Arizona State University

Why Research Matters
What if...

we could **diagnose diseases** before symptoms appear?

we could **fuel our cars using algae**?

we could produce graduates with the **hands-on skills** employers need?

we could design cities in ways that **improve our health**?

we could develop techniques to **improve education** and increase our capacity to learn?

we could attract industries that **provide sustainable, high-wage jobs**?

we could **satisfy our curiosity** about the origins of the universe, life and humanity?

“**Research** is this means by which we make advancements in the way we learn a better technique, create a better solution, produce a better tool, and develop a new idea. It’s only by the conduct of research and discovery that we can move these things forward, and that’s what we’re committed to at ASU.”

– Michael M. Crow, president, ASU
On the cover: Pillars of Creation

This well-known Hubble Space Telescope image shows “pillars” of interstellar gas and dust in the process of creating new stars. The image shows the Eagle Nebula, which is located about 7,000 light years from Earth. The photo is made up of 32 different images from four different cameras and was produced by Jeff Hester and Paul Scowen of Arizona State University in 1995. It was featured on a U.S. postage stamp in 2000.

(NASA/Jeff Hester/Paul Scowen)
Why research?

This New American University is preparing for the future. A future in which research will become increasingly important in order to advance, create and share knowledge. Research is imperative for solving economic, societal and cultural challenges, ultimately improving our quality of life.

ASU is focused on expanding, advancing and enriching our current research efforts, attracting the best and brightest scholars, and leveraging our place to boost our research efforts for the betterment of our students, community and world.

““The world has changed far more in the past 100 years than in any other century in history. The reason is not political or economic but technological – technologies that flowed directly from advances in basic science.””

– Stephen Hawking
The knowledge enterprise is a new model for a 21st century research university, which conducts transdisciplinary, use-inspired, and socially embedded research. ASU pursues discovery that benefits the public good and assumes major responsibility for the economic, social and cultural vitality of the communities that surround it.

In 2002, Arizona State University embarked on a mission to create a new model of higher education – a New American University – to simultaneously increase enrollment and performance. Since then, we have torn down academic walls and forged new disciplines, more than tripled research volume, and awarded 146,000 degrees while dramatically improving academic performance and impact across the board. And we did it with speed and scale that has garnered worldwide attention.
Student success

ASU ranks 5th in the nation for best-qualified graduates, according to a Wall Street Journal survey of corporate recruiters.

Approximately 82,000 students enrolled in fall 2014
18,916 degrees awarded in the 2012–2013 academic year

“Intel hires more graduates out of ASU than any other university. They demonstrate an ability to be critical thinkers, to problem-solve, to think logically and give us a fresh look at some of the issues and challenges that we’re facing.”

— Jason Bagley, Intel

iProjects connects teams of students with outside organizations to solve real-world business challenges while giving students valuable hands-on experience. Since 2010, hundreds of iProjects innovations have resulted in approximately $3 million in IP value for sponsors.

“One of the great concepts of the iProject is that we get to take a lot of the different things that we learned in class and then apply it in real-world scenarios where we’re actually building prototypes. It’s really been a unique experience to take a little bit of theory here and a little bit of hard work here and then combine those to see what real product you can make.”

— Jason Kerestes, iProjects program
ASU undergraduate and graduate students are gaining unparalleled experience by helping to build an instrument that will fly on a NASA mission to an asteroid.

OTES, short for OSIRIS-REx Thermal Emission Spectrometer, is being built in ASU’s Interdisciplinary Science and Technology Building 4 (ISTB 4), led by scientists in the School of Earth and Space Exploration. OTES is scheduled for launch in 2016 as part of NASA’s OSIRIS-REx mission, which will rendezvous with an asteroid, survey its surface, and then collect a sample to return to Earth. OTES will play a key role in choosing the sample site.

Sharing science at ISTB 4

- Open lab spaces where visitors can see science as it happens
- 250-seat, high-definition, 3-D Marston Exploration Theater
- Gallery of Scientific Exploration with interactive exhibits and videos
- Meteorite displays
- Full-sized replica of Mars rover Curiosity
Breaking bad chemicals

TCE (trichloroethene) is an industrial solvent that has seeped into a lot of groundwater in the U.S. It also causes cancer in humans. Certain microbes, known as dehalococcoides, can break down TCE and turn it into harmless ethene. But in some cases, the microbes fail to complete the process, creating a mid-stage chemical that could be even more dangerous than TCE.

