

ASU

ARIZONA STATE UNIVERSITY
VOLUME 23 NUMBER 1

Thrive

Innovation review

Highlights of innovative breakthroughs leading up to a fifth year ranked No. 1 in the U.S.

Engineer a solution

Research and big thinking on how AI will impact the future of work in Arizona and beyond

A bright idea

Jesse Senko's pioneering work with solar lights protects sea turtles and transforms the future of fishing



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Alex Stuckey

A Pulitzer Prize-winning journalist, she covers NASA for the Houston Chronicle.

Innovation mindset

Imagine all the things that you wish were different. Imagine big problems. Imagine that you know someone with a medical issue that needs to be resolved. Imagine that we had better outcomes in our K–12 education enterprise. Imagine the people you know who have not achieved their full potential could be empowered to do it. Every one of these things will be a product of constant innovation – the forces of creation, the moving out of old, the moving in of new, adaptation to new ways of doing everything. This is the innovative mindset in action.

We have built and continue to build an environment where innovations are the product of everything we are doing. All of our interactions, the people we are talking to, the people we are learning with, the communities we are working with – are all driven by innovation on every level. It is in each of us. When this is in action, then we see more resolution, more solution, more forward progress, more individual attainment, more fulfillment than without it.

This fall we received the No. 1 innovation ranking from U.S. News & World Report for the fifth year in a row. The ranking doesn't point to one specific achievement of the university – it points to the sum of our efforts. It points to the tremendous energy that we've been able to create among faculty, staff, students and alumni that is unlocking new value for Arizona locally and around the world.

In this magazine, you will find the members of our community creating innovation at new intersections of big ideas. And stories of access multiplied by inclusion are woven throughout as they are woven throughout ASU, making all our efforts stronger.

Thank you for all you do in creating and sustaining the culture of innovation in Arizona.

Michael M. Crow

President, Arizona State University
asuthrive@asu.edu

Innovation
starts with you

ASU

Go

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JAROD OPPERMAN; ERIKA GRONEK



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alumni.asu.edu/linkedin
linkedin.com/school/arizona-state-university



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instagram.com/asu_alumni
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Explore the world

Cady Coleman: We are the crew of Spaceship Earth, writes ASU's Global Explorer in Residence. 44

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Jesse Senko, right, and Juan Pablo Cuevas untangle a fishing challenge.



Lindy Elkins-Tanton leads the NASA-funded Psyche mission to explore the building blocks of planet formation.

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Lindy Elkins-Tanton and the Interplanetary Initiative reach for the stars to shape our place in space. 54

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Sun Devil student-athletes balance the rigor of sport with the challenges of Barrett, The Honors College. 63



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Jan.

Sun Devil hoops

Watch the Sun Devil Men's and Women's Basketball teams drive for another showing in the NCAA brackets!

Now through March, Desert Financial Arena, Tempe campus

TheSunDevils.com

Ticketed **Family**



Sustainability Solutions Festival

Take part in a series of events for audiences of all ages and backgrounds, from students to business leaders. This year's theme is focused on the question: "How can we individually and collectively reimagine our lives and our planet?" Events feature business development conferences, community gatherings, film screenings and additional opportunities.

Feb. 1–22, Valley-wide

sustainability.asu.edu/sustainabilitysolutions/events/rsvp/solutions-festival-2020

Free **Ticketed** **Family**



Open Door

Whether you're a thrill-seeker, lifelong learner, science guru, art enthusiast or adventure chaser, you will find a unique experience at each of ASU's four metro-Phoenix campuses, and you are invited to visit them all during ASU Open Door.

Events include hundreds of interactive, hands-on activities and opportunities to visit with ASU students, faculty and staff. This signature event of the Arizona SciTech Festival offers you and your family the chance to discover all things science, technology, engineering, arts and math.

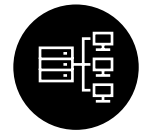
Saturday, Feb. 1, 1–5 p.m., West campus

Saturday, Feb. 22, 1–5 p.m., Tempe campus

Saturday, Feb. 8, 1–5 p.m., Downtown Phoenix campus

Saturday, Feb. 29, 1–5 p.m., Polytechnic campus

opendoor.asu.edu **Free** **Ticketed** **Family**



Cybersecurity challenge

Talented minds from high schools and colleges in Arizona will address challenging, real-world problems that face today's cyber professionals, digital forensics scientists, and network/security/system engineers. Students of all ages are welcome to attend.

Saturday, Feb. 22, 8 a.m.–5 p.m., La Sala ballrooms, West campus newcollege.asu.edu/cybersecurity/challenge

Free **Family**

Mar



Ceramic Studio Tour

Travel the Valley and enjoy the art of local artists during the 19th Annual Ceramic Studio Tour. This event showcases the work of professional artists offering the public a rare opportunity to view working spaces of participating artists. Some work will be available for sale.

Feb. 22–23, 10 a.m.–5 p.m. self-guided tour

asuartmuseum.asu.edu/programs-and-events/ceramics-programs/ceramics-studio-tour

Free Family



Nicholas Bernard and other Valley artists will host studio tours.

Find your fit: an in-depth tour of each metro Phoenix ASU campus

As part of Sun Devil Day events, join your guides for an experience on each of the four metro Phoenix campuses. In these half-day events, prospective students tour campus buildings while meeting college representatives and ASU students.

Tours in March and April
visit.asu.edu/sundeilday

Free Family

Broadway show and Tony-Award winner 'Once on This Island'

In the sweeping, universal tale of Ti Moune, a fearless peasant girl in search of her place in the world, she is guided by the mighty island gods as she sets out on a remarkable journey to reunite with the man who has captured her heart. The groundbreaking vision of the two-time Tony Award-nominated director, acclaimed choreographer and Tony Award-winning songwriters, "Once on This Island" is a timeless testament to theater's unlimited possibilities.

March 3–8, ASU Gammage Auditorium, Tempe campus

asugammage.com

Ticketed Family

A day for Devil donations

Join ASU's annual day of giving during which faculty, staff, students, parents, alumni, donors and ASU supporters have the opportunity to give to a particular cause through ASU. Your tax-deductible donations may be made to specific colleges, programs or initiatives.

Thursday, March 19

givingday.asu.edu

Donation



Sun Devil GIVING DAY

What does it mean to eat in our time?

Artists, scientists, innovators, activists, farmers and cooks of all skills are invited to join in producing interactive art-works, exhibits and performances that playfully explore what it means to eat in a time of environmental and social change.

Saturday, March 21, 4–10 p.m., Mesa Arts Center

emerge.asu.edu

Free Family



Bring a friend and your appetite for experimentation to the Emerge event on what it means to eat.



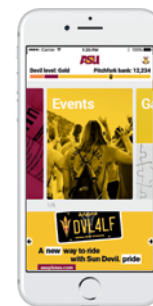
Adventures in Earth and space

Explore and interact with intriguing science exhibits, immerse yourself in outer space with 3D planetarium shows, check out a full-scale replica of the Curiosity Rover currently on Mars and more.

Friday, March 27, 6:30–9:30 p.m., Interdisciplinary Science and Technology Building IV (ISTB4), Tempe campus

sese.asu.edu/events

Free Family



Check in at events to earn Pitchforks and rewards!

Log in to the Sun Devil Rewards app for ASU event listings, news, games and more. Earn and be rewarded!
sundeilrewards.asu.edu

Visit asuevents.asu.edu for events at ASU.

Athletics event and ticket information at TheSunDevils.com



Aaron Pool, '09 BS, founder of Gadzooks Enchiladas & Soup, is a three-time Sun Devil 100 winner and Pool Family Endowment sponsor.



Career



Bringing innovation directly to you

Fast Company and ASU have partnered to bring some of the world's most innovative visionaries together with alumni for thought-provoking live storytelling. Now we're bringing the learning resources directly to you. Check out alumni.asu.edu/cpe/innovation-you or subscribe to our YouTube channel at youtube.com/ASU

Free **Networking**

Community

Honoring high-performing alumni businesses

The annual Sun Devil 100 celebrates the business achievements of ASU alumni around the world. The ASU Alumni Association selects leaders who demonstrate innovation, growth and entrepreneurial spirit. Honorees are invited to campus to be recognized, to connect with each other, to meet ASU leaders and interact with aspiring student entrepreneurs.

Wednesday, April 29, 11:30 a.m.,
Memorial Union, Tempe campus
alumni.asu.edu/events/sun-devil-100

Ticketed



Events for budding and established entrepreneurs

From conferences to competitions, whether you are a small-business owner or simply curious about entrepreneurship, events in the ASU community of business builders are a great way to grow your network and get plugged in.

entrepreneurship.asu.edu/events

Free **Networking**



Volunteer, Devils

ASU Alumni chapters nationwide gather in the spring to participate in family friendly volunteer activities, from building homes to feeding the hungry. Sun Devils support their local communities!

See March and April listings for ASU Cares events in your area at alumni.asu.edu/volunteer/asu-cares

Networking **Family**



Career fair for students and alumni

The spring career fair is the largest recruiting event at ASU and is open to students and alumni of all majors and degree levels. More than 150 employers from a variety of industries will be on-site to meet with you.

Feb. 25 and 26, 1–4 p.m., ASU Memorial Union, second floor, Tempe campus
links.asu.edu/asucareerfair

Free Networking
Job search

Career services for life

All ASU alumni have lifetime access to ASU career fairs, webinars, networking and other career development events. ASU is here to help you chart your career path.

alumni.asu.edu/services/alumni-career-and-professional-development-services

Free Networking Job search

Chapters

Get involved in the US and worldwide

Join an alumni chapter in your area or one based on your special interest or college. Attend events and meetups to catch up with friends and make new connections.

alumni.asu.edu/chapters

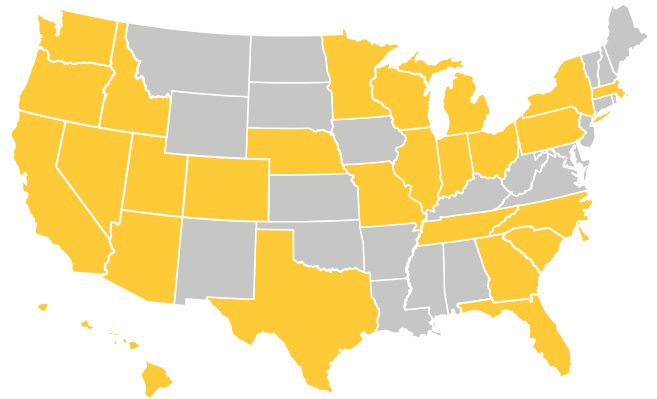
Networking

Linking together

When Sun Devils connect and help one another, great things can happen. Join the official ASU Alumni group on LinkedIn and search the ASU alumni network for local connections in your area. Find the latest employment opportunities and find out what other ASU alumni are doing.

alumni.asu.edu/linkedin

Networking



Alumni chapters

Tillman Honor Runs in your area

Join in the planning for this year's Pat Tillman Honor Runs, honoring his legacy of service and hosted coast-to-coast by ASU alumni chapters nationwide. Find out how to get involved at alumni.asu.edu/events/tillman-honor-runs

Family

Stay in touch

Update your info to stay in the know with exclusive invites to special events and more.

alumni.asu.edu/update

Entertainment career fair in Los Angeles

Employers from throughout the entertainment industry with open career and internship positions will be on-site to meet with you. Past participating companies include Lionsgate, PXL Agency, CBS, NSQ, Buchwald, Paradigm Talent Entertainment, Bob Industries, Cedar Shore Productions, and The Hideaway Entertainment. The event is open to current students and alumni.

Friday, Feb. 7, 1–4 p.m. PT, The Culver Hotel, Gallery Room, Culver City, CA
filmspark.asu.edu/careerfair

Free Networking
Job search

Recruit-a-Devil today

Highly qualified ASU students and alumni are prepared to grow your business and build your workforce as team members. Through ASU Career and Professional Development Services, you can post jobs and internships, attend career fairs, connect with prospects and more.

career.asu.edu/employers

Free Job search

**MARS ON THE MALL****Washington visitors walk the red planet**

Tourists at the National Mall in Washington, D.C., experienced a unique look at Mars — the world's largest map of its surface. A combination of 24,000 individual images taken by the Thermal Emission Imaging System camera on NASA's Mars Odyssey orbiter, it provided "a more physical experience," says Jonathon Hill, project lead and Mars scientist at ASU's School of Earth and Space Exploration. "We wanted to show people the map's incredible detail."

