



Evidence Document

for Higher Learning Commission Reaccreditation

Document Title: Leading Change Through Research 2016

Office of Origin: Research and Economic Development

Document Summary:

The University of Arkansas is the seventh fastest growing public doctoral institution in the country, according to the *Chronicle of Higher Education*. The university enrolls more students than any other institution in the state and has consistently been recognized among the nation's best values in a college education. Federal agencies, research foundations and top industries alike turn to the university to solve problems and advance technology. The university fosters a culture of discovery and innovation that builds partnerships through expanded sponsored research agreement options, improved research funding and industry partnerships.



UNIVERSITY OF
ARKANSAS

Leading Change Through Research

2016

Jim Rankin
Vice Provost for Research and Economic Development

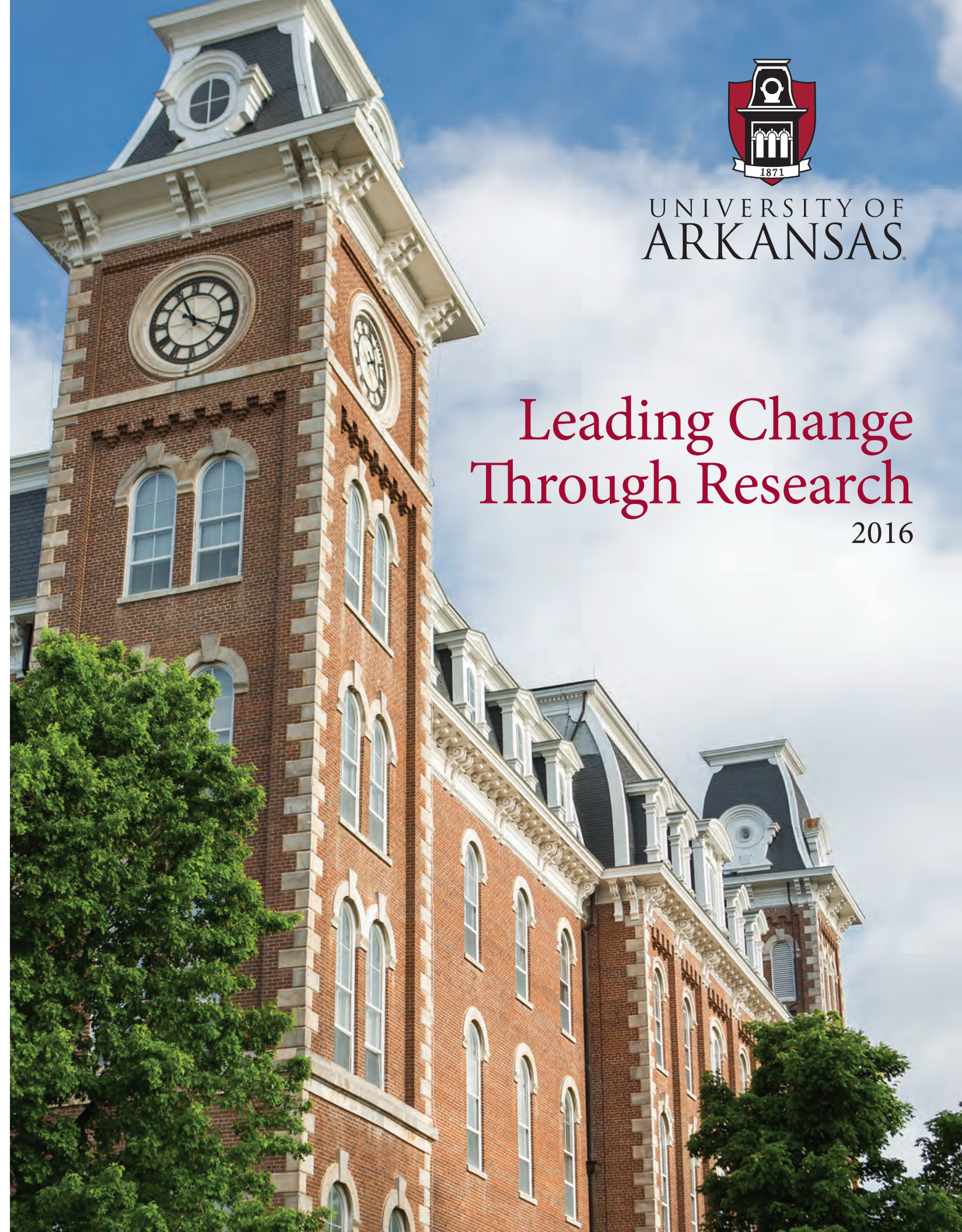
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Research.uark.edu



UNIVERSITY OF
ARKANSAS



MESSAGE FROM CHANCELLOR JOSEPH E. STEINMETZ

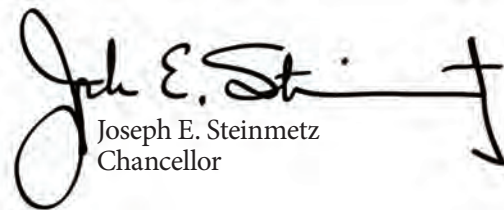


This is an exciting time to be at the University of Arkansas. As I begin my first year as chancellor, I intend to spend time listening to and learning from our campus constituencies and you. The thing that drew me to Arkansas, to this position, at this time, was the profound opportunity to help direct the future of this great institution to even greater heights. Consider some of our progress:

- Our enrollment has reached 26,754, while our student-to-faculty ratio has remained 19:1.
- The U of A is the seventh fastest growing public doctoral institution in the country, according to the *Chronicle of Higher Education*.
- In fiscal year 2015, federal research expenditures jumped to \$133.7 million, the highest ever.
- Our research awards from all sources have grown by 26 percent over the last two years. National Science Foundation funding exceeded \$11.5 million.
- The necessary complement to public support, private gifts, totaled more than \$116.5 million, creating 17 new faculty support funds and 119 new student support funds.

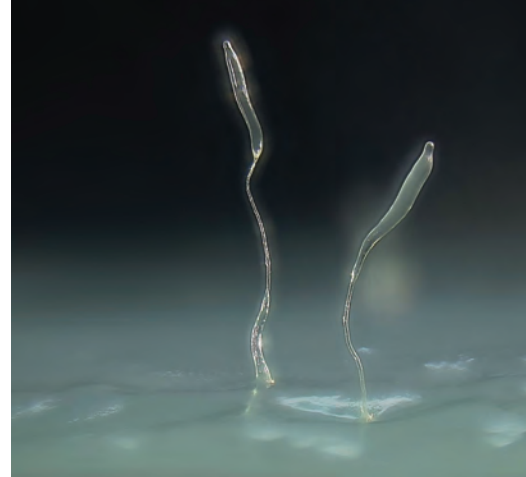
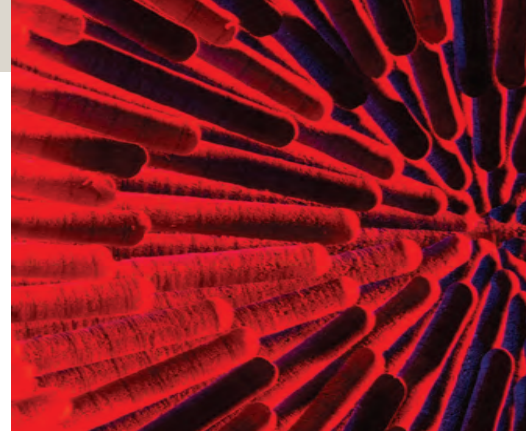
And we are now poised to continue building on that great foundation and look forward to working with you on ways in which we can continue to advance this institution – and advance Arkansas through applied research, scholarly endeavor and educating citizens.

On behalf of the University of Arkansas, I thank you for your service and support.


Joseph E. Steinmetz
Chancellor



UNIVERSITY OF
ARKANSAS



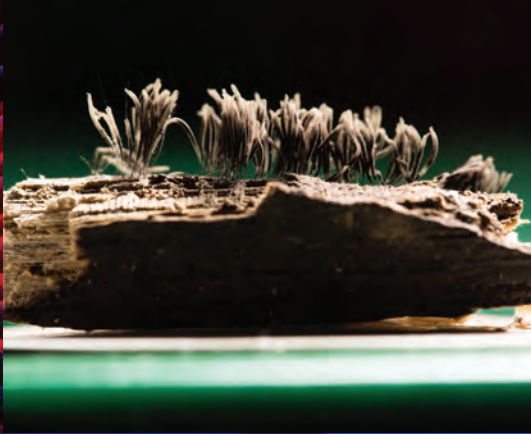
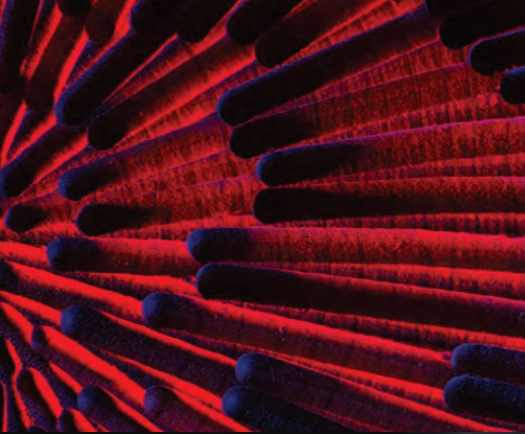