An ASU graduate student working in the Biodesign Institute discovered that some of the microbes weren’t getting enough hydrogen to complete the cycle. Nearby microorganisms were out-competing the dehalococcoides for hydrogen. The competitors were sometimes helped by people adding carbonates to raise the pH of contaminated aquifers. Optimizing carbonate levels could improve the cleanup of TCE. The results were published in the journal PLOS ONE.

The Biodesign Institute

• Received Arizona’s first platinum-level LEED certification from the U.S. Green Building Council for environmental excellence
• Represents Arizona’s single largest research infrastructure investment in the biosciences
• Named Lab of the Year by R&D Magazine
Predicting violence

Does religion turn weak groups violent? Most people intuitively know not to pick fights with more powerful opponents. But certain factors might make them more likely to take the risk. A team of ASU faculty who study social and political groups all over the world has discovered that one of those factors is religion. By focusing on two issues known to increase conflict — incompatibility of values and competition for limited resources — the researchers found that religious infusion was predictive of conflict in both cases. The findings were published in the journal Psychological Science, the highest ranked empirical journal in psychology.

“To be able to better understand why this conflict occurs and predict it beforehand increases our chances of reducing its likelihood in the future. That should be important to all of us.”

— Steven Neuberg, ASU psychology professor

New clues about cancer

Colon cancer is the second leading cause of cancer deaths in the U.S., in spite of colonoscopy screenings. Scientists have long known that inflammation is linked to colon cancer, but have not understood how. Recently, researchers in ASU’s Biodesign Institute discovered a specific gene — CXCR2 — that is involved in both tumor formation and inflammation. The results, published in the journal Cancer Cell, could help scientists develop better treatments.
The power of green

Imagine if we could turn sunlight and water into fuel for our cars and planes in the same clean, efficient way that plants use to make their own food (and ultimately, become fossil fuels). That is the goal of ASU’s BISfuel—the Energy Frontier Research Center, funded by the U.S. Department of Energy. Recently, ASU chemists at the center reported a major advance in their quest to perfect an "artificial leaf." The discovery, published in Nature Chemistry, improves efficiency from an earlier model by looking more closely at the natural process.
Getting flexible

Making electronics flexible opens up a world of possibilities – from video screens embedded in soldiers’ uniforms to X-ray detectors that can wrap around natural gas pipes to detect leaks. ASU’s Flexible Electronics and Display Center (FEDC) has produced the world’s largest flexible x-ray detector and the world’s largest flexible OLED display, using mixed oxide thin film transistors (TFTs).

- CNN cited FEDC among its top 10 ideas of 2013
- more than 40 industry partners, from small startups to large corporations
- 14 patents issued for technologies developed at FEDC

“Mixed oxide TFTs offer a highly cost-effective approach for manufacturing displays that deliver high performance, including vibrant colors, high switching speeds for video and reduced power consumption – all features that will be required for the next generation of consumer electronics.”

— Nick Colaneri, director of FEDC

Flexible Electronics and Display Center

FEDC is located in the MacroTechnology Works building at the ASU Research Park. This unique facility enables ASU to advance research in partnership with private industry. FEDC has a dedicated pilot line that mirrors industry leaders in terms of tools used and quality of products produced.
Picturing proteins

ASU scientists have developed a way to observe chemical reactions in proteins in real-time. Using this technique, an international team led by ASU produced the first-ever snapshots of photosynthesis in action. Photosynthesis is the process that plants use to make fuel from sunlight. Unlocking the secrets of photosynthesis could help us produce our own clean, renewable energy.

The images were created using the world’s most powerful X-ray laser at the Department of Energy’s SLAC National Accelerator Laboratory, through a new method called “time-resolved serial femtosecond X-ray crystallography.” The technique was lauded as one of the “top 10 breakthroughs of 2012” by the journal Science. In addition to helping us understand photosynthesis, the technique could also open up new avenues for drugs to treat diseases.

ASU is now part of a seven-university Science and Technology Center funded by $25 million from the National Science Foundation. The BioXFEL center focuses on developing this X-ray technology to analyze a vast array of molecules that could serve as drug targets.
“We have found that students retain knowledge better when they learn it with their bodies. And these motion-capture gesture-rich games have the added benefit of getting students out of their seats and moving.”