Update in the news



The Worleys — Paul, baby Scarlett, Elise, toddler Emmaline — and Christine Attardo, from left, plant their feet on Mars. ASU unfurled the world's largest map of the red planet's surface at the National Mall in Washington, D.C., in October.

Dream deal to earn degree

ASU-Uber partnership expands education opportunities.

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Public service with a crown

Alum wins Miss Navajo Nation 2019.

11

A solution to Gulf War illness

ASU researchers find FDA-approved antiviral drugs offer effective treatment.

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Visions of many futures

A new science fiction anthology takes the cutting-edge science of now — tech like robotics, gene editing and space colonization — to surprising places.

In “Future Tense Fiction: Stories of Tomorrow,” a disease surveillance robot’s social programming gets put to the test. In a futuristic sport, all the athletes have been chemically and physically enhanced.

“Future Tense Fiction” — a partnership of ASU, the online magazine Slate and the think tank New America — commissioned the series of stories from leading writers who imagined what life might be like in a variety of possible futures.

Find it wherever books are sold.



Dream deal to earn degree

After high school, Shannon Rozas put her education on hold to raise a family of three with her husband of 27 years, Daryn.

Today she is back in school thanks to a partnership between ASU and Uber, where Daryn drives, extending fully funded undergraduate degree opportunities to eligible family members through ASU Online. That allows Shannon to pursue a degree in liberal studies tuition-free, and earning a degree will boost her chances of different employment opportunities.

“Not having a degree put me at a disadvantage,” she says. “All these years it has been on my mind to finish my degree, and I couldn’t believe that this opportunity would be possible because of ASU and Uber.”

“I want to be a good role model for my kids and show them that it is never too late to pursue your dreams.” — CARRIE PETERSON

“I couldn’t believe this opportunity would be possible because of ASU and Uber.”

— SHANNON ROZAS ON PURSUING A DEGREE IN LIBERAL STUDIES

Building strength on a vegetarian diet



Mung bean protein supplements improved strength among underactive vegetarians.

Vegetarian diets generally protect against chronic disease, but there is one aspect to be aware of: the possibility of nutrient deficiency. It is much harder for humans to absorb protein from plant-based sources, often making protein supplementation a priority. College of Health Solutions professors Carol Johnston and Chris Wharton examined the relationship between protein intake, strength and lean body mass in 37 underactive

vegetarians. For eight weeks, a small subgroup was given a mung bean protein supplement. At the end of the trial, researchers found improved strength among those who took the supplement compared with measures of their strength taken before the trial.

Mung beans were chosen because they tend to have higher amounts of protein than other plants, and they can be raised sustainably.



Urban agriculture’s power

A group of researchers led by ASU assessed how urban agriculture can help Phoenix meet its sustainability goals.

“Our analysis found that if Phoenix used only about 5% of its urban spaces — 2% of its land, and about 10% of its building surfaces — for urban agriculture, the city could meet its sustainability goals concerning local food systems,” says Matei Georgescu, associate professor in the School of Geographical Sciences and Urban Planning and co-author of the study.

The study estimates that nearly 28 square miles are available for urban agriculture in Phoenix. This can supply the city with nearly 183,000 tons of fresh produce per year, meaning that the city’s output could meet 90% of the current annual fresh produce consumed by Phoenicians.



Devil Clefs’ Billie Eilish mashup hits viral high note

The ASU a cappella group Devil Clefs went viral in November after the 18-member group posted a video singing a mashup of “idontwannabeyouanymore” and “when the party’s over” by Billie Eilish on TikTok, a short-form mobile video platform. Recorded in a stairwell in ASU’s Music Building in Tempe, the video garnered more than 1.9 million likes and 6 million views on social media. “It just blew up out of nowhere,” says sophomore fashion student Milena Santiago, who wrote the mashup arrangement.



Google chooses Cronkite School project in innovation challenge

The Walter Cronkite School of Journalism and Mass Communication at ASU is a recipient of Google News Initiative’s first North America Innovation Challenge, a program that funds innovative projects that focus on increasing audience engagement in local newsrooms.

Cronkite will develop an Interactive Story Wall that will be used by Cronkite News broadcasters as a tool to tell data-driven stories through visualizations.

Keep up with the headlines at ASU

by subscribing to the ASU Now e-newsletter at asunow.asu.edu/subscribe.



Public service with a crown

Becoming Miss Navajo Nation 2019 was no easy feat. Over five days, alum Shaandiin Parrish’s traditional knowledge was put to the test with a series of rigorous competitions focused on Navajo language, culture and practices.

“As the titleholder, you are responsible for visiting communities in our tribal lands in Arizona, New Mexico, Colorado and Utah, making sure people feel like their concerns are being heard and they matter,” she says.

Winners spend a year visiting more than 27,000 square miles of tribal land. Because the Office of Miss Navajo Nation is a branch of the tribal government, the titleholder also serves as a goodwill ambassador, promoting community health, economic development and other initiatives.

DESIGNED TO SUSTAIN

Entrepreneurs combine food and sustainability

Prepped, a free, early-stage food business accelerator program designed for ventures owned by women and underrepresented minorities, has added sustainability to its mix. The program is geared toward owners of emerging food businesses that are beyond the idea stage and seeking the tools to scale. Now, in addition to the already established curriculum that includes food costing and financial literacy, small business marketing and communication strategies, and permits and licensing, participants of Prepped are learning green business operations so that sustainability is built into their companies from the start.

Sana Sana Foods owner Maria Parra Cano talks with a customer about her plant-based ancestral foods. At the Prepped Showcase, she won the grand prize of \$5,000 to support her business' growth.

A solution to Gulf War illness

A team of scientists, including ASU virologist Efreim Lim, has shown that adjusting GI tract viruses by repurposing existing FDA-approved antiviral drugs offers a route for effective treatment for Gulf War illness and its symptoms.

In the 29 years since Desert Storm, the illness has plagued more than 200,000 Persian Gulf veterans with a variety of symptoms. Existing treatments have been unreliable. By utilizing existing antiviral drugs for treatment, clinicians can begin testing these FDA-approved medications in patient cohorts at an accelerated pace compared to the lengthy timeline associated with traditional trials.



Barrett named Air Force secretary

Three-time ASU alum Barbara Barrett's impressive list of accomplishments grew in mid-October when the U.S. Senate confirmed her as the next secretary of the Air Force.

"I can think of no position that offers more excitement, challenge and meaning than the secretary of the Air Force," Barrett said in an Air Force news release. "Our Air Force is the best in the world because of extraordinary airmen and civilians with whom I am now proud to serve."

Barrett earned bachelor's, master's and law degrees at ASU, becoming the first woman to run for governor in Arizona and the first civilian woman to land in an F/A-18 Hornet on an aircraft carrier. Her distinguished career included a stint as U.S. ambassador to Finland.



ASU Law again No. 1 in state for bar passage

For the seventh consecutive year, the Sandra Day O'Connor College of Law received the highest overall bar passage rate in Arizona for the calendar year, according to the July 2019 results released Oct. 25.

Results of the Arizona Bar Exam show ASU Law first-time test takers had an 88% passage rate, which is up 9% from last year. This is well above the state's overall first-time taker passage rate of 78% and more than 20% higher than the next highest bar passage score in Arizona.

88%

ASU Law first-time test takers' bar passage rate, above the state average



PBS NewsHour West debuts

PBS NewsHour West, the new bureau and West Coast feed of "PBS NewsHour," hit the air for the first time in October from inside the Cronkite School.

PBS NewsHour West is housed at the Walter Cronkite School of Journalism and Mass Communication under a new partnership with ASU. In addition to producing news stories based in the Western U.S., the Phoenix-based team will update the "PBS NewsHour" Eastern time zone broadcasts for West Coast audiences.

Made possible with the generous support of the Corporation for Public Broadcasting, PBS NewsHour West allows the "NewsHour" nightly broadcast to better serve audiences in the West and online, and to continue its expansion into a 24/7 news operation.

1 in 4 Arizona suicides are related to domestic violence

One in four suicides in Arizona is related to violence involving an intimate partner, according to a new report from ASU's Center for Violence Prevention and Community Safety.

The report is a compilation of statistics taken from the examination of 5,711 violent deaths in Arizona between 2015 and 2017. Researchers found that 3,678 of those deaths were determined to be suicides, says Professor Charles Katz, with 25.6% of those involving "intimate partner violence."

Seize the day with \$20K

ASU® graduates have invested in themselves, and MidFirst Bank continues to find new ways to invest in ASU®. This year, we are providing a new opportunity for the December 2019 and May 2020 graduating classes.

One graduating senior will be awarded \$20,000
to help launch the next phase of their life. One swipe of an ASU® Debit Card
is all it takes to win, and every swipe is another entry.*

For more details, visit midfirst.com/asu20k.



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*Sweepstakes: Terms and conditions apply. Visit midfirst.com/asu20k for official rules. Member FDIC.



Advance your career

LASER FOCUS

A first-of-its-kind instrument provided a one-of-a-kind experience for five ASU students working on the Compact X-ray Free Electron Laser (CXFEL) through internships made possible by Bill and Susan Levine. "We were able to get a skill set that you really don't see in a lot of interns or college students," says engineering student Brett Liebich. When completed, the CXFEL could advance discoveries in drug development, sustainable energy and more.

Alex Gardeck, a mechanical engineering student, examines the precision thermal trim unit that uses water to cool components in the R/F room of the Beus CXFEL Laboratory beneath Biodesign Institute Building C.

That is the question


Jaime Casap asks: What problem do you want to solve?

16

Working with tech

How to succeed by cultivating adaptability.

20



Environmental issues may be your passion and a world powered by clean energy may be one of the ways you imagine a solution. Focusing your strengths, passions and interests on solving your chosen problem can lead you on a path to make a real difference and find a satisfying career along the way.

What problem do you want to solve?

“Don’t worry about what you want to be when you grow up. Spend time thinking about the problem you want to solve and then utilize everything you’ve got to take on that problem and change the world!”

— JAIME CASAP,
CHIEF EDUCATION
EVANGELIST AT GOOGLE

That is the question to consider when pondering your future

Story by JAIME CASAP, '93 MPA

“So kid, what do you want to be when you grow up?”

The question has been passed down from the beginning of time.

When I think about that, I imagine a 10 year old in the 1700s brimming with pride and answering, “I’m going to be the best wheelwright in the world!” (Look it up.)

While this question helped us think about our future, it is no longer useful or relevant. We are at the beginning of the digitalization economy, and we can’t even imagine the type of work that will require. Change happens gradually and then suddenly, and you, my friend, are living in “suddenly” times. The jobs of the future do not exist today. Digitalization is also causing jobs to shift and change like never before. All roles will be impacted by automation, robotics and digitalization.

So I have three better questions for you to answer.



Jaime Casap, '93 MPA in public administration, is the chief education evangelist at Google. He evangelizes the potential of digitalization as an enabling capability in pursuit of promoting inquiry based learning models. He collaborates with school systems, educational organizations and leaders focused on building innovation into our education policies and practices. Subscribe to his YouTube channel at [youtube.com/jaimecasap](https://www.youtube.com/jaimecasap).



1. What problem do you want to solve?

What is the problem you want to take on? It doesn't have to be a social problem like climate change, for example, it can be any problem. If you don't know, that's OK. Start the process of thinking about it. Search deep enough and you will discover patterns about what motivates you or what gets you excited.

2. How do you want to solve that problem?

There are a million ways to undertake a problem, so how do you want to use your gifts and your talents? If you tell someone you want to solve climate change, for example, they might suggest becoming a scientist or policymaker. However, that may not be where your talents are. Maybe you are a remarkable photographer and the way you solve climate change is by documenting its impact on human life.

3. What do you need to know to solve that problem?

What are the knowledge, skills and abilities you need to take on a problem like climate change? What do you need to learn? You could study biology, photography and

sustainability. When you do this, you can see the type of classes you should be taking. And even if you already have a degree, you can see the classes you need to keep taking because we live in a time where lifelong learning is essential!

These three questions line up nicely with what my Twitter friend Daniel Pink wrote in his book "Drive" regarding what motivates all human beings. It's the same three things — Purpose, Autonomy and Mastery. What problem do you want to solve (purpose)? How do you want to solve it (autonomy)? What do you need to learn to solve that problem (mastery)?

