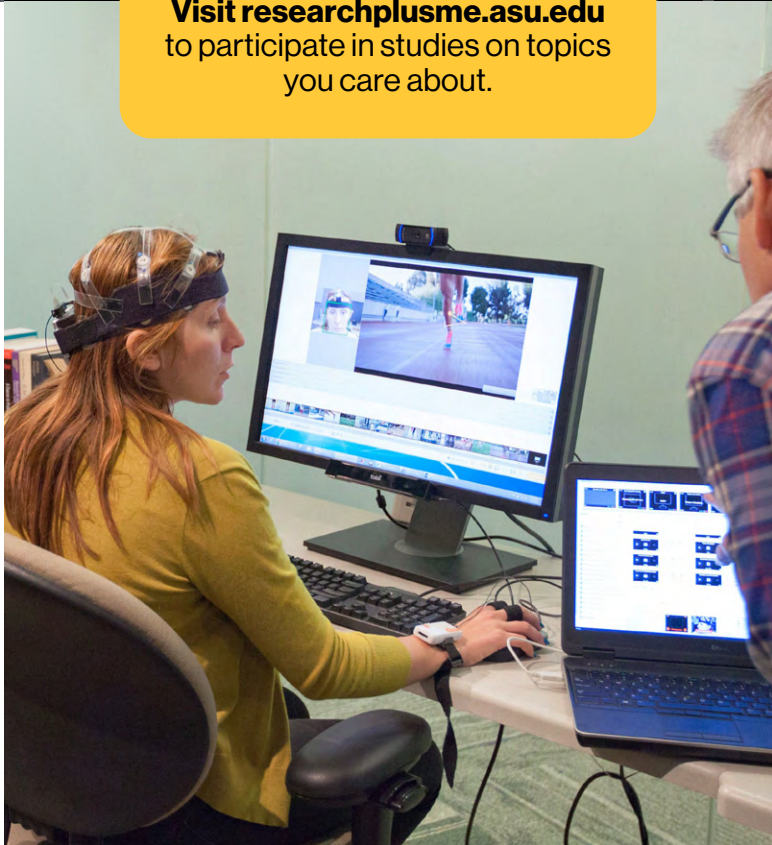
They also linger in the human body. A large number of studies suggest that high levels of certain PFAS in the body may lead to health problems ranging from high cholesterol to pregnancy complications to increased risk of some cancers. Scientists are still learning about the true scope of PFAS-related health effects.

Improving the quality of health research, one study participant at a time

From creating new cancer drugs to developing more effective teaching methods, research plays an important role in improving our lives. But researchers can't do this work alone; many studies depend on members of the community volunteering to participate. Finding those volunteers, however, can be difficult and time-consuming.

Research Plus Me is a new online platform at ASU created to address this challenge. It was designed and developed with support from the ASU and Common Spirit/Dignity Health collaboration. Researchers can post studies that need participants, making it easy for ASU students, alumni, staff and the public to connect with studies on topics they care about. Some of the studies also offer financial compensation to participants.

Visit researchplusme.asu.edu to participate in studies on topics you care about.

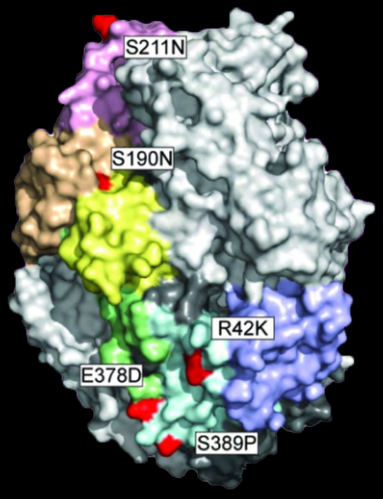


Health research updates

The essential nutrient that may help fight Alzheimer's disease

The vast majority of Americans — 90% to be precise — are deficient in choline, an essential nutrient that's vital for neurological health as well as liver and metabolic function. Could this deficiency play a role in the memory-robbing Alzheimer's disease? A new study by researchers at the ASU-Banner Neurodegenerative Disease Research Center, ASU School of Molecular Sciences, and the Banner Brain and Body Donation Center presents evidence that low levels of choline in the bloodstream are associated with increased severity of Alzheimer's disease pathology in the brain.