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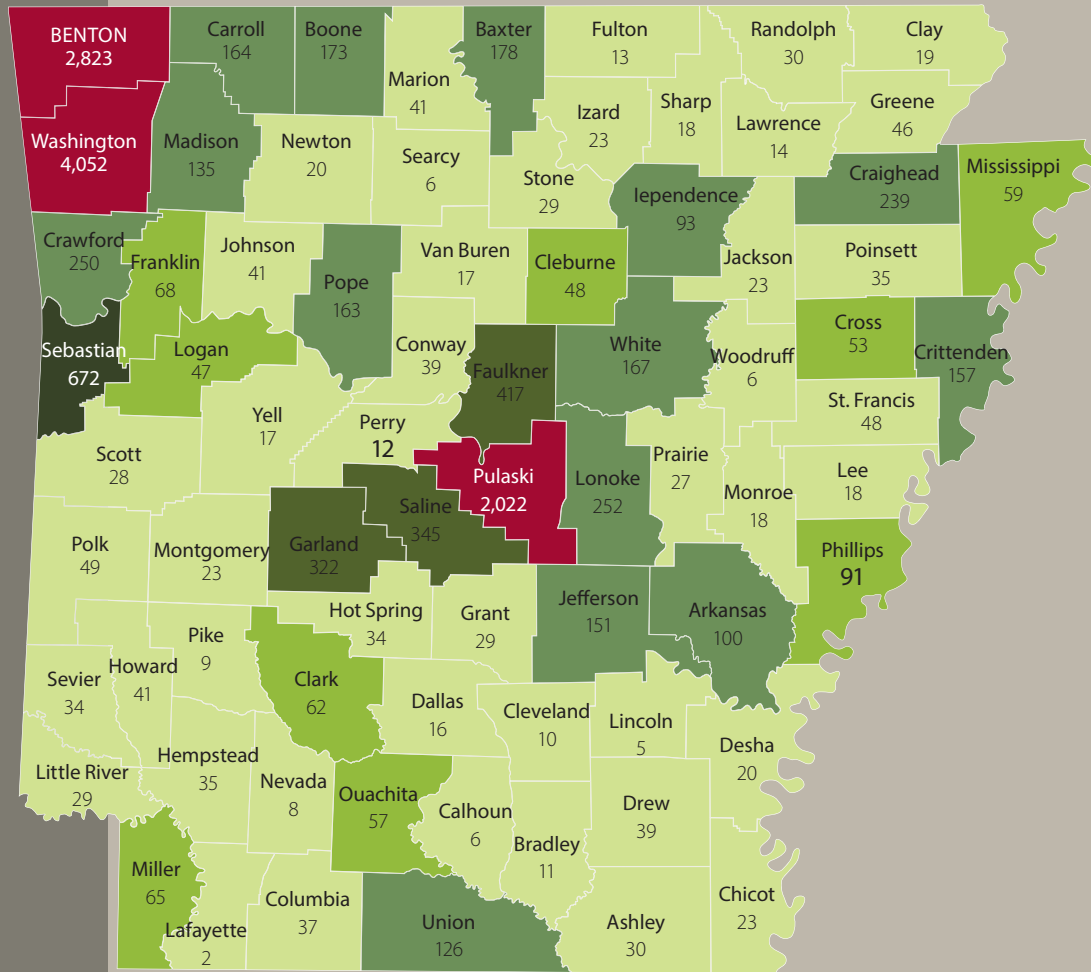
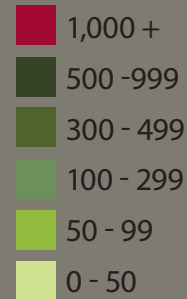
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STUDENT BODY OVERVIEW

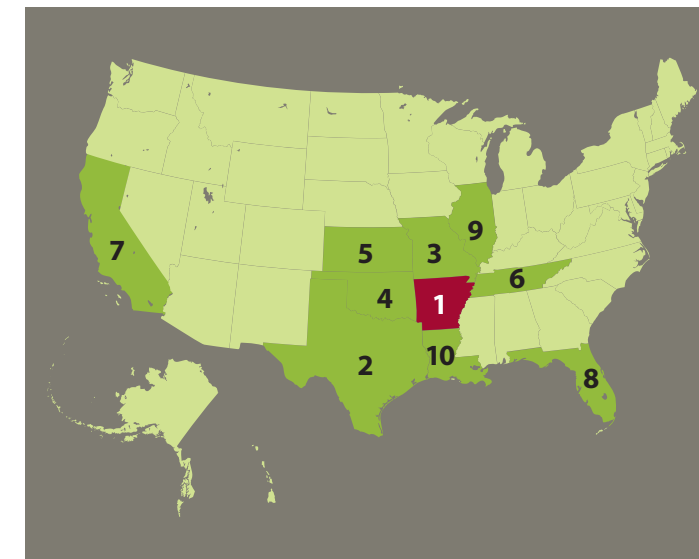
The University of Arkansas enrolls more students than any other institution in the state. Students hail from every county in Arkansas, all 50 states, and many countries. The student enrollment has grown to more than 26,000 students, with approximately 17 percent of enrollment in the Graduate School and Law School. As the state’s land-grant flagship institution, the majority — 15,237 of our students — are residents of Arkansas. The enrollment growth continues to show improvement in both academic quality and diversity of the student body. Since 2009, the percentage of freshmen with a GPA of 3.75 or higher has risen by 69 percent. Those scoring a 30 or higher on the ACT is up by 41 percent. Overall, the academic quality shows 41 percent of the freshman class has a GPA of 3.75 or higher and 17 percent scored at least a 30 on the ACT. Arkansas is tied for third in the highest percentage of high school graduates who opt to stay in state for college, according to the *Chronicle of Higher Education*.

IN-STATE ENROLLMENT BY COUNTY



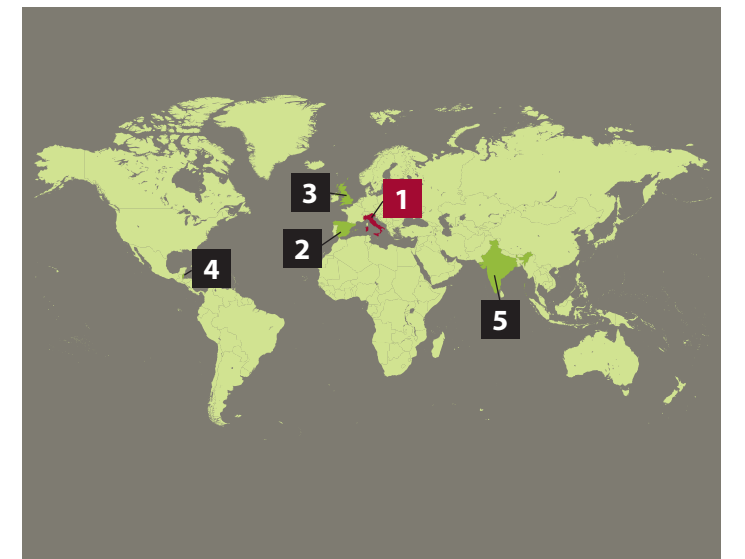
UNIVERSITY OF ARKANSAS FALL TERM 2015 ENROLLMENT BY ACADEMIC COLLEGE AND STUDENT LEVEL

Academic Unit	Dale Bumpers College of Agricultural, Food & Life Sciences	Fay Jones School of Architecture	J. William Fulbright College of Arts & Sciences	College of Education & Health Professions	College of Engineering	Sam M. Walton College of Business	School of Law	Graduate School – Interdisciplinary Programs	Correspondence Only	Total
Undergraduate	1,811	481	6,957	4,089	3,331	5,432			58	22,159
Graduate	357		913	1,321	927	446		256		4,220
Law							375			375
TOTAL	2,168	481	7,870	5,410	4,258	5,878	375	256	58	26,754



Top Enrollment States Fall 2015

- 1 **ARKANSAS** – 14,472
- 2 **Texas** – 5,095
- 3 **Missouri** – 1,605
- 4 **Oklahoma** – 1,057
- 5 **Kansas** – 713
- 6 **Tennessee** – 482
- 7 **California** – 221
- 8 **Florida** – 178
- 9 **Illinois** – 167
- 10 **Louisiana** – 152



University of Arkansas Study Abroad 2014-2015

International educational experiences through study abroad and international exchange contribute to better global citizenship. Service learning helps students gain experiences in solving real problems while helping communities. This past year, 901 students studied in 51 countries.

Top 5:

- 1 **Italy** – 198
- 2 **Spain** – 82
- 3 **England** – 72
- 4 **Belize** – 59
- 5 **India** – 45

WORKFORCE & ALUMNI FOOTPRINT

As graduates of the University of Arkansas, former students are connected to the broad alumni network across the state and the country. This important connection leads to future opportunities for the students. These University of Arkansas alumni have had a tremendous impact on the state and its 75 counties. There are 68,622 alumni living in Arkansas, accounting for 2 percent of the state's population. They earned \$2.3 billion in wages or 9.0 percent of the state's total and paid \$114.8 in state income taxes, \$54.9 million in state sales taxes, and \$11.2 million in county sales taxes.