One of the many reasons why I love Arizona State University is its focus on solving the world's problems. Its size, scale, programs, areas of research, areas of study and partnerships tackle almost any problem you define. If you bring an issue to ASU, you can connect with a person who can help.

So don't worry about what you want to be when you grow up. Spend time thinking about the problem you want to solve and then utilize everything you've got to take on that problem and change the world! ■



The psychology of workplace satisfaction

When something boosts your mood, your brain releases neurotransmitters like serotonin, dopamine and oxytocin. Studies have shown the simple act of smiling can release some of those chemicals — and the feeling is contagious.

Smile to a room full of coworkers, for example, and others will likely do the same. That's an easy way to help create a happier workplace.

ASU alum Melanie Katzman '82 and '85, shares research-based, actionable things you can do to improve your success and joy at work in her new book, "Connect First: 52 Simple Ways to Ignite Success, Meaning, and Joy at Work." She maintains a clinical psychology practice and consults on workplace diversity and leadership with some of the largest organizations in the world.

Welcome to a new paradigm in retirement living.

Mirabella at ASU is an unparalleled blend of resort-like living with a thriving, intergenerational adventure. Experience a retirement lifestyle filled with continued-learning opportunities, as well as the wealth of Sun Devil sports, arts, and cultural outlets campus life provides. All while enjoying some of the largest view homes in the valley and the finest amenities right outside your door.

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ASU

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Mirabella at ASU is a nonprofit, resident-centered community developed in partnership with Pacific Retirement Services and Arizona State University. Equal housing opportunity. Apartment homes are unfurnished.



Opening
Fall 2020

ASU Universal Learning™ made possible by you

When retirees Laura and Herb Roskind audited classes in ASU's Institute for Human Origins, they had no idea the experience would inspire their passion and philanthropy. But through a charitable gift annuity, Laura and Herb have created — and benefited from — academic opportunities for students and faculty.

We don't always see our generous donors, but you're always in the picture.

ASU
Arizona State
University

CAMPAIGN ASU 2020

Together, our potential is limitless
asufoundation.org



How to succeed by
cultivating adaptability
for the future of work

Story by SETHURAMAN
PANCHANATHAN

Adapt



Sethuraman Panchanathan is ASU's chief research and innovation officer. "Panch" leads the Knowledge Enterprise which advances research, innovation, strategic partnerships, entrepreneurship and international development at ASU. His research is in human-centered multimedia computing, haptic user interfaces, person-centered tools and ubiquitous computing technologies.

All jobs require critical thinking skills that allow us to assess situations, projects and directives, make informed judgments, and pivot as necessary when changing circumstances and priorities dictate. In today's workplace climate, the term adaptability takes on new meaning. Jobs and career paths are in a state of flux. This presents opportunities for dynamic growth and advancement, particularly if you can demonstrate to a current or potential employer your understanding of this changing paradigm. As an advisor to the

White House American AI and Industries of the Future initiatives, I am innately aware of the nation's perception of the advancement of automation and its potential impact on the ways we live, learn and work. With the recent, rapid advances in technology and artificial intelligence (AI), we're all looking for ways to position ourselves to be successful in the future of work. I encourage an attitude of optimism, as we collectively embrace a world in which machines

and humans work together to accomplish things neither could do alone. It's imperative that as lifelong learners, we continually strive to adapt to evolving workplace dynamics in the following ways:

Develop and employ an entrepreneurial mindset. This doesn't always mean you have to launch your own business, but rather, it's a matter of finding ways to innovate, to grow, take calculated risks, and expand and excel in your profession.



ability

Be aware of factors that stand to change the fundamentals of the way you work. Is automation playing an increasing role in how your company operates? Are new hires expected to have particular skill sets that you don't have? Pay attention to what's coming through the pipeline and be proactive in adapting as necessary to ensure you remain relevant.

Be enthusiastically prepared to evolve with your company. This could mean requesting mentoring to come quickly

up to speed on institutional knowledge, cross-training to learn the needs and operations of other departments, or upskilling and reskilling as necessary to advance and thrive in your company.

Expect and embrace change and prepare accordingly. Develop not only your professional abilities, but other skills, like critical thinking, empathy and creativity. Being well-versed and well-rounded in your mindsets will ensure you are

an asset to your employer (or employers) throughout the course of your career. As the future of work continues to evolve, corporations will be drawn to lifelong master learners who possess an innovative, creative mindset. As such, being adaptable in today's workplace includes recognizing and accepting that change is continuous. Choose to go with changing the tide rather than fight against it. ■

“Jobs and career paths are in a state of flux. This presents opportunities for dynamic growth and advancement, particularly if you can demonstrate ... your understanding of this changing paradigm.”

— SETHURAMAN
PANCHANATHAN

FIVE YEARS OF INNOVATION

ASU celebrates five consecutive years as the No. 1 school for innovation, according to U.S. News & World Report's annual comparison of more than 1,500 U.S. institutions. So what makes ASU No. 1? "Innovation means saying yes," says ASU President Michael M. Crow, "and that's always what we strive to do."

The Crater Carpet, an interdisciplinary meeting place at the School of Earth and Space Exploration.


ASU sponsors the First Lego League, an innovative global robotics program designed for children 9-14.

The School of Arts, Media and Engineering specializes in emerging computational media technologies.



Review of innovation

Yuval Mazor's lab at the Biodesign Institute studies structural biology related to photosynthesis.



ASU's McCord Hall is home to high-caliber master's degree programs within the W. P. Carey School of Business in Tempe.

Innovation and year in review
Milestones and highlights from five years of innovation and 2019.
24

Building innovation culture
Inside five years of No. 1 in innovation.
30

2015 - 2018

Innovation review

Milestones

Highlights of ASU innovation stories that made headlines

2015

SCIENCE MAGAZINE • March 4

Fossil pushes back human origins 400,000 years

ASU graduate student Chalachew Seyoum changed evolutionary science when he discovered the 2.8-million-year-old jawbone at the Ledi-Geraru site in Ethiopia. The fossil predated other Homo fossils by 400,000 years. In 2019, ASU investigations at the Ledi-Geraru and nearby sites are producing insights into the patterns of behavior in our earliest ancestors — including the earliest evidence of making and using stone knives.



POPULAR SCIENCE • Sept. 23

Brilliant 10: Arianne Cease prevents biblical plagues with modern data

Professor Arianne Cease was recognized for her investigation into what transforms harmless individual locusts into ravenous swarms that threaten the livelihoods of one in 10 people on Earth. She won a half-million-dollar grant from the Office of U.S. Foreign Disaster Assistance to launch a pilot study using soil amendments to keep locust numbers low across a broad area in Senegal.

FORBES • Oct. 24

Did Starbucks just create the most epic \$250 million recruiting tool ever?

The first-of-its-kind ASU Starbucks College Achievement Plan was expanded to offer 100% tuition coverage for every eligible U.S. Starbucks employee. The program has expanded employees in the UK, and ASU has launched many new partnerships including a partnership with Uber.



2016

THE NEW YORK TIMES • Sept. 2

FDA bans sale of many antibacterial soaps, saying risks outweigh benefits

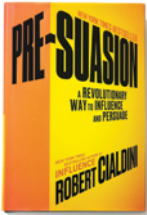
The Food and Drug Administration prohibited the sale of personal-care products containing prominent antimicrobials, including triclosan and triclocarban, prized for their antimicrobial properties. ASU researcher Rolf Halden found that the ingredients pose significant risks to human health and the environment. Halden recently joined a team that will use an open-access viral databank to provide a multidimensional view of viruses and their infectious trends. The project is funded by a \$1.53 million grant from the National Library of Medicine.

THE WALL STREET

JOURNAL • Sept. 6

The art of setting the stage for persuasion; pre-suasion is a way to put people in a receptive mood before asking them for something

Robert Cialdini's book goes on to become a New York Times and Wall Street Journal bestseller. In 2019, he was elected a member of the National Academy of Sciences, one of the country's most distinguished



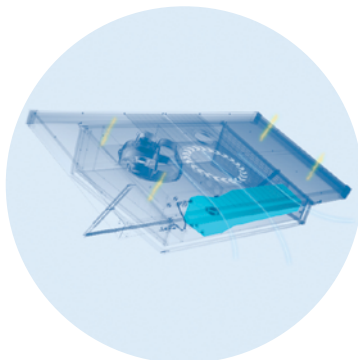
scientific organizations. Frequently regarded as the “Godfather of Influence,” he is known and respected worldwide for his body of work.

2017

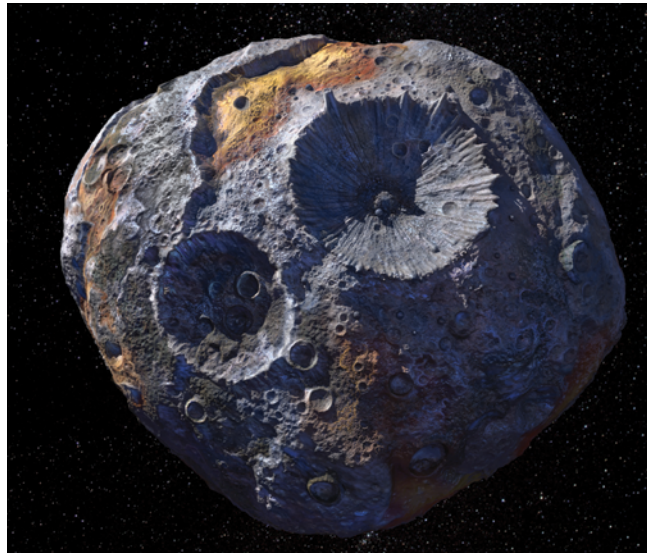
FORBES • Nov. 15

Meet Zero Mass Water, whose solar panels pull drinking water from the air

“It’s often said you can’t make something out of nothing. Cody Friesen may have come as close to succeeding as anyone,” wrote the author of the Forbes article. Friesen, an ASU engineering professor and founder of Zero Mass Water, continues to address the global water crisis and in 2019 he was awarded the prestigious \$500,000 Lemelson-MIT prize.



SOURCE Hydropanels pull water from the air.



FORBES • May 26

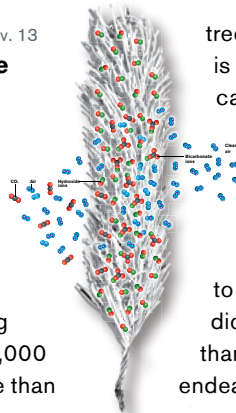
NASA will reach unique metal asteroid worth \$10,000 quadrillion four years early

The Psyche Mission was the first ASU-led deep space NASA mission. Today, the first pieces of the actual spacecraft that will travel on the long voyage are being built.

THE NEW YORKER • Nov. 13

Can carbon dioxide removal save the world?

The New Yorker chronicled ASU researcher Klaus Lackner’s journey as he dedicated his career to developing technology that is 1,000 times more effective than



trees. Today, Lackner is leading the largest carbon dioxide removal project to date. A forest of 1,200 mechanical “trees” is poised to pull more carbon dioxide out of the air than any human-made endeavor before it.

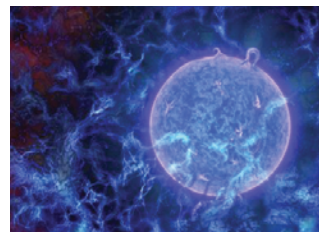
2018



NATURE MAGAZINE • Oct. 3

Simulated labs are booming

With the help of Google and Labster partners, ASU launched first-in-the-U.S. virtual-reality biology lab courses. Students are now enrolled in courses such as cell and molecular biology, animal physiology and ecology.



PHYSICS WORLD • Dec. 6

Breakthrough of the year: Ancient hydrogen reveals clues to dark matter’s identity

ASU cosmologist Judd Bowman and his team were recognized for detecting evidence of the earliest stars in the universe, born a mere 180 million years after the Big Bang. Bowman continues to inspire students to explore the stars, and he most recently mentored the student-run Phoenix CubeSat mission.