The research shows that, compared with healthy individuals, patients with Alzheimer's disease have reduced circulating choline and its derivative, acetylcholine. Levels were lowest in those with the most severe pathology. The research, published in Acta Neuropathologica, offers hope that supplying sufficient choline may help to protect the brain from Alzheimer's disease, or at least delay the onset of symptoms of Alzheimer's and other neurodegenerative diseases.



Staying ahead of dangerous virus mutations

Arizona and the nation faced a "tripledemic" with an upsurge of three viral diseases — influenza, COVID-19 and respiratory syncytial virus (RSV) — in the first four months of 2023. The upsurge posed questions about how viruses can mutate in ways that make it possible to evade vaccines.

In a first-of-its-kind study led by Biodesign Institute researchers, mutations were found in key areas of RSV, which the pathogen may have developed in an effort to evade targeting by vaccines designed to eradicate it. The feat was accomplished by analyzing viral genomic sequences from patient samples collected in Arizona during the 2022-23 season.

The innovative study, published in the journal Emerging Infectious Diseases, underscores the importance of tracking viral evolution to improve vaccine formulations.

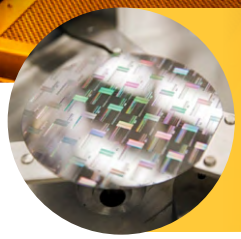
All calories are not created equal

Obesity currently affects four out of 10 Americans, according to data from the Centers for Disease Control and Prevention. Many weight-conscious consumers select their foods based on calorie content alone. But an unprecedented study reveals that contrary to popular belief, not all calories are created equal. ASU and AdventHealth researchers collaborated on the study that appeared in the journal Nature Communications and found that the body reacts differently to calories ingested from high-fiber whole foods versus processed foods.

The findings show that more processed foods, which are rapidly absorbed in the upper gastrointestinal tract, provide more calories to the human body, leaving fewer calories for the gut microbiome. In contrast, high-fiber whole foods make the full journey down the digestive tract to the large intestine, where they nourish the trillions of bacteria that constitute the gut microbiome.

The new data represent a promising step forward in understanding the complex relationship between diet, gut microbes and health, suggesting that adopting a fiber-rich diet could potentially combat obesity, promote metabolic health and improve general well-being.

Recapturing America's technological edge



ASU is a key player in advancing the US semiconductor industry and strengthening national security

Much is at stake as America strives to rebuild its technological leadership: Strengthening national security. Rebuilding supply chains. Unleashing the next generation of innovation. Solidifying America's technological leadership in the 21st century.

In September, the U.S. Department of Defense selected Arizona State University for a Microelectronics Commons regional innovation hub, one of eight nationwide. Each hub will receive funding for the development of advanced new chips for use in electromagnetic warfare, artificial intelligence, 5G and 6G wireless technologies, and quantum computing, among other areas. Microelectronics Commons is a $1.63 billion DOD program funded by the 2022 CHIPS and Science Act.

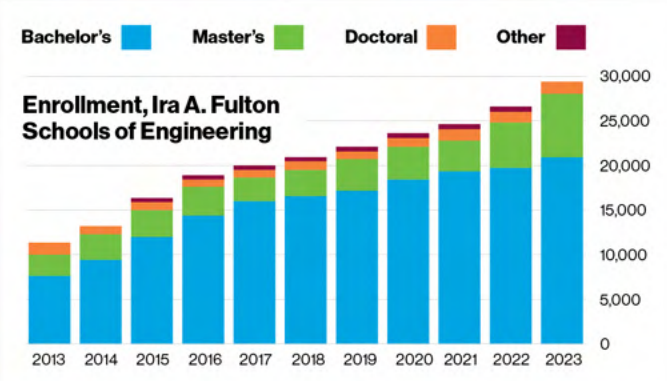
> **"Today [ASU] is a microelectronics Petri dish — a hive of research and development for the semiconductor industry — while also establishing itself as America's leading conveyor belt of engineers. All of this has laid the groundwork for the 'Valley of the Sun' as the beating heart of the country's chipmaking boom."** — Financial Times

While the research will be directed at meeting the needs of the DOD, it is also expected to be useful for commercial applications. One goal is to accelerate what the industry refers to as the "lab-to-fab transition," the process of taking new chip technologies and turning them into viable commercial products.