— Mina Johnson-Glenberg, associate research professor at the Learning Sciences Institute
Ideas to market

Start up, spin out, move ahead

Startup companies that have licensed ASU intellectual property received more than $68 million in venture capital funding in fiscal year 2013 and nearly $400 million in total funding from 2003 – 2013.

Three ASU spinouts, Fluidic Energy, HealthTell and Heliae, now employ more than 370 people worldwide, with 215 of those jobs currently in Arizona.

Fluidic Energy has developed a revolutionary sustainable energy storage solution, using the world’s first proven high cycle life metal air battery. Metal air technology, often used in smaller scale devices like hearing aids, has the lowest cost per electron of any rechargeable battery storage in existence. Fluidic’s technology allows utilities and other end users to store intermittent energy generated from solar and wind, as well as maintain reliable electrical delivery during power outages.

“Entrepreneurship support is embedded in every department at ASU—not just in business and engineering but also in the sciences and social sciences, arts and humanities. We challenge all our faculty and students to make their dreams into reality.”

— Mitzi Montoya, vice president and university dean for Entrepreneurship and Innovation

79 spinout companies from ASU
12 new companies formed in 2014

ASU ranks 4th in the nation for U.S. patents among universities without a medical school, after MIT, CalTech and Georgia Tech.
ASU provides a wide variety of resources to support student entrepreneurs, including academic courses, funding competitions, and training and mentorship programs. Some of our student entrepreneur successes include:

- Inc. magazine’s “Coolest College Startups” competition — winner in 2012 and finalists in 2012 and 2013
- Microsoft Imagine Cup — winners of the U.S. competition in 2011 and 2012, second-place winner in the 2011 world competition

Every 20 seconds, a child dies due to lack of clean water.

In developing countries, women and children often spend 6 hours a day fetching water. Carrying water causes health problems and keeps children out of school.

SafeSIPP

ASU engineering students have developed a water transportation and purification system that could save millions of lives in the developing world. SafeSIPP allows a person to easily transport 30 gallons of water using a rolling barrel that filters the water as it moves. SafeSIPP is a student-led startup supported by ASU’s Edson Student Entrepreneur Initiative.
Economic development

Growing green gas

The Algae Testbed Public-Private Partnership (ATP³), led by ASU, serves as a hub for research and commercialization of algae-based technologies, including biofuels. Funded by a $15 million investment from the Department of Energy, the partnership includes members from academia, government and industry. The Arizona Center for Algae Technology and Innovation (AzCATI) on ASU’s Polytechnic campus provides open test bed and evaluation facilities for ATP³.

In 2012, the governor of Arizona signed legislation that allows algaculture (the farming of algae) to be defined as agriculture on state trust lands. Additionally, land used for algaculture enjoys the same low property tax rate as agricultural land. This legislation, combined with ASU’s research expertise in the field, makes Arizona an attractive location for algae-based industry.

“Research conducted at ASU helps develop the innovative products of tomorrow, while students educated at ASU attract the best employers. ASU is nothing less than an economic powerhouse for the State of Arizona.”

— Janice K. Brewer, Arizona Governor
“Our colleges and universities play a critical role in regional economic development, ensuring that as a nation we continue to lead the world in innovation, maintain our competitive advantage, and maximize our economic prosperity.”

— Michael M. Crow, president of ASU
for innovation

State-of-the-art research facilities

ASU provides the tools and space to help researchers from academia, industry and government answer questions and develop innovative technologies. Stakeholders from Arizona and around the world rely on ASU for hundreds of tools, services and collections.
Putting an end to human trafficking

Do you think slavery exists only in history books? Think again. More than 20 million people around the world are enslaved and exploited for forced labor and prostitution. And it happens on our own soil, too. ASU faculty and students are working with law enforcement agencies to understand the factors that lead to sex trafficking in order to reduce its prevalence while helping survivors.

Cooling down hot cities

In Phoenix, summer temperatures are higher in the city than in the surrounding desert due to manmade structures, like roads and buildings, that absorb the sun's heat. This "urban heat island" effect has an impact on human health and increases water and energy use. Phoenix is just one example of cities around the world—from New York to Athens—that are struggling to manage their own heat islands.