Year in review

In the news

Highlights of ASU innovation stories that made headlines



RENEWABLE ENERGY WORLD •

Jan. 1

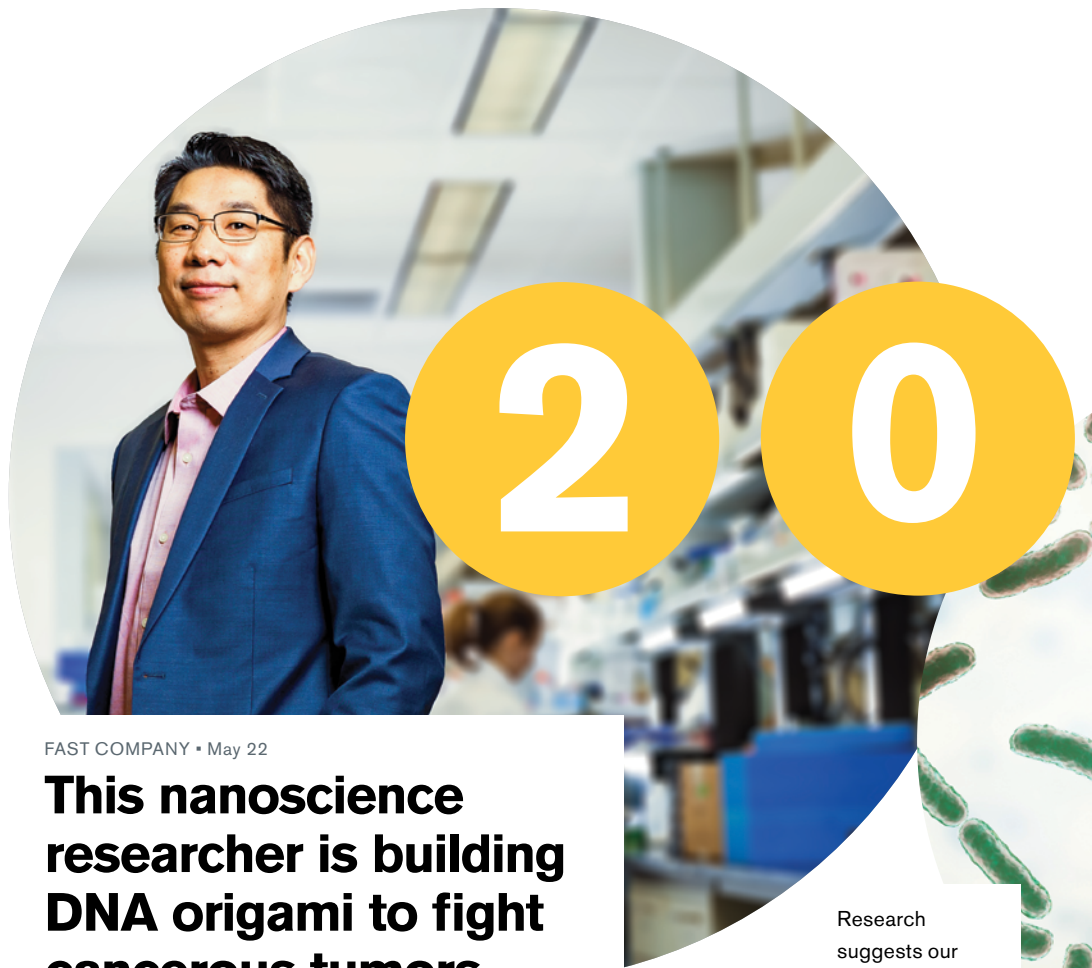
ASU researchers break solar-cell efficiency record at 25.4%

ASU researchers have set a new world record for solar efficiency, breaking their own previous record set in 2017. The cost of solar electricity is largely driven by the efficiency of the panels and the improvements could drive down the long-term cost of solar energy.

MEDCITY NEWS • April 29

Mayo Clinic and Arizona State University reveal 6 startups in new MedTech Accelerator

Early-stage medical device and health care technology companies join the accelerator as they tackle issues like hand injuries, remote patient



FAST COMPANY • May 22

This nanoscience researcher is building DNA origami to fight cancerous tumors

In a major advancement in nanomedicine, ASU scientists, in collaboration with researchers from the Chinese Academy of Sciences, successfully programmed nanorobots to shrink tumors by cutting off their blood supply. For his work, ASU's Hao Yan was named one of Fast Company's Most Creative People in Business of 2019.

Research suggests our gut microbiomes affect our brain communication and neurological health.

THE ARIZONA REPUBLIC •

June. 14

How the gut microbiome could provide a new tool to treat autism

ASU researchers Rosa Krajmalnik-Brown and James Adams demonstrated long-term beneficial effects for children through a revolutionary technique known as Microbiota Transfer Therapy.

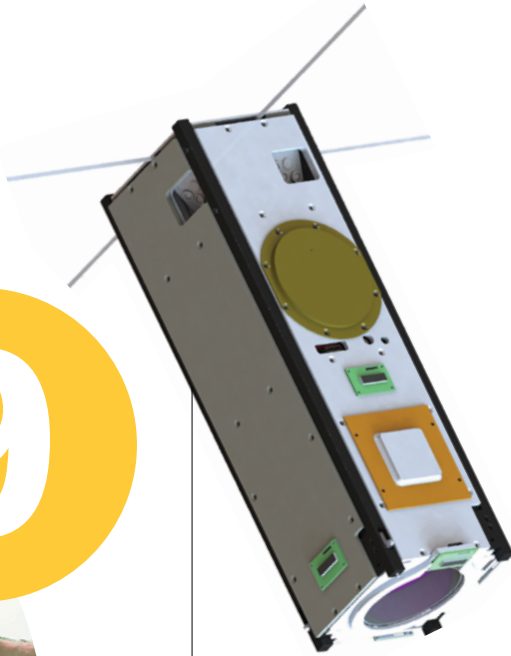
monitoring and sexual health. The companies get support and expertise as they develop or optimize new products, license intellectual property and sponsor research and clinical studies.



The TENZR wearable sensor measures movement to rehabilitate injured wrists and elbows. Its creators participated in the MedTech Accelerator.

1

9



The Phoenix CubeSat will orbit Earth for two years collecting infrared images.

THE ARIZONA REPUBLIC • Nov. 8

Satellite built by students soars to space on mission to map heat in Phoenix, other cities

A spacecraft the size of a jumbo loaf of bread, launched from Wallops, Virginia, is bound for the International Space Station. The Phoenix CubeSat is the creation of more than 100 science and engineering students, faculty and researchers at ASU. The spacecraft is designed for a two-year mission to study urban heat island effect.

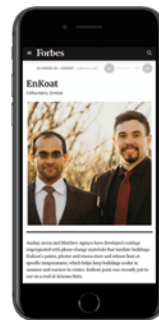
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FORBES • Dec 3

Obsessed with efficiency: the 2020 Forbes 30 Under 30 in energy

Startup EnKoat (a shorthand for energy saving coatings) emerges from ASU engineering research, poised

to make big energy and environmental conservation impact. The product could help maintain comfortable temperatures in the interiors of houses and other structures. Founders Aashay Arora, '18, and Matthew Aguayo, '18, received their doctoral degrees in civil, environmental and sustainable engineering. Their early pitches at ASU's Change the World Competition and ASU Venture Devils Demo Day provide early support and funding.



—

KJZZ • Dec. 11

\$8.7 million grant aims to get more Arizona kids enrolled in college

ASU and the Be A Leader Foundation have been awarded a grant to form a Network for School Improvement. The program expands their existing school partnerships to build the K-12 pipeline and increase access to higher education for Arizona students. The \$8.7 million grant will be funded by the Bill & Melinda Gates Foundation.

THE WASHINGTON POST •

Oct. 17

It's time to end the obsession with college exclusivity

Amid the "Varsity Blues" scandal involving parents paying sometimes hundreds of thousands of dollars to fraudulently get their children into exclusive universities, The Washington Post invited President Crow to weigh in.



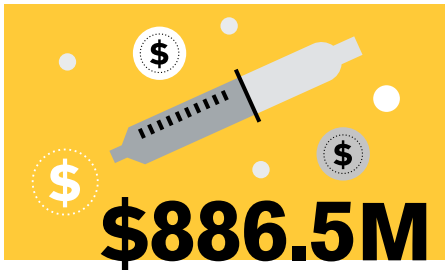
"Though small and elite colleges have their roles, higher education is too important for individual and social progress to be held hostage to exclusivity thinking."

— MICHAEL M. CROW, PRESIDENT, ASU

Year in review

By the numbers

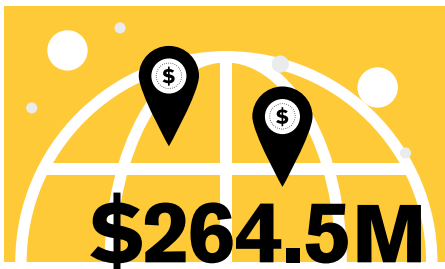
Economic impact



ASU's research-based economic impact on Arizona economy



2-year economic impact on Arizona from ASU startups and affiliated businesses



annual economic impact generated by international students at ASU

SOURCE: Seidman Research Institute

Research



in the world for patents

ASU with Stanford, MIT and Harvard

— U.S. NATIONAL ACADEMY OF INVENTORS AND THE INTELLECTUAL PROPERTY OWNERS ASSOCIATION



Top 1% of world's most prestigious universities

— TIMES HIGHER EDUCATION, WORLD UNIVERSITY RANKINGS, 2020

#7 in the U.S. for research expenditures ahead of Princeton and Caltech



— NATIONAL SCIENCE FOUNDATION, 2018

Academics

#1 most innovative in the U.S. five consecutive years, ahead of Stanford and MIT

— U.S. NEWS & WORLD REPORT, FIVE YEARS, 2016-2020

#9 in first-year experience

— U.S. NEWS & WORLD REPORT, 2020

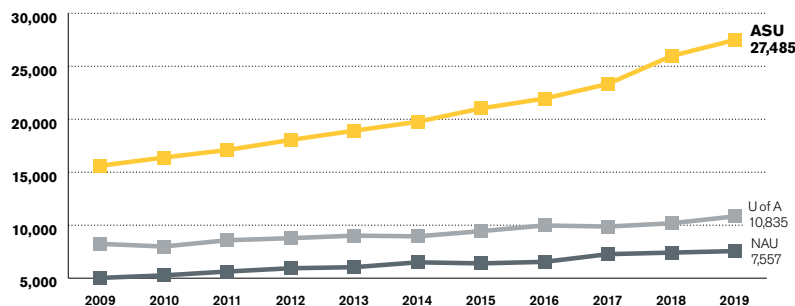
#10 in U.S. for best undergraduate teaching

— U.S. NEWS & WORLD REPORT, 2020

Top producer of Fulbright Scholars

With 21 students in the U.S. government's flagship international educational exchange program, ASU ranked third among public universities in Fulbright awards in 2018-19 and 11th among all research institutions, ahead of Harvard, Columbia and Stanford. ASU's selection rate of 39.6% was the highest among top-producing schools.

Degrees awarded



ASU annually graduates thousands of innovators who excel in engineering, business, education, the arts and other fields. In 2018-19, ASU awarded degrees to 19,340 undergraduate and 8,145 graduate students.

— ASU OFFICE OF INSTITUTIONAL ANALYSIS, ARIZONA UNIVERSITY ANALYTICS AND INSTITUTIONAL RESEARCH, NAU INSTITUTIONAL RESEARCH AND ANALYSIS

#1 in the world for global management

Thunderbird global management degree

— TIMES HIGHER EDUCATION AND WALL STREET JOURNAL

#2 supply chain and logistics program

for second consecutive year, ahead of Penn State, Ohio State and Michigan

— U.S. NEWS & WORLD REPORT, 2020

Athletics

Best in field

- Triathlon team national champions
- Triathlon individual national champion: Hannah Henry
- Wrestling: Zahid Valencia, NCAA champion at 174 lbs.
- Women's Track and Field: Samantha Noenning, NCAA champion in shot put (indoors and outdoors)
- Cliff English, College Triathlon Coaches Association Coach of the Year
- Matt Thurmond, Pac-12 Men's Golf Coach of the Year
- Armen Kirakossian, GCAA/TaylorMade Jan Strickland Outstanding Assistant Coach Award
- One of the top 50 greatest college football programs over 150 years of college football, according to ESPN

3.24 highest cumulative GPA of all time

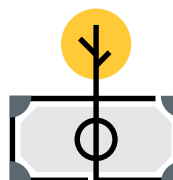
77% with a GPA above 3.0



Philanthropy

101.5K+ donors

Campaign ASU 2020 set a fundraising record for the fifth consecutive year. More than 101,500 individuals, corporations and foundations donated \$413.7 million in fiscal year 2019, a 65% increase from fiscal year 2018.



7,400+

ASU students received scholarships funded by private support in 2019.