> **“High-quality universities are one of America’s greatest advantages in the global competition for semiconductor manufacturing, research and development. What Applied Materials and ASU are doing is smart, and the successful implementation of the Materials-to-Fab Center will establish an innovation and job creation engine for the semiconductor ecosystem in Arizona.”**
>
> Arizona Governor **Katie Hobbs**

Jobs and economy

ASU has become America’s biggest supplier of engineers



By the numbers

$40B
TSMC investment in Arizona
in 2021-ongoing

$20B
Intel investment in Arizona
in 2021-ongoing

$70B+
Chip investment in Maricopa County
in 2003-2023

$20B
Chip investment in Onondaga County, NY
in 2003-ongoing

The investment in Maricopa County vastly outsized other tech counties, including Onondaga County, New York; Licking County, Ohio (Columbus); Williamson County and Travis County, Texas (Austin); Utah County, Utah (Provo). Sources: ASU, TSMC, Intel, fDi Markets/Financial Times, investment numbers for counties use company investments that create new jobs or facilities.

Learn more at engineering.asu.edu.

ASU’s regional innovation center is called the Southwest Advanced Prototyping Hub, or SWAP Hub. Industry leaders such as Sandia National Laboratories, Siemens, NXP, Synopsys, NI, Northrop Grumman Mission Systems, Lockheed Martin and Intel are among hub team members at work on four seed funding projects:

- Exploring immersion cooling for three-dimensional integrated circuits.
- Developing reliable and reconfigurable gallium nitride-based radio frequency power amplifiers for advanced communications.
- Establishing built-in monitoring and artificial intelligence hardware running on edge devices.
- Evaluating the scaling of high-frequency and high-power diamond semiconductor devices.

In addition, ASU has formed an alliance with Applied Materials, Inc., the world’s largest provider of semiconductor manufacturing equipment. Together they will create a world-class shared research, development and prototyping facility, the Materials-to-Fab (MTF) Center, in the university’s MacroTechnology Works building at the ASU Research Park. The alliance is supported by the Arizona Commerce Authority.

The center, expected to be operational within two years, is designed to accelerate materials engineering innovations, commercialize academic research and strengthen the pipeline of future semiconductor industry talent. It will bring state-of-the-art semiconductor manufacturing equipment into a collaborative environment for use by industry partners, startups, government entities and academic institutions. The MTF Center will provide students and faculty with opportunities for hands-on learning and research on the same equipment used in leading-edge production fabs.

X-ray excellence

ASU made several big leaps in its quest to transform X-ray science and accelerate discoveries with the compact X-ray free electron laser (CXFEL) project.

In February, the project marked a major milestone for its first phase when scientists generated the first X-rays with the compact X-ray light source (CXLS). This key instrument will help scientists see deeper into matter and living things. With its high-flux beam of hard X-rays, CXLS can map atomic structures and directly track the movement of atoms.

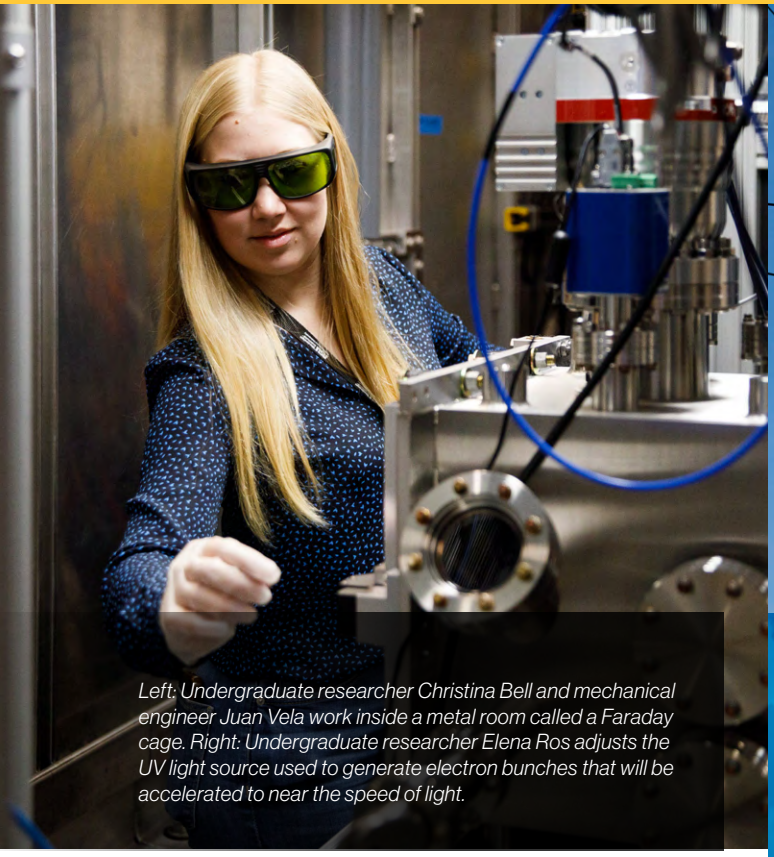
"This marks the beginning of a new era of science with compact accelerator-based X-ray sources," says Robert Kaindl, director of ASU's Compact X-ray Free Electron Laser (CXFEL) Labs at the Biodesign Institute and professor in the Department of Physics.

