ANNUAL RESEARCH REPORT

FY 2015

JULY1, 2014 - JUNE 30, 2015

EDUCATE · DISCOVER · IMPACT

This Page Intentionally Left Blank

Annual Research Report - FY2015
July 1, 2014 - June 30, 2015

This Page Intentionally Left Blank

Table of Contents

Enterprise Metrics

Introduction	4
Total Research Expenditures	8
Invention Disclosures Transacted	9
Licenses & Options Executed	10

Introduction

Much of the innovation that improves people's lives springs from university research and Arizona's public universities are critical incubators for such research and activity. This report provides an in-depth and comprehensive review of Arizona's higher education research enterprise.

The research indicators are categorized into six areas for each university:

- Enterprise size
- Discovery and scholarly impact
- Economic development
- Leadership and recognition
- Technology transfer activity
- Strategic Initiatives

The Arizona Board of Regents has defined several key measures to evaluate the growth of its research enterprise in the university system and it continues to make steady progress.

Through research activity at the universities, millions of dollars are reinvested annually into the community. In 2015, Arizona's public universities brought in more than $1 billion in research expenditures–$50 million above last year.

In the fall of 2015, the Regents adopted a revised set of enterprise metrics. As part of that refresh, it was determined that three metrics most clearly defined the research efforts: Total Research and Development Activity, Licenses and Options Executed, and Invention Disclosures Transacted. All three universities report on Total Research and Development Activity. Licenses and Options Executed was selected as a meaningful metric for both Arizona State University and the University of Arizona; while Invention Disclosures Transacted better reflected Northern Arizona's work in research.

BOARD OF Regents ARIZONA'S PUBLIC UNIVERSITIES ®

EDUCATE · DISCOVER · IMPACT

Several other indicators reflect the robust nature of Arizona's Public University's research enterprise.

- $486,772 in Federally Financed Research
- $199,902 in Other Sponsored Projects
- 3,842 Faculty
- 100 Patents
- 24 Startup Companies
- 1,010 Ph.D.s Awarded

Increasing the research capabilities and performance of the Arizona University System to a level of competitive prominence with peer rankings of top American research universities is a significant part o the regents' overarching goal to contribute to the vitality of Arizona's future.

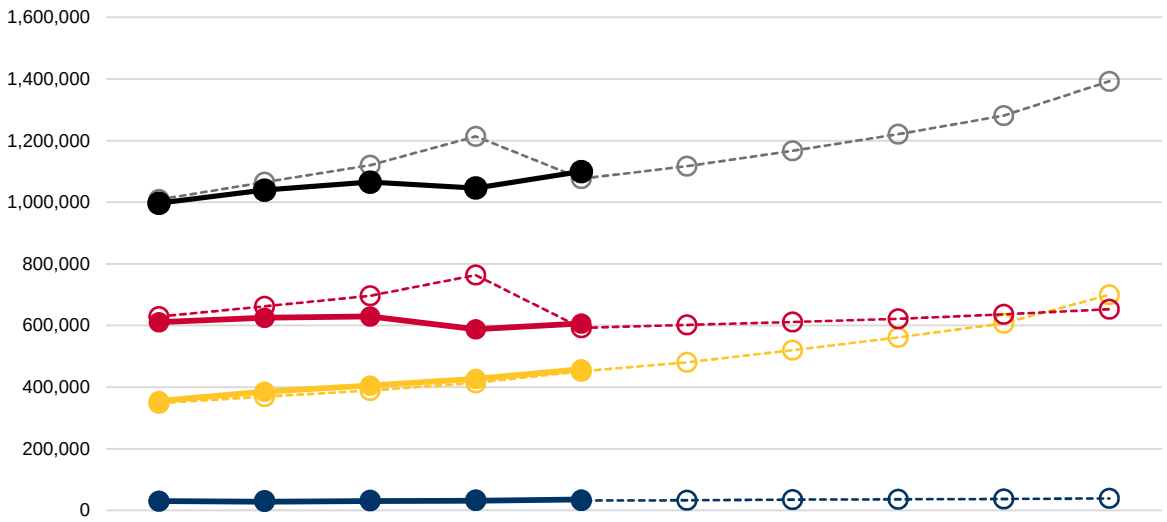
The information in this report demonstrates that the discovery and innovation taking place at Arizona's public universities is expanding and that translates to more discoveries, a better quality of life for Arizonans, and more jobs for the State.