2016 -
2020



Building the culture of innovation

A look inside the processes and
community behind five years of the
nation's top innovation ranking

Story by KERIDWEN CORNELIUS
Photos by JAROD OPPERMAN





On Nov. 1, the Arizona State University community held Innovation Day.

But 1,000 of the participants didn't just revel in the university's successes. They're tackling some of its problems.

Student-athletes and international students are brainstorming ways to engage international students in sports events so they feel like they belong in America. A faculty led team is creating opportunities to foster employees' well-being and career success. Staff are cultivating experiences that support students' emotional and social needs. Community-led teams are addressing safety on campuses and initiating ways to boost degree completion in northern Arizona.

The initiative, called ASU Spark, uses a democratic method for igniting ideas that was conceived, prototyped and tested at ASU. Proposals were submitted by everyone from long-time faculty to one person who had been at ASU for three months. In some teams, a dean and an intern might work together, and facilitators are trained to ensure everyone's ideas are



Zainab Al Nasr and Pengjian Wang collaborate on Innovation Day to determine how athletics might encourage more inclusivity with international students using the ASU Spark Method.

given equal consideration. “To me, that is the story of innovation at ASU,” says Minu Ipe, the knowledge enterprise architect and senior fellow for leadership and institutional design at ASU. “It’s the sense that it doesn’t matter who you are, that this institution allows you to solve problems, to imagine what the future could be, to live in that space of ‘What could we be?’ And then you get an opportunity to mobilize people around you, figure out how to solve the problem, and have an impact.”

ASU’s innovation story often gets told through marquee examples — undergrads designing a spacecraft funded by NASA, daring collaborations between dancers and scientists, students fashioning wearable technology with a Nobel Prize winner. But all of that emerges from something subtler: an innovation mindset encouraged in every

student, teacher, employee and community member.

“People feel empowered,” says Maria Anguiano, senior vice president and university planner in the Office of the President. “There’s a mindset that things can be done and therefore we should do them.” When you set goals and create a can-do culture, she adds, “that literally trains everyone’s minds into a problem-solving mode.”

Lifelong access to learning

Anguiano, a first-generation college graduate, is particularly passionate about ASU’s efforts to solve one of society’s biggest problems: a lack of access to higher education. ASU is bucking exclusivity by setting a goal to achieve excellence through inclusivity. But that mission opens the door to an array of challenges, because it requires meeting the needs of a wide variety of people at

every stage of their lives.

ASU faculty combine forces with public and private sector partners to develop online courses infused with virtual reality, artificial intelligence and game-based learning. Learners can build the confidence and know-how they need to start a business, gain the skills to generate sustainability reports, prepare for a project management certificate, and integrate science-based mindfulness practices into their lives.

“Innovation is impact,” says Nikhil Dave, an undergraduate student and researcher in Knowledge Enterprise’s interdisciplinary Luminosity Lab. “It’s a matter of making meaningful impact, whether that’s within a small community in one person’s life, or in a whole society. That’s something cool about ASU.”

Programs “are not innovation

for innovation's sake," Anguiano emphasizes. "It's innovation because there's a problem to be solved, which is that there is not enough access to higher education."

One access-expanding initiative grew out of a problem at Starbucks: 74% of its U.S. employees considered themselves students or aspiring students, but only 32% were enrolled in school. So ASU unveiled the Starbucks College Achievement Plan, an unprecedented partnership that allows Starbucks employees to earn a bachelor's degree through ASU Online.

At annual forums, Starbucks program graduates tell stories that are "unbelievably moving," says Phil Regier, university dean for educational initiatives and CEO of EdPlus, ASU's international system of digital

learning opportunities. "They are stories about people overcoming dramatic odds, about people who never thought they'd be able to achieve a university degree."

On the other end of the spectrum, many adults want to enhance their work and life skills and earn certificates without officially entering a university. For these professionals, ASU recently debuted Universal Learning. The program is designed to help them keep up with a rapidly changing world at their own pace and on their own terms from anywhere and any time they can join in.

"Here you can dream it, think it and act on it almost right away," says ASU President Michael M. Crow.

Fertile environment

This fall, ASU welcomed its largest, most diverse, and most academically prepared first year

"To me, that is the story of innovation at ASU. It's the sense that it doesn't matter who you are, that this institution allows you to solve problems, to imagine what the future could be, to live in that space of 'What could we be?'"

— MINU IPE, ASU'S KNOWLEDGE ENTERPRISE ARCHITECT AND SENIOR FELLOW FOR LEADERSHIP AND INSTITUTIONAL DESIGN

class ever — an accomplishment that is also driven by a mission, Ipe says. That includes support of first-generation students. ASU received a First Forward designation from the Center for First-generation Student Success in 2019.

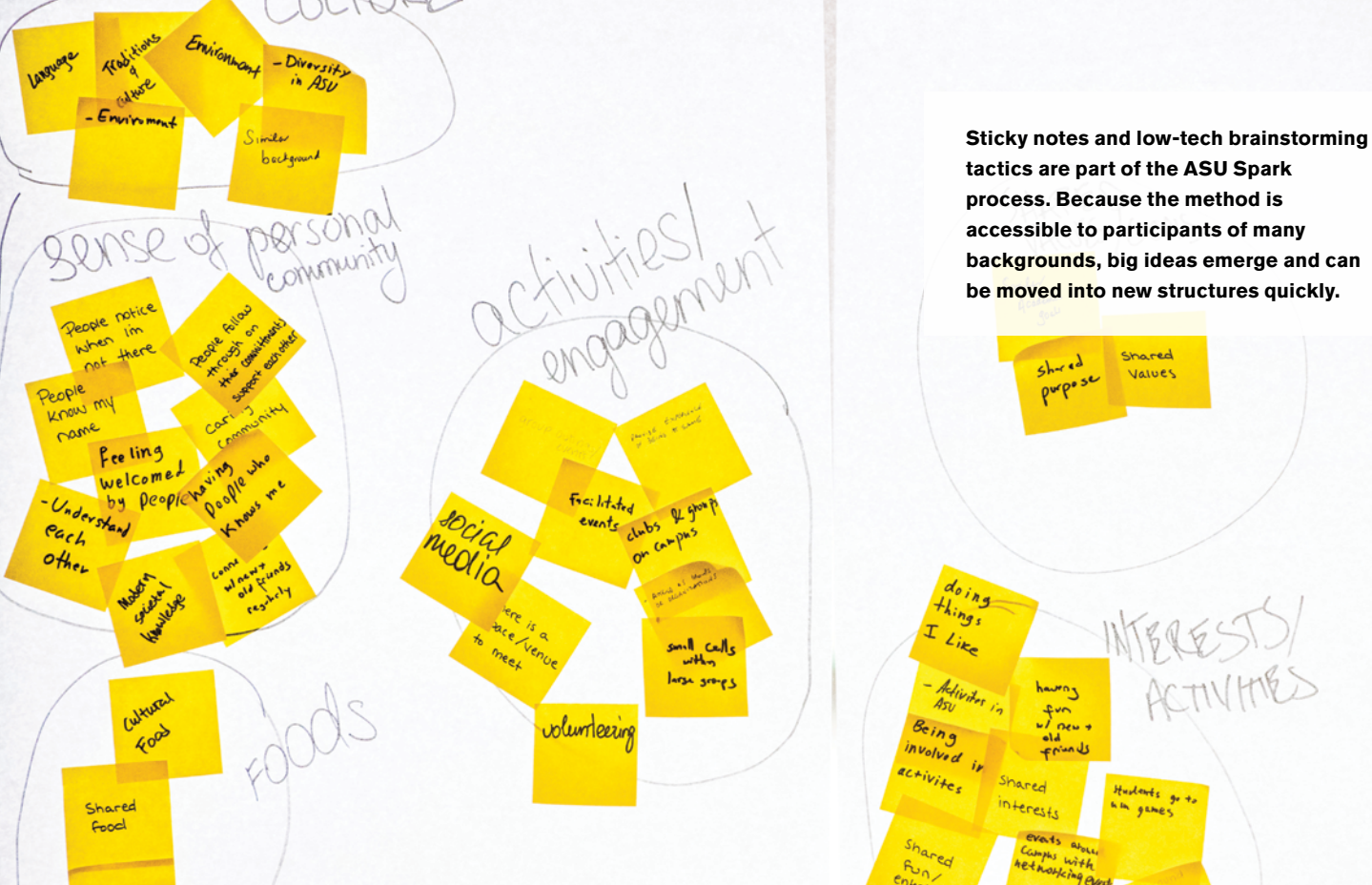
Almost 40% of ASU students are the first in their families to attend college, a rate that has tripled since 2002. Across ASU, several long-standing initiatives positively impact first-generation student outcomes. Among them are Access ASU, the First-Year Success Center's coaching initiative and TRIO, a set of federally funded college opportunity programs.

"When you bring in large volumes of students, and when we have a system that says we want to include people, what we are saying is we are including their ways of thinking, their ideas and their creative energies," Ipe says. "Then when institutionally we try to remove some of the barriers that get in the way of these collisions, you're really creating an environment that's absolutely fertile for new ideas to take root and grow."

This fall, 35 first-year students took a class called Innovation 101: Discover the Innovator in You. One



Collaborators from across ASU came together in small groups to actively work through challenges in a new format called ASU Spark. The method is intentionally low-tech and in-person to foster communication and solutions-oriented outcomes.



Sticky notes and low-tech brainstorming tactics are part of the ASU Spark process. Because the method is accessible to participants of many backgrounds, big ideas emerge and can be moved into new structures quickly.

“Here you can dream it, think it and act on it almost right away.”

— MICHAEL M. CROW, ASU PRESIDENT

of their tasks was to figure out how to nurture a stronger sense of belonging through ASU’s mobile app. The university’s technology department had been wrestling with this challenge, and who better to take it on than newbies struggling to fit in?

Another effort designed by ASU undergrads launched in November. The Phoenix CubeSat, a bread loaf-sized spacecraft, will orbit Earth to collect thermal infrared images to determine how different city designs impact the

urban heat island effect. In this NASA-supported mission, students studying engineering, urban planning, design, space exploration and journalism are banding together to help make cities more sustainable.

Meanwhile, the interdisciplinary Luminosity Lab empowers students. “I love it,” says senior Catharine Lewis, “because it has the smartest and the most interesting people who are willing to work with me and teach me things that we can collaborate about, whether they’re from engineering or business or design or whatever background source.”

Interdisciplinary collaborations like these are as common on campus as ASU sweatshirts. A new initiative at the Institute of Sustainability is harnessing the humanities to cultivate imaginative solutions to environmental

crises. The Biodesign Institute partners with dancers to choreograph performances that open the public’s eyes to the creative and human sides of science. SciHub, co-led by Nobel Prize-winning physicist Frank Wilczek, brings together students and professionals in science, tech, engineering, design and art to invent commercial products. They’re currently developing technology to correct colorblindness and allow people to see new colors, infrared and ultraviolet.


Innovation is a must at ASU, says Ipe. “We are in the process of designing a very different kind of institution — one that ultimately leads to social transformation and economic impact.

“We need new ways of thinking, because we are in uncharted terrain.” ■

Location. Location. Innovation.

Welcome to Innovation Zones at ASU, a portfolio of co-location offerings at Arizona State University – named the country's most innovative university by U.S. News & World Report. Companies benefit from direct connections with ASU students, world-renowned research, and nationally leading programs in engineering, bioscience, business, cybersecurity, health care and more. You'll be surrounded by Fortune 500 companies as well as dozens of innovative startups. ASU offers you both location and innovation.

View locations at innovationzones.asu.edu.

A photograph showing two students in a laboratory setting. One student, with long dark hair and wearing a blue striped shirt, is smiling and looking at a sea sponge held by another student. The second student is partially visible in the foreground, holding the sponge with green-handled tweezers. The background is slightly blurred, showing a white wall and some greenery.

Students in ASU's Biomimicry Center examine sea sponges as part of their bioengineering studies.

WHAT WOULD NATURE DO?

That's the question for ASU's Biomimicry Center and School of Sustainability. The engineering of modern innovations such as high-speed bullet trains and sharkskin swimsuits illustrates how biomimicry applications can be hidden in plain sight. "Bringing biomimicry to the built environment allows us to create cities, buildings, products and human systems that function like the natural world — sustainable and aesthetically beautiful," says Sara El-Sayed, a research associate at the center.