In March, the National Science Foundation announced a $90.8 million award to ASU that will support a 5-year project to complete the world's first CXFEL. This one-of-a-kind, room-sized X-ray laser instrument will fill a critical need for researchers to explore the intricacies of complex matter at atomic scale and ultrafast time.

The CXFEL will allow scientists to observe molecular processes in detail — processes that are important for advancing research in human health, drug development, renewable energy, quantum technologies and semiconductor manufacturing.

Additionally, the CXFEL will dramatically shrink the size of the technology used by existing large-scale X-ray free-electron laser (XFEL) facilities, making this technology accessible to more research institutions at a fraction of the cost.

"We have entered a new frontier in making scientific discovery more accessible and more affordable. This is one of the most significant ASU research projects to date



Left: Undergraduate researcher Christina Bell and mechanical engineer Juan Vela work inside a metal room called a Faraday cage. Right: Undergraduate researcher Elena Ros adjusts the UV light source used to generate electron bunches that will be accelerated to near the speed of light.

and it is one that will have a positive impact in many critical areas related to the world's grand challenges," says ASU President Michael M. Crow.

Recent science done on a large-scale XFEL hints at the enormous potential of ASU's device. A research team led by ASU revealed the structure of a viral protein that helps the highly transmissible COVID-19 variant, XBB.1.5, evade the body's immune defenses.

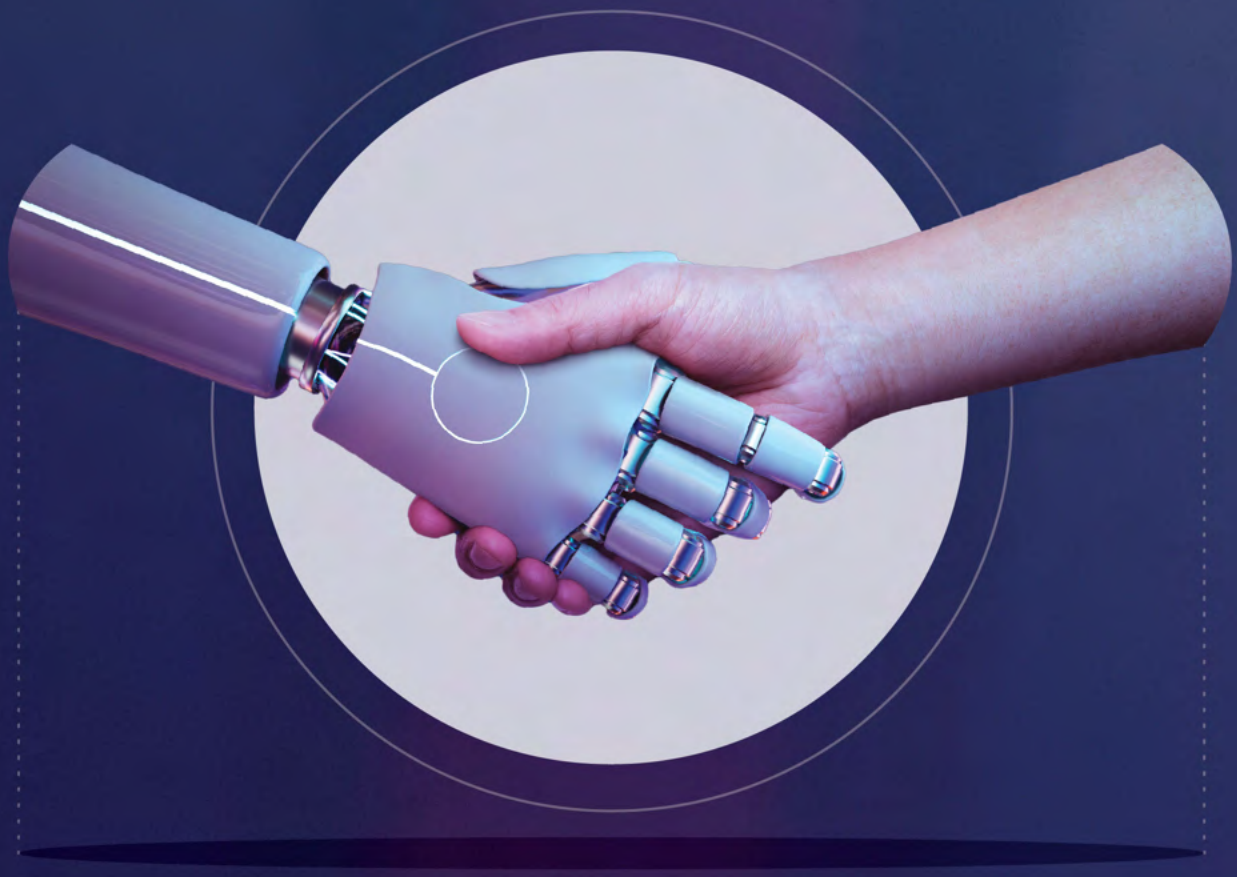
With a technique called serial femtosecond X-ray crystallography, researchers imaged the protein at high resolution in its near-natural, room-temperature state, rather than frozen. Its structure reveals underlying details of the protein's flexibility, dynamics and other features that are crucial in the design of new drugs. Its findings may help advance treatments for SARS CoV-2.