This Page Intentionally Left Blank

Enterprise Metrics

Enterprise Size

Total Research Expenditures (in Thousands)



ABOR Enterprise Plan	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Goal	1,009,276	1,065,160	1,120,569	1,213,978	1,077,418	1,117,360	1,167,320	1,221,540	1,281,880	1,393,140
Actual	996,565	1,039,424	1,065,136	1,046,329	1,099,837					
Difference	-12,711	-25,736	-55,433	-167,649	22,419					

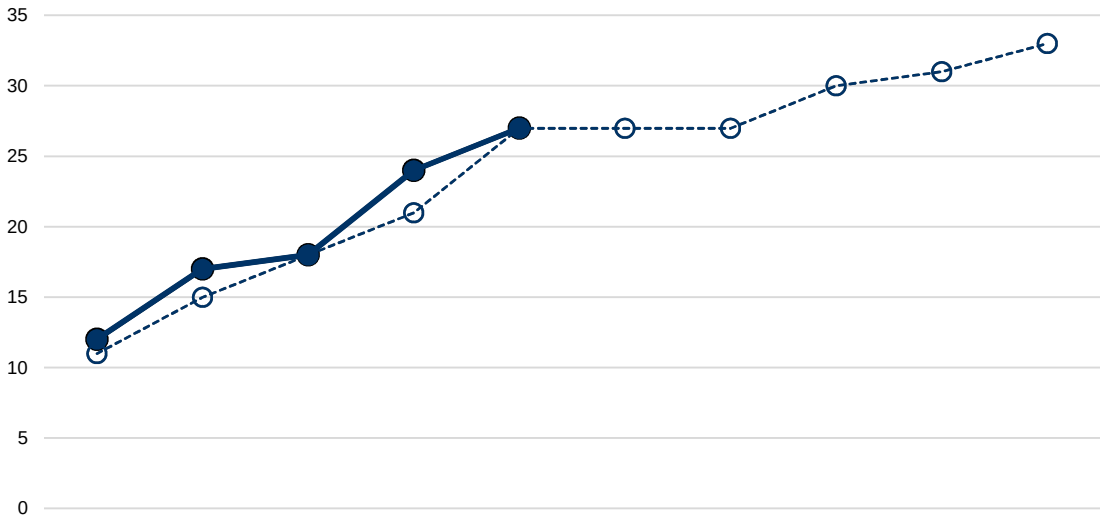
Arizona State University	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Goal	348,525	370,000	390,000	415,000	452,000	481,300	520,600	562,500	607,400	700,000
Actual	355,215	385,959	405,154	426,651	458,412					
Difference	6,690	15,959	15,154	11,651	6,412					

Northern Arizona University	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Goal	30,751	32,160	33,569	34,978	32,600	33,900	35,200	36,600	38,000	39,500
Actual	30,785	28,100	30,516	31,590	35,206					
Difference	34	-4,060	-3,053	-3,388	2,606					

The University of Arizona	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Goal	630,000	663,000	697,000	764,000	592,818	602,160	611,520	622,440	636,480	653,640
Actual	610,565	625,365	629,466	588,088	606,219					
Difference	-19,435	-37,635	-67,534	-175,912	13,401					

Discovery and Scholarly Impact

Invention Disclosures Transacted (Northern Arizona University)