A person is holding a magnifying glass over a star-shaped object, likely a starfish, in a workshop or classroom setting. Other people are visible in the background, some looking at the object. The scene is brightly lit and appears to be a hands-on learning or research environment.

Engineer a solution

Changing the mind of a robot

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“ We are rethinking how a **robot’s ‘mind’ should work** in order to make it more amenable to providing on-the-job training and collaborating with humans.”

— SIDDHARTH SRIVASTAVA,
ASSISTANT PROFESSOR,
SCHOOL OF COMPUTING,
INFORMATICS, AND
DECISION SYSTEMS
ENGINEERING





Changing the mind of a robot

Story by KARISHMA ALBAL

Research and big thinking on how AI will impact the future of work in Arizona and beyond

What happens when technology advancements threaten to automate people's jobs?

The question is on the minds of many as research and development in artificial intelligence and machine learning rapidly grows.

A new project led by Siddharth Srivastava, an assistant professor in the School of Computing, Informatics, and Decision Systems Engineering at Arizona State University, aims to help alleviate this concern.

Srivastava and his multidisciplinary team are creating autonomous systems that are not only more adaptable and efficient in manufacturing environments, but also have built-in intelligent tutoring systems that will cooperate with factory workers and retrain them to use AI technology so they are not displaced from their jobs.

Funded by a \$1 million grant from the National Science Foundation as one of its Convergence Accelerator awards, the project is highly focused on using AI to augment the workplace rather than replace workers.

"Suppose you have this new robot, it's very efficient,


but you need to hire five computer science graduates to operate and maintain it instead of five current factory workers,” Srivastava says. “That’s not feasible, first of all because we don’t have that many computer science graduates in society. Our idea is that instead of getting people to enroll in a new college program again, what we can do instead is design our AI systems, our robots, in a way that will help people to come on board.”

Srivastava is collaborating with ASU faculty members in the Ira A. Fulton Schools of Engineering and the School for the Future of Innovation in Society to bring the project to life.

“We have 10 team members, including experts in robot control, tutoring systems and human systems engineering — a field that involves thinking about how the robot and the human would interact and how you would build a situation where the human trusts the robot,” Srivastava says. “We also have experts in law to help solve the sociotechnical aspects of the problem.”

How artificial intelligence can preserve jobs

Traditionally, AI has mostly been developed with a mind to automate human-performed tasks — that is, to perform tasks in place of a human. For example, machines play chess better than humans do and are also faster at distinguishing patterns and performing calculations. One



When Raytheon had a problem with a \$350,000 robotic arm, the industrial corporation joined ASU’s eProjects program, bringing students and industry together to solve real-world problems. The arm was shipped from Tucson to the innovation lab on ASU’s Polytechnic campus in Mesa where ASU students repaired and tested it. Then they returned the robot ready to work.

“Training is where we need to invest more money in order to have a successful integration of workers and autonomous systems so we can minimize safety risks.”

— KATINA MICHAEL,
PROFESSOR, SCHOOL FOR
THE FUTURE OF
INNOVATION IN SOCIETY
AND THE SCHOOL OF
COMPUTING, INFORMATICS,
AND DECISION SYSTEMS
ENGINEERING

example of AI working to augment human-performed tasks rather than replace them can be found in intelligent tutoring systems.

The ASU team is focusing on this interaction, particularly in implementing the intelligent training systems for factory workers. This eliminates the concern about driving up the demand for highly educated workers to unsustainable levels and also empowers human workers to incorporate AI into their work.

“We are now considering scenarios in which the AI system teaches humans on the job,” Subbarao Kambhampati, a professor of computer science, says. “If you are using one machine, and there is a big technological advancement, then the question is what is the



ASU engineering by the numbers

Nation's largest producer of future engineers

—BUSINESS INSIDER AND HIRINGSOLVED SURVEY

Students in engineering and technology

21,206	22,458	23,903
FALL 2017	FALL 2018	FALL 2019

#4 master's degrees awarded by school

— American Society for Engineering Education, Engineering by the numbers, 2018

#8 online graduate engineering programs for veterans

—U.S. News and World Report, 2020



\$63,500

Average salary for first job offer

for a Fulton Schools graduate with a bachelor's degree in engineering

SOURCE: Ira A. Fulton Schools of Engineering

best way to get people to come up to speed in using these new machines?"

This retraining process is essential to helping factory workers in the evolving manufacturing industry keep their jobs. It's a necessary transition into a future when machines can augment human activities without replacing the people who have traditionally performed them.

In that scenario, workers would be able to assign robots a wider variety of tasks while the robots teach workers how to use the robots and why robots are making the decisions they do.

"[Robots] are more adaptable in that their behavior adapts to the changes in their environment, they

adapt to the tasks that you give them and at the same time they can answer your questions," Srivastava says. "A worker who doesn't know the internals of the robot can ask it, 'Why did you go along this path when I think you should have just gone straight?' And the robot can answer, 'If I go this way then my hand might collide with that table.' So, in that process, the worker learns about the robot's constraints and how to operate it."

Moving toward a more robotic future

Could machines ever replace humans? Is it cheaper to have an all-robotic workforce?

The answer is complicated, says Katina Michael, a professor

jointly appointed in the School for the Future of Innovation in Society and the School of Computing, Informatics, and Decision Systems Engineering, one of the six Fulton Schools.

“At face value, initially it seems that robots would do better than the operational expenditure of the human labor force,” she says, “but when you look at this quite clinically,

“Ultimately, it’s getting that multidisciplinary conversation going between people who actually build the machines and people who think very critically about job design and human workers.”

— ERIN CHIOU, PICTURED BELOW, ASSISTANT PROFESSOR OF HUMAN SYSTEMS ENGINEERING, POLYTECHNIC SCHOOL

you’re almost shifting costs from the human labor force to the robotic labor force. It’s quite debatable as to whether costs will be reduced.”

While robots can operate 24/7, people need breaks, time off, insurance coverage and compensation. However, robots must be updated and maintained, and they also need power to operate — human workers are still extremely necessary in the workplace.

Although the research project is focused on AI development, it is ultimately centered around training human workers and ensuring job security. The team wants to enhance communication between both humans and robots to obtain the best of both worlds in the manufacturing industry.

“Many corporations are trying to save money somewhere, but training is where we need to invest more money in order to have a successful integration of workers and autonomous systems so we

can minimize safety risks. If we don’t have adequate training, we don’t have adequate responses to reducing the incidence of on-the-job disasters,” Michael says.

An interdisciplinary interaction

“We’re interested primarily in how humans and robots work together,” Michael says. “With the humans doing their bit and the robots doing their bit, we want to see if there is any incongruousness or congruousness that can be observed.”

Erin Chiou, an assistant professor of human systems engineering at The Polytechnic School, one of the six Fulton Schools, is studying the interactions of humans and machines for data to guide the design of systems that prioritize the collaboration of humans and robots.

“Ultimately, it’s getting that multidisciplinary conversation going between people who actually build the machines and people who think very critically about job design and human workers,” Chiou says.

The ASU team also has experts looking at the legal, social and economic implications of implementing such technology in the workplace, all of which will be considered when designing the new systems.

“It’s not about changing the hardware, it’s about how to change the software,” Srivastava says. “We’re thinking about how it should act and what it should do. We are rethinking how a robot’s ‘mind’ should work in order to make it more amenable to providing on-the-job training and collaborating with humans.” ■



Connecting research to business

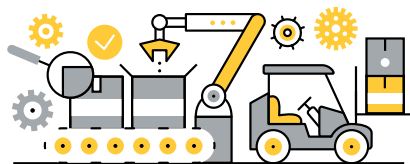
In the past three years, engineering faculty members at ASU have brought research to market in powerful ways, including:

192
patents

awarded
for devices,
processes and
materials

24
startups

innovating in
the areas of
sustainability,
personal health
diagnostics
and more



“Some companies want to know how new discoveries will apply to their businesses or may be looking for the next big idea they could take to market.”

— JOSEPH HUANG, EXECUTIVE DIRECTOR OF
THE BUSINESS ENGAGEMENT CATALYST



Wearable tech is a major growth area with multiple startups at ASU, including Hooolest Performance Technologies, made up of three ASU engineering students. They won the \$100,000 grand prize at the ASU Innovation Open and are now creating their earbud devices which block stress by stimulating the vagus nerve.

ASU's Ira A. Fulton Schools of Engineering is the largest and most comprehensive engineering program in the U.S.

Prestigious engineering faculty in national academies

38 IEEE Fellows

8 National Academy of Engineering members

4 National Academy of Construction members

5 National Academy of Inventors members

97 NSF CAREER awardees since 1995

“We want to help companies think about how they can drive workforce development for their companies ... and plug in throughout the university in the best possible way.”

— DAVID WAHLS, SENIOR DIRECTOR OF DEVELOPMENT FOR
THE FULTON SCHOOLS OF ENGINEERING



355+
faculty
members

conduct research
and entrepreneurial
ventures to bring
research to market.

Their research includes
solar cells, computer
science, transportation,
robotics, construction,
aerospace
and more.

Engineering schools at ASU further industry partnerships to support Arizona's growth

In the past year, engineering Dean Kyle Squires has built new working groups that make partnerships easier for companies and investors to work with the schools.

The new Industry Engagement Catalyst includes 30 top senior executives from major national corporations who are helping the schools shape and direct future growth.

The Catalyst includes cross-sector leaders such as executives at Intel, American Express, Starbucks, the Greater Phoenix Economic Council, Arizona Commerce Authority, Fulton Homes, Sunbelt Holdings, Honeywell, Motorola and more.

Another recent launch, the Business Engagement Catalyst, helps companies navigate the complex university environment to identify and activate new connections with faculty and research.

The team has experience in the academic world as well as in business, understanding the needs and culture of both sides, and helping them facilitate successful partnerships.

Learn more at
engineering.asu.edu/engage.



VIEW FROM SPACE

We are the crew of Spaceship Earth

During my 180 days in space, first on two space shuttle missions and then on an expedition to the International Space Station, I felt like a colonist. It took living up there to realize that space is a place that belongs to all of us.

That's one of the things that excites me about being here at ASU — we all belong here too.

As space crews, we have the luxury of knowing that the mission of exploration is imperative. Exploring really is the way to make change, and I tell people that ASU is changing the very fabric of

education. I joined ASU as Global Explorer in Residence because I wanted to be a part of that.

Exploration takes work and it takes a team. In order to gather yours, you may need to look at the people around you differently. You need to teach yourself to constantly strive to see more; each time, look differently. When we do that, we achieve a crew that is our very own.

Looking at Earth from space I saw that we are the crew of Spaceship Earth — all of us.

— CADY COLEMAN

A woman with short brown hair, wearing a blue flight suit, is smiling and looking upwards. She is standing in front of a large, complex piece of machinery, which is the Soyuz rocket. The rocket is white with red and black accents. The background shows a large industrial building with windows.

Explore the world

U.S. astronaut Cady Coleman stands near her Russian Soyuz rocket at the Baikonur Cosmodrome in Kazakhstan. Coleman, Russian cosmonaut Dmitry Kondratyev and Italian astronaut Paolo Nespoli rode the ship to the International Space Station in 2010.

A bright idea

Jesse Senko rescues sea turtles — and fishing's future.

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Envisioning the future of space


Interplanetary Initiative shapes our place in space.

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A BRIGHT

ocean

ASU researcher Jesse Senko, right, deploys a solar-powered illuminated net in the Sea of Cortez, which renowned explorer Jacques Cousteau described as the "aquarium of the world."



Jesse Senko's solar-powered lights are rescuing more than sea turtles from fishing nets — they're helping to transform the future of sustainable fishing

Story by SCOTT SECKEL

Photos by LINDSAY LAUCKNER GUNDLOCK

Twelve-year-old Jesse Senko is on vacation with his family in the Cayman Islands. They're on a snorkeling tour. Senko is in the water, dazzled by the fish, when a big green sea turtle appears in front of him. Because he is a 12-year-old boy, he grabs it. The turtle takes off. Every 15 to 30 seconds it surfaces for air.

Senko's mother is on the boat, throwing up, panicking, screaming "Come back!" The boat operator is cursing because what to do when a kid takes off on a turtle is definitely not in the employee manual.

Senko hears them screaming. He doesn't care. He's enjoying the ride. Sea turtles can hit close to 30 mph. Eventually the turtle returns to the boat. With one powerful flap of its flippers, it rids itself of its hitcher.