Raytheon to open new facility at SkySong

Raytheon, the world's largest aerospace and defense company, announced it will open a new facility at SkySong, the ASU Scottsdale Innovation Center. The move strengthens its partnership with ASU, which has the largest engineering program in the country, to create a steady pipeline of talent for the future and further many research and development projects.

The new engineering design hub will focus on digital design products that support the rapid growth and demand for the company's defense portfolio, which has been concentrated in southern Arizona.

> **"We've been working for years to expand our presence in the Greater Phoenix area to take advantage of a talent pool that is uniquely qualified to drive this type of innovation. This expansion will also provide greater opportunities to collaborate with other tech companies and suppliers in the region."**
>
> **Wes Kremer,** president of Raytheon



Making trustworthy AI

AI is a growing presence in our lives and has great potential for good — but people working with these systems may have low trust in them. A research team at ASU's Center for Accelerating Operational Efficiency is working to address that concern by testing a tool that could help government and industry identify and develop trustworthy AI technology.

The tool, called the Multisource AI Scorecard Table (MAST), is based on a set of standards originally developed to evaluate the trustworthiness of human-written intelligence reports.

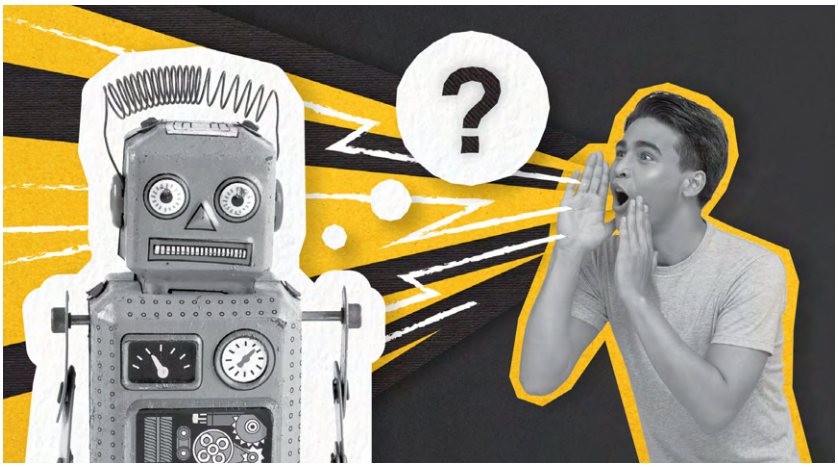
Funded by the U.S. Department of Homeland Security, the research group tested whether MAST effectively measures the trustworthiness of AI systems. To do so, they had volunteer groups of transportation security officers complete tasks with a simulated AI system programmed to score high or low on MAST. Afterward, the officers answered a survey that included questions on how trustworthy they thought the AI was.

If the ASU team is able to show that the MAST tool is useful for assessing AI trustworthiness, it will help in building and buying systems that people can rely on, paving the way for AI's smooth integration into critical sectors, protecting national security and multiplying its power for positive impact.