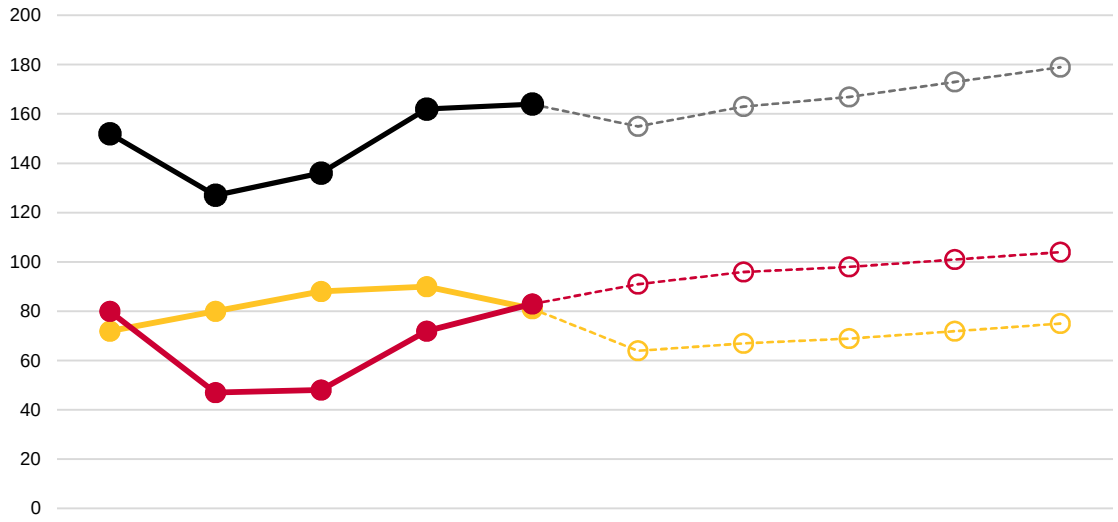


ABOR Enterprise Plan	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Goal	11	15	18	21	27	27	27	30	31	33
Actual	12	17	18	24	27					
Difference	1	2	0	3	0					

Northern Arizona University	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Goal	11	15	18	21	27	27	27	30	31	33
Actual	12	17	18	24	27					
Difference	1	2	0	3	0					

Discovery and Scholarly Impact

Licenses & Options Executed *(Arizona State University & University of Arizona)*



ABOR Enterprise Plan	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Goal	152	127	136	162	164	155	163	167	173	179
Actual	152	127	136	162	164					
Difference	0	0	0	0	0					

Arizona State University	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Goal	72	80	88	90	81	64	67	69	72	75
Actual	72	80	88	90	81					
Difference	0	0	0	0	0					

The University of Arizona	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Goal	80	47	48	72	83	91	96	98	101	104
Actual	80	47	48	72	83					
Difference	0	0	0	0	0					

Annual Research Report - FY2015

Introductory Letter

I am excited to share the achievements in FY15 in the areas of research, entrepreneurship and innovation at Arizona State Univeristy (ASU). The work of our faculty, students and researchers is resulting in significant impact in our state and around the world.

ASU's thriving knowledge enterprise is built on access, excellence and impact. As a result, we are educating and training more students than ever before, excelling in all aspects of academic endeavor. We were ranked as the most innovative school in the country by U.S. News and World Report, based on a survey of university presidents and leaders.

Our students pursue diverse degrees that engage their curiosity, encourage entrepreneurship across disciplines and prepare them to be successful. Our faculty and researchers are engaged in use-inspired research that is expanding our knowledge of the world, and universe, that we live in. The power of the knowledge enterprise lies in fostering creative research that is translated to real-world solutions.

This year, among many other notable accomplishments, ASU researchers produced groundbreaking photographs of photosynthesis in action and were instrumental in the development of a therapeutic treatment for Ebola. In addition, our ongoing successful work in the information security discipline was recognized with awards of over $1 million from the U.S. Department of Defense to support research on social media and terrorist networks. In economic development and entrepreneurship, ASU now ranks among the top 50 international universities for the number of patents issued to its researchers in 2014.

I invite you to read the details of these achievements and the highlights of many others over the past fiscal year in the report that follows.