"Right at that moment I say to my parents, 'That was awesome! I want to study these things!'" Senko says. "Ever since then I've been obsessed with sea turtles."

Flash forward a few decades.

Senko is now a marine biologist and conservation scientist at Arizona State University. Most scientists spend their careers working on one problem, or part of a problem, or a tiny part of a problem. Senko is working on about 10 problems at once. Saving sea turtles is job one, but that's related to sustainable fishing, which ties into resilient coastal communities. Engineering transformative fishing gear and reducing plastic trash in the oceans are other parts of his puzzle.

"Fishing gear is the greatest threat to sea turtles worldwide," Senko says. "Sea turtles are vital for the health of the world's oceans. They perform fundamental roles in ocean ecosystems, many of which are not fulfilled by other species. And humans need healthy oceans to survive and thrive."

In the Sea of Cortez, on a tiny

"As scientists, we are great at assessing and identifying problems. We're awful at solving them. ASU is about solving problems."

— JESSE SENKO

remote island lost in time and inhabited by one fishing family, all the strands of Senko's work come together.

It's about solving problems

He grew up on the coast of Connecticut on Long Island Sound. His father had him out on boats

when he was in diapers. He's been fishing since he could hold a rod. He majored in fisheries and wildlife sciences at the University of Connecticut and received his master's degree in wildlife ecology and conservation from the University of Florida.

He studies sea turtles, and Gainesville is about a 90-minute drive from the Atlantic. Why come to ASU in the middle of the desert, to earn a PhD in biology?

"As scientists, we are great at assessing and identifying problems. We're awful at solving them," he explains. "ASU is about solving problems."

Upon completing his PhD at the most innovative university in the country, he joined ASU's new School for the Future of Innovation in Society, which works on solving global problems and the unintended consequences behind them.

Senko's passion is sea turtles, some of the oldest creatures on earth. Whatever killed the dinosaurs, turtles survived it. They can live to 100.

The Mexican government banned sea turtle hunting in 1990. Get caught with one — dead or alive — and it's a 9-year prison sentence. Recovery has been slow, though. Sea turtles swim right into the fishing nets and drown.

When Senko was working on his PhD in Baja California, he noticed lights put on gill nets to attract fish reduced sea turtle bycatch. Turtles and sharks can see nets and avoid them. As an experiment, he put battery-powered lights on fishing nets. He found a 50% reduction in turtle bycatch and a 95% reduction in shark and ray bycatch. He saw turtles swim up to nets and turn around.

The East Pacific hawksbill turtle is among the most endangered sea turtle populations and one of the oldest creatures on Earth.





Senko (far left) activates the solar-powered lights (left), on one of the two nets they use to fish. The “treatment” net is illuminated while the “control” net has deactivated lights. Below, Senko shows PhD student Janie Reavis how to measure a sea turtle’s shell.

But batteries and fishing lights are expensive. Glow sticks, used by commercial fishermen everywhere, are cheaper. But they’re usually tossed into the ocean after one night, adding to the global plastic problem.

With solar-powered fishing lights, fishermen can toss their nets on the deck or dock and the lights recharge themselves. This is where ASU’s interdisciplinary mission paid off — Senko isn’t an engineer.

So he cast around the university and assembled a team to develop solar-powered net lights. First, engineers: Jennifer Blain Christen, Mark Bailly, Christopher Lue Sang, Stuart Bowden and Michael Goryll from the School of Electrical, Computer and Energy Engineering in the Ira A. Fulton Schools of Engineering. The only environment harsher than the sea is space. They cracked the problem of creating something that functions on the ocean.

Second, another turtle expert: Agnese Mancini, the scientific coordinator of Grupo Tortuguero de las Californias, a Mexican nonprofit coalition of people and communities working to save sea turtles.

Finally, fishermen: brothers Felipe and Juan Pablo Cuevas, arguably the most famous among their peers in the waters of Baja California Sur. They hail from one of the most unusual places in the world, the remote island of El Pardito.

From here, Senko’s revolution is being launched.





Juan Pablo Cuevas and Senko repair an entangling net, which they will use to help compare catch rates of sea turtles, sharks and target fish.

Island of discovery

Civilization is far, far away from El Pardito — two long hours by boat from La Paz.

The island is tiny, about 2.5 acres, most of it hill. The island is part of the Islas del Golfo de California Protected Area which is managed by Mexico's National Commission on Protected Areas. Small houses built from a variety of materials are connected by trails and paths and stairs. Thatched palapas cover deep patios with hammocks and sleeping pads. Dried shark jaws, shells and a Turk's head knot adorn rafters. There's no electricity, no running water and no communications except for a radio. All the houses are solar-powered.

The original people came to the island to escape mosquitoes. Juan Cuevas and his wife settled on El Pardito in 1927, raised a family, and dove for pearls. Only two of the kids stayed. The rest left for the mainland.

The pearl fishery tanked in the late 1930s. During World War II the Cuevases fished for sharks. Today, they primarily fish for yellowtail, grouper, halibut, snapper and triggerfish when using nets.

“I want my kids to learn how to fish, but I also want them to go to school. I want them to learn about fishing and maybe research.”

— FELIPE CUEVAS
ON JESSE SENKO'S
IMPACT

Conservation for the Cuevas brothers is not just turtles, it's the whole marine ecosystem. They are working on eight projects with a variety of organizations.

They are as attuned to the sea as a farmer is to his land. They began to notice it wasn't like it was when their father fished full time. They had to go farther and farther for good catches. The watershed moment came on a trip when they went all the way to the Pacific to catch sharks and didn't bring in much.

They want to learn how to read the results of scientific studies so

they can teach conservation to other communities in the area. They also want to learn how to fish better and preserve the balance of life. They're well aware of what can go wrong. About 90% of the world's fisheries are small-scale and they're not well-managed. If they're not careful, they can put themselves out of business.

The brothers also want to see more studies on reproduction. Anecdotally they know more about different fish and their behaviors and connections than most marine biologists because they've seen it all for decades. Parrotfish are better off in the water because they play a more valuable role there than on a plate. There's a nearby island where parrotfish were overfished and now it's overrun by sea urchins. The coral is suffering too.

They want to see more size restrictions and seasonal bans. The Mexican government is unwilling to implement either for two reasons: Both are unpopular and they would be difficult to enforce.

Felipe Cuevas discussed the future he wants for his children and Senko's impact. “I want them to learn how to fish, but I also want them to go to school,” he says. “I want them to learn about fishing and maybe research. I want my kids to be curious about history on the island.”

Lightbulb moment

Grupo Tortuguero has a permit to catch, study, measure, tag and release turtles. In the morning, the Cuevas brothers head out and catch a hawksbill turtle in a mangrove swamp about three miles from the island. Hawksbills have been a protected species since



Sunrise at Isla El Pardito in La Paz, Baja California Sur, Mexico. The 2.5-acre island has been inhabited by a single family for more than 100 years.

Senko measures an East Pacific green turtle with his fishing partners, Felipe (left) and Juan Pablo (right) Cuevas. The turtle was captured in a non-illuminated "control" net with deactivated lights.

Learn more about the work ASU researchers are doing to save the turtles

See video featuring the team working directly with turtles and fishermen and watch Jesse Senko present about his work in Washington, D.C. on our YouTube channel at youtube.com/ASU.



1990, but are still poached for their tortoiseshell, which is used in combs, jewelry and eyeglass frames. In 15 years of research in Baja, this is only the second hawksbill that Senko has seen.

At sunset, he goes out with the brothers to test the lights in a turtle-rich area. They drop two nets separated by a 200-meter length of line. One net has lights switched on — the treatment net. The other has lights turned off — the control net.

The lights look like a blinking landing strip in the darkness. The group takes off to go fishing for an hour. Leave the nets unattended for longer than an hour and a turtle could drown.

An hour later, after handlining snapper, grouper, two needlefish and a huge moray eel that the brothers did not want in the boat, they return to the nets. The middle light on the treatment net is not working. There's a big dark area in the middle. And that's exactly where they find a green turtle, away from the lights.

The lights work.

They haul the turtle on board, free it, and release it back into the water. Senko notes that the floating lights need to be weighted so they're below the surface, casting more light down and less up.

More testing remains. Would different colors or wavelengths be more effective? What about adding a sound, like that of orcas? How about hanging them at varying depths?

And there are other fisheries to introduce the technology: Trinidad and Tobago, Peru, Indonesia, Philippines, Malaysia and Greece.

Senko's turtle ride has only just begun. ■

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imming, Gymnastics,
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Become Reality!
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The dream maker

**Rhodes Scholar
Shantel Marekera
helps preschoolers
achieve their goals
at home in Zimbabwe**



Shantel Marekera reaches out to children from low-income families in her native Zimbabwe by providing preschool education through her Little Dreamers Foundation.

Shantel Marekera is giddy. She's found her own kind of fairy tale as a Rhodes Scholar at the University of Oxford, Arizona State University's second in three years, and is eagerly working toward her second master's degree in international relations.

Her passion for advocacy, policy and international human rights law, particularly as it concerns women's rights in her homeland, runs deep. The Zimbabwe-born Marekera launched the Little Dreamers Foundation, a subsidized preschool for low-income children, in her suburban community of Harare.

"I strongly identify and connect with the community that I work with and for, and that's where my drive always comes from because I know I am helping to make my community better for current and future generations," says Marekera, a summa cum laude '18 ASU graduate who completed both her bachelor's and master's degrees in justice studies in only four years, including research and achievements in Barrett, The Honors College.

In 2005, Zimbabwe's government implemented changes to its education system, mandating all children graduate from preschool before enrolling in primary school. This put myriad strains on financially disadvantaged families since preschool costs as much as \$200 per month. In the face of economic hardship, most families prioritize sending their sons to school.

Determined to help girls in her native community attend school, Marekera tapped into her entrepreneurial spirit and created the Little Dreamers Foundation. It provides tuition, meals and scholastic materials to students

"Shantel is a brilliant young woman, focused on the best kinds of justice and committed to her country and community. She is the epitome of what the School of Social Transformation hopes for in our students."

— BRYAN BRAYBOY, MAREKERA'S FORMER TEACHER, PRESIDENT'S PROFESSOR OF INDIGENOUS EDUCATION AND JUSTICE, AND SCHOOL OF SOCIAL TRANSFORMATION INTERIM DIRECTOR

for less than \$30 per month. She received financial assistance from a fellowship co-sponsored by the Igniting Innovation Summit and The Resolution Project, which support socially responsible young leaders. The preschool opened in August 2018 with a ratio of one boy to three girls.

Marekera hopes to introduce a new branch of the preschool each year in a different part of Harare and ultimately open a primary school.

"I feel so honored to play even the smallest role in the future of these amazing children," she says. "I am so proud of their potential and all they have to offer to the world."

By living out her dream, Marekera is creating dreams for others.

—JANE LEE

Envisioning the **FUTURE** of space

Lindy Elkins-Tanton and the Interplanetary Initiative reach for the stars to shape our place in space

Story by ALEX STUCKEY

Lindy Elkins-Tanton, managing director of ASU's Interplanetary Initiative, introduces one of her missions: "I hope we train a whole group of people — these great young minds— to go off and make the world better where they end up."



The 60 people sitting in an Arizona State University conference room in January 2017 had virtually nothing in common.

There were theater majors and scientists; sophomores and school deans; local residents; and private sector employees.

A passion for space — and planetary scientist Lindy Elkins-Tanton — brought them together.

“We brainstormed the biggest questions we have to solve that would have a positive effect on humans’ interplanetary future,” Elkins-Tanton says. “These are not like the sort of things you could do for a thesis. Imagine throwing a javelin over a hill and trying to run to catch up with it.”

On that day, the Interplanetary Initiative was born.

And for the past two years with Elkins-Tanton at the helm, the Initiative has been partnering students and faculty members of all disciplines to examine some of the most complex, space-related questions society faces — with the help of small amounts of university seed money.

The projects include a card game called “Port of Mars” that examines the best way to sustain healthy communities in space, and the Interplanetary Podcast that aims to have public conversations about space while also highlighting the work done at ASU.

It all comes at an important time in space exploration, as the U.S. races toward some of the most complex human missions to date, including a long-term return to the moon and a potential mission to Mars.

“We want people who will take the first steps to solve something that’s unsolved,” Elkins-Tanton says.

Educational movement

January 2017 marked a busy month for Elkins-Tanton. Four days into the new year, she got a phone call at 5:30 a.m. — a phone call she had been waiting six years to receive.