At ASU, researchers in ecology, sociology, geography, mathematics, computer modeling, geophysics, engineering, medicine and other fields are studying the urban heat island effect from many angles. Their discoveries in the Phoenix area include:

• Neighborhoods with low socioeconomic status tend to be hotter than other parts of the city
• The heat released from air conditioners raises outdoor temperatures at night
• "Cool roofs," painted white to reflect sunlight, can affect rainfall patterns and increase heating costs in winter
• "Cool islands," such as parks with shade trees, can provide a refuge from heat
How do we make policy, economic and business decisions in the face of an uncertain future?

ASU’s Decision Theater Network provides an immersive visualization and simulation environment to guide stakeholders in the choices they make. For example, the WaterSim model allows users to gauge future water supply conditions in Phoenix in response to various climate, drought, population growth, technology and policy scenarios. The model helps ensure that we have enough water to meet our needs today and in the future.

In 2013, ASU launched a second Decision Theater at the McCain Institute for International Leadership in Washington, D.C. This node of the Decision Theater Network serves as a gateway between ASU and policy makers at the national and international level.
Working in partnership since 2003, ASU and Mayo Clinic are advancing research and education in health and biomedicine. The partnership includes joint educational programs, seed grants that incubate research collaborations, joint faculty appointments and the strategic location of ASU’s Department of Biomedical Informatics at the Mayo Clinic Scottsdale campus. These joint endeavors provide opportunities for ASU students and faculty to be embedded in clinical environments and also connect Mayo Clinic doctors and researchers to cutting-edge academic research.

The new Mayo Medical School – Arizona Campus includes a key collaboration with ASU. All students will complete a specialized master’s degree in the Science of Health Care Delivery granted by ASU, concurrently with their medical degree from Mayo Medical School.

ASU, Mayo Clinic and Mountain Park Health Center have created the Sangre por Salud Biobank, which supports studies on issues such as obesity, metabolism and diabetes that impact the health and wellbeing of Arizona’s Latino population.
ASU researchers share their ideas, discoveries and inventions in a variety of ways. These include partnering with organizations dedicated to public education, hosting local and national events, and creating stories and videos for print and web publications.
Public discussions on big questions

What does it mean to be human? [humanities.asu.edu]

How can we ensure our future survival? [sustainability.asu.edu]

Who are we and where did we come from? [origins.asu.edu]

Stories and videos of ASU’s scientists, scholars and innovators

[researchmatters.asu.edu]

Chain Reaction
Science and discovery for K-12 students and teachers

[chainreactionkids.org]
How we succeed

**Intellectual fusion**

To address the complex challenges facing our world today, ASU has altered its structure to support interdisciplinary scholarship. Academic departments are organized around challenges, not traditional disciplines. In addition, several major research institutes operate independently from academic units. These allow researchers to collaborate freely across departmental boundaries and pursue large-scale grants together.

**Entrepreneurial spirit**

Entrepreneurship permeates every aspect of the university, and opportunities are offered in and out of the classroom in all departments and schools.

“At ASU, we strive to create an ecosystem where the entrepreneurial spirit thrives, prospers and helps transform society.”

— Sethuraman “Panch” Panchanathan, senior vice president, ASU Office of Knowledge Enterprise Development
ASU is one of the fastest growing research universities in the nation with more than $400 million in research expenditures.

**Progress through partnerships**

The scale and impact of our research skyrockets when we combine forces with other organizations in the public and private sectors. ASU researchers and entrepreneurs collaborate with hundreds of organizations that include:

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Be a part of this

Get involved

• Be a student researcher
• Attend events
• Find a research collaborator
• Visit our website
• Ask questions
• Support research crowdfunding
• Participate in research studies

• Talk to us on social media
• Share your knowledge
• Sponsor a class project
• Imagine a better future
• Tour our campus
• Start a company
• Never stop learning

“I believe in innovation and that the way you get innovation is you fund research and you learn the basic facts.”

– Bill Gates

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If you’re a student.

If you’re an entrepreneur.

If you’re a changemaker.

if you’re a ________
In 1994, the Carnegie Foundation for the Advancement of Teaching designated ASU a “Research I” university for its productivity in high-quality research. Since then, our enterprise has continued to flourish, making ASU one of the fastest growing research universities in the nation and a leader in discovery and innovation.

Explore our past and recent discoveries through stories and videos at researchmatters.asu.edu