COUNTY SALES AND USE TAX RATE PAID BY UNIVERSITY OF ARKANSAS ALUMNI

County	Sales & Use Tax Rate	Associate's Degree	Bachelor's Degree	Graduate or Professional Degree	Total
Benton	1.00%	\$13,310	\$1,021,512	\$468,628	\$1,503,450
Craighead	1.00%	\$450	\$56,455	\$46,731	\$103,636
Faulkner	0.50%	\$481	\$70,690	\$42,056	\$113,227
Garland	1.50%	\$922	\$189,228	\$86,009	\$276,158
Jefferson	1.625%	\$794	\$86,894	\$102,875	\$190,563
Pulaski	1.00%	\$5,309	\$1,050,765	\$581,055	\$1,637,128
Sebastian	1.25%	\$1,403	\$392,101	\$264,021	\$657,525
Washington	1.25%	\$28,316	\$2,201,988	\$1,278,954	\$3,509,257
White	1.50%	\$90	\$72,003	\$49,557	\$121,651
Other 65 Counties	1.75%	\$11,148	\$1,847,140	\$1,226,066	\$3,084,353
Arkansas Total		\$62,222	\$6,988,776	\$4,145,952	\$11,196,949

Source: Center for Business and Economic Research

ESTIMATED STATE INCOME TAXES PAID BY UNIVERSITY OF ARKANSAS ALUMNI

County	Associate's Degree	Bachelor's Degree	Graduate or Professional Degree	Total
Benton	\$131,754	\$13,254,289	\$6,419,227	\$19,805,271
Craighead	\$3,981	\$595,749	\$611,497	\$1,211,227
Faulkner	\$9,177	\$1,680,838	\$1,106,118	\$2,796,134
Garland	\$5,107	\$1,550,847	\$752,341	\$2,308,295
Jefferson	\$4,534	\$631,705	\$790,378	\$1,426,616
Pulaski	\$51,067	\$12,445,174	\$7,813,847	\$20,310,087
Saline	\$14,036	\$1,689,156	\$903,410	\$2,606,601
Sebastian	\$10,448	\$3,876,406	\$2,854,200	\$6,741,055
Washington	\$214,689	\$21,325,989	\$13,479,354	\$35,020,032
White	\$573	\$561,488	\$426,608	\$988,668
Other 65 Counties	\$58,776	\$12,349,095	\$9,161,358	\$21,569,229
Arkansas Total	\$504,142	\$69,960,736	\$44,318,338	\$114,783,216

Source: Center for Business and Economic Research Estimates

ALUMNI IMPACT SPOTLIGHT

Thousands of Arkansas alumni hold key leadership positions in major business and industry across the state and nation. University of Arkansas alumni hold senior leadership posts at every Fortune 500 company in the state, including Walmart, J.B. Hunt Transport Services Inc., Tyson Foods, Inc., Murphy Oil Co., Windstream Corp., and more.

Doug McMillon
President and CEO
Wal-Mart Stores Inc.
B.S.B.A. in Accounting, 1989

John N. Roberts III
President and CEO
J.B. Hunt Transport Services, Inc.
B.S.B.A. in Marketing, 1988

William T. Dillard II
Chairman and CEO
Dillard's, Inc.
B.S.B.A. in Accounting, 1966

Ann Bordelon
CFO
Walmart Asia
B.S.B.A. in Accounting and Computer Information Systems, 1989

Gerald Alley
President and CEO
Con-Real and The Alley Group
B.S.B.A. in Finance, 1973

Clete Brewer
Chairman and CEO
BlueInGreen, LLC
B.S.B.A. in Finance, 1987

Ron Tucker
CEO
Baldor Electric
MBA, 1983

Ruben Martin
CEO
Martin Resources Management
B.S. in Industrial Management, 1974

Jennifer Robinson
CAO and Controller
Michaels Stores Inc.
MBA, 2013

Robert A. Sauerberg Jr.
President
Conde Nast
B.S.B.A. in Finance, 1983

John Bracken
President and Managing Partner
Blistex Bracken LLC
B.S.B.A. in Finance, 1983

Scott T. Ford
Former President and CEO
Alltel
B.S.B.A. in Finance, 1984

Steve Clark
Co-founder, Rockfish Interactive
Founder and Chairman, Noble Impact
Owner and President, Propak, Inc.
B.S.B.A. in Finance, 1986

Samuel T. Sicard
President and CEO
First National Bank, Fort Smith
B.S.B.A. in Finance, 1998

Jim Williams
President
Landplan Development Corporation
B.S.B.A., 1967

Jerry Jones
Owner and General Manager
Dallas Cowboys
B.S.B.A., 1965

Jerry C. Jones
Chief Ethics and Legal Officer
Axiom
B.S.P.A., 1977

Larry Crain, Sr.
President and Chairman
Crain Management Group
B.S.B.A., 1963

Joe T. Ford
Founder and former CEO
Alltel
B.S.B.A., 1959

Sonja Hubbard
CEO
E-Z Mart Stores Inc.
B.S.B.A. in Accounting, 1986

Mary Ann Greenwood
Chairman
Greenwood Gearhart Inc.
B.S.B.A. in Finance, 1962 and Ph.D. in Economics, 1979

Lisa Barrentine
CEO
First Preston HT
B.S.B.A. in Accounting, 1986

Janet Ryan Stegall
Managing Director
U.S. Trust
B.S.B.A. in Accounting, 1988

Darrell Chambliss
Executive VP and COO
Waste Connections
B.S.B.A. in Transportation, 1986

Charles Baldwin
CAO
Cabela's
B.S.B.A. in Management, 1991

Craig Hughes
CEO
Total Transit
B.S.B.A. in Marketing and Transportation, 1976

James Moneyhun
CFO
Quality Business Systems
MBA, 2004

Reynie Rutledge
Chairman, President and CEO
First Security Bancorp
MBA, 1973

Lee Bodenhamer
President (retired)
Centennial Consulting
B.S.B.A. in Accounting, 1957 and MBA, 1961

John Reap
President and CEO (retired)
Town North Bank, NA
B.S.B.A. in Finance, 1970

Wes Kemp
President and CEO (retired)
ABF Freight System, Inc.
B.S.B.A. in Management, 1969

Heather Nelson
President and COO
SEAL Corporation
B.S.B.A. in Marketing Management, 1994

Frank Fletcher Jr.
Chairman, CEO and Owner
Frank Fletcher and Associates, Inc.
B.S.B.A. in Marketing, 1963

George Stasick
Former CEO and Executive Advisor
SalonQuest
B.S.B.A. in Marketing, 1971

Joe T. Hays
Founder and Managing Director
Diamond State Ventures
B.S.B.A. in Finance, 1981

Bill Underwood
Chairman
Underwood's Fine Jewelers
B.S.B.A., 1961

J. Stephen Lauck
President and CEO
Ashfield Capital Partners
B.S.B.A. in Finance, 1967

Tobi Fairley
Principal and CEO
Tobi Fairley Interior Design
MBA, 2000

Ken Shollmier
CEO (retired)
Shollmier Distributing, Inc.
B.S.B.A., 1963

Coleman Sisson
Chairman and CEO
BubbleUp, Ltd.
B.S.B.A. in Data Processing and Quantitative Analysis, 1979

Walter V. Smiley
Chairman
Smiley Investment Company
B.S. in Industrial Management, 1963 and MBA, 1964

George W. Edwards
President and CEO (retired)
Kansas City Southern Railroad
B.S.B.A. in General Business, 1962

Carl S. Rosenbaum
Chairman
Safe Foods Corporation
B.S.B.A., 1956

J. Thomas May
Chairman and CEO (retired)
Simmons First National Corporation
B.S.B.A. in Finance, 1972 and MBA, 1973

Ryan Frazier
CEO
DataRank
B.S.B.A. in international business and marketing, 2010

ACCESSING A GREAT EDUCATION

The University of Arkansas has consistently been recognized among the nation's best values in a college education. Kiplinger, Forbes, the Princeton Review and other external ranking organizations, including the White House Online College Scorecard, continue to rate the U of A highly for return on investment, tuition costs, graduation rates, loan default rates, and the average amount borrowed by students.

Among the peer Southeastern Conference plus eight benchmark schools highlighted below, tuition at the U of A falls beneath both the average and the median cost for in-state and out-of-state students.

SEC+ 8 PEER TUITION 2014-15

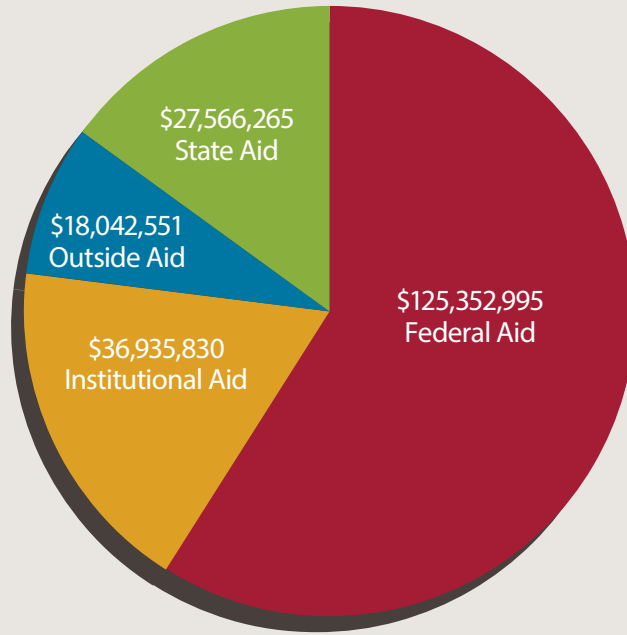
	Resident	Non-Resident
University of Arkansas	\$8,210	\$20,300
Average	\$11,362	\$25,820
Median	\$9,826	\$26,099
Vanderbilt University*	\$43,838	n/a
Clemson University	\$13,446	\$31,462
University of Tennessee	\$11,876	\$30,326
University of South Carolina	\$11,158	\$29,440
University of Georgia	\$10,836	\$29,046
University of Kentucky	\$10,616	\$22,888
University of Kansas	\$10,448	\$25,731
Auburn University	\$10,200	\$27,384
University of Texas at Austin	\$9,830	\$34,836
University of Alabama	\$9,826	\$24,950
Texas A & M University	\$9,685	\$26,583
University of Oklahoma	\$9,495	\$22,269
University of Missouri	\$9,433	\$24,460
Louisiana State University	\$8,750	\$26,467
University of Arkansas	\$8,210	\$20,300
University of Nebraska	\$8,170	\$22,090
Iowa State University	\$7,731	\$20,617
Mississippi State University	\$7,140	\$18,478
University of Mississippi	\$7,096	\$19,144
University of Florida	\$6,313	\$28,591

* = Private Institution

Undergraduate Student Financial Aid

69% of University of Arkansas students received some type of financial aid during the 2014-15 academic year. The university administered more than \$207 million in aid to a total of 18,113 students during the 2014-2015 academic year.