Creating ChatGPT literacy at a critical time

After reaching more than 100 million active users less than a year after its launch, ChatGPT is the fastest-growing consumer application in history, according to a UBS study.

Growing just as fast is the need for ChatGPT literacy. To use the tool well and to understand its outputs correctly, people must know how it works and which tasks it does well (or not).

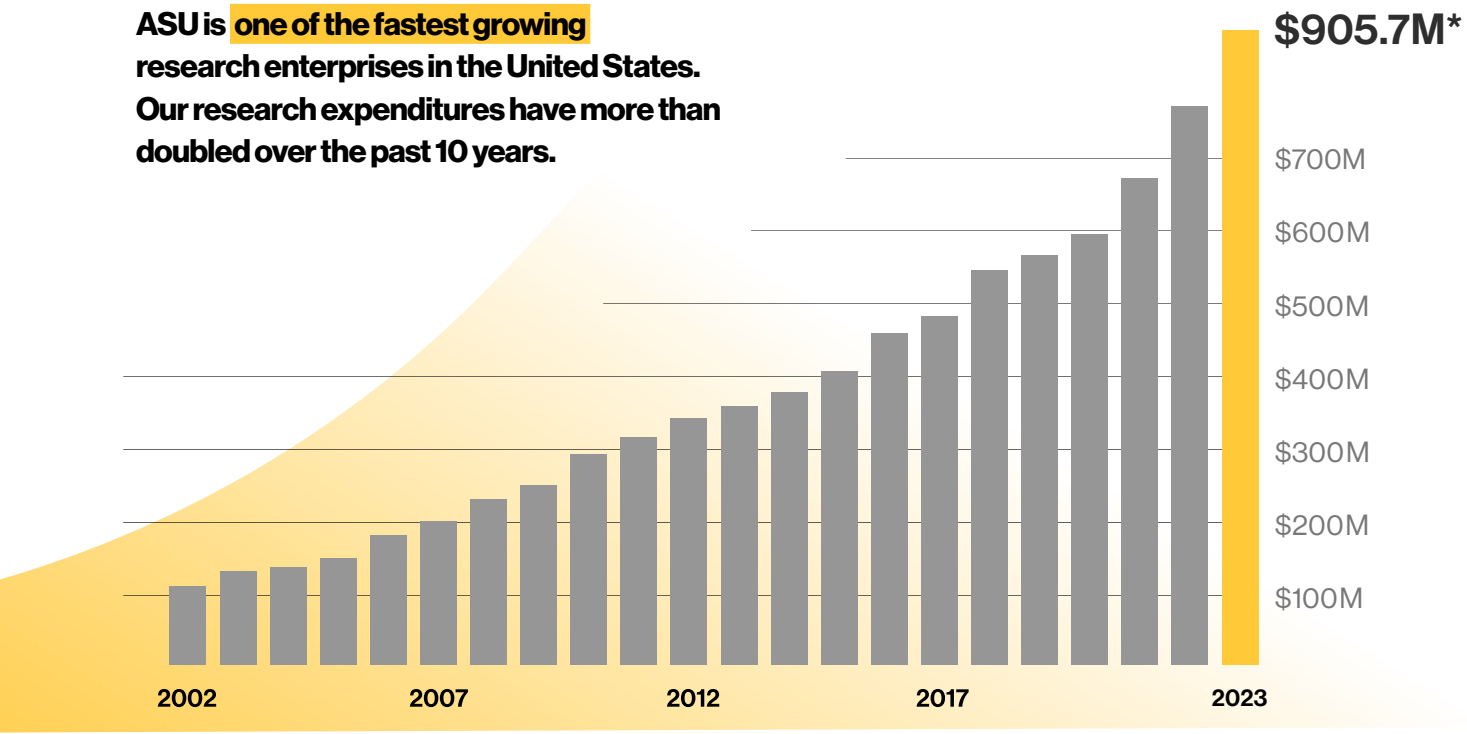


Andrew Maynard, a professor in ASU's School for the Future of Innovation in Society, studies how society can successfully transition to a future in which transformative technologies change our lives. To help people get better results from chatbots, Maynard is teaching a new ASU Online course called Basic Prompt Engineering with ChatGPT: Introduction. The course is open to students in any major and, despite its name, is not really about engineering. Maynard says it is like driver's ed for ChatGPT users.