NASA delivered the news it was funding her Psyche project, set to explore a metal asteroid orbiting the sun between Mars and Jupiter.

“We were the underdogs by far,” Elkins-Tanton says.

The Psyche mission is scheduled to launch to the asteroid 270 million miles from the sun in 2022, with a landing expected in 2026. Scientists expect it will cost an estimated \$760 million. They believe the asteroid is the nickel-iron core of an early planet, a building block of the solar system.

In the days following NASA’s phone call, Elkins-Tanton started building the Interplanetary Initiative with its first meeting. She became managing director and co-chair of the Initiative that day, though she had been approached about starting the program months earlier by ASU President Michael M. Crow.

“It’s a more complicated story,” she says. “There wasn’t a moment when I said I want to run a space mission, but there is the thrill of

Elkins-Tanton seeks a team of people who are “synergistic and respectful and integrated and diverse” — including students.



The Psyche mission to a metal asteroid 270 million miles from the sun is set to launch in 2022.

running a space mission and the thrill of running Interplanetary, which has a lot to do with the team and the vision.”

Elkins-Tanton originally joined ASU in 2014 as director of the School of Earth and Space Exploration following a stint as director at the Carnegie Institution for Science’s Department of Terrestrial Magnetism. Before that, she spent time working at both the Massachusetts Institute of Technology and Brown University.

Then came the Interplanetary Initiative. In Crow’s eyes, it was a means of bringing people of all disciplines together to solve a problem, which resonated with Elkins-Tanton.

“I’d been in search of a place where people were connected intensely and made things that were impossible as just an individual,” she says. “I think of the Interplanetary Initiative as a pilot for what future universities could be. What we’re trying to do here is



“I’d been in search of a place where people were connected intensely and made things that were impossible as just an individual.”

— LINDY ELKINS-TANTON

interest. At that point, the university hands out seed money — about \$10,000 or so — to each of the top ideas.

Students don’t receive a degree or a certificate through this approach, but they get something even more rewarding, Elkins-Tanton says. They get research experience.

The Initiative is set up to allow a diverse group of individuals to get involved in space research who otherwise would never have been exposed to the topic.

That includes Kevin Hubbard, a graduate associate in ASU’s School of Earth and Space Exploration who was pursuing a PhD in politics in spring 2017 when he happened upon the Initiative. He was enjoying political science, he says, but he was looking for something new and exciting to be the subject of his dissertation. He decided to focus his initiative-based research on space policy — specifically, how to manage conduct on the lunar surface.

“We don’t want to ruin the

place that we plan to live on in the future,” he says.

Hubbard is examining the policy around mining the seabed in the Pacific Ocean, and how that could apply to space. Space is a harsh environment like the sea, he adds, and no nation state has exclusive rights to the area.

It’s a timely topic with NASA planning a return to the moon for the first time since 1972 with the hope of humans staying there for an extended period. The Artemis program plans to land the first woman and next man on the moon by 2024, but that’s only the start. “NASA’s trying to make a sustainable presence on the moon,” Elkins-Tanton says.

The big questions

Can humans adapt to space?

That’s one of the big questions the Interplanetary Initiative is trying to understand and answer. For Artemis, the Initiative is partnering with private companies and research groups working with NASA on specific aspects of engineering and science. “We’re also working with NASA to help them create information clearinghouses to fill in the gaps of knowledge we need to make it to Artemis,” Elkins-Tanton says.

Meanwhile, about 120 individuals, including faculty members and students, are participating in 13 active projects at the Initiative, she says.

One is the Port of Mars card game, launched in 2016. It examines how people might socially respond to living on Mars.

reinvent the way research teams are built and the way education is done.”

Anyone can participate, regardless of their major or involvement at the school. The individuals who show up brainstorm the questions they believe need to be answered to improve humankind’s relationship with space exploration.

The group votes on the top 10 or so ideas, and then the members divide into teams based on

“Port of Mars is a rehearsal for the future, a social science experiment cosplaying as a game ... how do we make sure they won’t tear each other apart?”

— LANCE GHARAVI, PROJECT LEAD AND ASSOCIATE PROFESSOR, SCHOOL OF FILM, DANCE AND THEATRE, WORKING ON INTERPLANETARY INITIATIVE PROJECTS



Players participate on teams, and each round of the game is monitored by an ASU volunteer. They then use how players respond to conflict and morality questions to determine how a Mars colony might work. Team members presented at the Broto conference on art and climate change held in Massachusetts in May 2019 and are working to make the game digital.

“Port of Mars is a rehearsal for the future,” says Lance Gharavi, project lead and an associate professor in the School of Film, Dance and Theatre, “a social science experiment cosplaying as a

game ... how do we make sure they won’t tear each other apart?”

The Initiative’s project on “Five Senses in Space” is inventing a “smell engine” that will use haptic, auditory and visual systems with virtual reality to create a holodeck-like experience of space here on Earth. It also could be used in the reverse, providing an Earth-like experience for astronauts on long duration space missions. They’re also building a simulated Martian habitat.

After receiving initial seed money from the university, the project last year had three student payloads launched into space on

Blue Origin’s New Shepard rocket. Students currently are analyzing the data from the payloads, which include instruments built to capture elements of the senses in space.

Students plan to use this data on Earth to convey how space impacts the senses.

Other Interplanetary Initiative projects include:

- Rapid Response Space, focusing on growing the applications and capabilities of small space satellites.
- Space Works, creating courses that help students apply their knowledge through team-based challenges related to the



Lance Gharavi teaches Anissa Flores to play Port of Mars, a card game developed as part of the Interplanetary Initiative. It uses play to examine how people might socially respond to living on Mars, including a no-win scenario.

Interplanetary future, soon powered by a new major

Starting this August, more students will be able to participate in the Interplanetary Initiative. ASU approved a new major associated with this educational movement with 15 ASU units contributing to the curriculum. The Bachelor of Science degree also will be available online to encompass as many interested students as possible. It will take three years to complete instead of the typical four.

“They’ll learn how to solve problems intellectually and also how to solve them with their hands in a maker’s space,” says Lindy Elkins-Tanton, the Initiative’s managing director. “We have a vision of creating a critical mass of people who are problem-solvers.”

Currently, ASU is conducting practice classes in preparation for the major, with at least 100 students involved thus far. Elkins-Tanton is also lining up companies to take interns for the summer.

“This is a way of building up the ecosystem and pushing us toward the future we think will work more efficiently,” she says.

needs of NASA and the industry.

- Humans and Robotic Connection, working to create intelligent software and hardware that can assist human dexterity and cognition.

- Space Advisory, looking at how to best support a prosperous and equitable future.

“By working toward the vision of an optimistic human space future here on Earth and we make our life here on Earth better,” Elkins-Tanton says. “What we’re trying to do with Interplanetary Initiative is speed up that process for everyone.” ■

The Interplanetary Initiative is partially supported by Arizona’s Technology and Research Initiative Fund, which has enabled thousands of scientific discoveries, more than 800 patents, 280 new startup companies and hands-on training for approximately 33,000 students across Arizona’s universities. Publicly supported through voter approval, TRIF is an essential resource for growing Arizona’s economy and providing opportunities for Arizona residents to work, learn and thrive.

TERRITORIAL CUP HISTORY

Did you know the oldest rivalry trophy in college football resides in Tempe? According to legend, ASU won the first Territorial Cup on Thanksgiving Day in 1899 with an 11-2 victory against Arizona in Tucson in the first football game between the schools. But that's not entirely true, according to Robert Spindler, ASU's university archivist. Turns out ASU — then Territorial Normal School — captured the Arizona Territorial Football League Championship Cup with a 5-1-1 record, topping Arizona, Phoenix Union High School and Phoenix Indian School. However, the Territorial Cup became emblematic of the fierce rivalry between the two colleges, both founded on the same day in 1885. They have played 93 times, annually since 1946. A replica of the Cup has been awarded to the winner since 2001. ASU has won 12 of 19 times.



The original Territorial Cup, above, disappeared in 1900 for 83 years. Found again in a Tempe church, it was returned to ASU, the rightful owner.



Play like a Sun Devil®

Brandon Aiyuk shows off the Territorial Cup replica awarded to the ASU-Arizona winner — making three in a row for ASU.

ASU'S CUP RUNNETH OVER

The Territorial Cup is the No. 1 sports rivalry in North America, according to knowrivalry.com. So nothing's bigger for Sun Devil Football than beating Arizona, which they did for the third consecutive year on Nov. 30 in Tempe. "What I learned today was that emotions run high in this game," freshman quarterback Jayden Daniels said after the 24-14 victory. "It means a lot to everybody in Arizona." Junior Eno Benjamin led the way with 168 rushing yards, most in the series since 1973, and two touchdowns.

Honor roll
Sun Devil athletes excel in Barrett, The Honors College.
63

Football

Sustainability and sport

Showcasing ASU's environmental commitment, including the nation's first School of Sustainability, Sun Devil Football sported "selfless" uniforms this season. In partnership with adidas, the all-white uniforms were made with multiple sustainable processes.

Numbers

- Custom-made block numbers and nameplates on the back use less material.

Cleats

- Made from recycled material.

Color

- White color in the uniform eliminates the need for dyes.

Jersey

- More than 70% Econyl® yarn (regenerated nylon).
- Climacool technology with a body-mapping design for a refined fit.
- Sleeve design resembles Arizona's state flag and recognizes ASU's solar installations.



Frank Darby, redshirt junior wide receiver, capped a milestone season with two touchdowns in ASU's upset victory against Oregon.



"I love that Barrett provides so many opportunities to learn and grow beyond the typical college curriculum."

— OLIVIA JENKS,
TRIATHLETE AND
KINESIOLOGY MAJOR

Hitting records and the books

Sun Devil student-athletes balance the rigor of sport with the challenges of Barrett, The Honors College

The challenge of competing in triathlons wasn't enough for Olivia Jenks. She also wanted to be challenged in the classroom, so she chose Barrett, The Honors College at Arizona State University.

"I knew I wanted to challenge myself beyond the typical course load of college," says Jenks, a sophomore majoring in kinesiology. "I also wanted to be able to live with and be surrounded by other academically minded students and student-athletes. Barrett allows me to be an academic leader, while also providing a great education in smaller, more focused classes."

Jenks is among 68 student-athletes from football to water polo in Barrett, including fellow triathletes Audrey Ernst, Kira Stanley and Mckenzi Wilson.

Considered the nation's gold standard among honors colleges, Barrett's residential community has more National Merit Scholars than MIT, Duke, Brown and Stanford.

"Barrett, The Honors College is extremely proud of all of our varsity student-athletes," says Mark Jacobs, ASU vice provost and dean of Barrett. "It takes admirable focus, drive and energy."

68
student-athletes in Barrett in 2019, including students from 16 sports

4
triathlon team members in Barrett

Barrett sophomore Audrey Ernst finishes second in her division at the Women's Collegiate Triathlon 2019 National Championships at Tempe Town Lake.



Yoga participants rise with the sun in a morning class this winter in the Upper East Sideline Club as part of the LiveWell Stadium Yoga Series.

MIND-BODY PRACTICE

Different kind of workout at Sun Devil Stadium

If you can breathe, you can do yoga. In that spirit, the ASU 365 Community Union presented free yoga classes at Sun Devil Stadium in Tempe. "Yoga has beneficial effects on both physical and mental health," says John Barton, director of clinical psychology at ASU's Department of Psychology. "You can get out of the house and out of your head."

For more wellness opportunities in the stadium, see asu365communityunion.com/wellness

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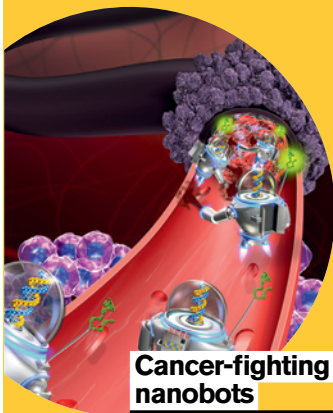
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Top 10 in the world for patents

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Cancer-fighting nanobots

ASU Biodesign Institute
Center for Molecular Design
and Biomimetrics

ASU faculty, students and alumni are leading discoveries that move our world forward. From patents and startups to new technologies and bioscience breakthroughs, our innovation mindset fuels extraordinary outcomes with global impact.



Mechanical "trees" that combat global warming

ASU Center for Negative Carbon Emissions