\$207,897,641 Total



The average amount of federal financial aid grants:

\$4,414

(2013-2014)

State program funding received by U of A students totaled:

\$27,566,265

The University of Arkansas' three-year default rate:

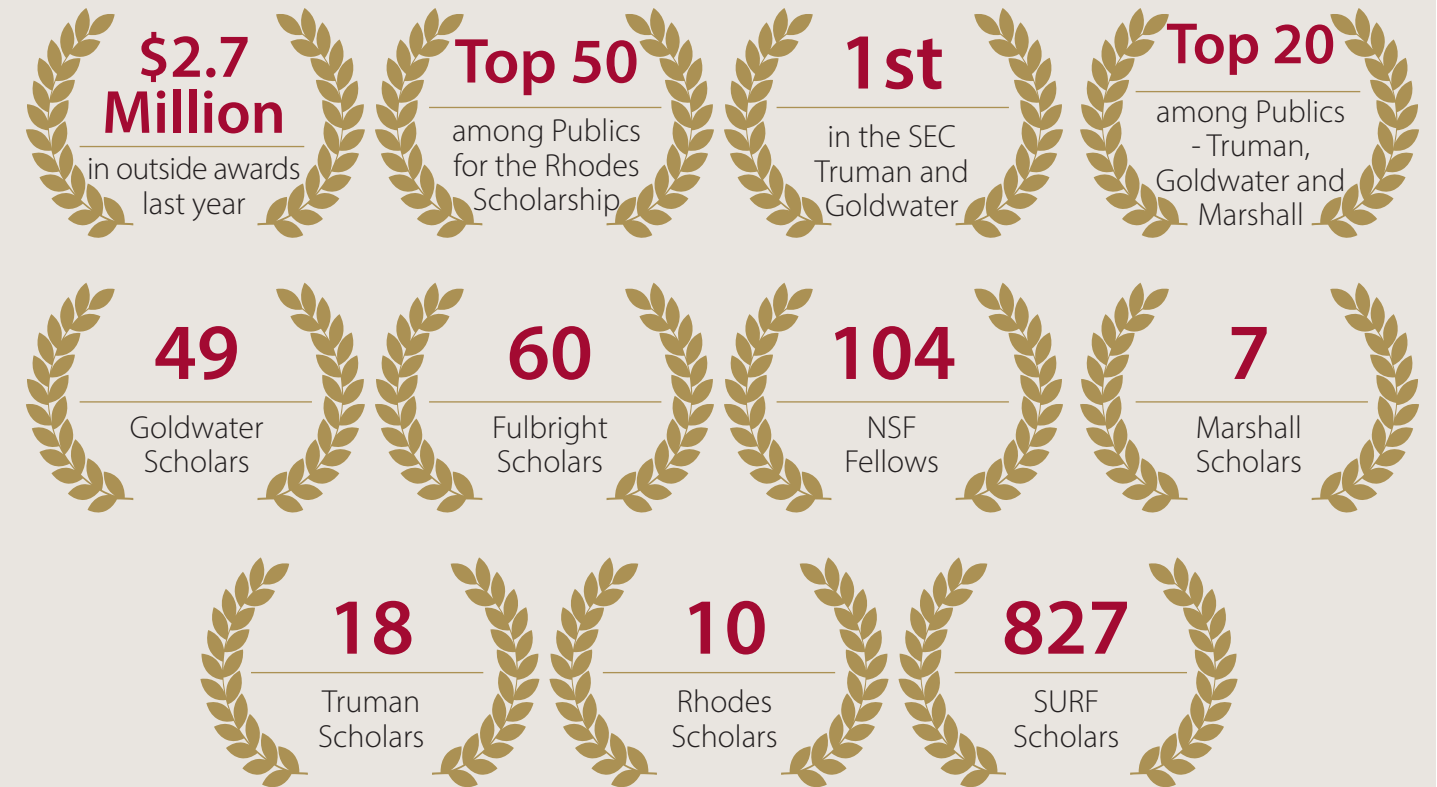
6.3%

(National average 11.8%)

GRANT AID – FUNDS THAT DO NOT HAVE TO BE PAID BACK

Type of Aid	Amount
Federal Pell Grant	\$20,906,585
Federal Supplemental Educational Opportunity Grant	\$936,753
State Workforce Improvement Grant	\$162,912
State Higher Educational Opportunities Grant	\$485,930
Other	\$1,706,350
Total	\$24,198,530

NATIONALLY COMPETITIVE AWARDS



INSTITUTIONAL FINANCIAL PROFILE

The University of Arkansas is nationally recognized for its innovative and groundbreaking research across all disciplines. That is why the Carnegie Foundation classified it among the top research universities for research and scholarly productivity, placing the U of A among just two percent of the nation's colleges and universities.

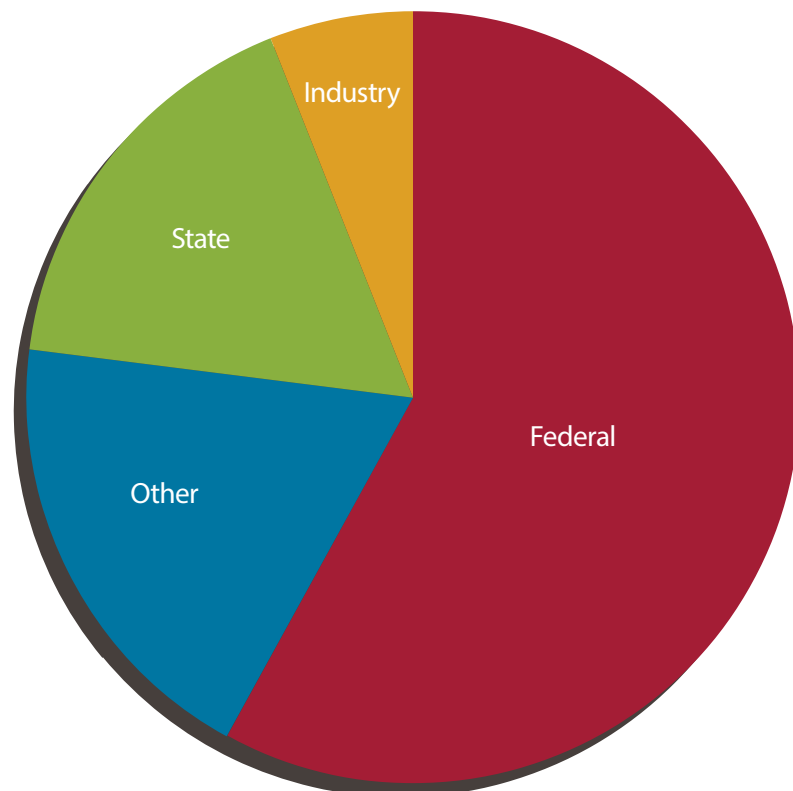
With more than 50 research centers and interdisciplinary flexibility, the U of A is positioned to continue to push research boundaries with innovative research funded through both the public and private sectors as well as through industry partnerships. The university supports researchers through development with its unique Technology Ventures program, which supports commercialization of research discoveries to bolster Arkansas' knowledge-based economy and facilitate the practical application of new technology in the marketplace.

TOP RESEARCH SPONSORS FY15

Federal	State	Industry
U.S. Dept. of Education \$12,211,543	Ark. Department of Education \$7,333,403	Dell, Inc. \$301,000
National Science Foundation \$11,511,268	Ark. Biosciences Institute \$7,333,403	MAST \$298,920
U.S. Dept. of Health and Human Services \$6,773,135	Ark. Department of Human Services \$1,129,965	Flexible Water Solutions \$151,801
U.S. Department of Agriculture \$5,159,798	Ark. Natural & Cultural Resources Council \$1,042,000	Arvest Bank \$145,664

RESEARCH DOLLARS FY15: FEDERAL AND NON-APPROPRIATED STATE NUMBERS

Federal	\$46,100,987
Other	\$15,138,939
State	\$13,600,943
Industry	\$4,914,116
Total	\$79,754,985



U OF A RESEARCH CENTERS AND INSTITUTES

The University of Arkansas is home to 52 research centers and institutes focused on advancing technology, improving education and bettering our world. The centers and institutes were established through federal, state and private funds to provide research and service to the campus, region, state and nation. The collaborative nature of our centers and institutes and the unique equipment and faculty expertise provide a strong environment for public service, industry partnership and innovation.