"Having a car is great, but having people driving them without knowing the rules of the road or basic driving skills doesn't lead to safe roads," he says. "It's the same with ChatGPT. The more people understand how to use it in safe and responsible ways, the more likely we'll see the benefits of it."

Leading the nation
in research and innovation

ASU is one of the fastest growing research enterprises in the United States. Our research expenditures have more than doubled over the past 10 years.



*Pending acceptance from the National Science Foundation

Rankings by research expenditures

Source: National Science Foundation HERD Survey **2022**

#1 **Transdisciplinary research**, ahead of Johns Hopkins, Northwestern and the University of Pittsburgh

#1 **Anthropology**, ahead of Harvard, Duke and the University of Michigan

#2 **Business management and business administration**, ahead of the University of Chicago, Duke and Columbia

#2 **Education**, ahead of UCLA, Michigan State University and University of Oregon

#3 **Geological and earth sciences**, ahead of MIT, Penn State and Virginia Tech

#3 **Social sciences**, ahead of Cornell, UCLA and University of North Carolina at Chapel Hill

ASU innovations 2023

In fiscal year 2023, ASU innovators working with Skysong Innovations* generated:

315
invention disclosures

160
U.S. patents

21
new startup companies

* Skysong Innovations is ASU's exclusive intellectual property management company.

Repeatedly ranked

#1

innovation
ASU ahead of MIT and Stanford
— U.S. News & World Report, 2016–24

sustainability
ASU ahead of Stanford and UC Berkeley
— Sustainability Tracking, Assessment & Rating System, 2023

global impact
ASU ahead of MIT and Penn State
— Times Higher Education, 2020–23

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

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

#6 **Civil engineering**, ahead of Duke, University of Illinois at Urbana-Champaign and Clemson

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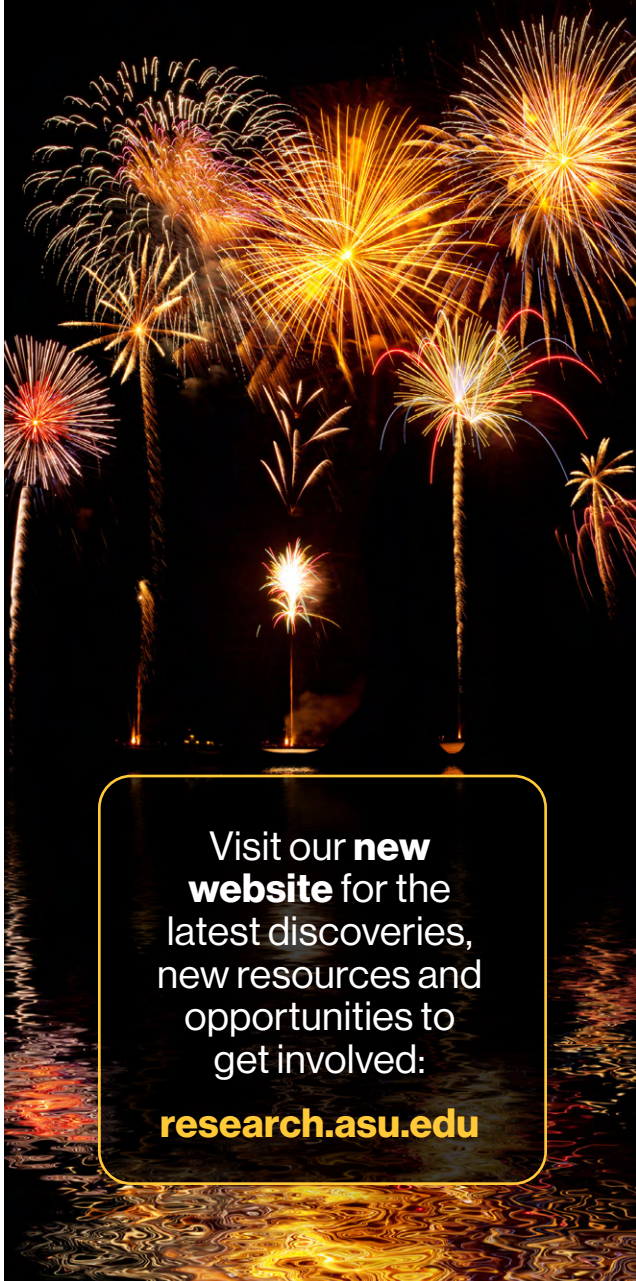
Arizona State University

new year

new look



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