Arkansas Center for Space & Planetary Sciences
<http://spacecenter.uark.edu>

Arkansas High Performance Computing Center
<http://hpc.uark.edu/hpc/>

Arkansas Water Resources Center
<http://arkansas-water-center.uark.edu/>

Bessie Boehm Moore Center for Economic Education
<http://bmcee.uark.edu/>

Center for Advanced Computing & Communications Research

Center for Advanced Spatial Technologies
<http://cast.uark.edu/>

Center for Arkansas & Regional Studies
<http://www.uark.edu/misc/carsinfo/>

Center for Business and Economic Research
<http://cber.uark.edu/>

Center for Communication and Media Research
<http://communication.uark.edu/7618.php>

Center for Children and Youth
<http://catalog.uark.edu/generalinfo/universitycentersandresearchunits/centerforchildrenandyouth/>

Center for Excellence in Logistics and Distribution (CELDi)
<http://celdi.org/>

Center for Executive Education
<http://execed.uark.edu/>

Center for Grid-Connected Advanced Power Electronic Systems (GRAPES)
<https://grapes.uark.edu/>

Center for Information Security and Reliability
<http://isr.csce.uark.edu/>

Center for Innovation in Healthcare Logistics
<http://cihl.uark.edu/>

Center for Mathematics and Science Education (CMASE)
<http://cmase.uark.edu/>

Center for Protein Structure and Function
<http://fulbright.uark.edu/departments/chemistry/research/center-for-protein-and-structure/>

Center for Retailing Excellence
<http://cre.uark.edu/>

Center for Social Research

Center for Statistical Research and Consulting
http://www.uark.edu/ua/csrc/CSRC/Welcome_.html

Center for Study of Representation

Center for Utilization of Rehabilitation Resources for Education, Networking, Training, and Service (CURRENTS)

Center of Excellence for Nano-, Micro-, and Neuro-Electronics, Sensors, and Systems (CENNESS)

Center of Excellence for Poultry Science
<http://www.poultryscience.uark.edu/>

Chemical Hazards Research Center
<http://chemical-hazards-research.uark.edu/index.php>

Community and Family Institute
<http://fulbright.uark.edu/departments/sociology/community-and-family-institute/>

Community Design Center
<http://uacdc.uark.edu/>

David and Barbara Pryor Center for Arkansas Oral and Visual History
<http://pryorcenter.uark.edu/>

Diane D. Blair Center of Southern Politics and Society
<http://blaircenter.uark.edu/>

Enhanced Learning Center
<http://class.uark.edu/>

Garrison Financial Institute
<http://gfi.uark.edu/>

Garvan Woodland Gardens
<http://www.garvangardens.org/>

Genesis Technology Incubator
<http://www.uark.edu/ua/artp/genesis.html>

High Density Electronics Center
<http://high-density-electronics.uark.edu/>

Human Performance Laboratory
[http://hpl.uark.edu/index.php/Information Technology Research Institute](http://hpl.uark.edu/index.php/Information%20Technology%20Research%20Institute)
<http://itri.uark.edu/>

Institute for Nanoscience and Engineering
<https://nano.uark.edu/>

Institute of Food Science and Engineering
<http://www.uark.edu/depts/ifse/>

International Center for the Study of Early Asian and Middle Eastern Musics
<http://www.uark.edu/ua/eeam/>

King Fahd Center for Middle East and Islamic Studies
<http://mest.uark.edu/>

Mack-Blackwell Transportation Center
<http://mack-blackwell.uark.edu/>

National Agricultural Law Center
<http://nationalaglawcenter.org/>

National Center for Reliable Electric Power Transmission (NCREPT)
<http://ncrept.uark.edu/>

National Office for Research on Measurement and Evaluation Systems (NORMES)
<http://catalog.uark.edu/generalinfo/universitycentersandresearchunits/normes/>

Office for Studies on Aging
<http://osoa.uark.edu/>

Office for Education Policy
<http://www.officeforeducationpolicy.org/>

Quality Writing Center
<http://class.uark.edu/>

Small Business and Technology Development Center
<http://sbtcdc.uark.edu/>

Southwest Radiation Calibration Center

Supply Chain Management Research Center
<http://scmr.uark.edu/>

Terrorism Research Center
<http://trc.uark.edu/>

Tyson Center for Faith and Spirituality in the Workplace
<http://tfsu.uark.edu/>

CHANGING OUR WORLD FOR THE BETTER

Federal agencies, research foundations and top industries alike turn to the University of Arkansas to solve problems and advance technology. When the Department of Energy needed someone to bolster the national power grid against cyber attack, it looked to U of A electrical engineer Alan Mantooth and his National Center for Reliable Electric Power Transmission. Toyota came to the U of A as well to improve the power of its electric cars. Biomedical engineer David Zaharoff is advancing the fight against bladder cancer, having harnessed the key to eradicating cancerous bladder tumors in mice. Physicists are finding the next generation of semiconductors with 2D layers of graphene while others are working on life-saving drugs and ways to prevent and treat traumatic brain injury. Researchers at the U of A are changing lives and leading change every day.

NATIONAL CENTER FOR RELIABLE ELECTRIC POWER TRANSMISSION

The Department of Energy and the National Science Foundation rely on researchers at the University of Arkansas' National Center for Reliable Electric Power Transmission (NCREPT) to solve the nation's power issues and find new and efficient ways to meet the every-increasing demand for energy and reliable electric power.

NCREPT is the highest-powered power electronics test facility at any university in the United States. The \$5-million power center operates within a 7,000-square-foot building located at the Arkansas Research and Technology Park in south Fayetteville. The center was established and operates through grants from the U.S. Department of Energy, the National Science Foundation and the University of Arkansas.

The center, which recently received a \$12.2 million award from the Department of Energy to focus on cybersecurity for the nation's power grid, is synonymous with Alan Mantooth, Distinguished Professor of electrical engineering. As executive director of the center, Mantooth is an internationally known researcher who has overseen more than \$60 million in research funding from the Department of Energy, the National Science Foundation, NASA, the Defense Advanced Research Projects Agency, the Office of Naval Research and more than 50 companies.







Within the NCREPT test facility, up to six-megawatts of electricity — enough to power more than 300 homes — can be harnessed to simulate the electrical grid and test the performance and reliability of power electronic devices



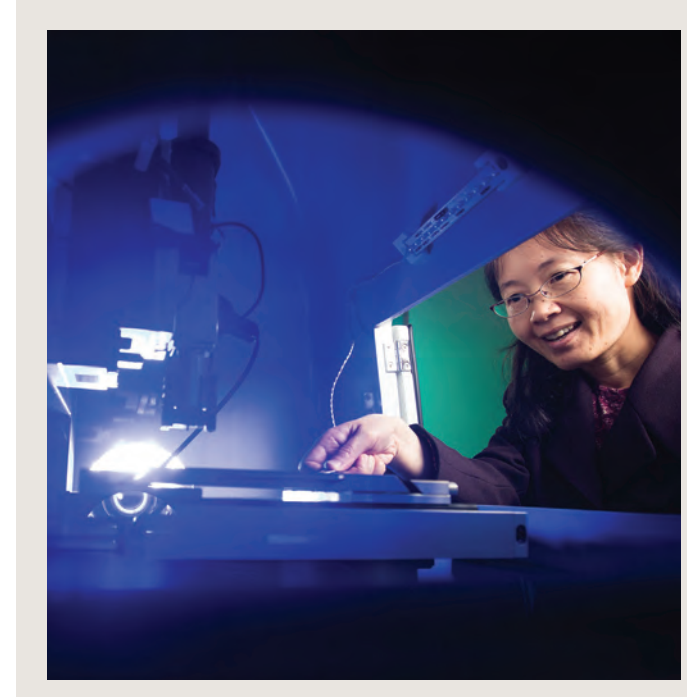
such as chargers for electric vehicles and safety devices for the power grid. Toyota has relied on NCREPT for several years to work on improvements for the Prius power system. The center's goal is to develop and accelerate power electronics technologies for the electric power grid and to serve as a resource for researchers and industry.

Projects completed at the center include a high-temperature silicon carbide power module, which won an R&D 100 award from *R&D Magazine* in 2009; a fault current limiter, a device that can prevent blackouts; and a charger for electric vehicles. Researchers also completed a design of integrated circuits that can survive at temperatures greater than 350 degrees Celsius – or roughly 660 degrees Fahrenheit. – which will improve the functioning of processors, drivers, controllers and other analog and digital circuits used in power electronics, automobiles and aerospace equipment.

UNIVERSITY OF ARKANSAS TRANSDISCIPLINARY RESEARCH STRENGTHS

 HEALTH	 NANO-TECHNOLOGY	 ENERGY AND THE ENVIRONMENT	 AMERICAN ART, ARCHITECTURE & HUMANITIES	 FOOD SAFETY	 SUPPLY CHAIN, RETAIL & TRANSPORTATION
Includes biomedical devices, chronic diseases, wellness, health care delivery and health care policy.	Includes materials growth and characterization, microelectronics -photonics and theoretical modeling.	Includes power electronics, smart grid, renewable energy sources, and environmental sciences.	Includes art history, American Art, sustainable community design, Civil War history, history of the West.	Includes foodborne <i>Salmonella</i> , pathogenic <i>E. Coli</i> , meat processing and handling and agricultural law.	Includes retail supply chain logistics and management, global retail operations and consumer sciences.

- HIGH PERFORMANCE COMPUTING** Arkansas High Performance Computing Center assists biologists, physicists, geoscientists, mathematicians and others with projects requiring super computers.
- ENTREPRENEURSHIP** Office of Entrepreneurship promotes entrepreneurial activities at the university and across the state, including through award-winning graduate business plan teams.
- INTERNATIONAL RELATIONS/ GLOBAL OUTREACH** University of Sen J. William Fulbright, immersive global experiences, enriched by international students and faculty, research is engaged in solving world challenges, and facilitating trade.
- SUSTAINABILITY** Office for Sustainability tracks and reports campus performance in sustainability and raises awareness of sustainable practices.



CENTER FOR ADVANCED SURFACE ENGINEERING

Working with silicon and other nanomaterials, University of Arkansas mechanical engineering professor Min Zou specializes in texturing material surfaces of commercial products and electro-mechanical systems on the molecular level to reduce friction and improve energy efficiency. Her work is contributing to improvements in electronic devices, human tissue engineering and even skillets coated with polytetrafluoroethylene, the polymer commonly known as Teflon.

“That’s a big, scary word,” says Zou, an internationally recognized scholar in surface engineering. “But it is pretty simple, really. Polytetrafluoroethylene is a material layer or coating – we call it a film – that essentially does not stick and is hydrophobic, meaning it repels water. Our goal is to make it even more water repellent.”

Continued on Page 12

Zou led a team of researchers who discovered a way to do exactly that, to make Teflon even more slippery. They treated thin films of the polymer with copper nanoparticles and found that the lubricating material significantly reduced wear while achieving a lower level of friction.

Her work led the National Science Foundation in 2015 to award a \$24 million grant to establish the Center for Advanced Surface Engineering and lead an interdisciplinary team from multiple institutions in continuation of her research. The grant enables the University of Arkansas to partner with industries and create new products for manufacturing, aerospace, defense, agriculture, oil and gas, food packaging and healthcare.

As part of the NSF's Experimental Program to Stimulate Competitive Research, or EPSCoR, the center will establish start-up companies to commercialize technologies developed by its researchers and create new products and jobs.

Also in 2015, Zou received another \$438,317 grant from NSF to identify the fundamental deformation mechanisms of a new type of nano-scale material discovered by her research team. One of her previous discoveries — a nanoparticle coating for glass that makes it self-cleaning and anti-fogging — is under commercial development for use on solar cells in solar panels.

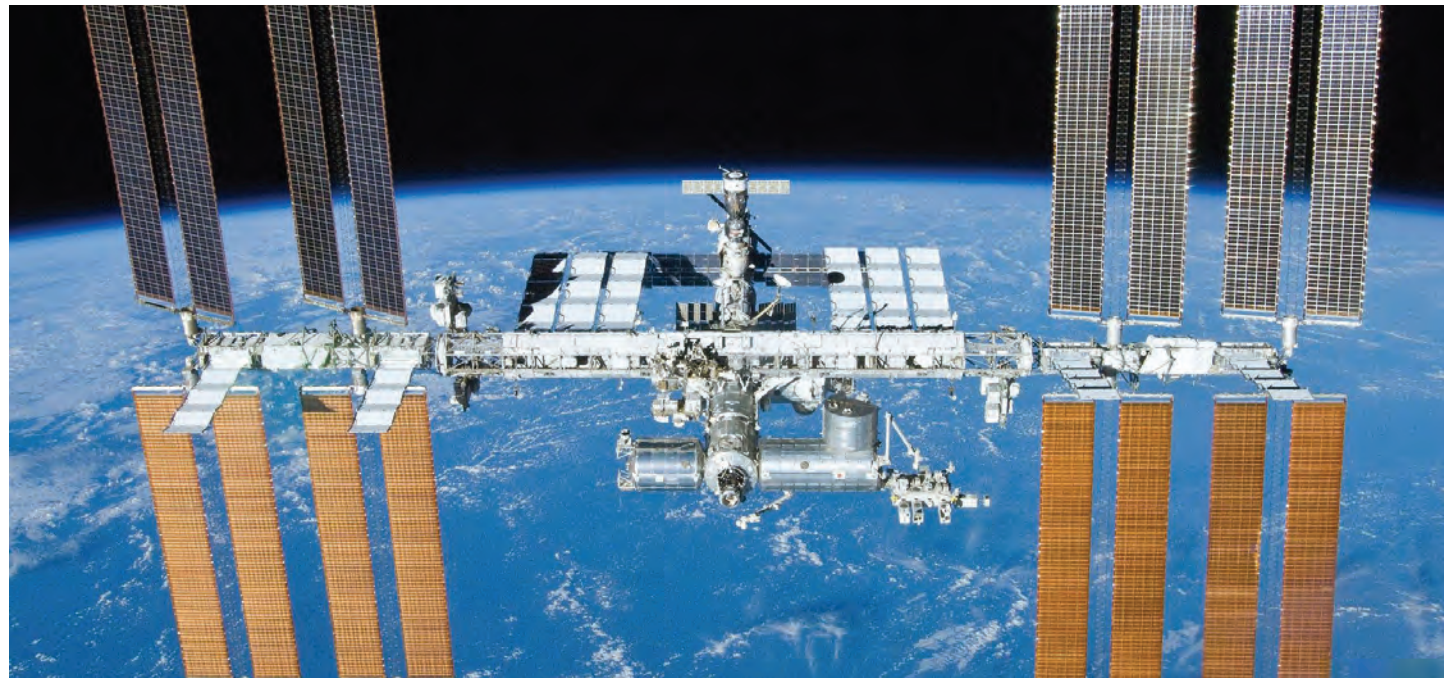


Photo by NASA

CENTER FOR SPACE AND PLANETARY SCIENCES

The University of Arkansas' W.M. Keck Laboratory for Planetary Simulations has drawn researchers from across the nation to conduct astro-biological research and planetary geomorphology. It has also been a primary tool used by researchers like the U of A's Vincent Chevrier in his research on the possibility of life and water on Mars. This year alone he has received four NASA grants totaling more than \$1.4 million to study environmental conditions on Venus, Mars and Saturn's largest moon, Titan. He is also researching whether microbes traveling on spacecraft from Earth could inhabit and contaminate Mars.

In 2012 Chevrier published a research article that explained how water could have produced various flow patterns seen

by a spacecraft orbiting Mars. Then, in 2015, after analyzing data collected on Mars by NASA's Curiosity rover, Chevrier and a former doctoral student, now a scientist at the Arecibo Observatory in Puerto Rico, published an article in Nature Geoscience explaining that water, in the form of brine, may exist on certain conditions on the surface of Mars.

Instrument design for simulation chambers, future missions and cube satellites comprise engineering aspects of the center's research. A large astrophysical program of the center, called AGES, correlates galaxy structure with central black-hole mass and conducts studies on active galactic nuclei, binary star systems and other astrophysical problems.

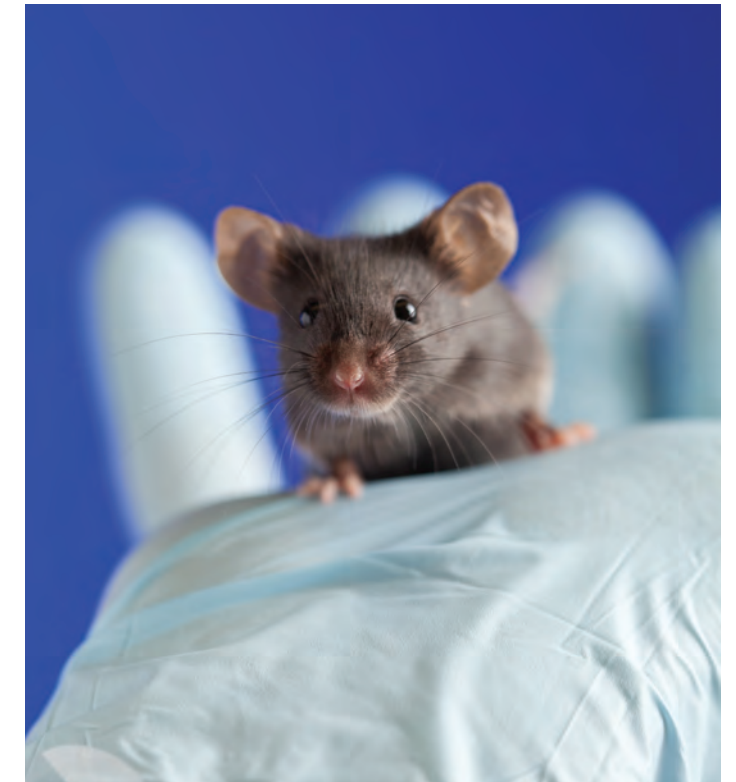
FOCUS ON HEALTH

Since establishing a department of biomedical engineering in 2012, the University of Arkansas has become a leader in healthcare research. Biomedical and biochemical engineers are working on treatments for cancer, diabetes, heart disease, neurodegenerative disorders like Alzheimers and chronic wounds.

Associate professor David Zaharoff is developing a treatment for bladder cancer with the help of \$3 million in federal and state grants and \$2 million from the National Cancer Institute. As the first engineer ever to work in the tumor immunology and biology lab at the National Cancer Institute, Zaharoff eradicated bladder tumors in mice after he treated them with his development of chitosan and IL-12. Today, scientists in his lab are refining this initial discovery to develop a drug that a pharmaceutical company can shepherd through clinical trials and commercialize.

Researchers in Zaharoff's lab work are also working with biopolymers, hydrogels and other biomaterials that produce an immune response to develop a post-surgical vaccine to prevent the recurrence of breast cancer. Once developed, this type of therapy would be "personalized," says Zaharoff, because the vaccine would consist of cancer cells taken from the patient's excised tumor. These cells would then be isolated and inactivated before being reintroduced into the patient, along with the delivery of other immune stimulating material.

Zaharoff is also collaborating with Suresh Kumar, associate professor of biochemistry, to develop new molecules and biopharmaceuticals that enhance a patient's immune response against cancerous tumors. The goal of this project is to help clinicians attack hidden metastatic tumors and prevent cancer recurrence.



Other recent discoveries include chemistry professor Julie Stenken's work studying chemical brain signaling associated with Alzheimer's with a grant from the National Institutes of Health. Stenken has also developed a way to slow the body's immune response to foreign bodies, which helps prolong the life of implanted glucose monitors in diabetics. And Joshua Sakon, associate professor of chemistry and biochemistry developed a treatment for osteoporosis and a treatment for baldness. Both developments have been patented and are in commercialization.



U.S. Air Force photo by Airman 1st Class Nadine Y. Barclay

HARNESSING THE POWER OF THE SUN

Discovery of better solar cell technology at the University of Arkansas is considered the largest technology leap in solar-cell efficiency since 1974. That discovery is moving toward commercial production with Picasolar, a new start-up company. That research started in a laboratory run by U of A electrical engineering professor Hameed Naseem.

For the past 25 years, Naseem and his graduate students have found ways to increase sunlight-to-electricity conversion efficiency and reduce the cost of expensive materials needed for solar-cell production. These technological breakthroughs will decrease cost-per-watt

Continued on Page 14

production of solar electricity to a point at which it can compete with traditional, fossil-fuel-based methods. This is critical because a goal of the U.S. Department of Energy is for solar power to provide 14 percent of America's electricity by 2030 and 27 percent by 2050.

The key to doing this is to make solar cells more efficient and reduce solar cell manufacturing costs so they can compete with fossil fuel production. Naseem focuses on the refinement and improvement of solar cells for a process called photovoltaic power generation, which uses semiconductors and solar cells constructed of silicon, the second-most abundant material in the earth's crust.

Naseem developed a process known as top-down aluminum-induced crystallization, which creates poly-silicon with crystal grains 30 times larger than grains currently produced in the photovoltaic industry, reducing the seams between crystals and associated defects.

Since 2009, two companies have started as a result of discoveries in Naseem's lab. The companies focus on commercializing a process to crystallize amorphous silicon into large grain poly-silicon. The goal is to increase solar power conversion efficiency and reduce the amount of silver needed to produce high-efficiency solar cells, thereby lowering material costs.

TERRORISM RESEARCH CENTER

The J. William Fulbright College of Arts and Sciences houses the Terrorism Research Center, the nation's most comprehensive database on terrorism in United States. The data stretches back more than 25 years and is used by U of A researchers to find patterns of behavior in domestic terrorism. It is funded through federal grants from the Department of Justice and the Department of Homeland Security.

Under the direction of Brent Smith, Distinguished Professor of sociology and criminal justice, the center is the only institution in the country to receive the FBI database of individuals indicted on charges related to terrorism.

The center's researchers have enriched FBI data through painstaking collection of documents and details of the prosecution and final judgment in each case. Project staff members have traveled to federal courthouses, often in remote areas, to retrieve and examine trial files, record data and photocopy relevant court documents. By augmenting and analyzing data to provide a comprehensive picture of terrorist activities and counterterrorism efforts in the United States, the researchers' efforts have yielded information about the potential future activities of terrorists and effective legal responses.

"We have a unique capacity to analyze terrorism data," Smith said. "Not only do we house an exclusive terrorism database, but we have the expertise to handle large datasets and the experience to ask productive questions."

Smith started the American Terrorism Study in 1988 with the support from the FBI.

In addition to studies on environmental and international terrorists, the center's researchers have received federal funding for research conviction rates and domestic



terrorism, including studies on so-called "lone-wolf" or "wolf-pack" terrorists.

The department has received major grants from the U.S. Department of Justice, the National Institute of Justice and the Department of Homeland Security. Smith recently received another grant from the National Institute of Justice that will allow the Terrorism Research Center to study how terrorists evade capture, how extended periods of evading capture increase the stature of terrorists and the effect this has on radicalizing others.



AN ARKANSAS PROMISE

Multiple federal agencies are looking to University of Arkansas rehabilitation researchers to develop a model for future programs to help teens with disabilities seek and obtain their first job. Promoting Readiness of Minors in Supplemental Security Income, better known as PROMISE, provides much-needed job-training services to low-income Arkansas teens who have disabilities.

The program, made possible by an initial five-year, \$32 million U.S. Department of Education grant to the College of Education and Health Professions and the Arkansas Department of Education, will help young Arkansans find meaningful education and career opportunities that will aid them in becoming self-sufficient in today's economy. The grant, believed to be the largest in the history of the university, seeks to improve the career and education outcomes of low-income Arkansas teenagers with disabilities who receive Supplemental Security Income.

The PROMISE grant is the first national study to investigate the strength of the possible correlation between initial paid work experiences and later competitive employment. It is a joint initiative of the U.S. Department of Education, the U.S. Department of Health

and Human Services, the U.S. Department of Labor and the Social Security Administration. Based on the results of the program, all four federal agencies may use PROMISE as a model for future programs.

University rehabilitation education researchers, led by Brent Williams, principal investigator on the grant, administer the PROMISE program. They are helping local agencies provide services – job coaching and benefits counseling – to 1,000 Arkansas adolescents between the ages of 14 and 16 who receive Supplemental Security Income. To determine the effectiveness of the job-training services, the researchers, over the course of five years, will gather data and analyze results, comparing them to a control group that did not receive training and counseling intervention.

"The findings from this research could go a long way toward facilitating the independence and societal inclusion of adolescents with disabilities while reducing the financial encumbrance of the Social Security Administration," Williams said.

In November 2015, the U.S. Department of Education expanded the Arkansas PROMISE program with an additional \$3.3 million grant to pay for work experiences for Arkansas teens with disabilities.

DRIVING INNOVATION

The University of Arkansas drives innovation through its robust entrepreneurship and sponsored research programs that allow industry leaders to collaborate across all disciplines to find innovative solutions to real-world problems. Much of the research and development at our 50 research centers is at the request of industry. And robust technology transfer and commercialization programs help researchers plug new discoveries into the marketplace.

The U of A fosters a culture of discovery and innovation that builds partnerships through expanded sponsored research agreement options, improved research funding and industry partnerships.

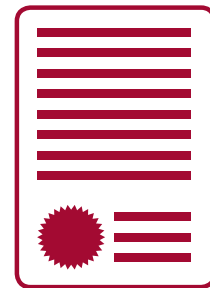
That is why the Carnegie Foundation lists the university among the top 2 percent in the nation for research activity and the National Academy of Inventors named the University of Arkansas as one of the top 100 universities worldwide for the number of patents granted.

ECONOMIC DEVELOPMENT:



SINCE 2008, 18 START-UP COMPANIES HAVE BEEN CREATED TO MARKET U OF A DEVELOPED TECHNOLOGIES.

These start-ups employ about 100 Arkansans and have raised more than **\$46 million** in private funding and government grants and incentives. They create more efficient power cells, streamline the process for pharmaceutical protein development, create less expensive and more efficient solar panels, develop life-changing drugs for osteoporosis and baldness and produce biodegradable bags. This track record of success led to the U.S. Department of Commerce in 2015 to select the U of A's ARK Challenge Accelerator Program to develop start-ups in mobile and cloud-based computing.



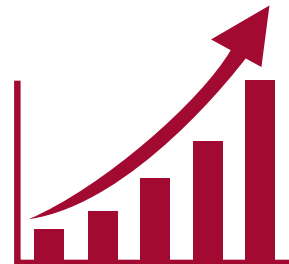
LICENSING:

THE UNIVERSITY NEGOTIATED 21 LICENSING AGREEMENTS IN FY15

that transferred U of A developed technology to the private sector for commercialization. Those agreements produced more than \$134,000 in revenue.

ENTREPRENEURSHIP:

The IGNITE Program connects Arkansas companies with research faculty and students to develop innovative solutions for industry and bring the expertise of industry leaders into the classroom. The New Venture Development classes train student teams how to commercialize new discoveries.



START-UP COMPANIES CREATED TO COMMERCIALIZE U OF A DISCOVERIES AND INVENTIONS HAVE RAISED MORE THAN \$46 MILLION IN FEDERAL GRANTS AND PRIVATE INVESTMENTS.

PATENTS:

PATENT APPLICATIONS SUBMITTED IN 2014 AND 2015: 55

NEW PATENTS RECEIVED: 15



NATIONAL SCIENCE FOUNDATION INDUSTRY & UNIVERSITY COOPERATIVE RESEARCH PROGRAM

The U of A is part of three National Science Foundation research centers focused on industry collaboration and problem solving. The board of each center is made up of industry leaders who decide which industry-related projects each center will pursue for a particular company in exchange for initial access to the findings. Funding for the centers is a mix of NSF grants and corporate membership fees.

- Center for Excellence in Logistics and Distribution — Develops efficient processes in inventory and system analysis and design.
- Grid-Connected Advanced Power Electronic systems — Develops technology to make the power grid safer and more adaptable with the emergence of renewable energy sources. Partners include: Baldor, Con Edison, Eaton, Lockheed Martin, Northrop Grumman and Southwest Power Pool.
- Membrane Science, Engineering and Technology Center — Focuses on membrane applications such as implementation of nanoscale surface patterning in emerging semiconducting technology. Partners include corporate leaders from the energy, chemical, pharmaceutical and food and beverage industries.



BUILDING A BETTER VEHICLE



The National Science Foundation announced in August 2015 the creation of a new \$18.5 million engineering research center for the development of more powerful and efficient vehicle electrical systems.

Alan Mantooth, Distinguished Professor of electrical engineering, serves as deputy director of the new center, named Power Optimization for Electro-Thermal Systems (POETS).

"We have extremely dedicated, exceptional researchers — truly the top scholars in our field — and it is very satisfying when others recognize the tremendous impact of our work," Mantooth said of his research team.

POETS will focus on improving current thermal and electrical systems in vehicle designs with the intent of making cars more fuel efficient and extending the range of electric cars. The center expands on Mantooth's work to develop more effective and efficient electric cars. It is made up of researchers across several disciplines and institutions, including U of A's Simon Ang and Juan Balda, professors of electrical engineering, and Greg Salamo, Distinguished professor of physics. Other partners include the University of Illinois, Howard University, Stanford University, the University of Sao Paulo in Brazil and the Royal Institute of Technology in Sweden.

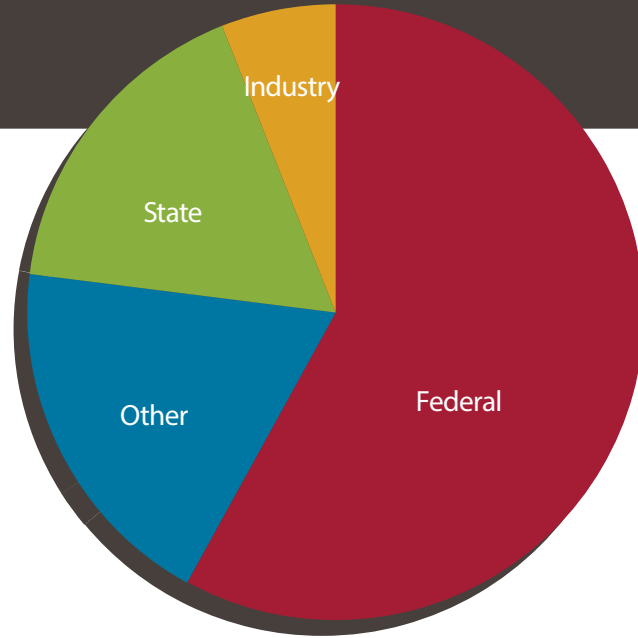
Mantooth has overseen more than \$60 million in federal and industry research and development funding, including POETS and a new \$15.5 million center based at the U of A devoted to strengthening cybersecurity for the national power grid.

NATIONAL IMPACTS OF FEDERAL RESEARCH

The University of Arkansas is known for leading change through research the nation depends on for its security and future. Biomedical and chemical engineers work to fight chronic diseases like cancer, Alzheimer's and diabetes, while sociologists work to find patterns in domestic terrorism for the U.S. Department of Justice. Engineers are securing the power grid against cyber attack for the U.S. Department of Energy and Homeland Security, while interdisciplinary teams work on technology for the military branches and the U.S. Department of Defense. U of A researchers have identified new species, investigated concussions in sports and made advances in renewable energy, electronics and nanotechnology. This research that is solving real world problems and advancing our society is sustained through support from federal agencies.

FY15 RESEARCH FUNDING)

Federal	\$46,100,987
Other	\$15,138,939
State	\$13,600,943
Industry	\$4,914,116
Total	\$79,754,985



NANOTECHNOLOGY AND FUEL EFFICIENCY

Mechanical engineering professor Min Zou developed a new way to coat surfaces with nanoparticles that reduces the friction and heat that hinder electronic devices. Her technology allows electrical systems to operate more efficiently and limits wear by protecting the surfaces of moving parts with a coating that works on the molecular level. Her work has improved non-stick kitchen wear as well. And one company, WattGlass, is working to commercialize her anti-reflective, self-cleaning glass coatings for use on commercial-grade solar cells in solar panels. Zou is known internationally for her surface engineering research, that is why NSF looked to her to build and run a new \$20 million center for surface engineering to advance her

research and build partnerships with industry to create new products for manufacturing, aerospace, defense and healthcare industries. Distinguished Professor of electrical engineering, Alan Mantooth, in 2015 was named deputy director of a new NSF-funded engineering research center, Power Optimization for Electro-Thermal Systems (POETS) which will focus on improving thermal and electrical systems in vehicles to improve fuel efficiency. Initial funding is \$18.5 million.

NATIONAL SCIENCE FOUNDATION | \$11.5 million in FY15
\$40 million since 2011

DIGGING UP THE ROOTS OF DISEASE TO SAVE LIVES THROUGH SCIENCE

Woodrow Shew, assistant professor of physics and Julie Stenken, professor of chemistry and biochemistry are tracking the interplay of chemical and electrical signals in the brain to gain insight into neurodegenerative diseases like Alzheimer's and Parkinson's. Stenken's research group at the U of A specializes in measurement of chemicals in the brain using microdialysis implants. The group is studying the affect of

varying levels of acetylcholine in the brain, which is tied to Alzheimer's. The development of the department of biomedical engineering in 2012 has led to a steady increase in NIH funding for health and disease research over the last three years.

NATIONAL INSTITUTES OF HEALTH | \$2 million in FY15
\$13.6 million since 2011

BRINGING SAFETY AND EFFICIENCY TO THE POWER GRID, CARS AND NUCLEAR REACTORS

The Department of Energy relies on U of A engineers to solve power limitations in today's world. The U of A is home to several power research centers, including National Center for Reliable Electric Power Transmission (NCREPT), which is the highest-powered power electronics test facility at any university in the United States. The Department of Energy has charged NCREPT director and Distinguished Professor Alan Mantooth with finding ways to secure the power grid from cyber attack with a new \$12.2 million grant. Paul Millett, assistant professor of mechanical engineering is investigating ways to

make nuclear reactors safer and more efficient by controlling volumetric swelling of the metal fuels within reactors. The Department of Energy awarded Picasolar, a start-up company that uses technology developed at the U of A to improve efficiency of solar cells, to continue development and testing of the technology needed to move the new technology into commercial production.

DEPARTMENT OF ENERGY | \$1.5 million in FY15
\$3 million since 2011

PROTECTING AMERICA'S ASSETS

The Defense Advance Research Project Agency, which commissions advanced research for the U.S. Department of Defense, continues to look to the U of A to advance technology in everything from power systems to night vision goggles. The latest grant was awarded to Laurent Bellaiche, Distinguished Professor of physics, to oversee an international team of researchers to develop ferroelectric and multiferroic perovskite oxides that convert energy from one form into

another. Every branch of the service has a research arm that has active grants funding research into technology advances at the U of A.

DEFENSE AGENCIES (DOD/DEPT. OF ARMY, AIR FORCE, NAVY) | \$722,933 in FY15
\$8.4 million since 2011

DISCOVERING WATER ON MARS AND HELPING BUILD SPACE VEHICLES

Researchers at the U of A's Arkansas Center for Space and Planetary Sciences received four grants totaling more than \$1.4 million to study environmental conditions on Venus, Mars and Saturn's largest moon, Titan. Researchers at the center previously published extensive findings on evidence of briny water on Mars. The research is conducted through the W.M. Keck Laboratory for Space and Planetary Simulation. That facility will also allow astrophysicist and assistant research professor Vincent Chevrier to study the survivability on Mars

of microbes that may be carried there on equipment from Earth. NASA also awarded a \$750,000 grant in 2015 to two U of A electrical engineering professors to use a new material they discovered in previous research to improve photovoltaic devices for use on space vehicles like the Mars rover currently in development.

NASA | \$595,373 in FY15
\$3 million since 2011

PROMOTING INDEPENDENCE THROUGH EDUCATION

PROMISE Grant: \$35.7 Million

The University of Arkansas is in year two of a five year, \$35.7 million grant from the U.S. Department of Education aimed at education and career outcomes in low-income Arkansas teenagers with disabilities. The goal of the study is to find a successful intervention and job coaching program that provides a path to societal and financial independence for teens in this subset as they move into adulthood so that they do not rely on

Social Security benefits to survive. The study will include 2,000 teenagers between the ages of 14 and 16 who receive social security benefits for their income level and disability.

DEPARTMENT OF EDUCATION | \$12.2 million in research grants in 2015
\$20 million in research grants since 2011

**including two years of PROMISE grant funding*

(Sources) National Center for Education Statistics <http://nces.ed.gov/avigator/?s=AR&z=72701&zd=0&of=3&l=93&id=106397>
Common Data Set <http://oir.uark.edu/cds/index.php>
Enrollment Services Annual Report <http://enrollmentservices.uark.edu/reports.php>
Federal Student Financial Aid <http://www2.ed.gov/offices/OSFAP/defaultmanagement/cdr.html>

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TECHNOLOGY VENTURES

Office of research commercialization and technology transfer
479-575-5806

RESEARCH FRONTIERS

Home of U of A research news
Researchfrontiers.uark.edu

CORE RESEARCH AREA CONTACTS

Core Facilities are entities authorized by the Office of the Vice Provost for Research and Economic Development (VPRED) to generate revenue by providing fee-based services to the University of Arkansas (UA) research community, the Arkansas Research Technology Park (ARTP), as well as external customers.

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