Sincerely,

Sethuraman "Panch" Panchanathan
Executive Vice President | ASU Knowledge Enterprise
Chief Research and Innovation Officer

Table of Contents

Enterprise Size

Introduction	6
Selected Accomplishments	7
Total Research Expenditures	8
Average Growth Rate in Total Research Expenditures Over 3 Years	9
Federally Financed Research Expenditures	10
Average Growth Rate in Federally Financed Research Expenditures Over 3 Years	11
Business Financed Research Expenditures	12
Average Growth Rate in Business Financed Research Expenditures Over 3 Years	13
Net Research Square Feet	14
Total Research Expenditures per Square Foot	15
Total Faculty Population	16
Total Research Expenditures per Faculty	17
Other Sponsored Project Expenditures (Instruction, Service, etc.)	18
Average Growth Rate in Other Sponsored Project Expenditures Over 3 Years	19

Discovery and Scholarly Impact

Introduction	22
Selected Accomplishments	23
Invention Disclosures Transacted	24
Invention Disclosures Transacted per $10 Million in Total Research Expenditures	25
U.S. Patents Issued	26
U.S. Patents Issued per $10 Million in Total Research Expenditures	27

Economic Development

Introduction	30
Selected Accomplishments	31
Intellectual Property Income	32
Intellectual Property Income per $10 Million in Total Research Expenditures	33
Licenses and Options Income	34
Licenses and Options Income per $10 Million in Total Research Expenditures	35
Licenses and Options Executed	36
Licenses and Options Executed per $10 Million in Total Research Expenditures	37
Startup Companies	38
Startup Companies per $10 Million in Total Research Expenditures	39
Ph.D. Degrees Conferred	40
Ph.D. Degrees Conferred per $10 Million in Total in Research Expenditures	41

Leadership and Recognition

Introduction	44
Selected Accomplishments	45
National Academy Members	46
National Academy Members per $10 Million in Total Research Expenditures	47

Technology Transfer Activity

Introduction	50
Technology Transfer Statistical Exhibits	51
Selected Patents Issued	52
Selected Licenses and Options Executed	53
Selected Startup Companies	54
Other Notable Activities	55

Strategic Initiatives

Summary	58

This Page Intentionally Left Blank

Enterprise Size

ASU's knowledge enterprise is constructed around the principles of conducting transdisciplinary, use-inspired and socially embedded research. ASU not only continues to be one of the fastest growing research enterprises among U.S. universities, but also remains nimble and responsive to emerging research and economic development opportunities.

Total research volume, proposal submissions and extramural awards in FY15 testify to our progress:

- $458.4 million in total research expenditures, representing a 7.4% growth over FY14
- $1.65 billion in proposal submissions
- $331.4 million in extramural funding

ASU continues to be ranked among the top U.S. universities for total research expenditures in the most recent National Science Foundation Higher Education Research and Development survey, including:

- 3rd in transdisciplinary and other sciences, ahead of MIT, Johns Hopkins and Brown
- 5th in earth sciences, ahead of Berkeley, MIT and Penn State
- 6th in social sciences, ahead of Princeton, University of Pennsylvania, Cornell and Duke
- 9th in HHS (including NIH) funded research expenditures for institutions without a medical school, ahead of Princeton, University of Maryland and Carnegie Mellon
- 10th in total research expenditures among institutions without a medical school, ahead of Caltech, Princeton and Carnegie Mellon
- 10th in bioengineering, ahead of Columbia, University of Michigan, Cornell and Rice University
- 11th in NASA funded research expenditures, ahead of Harvard, Duke and Johns Hopkins
- 18th in humanities, ahead of The Ohio State University, Cornell, Princeton and the University of Illinois at Urbana Champaign

The **U.S. Agency for International Development** has awarded Dr. Sayfe Kiaei and colleagues **$17.9 million** to establish the Partnership Center for Advanced Studies in Energy, a collaboration with Pakistan National University of Science and Technology in Islamabad and the University of Engineering and Technology, Peshawar.

Four major grants totaling **$17 million** were awarded to the Mary Lou Fulton Teachers College by the **U.S. Department of Education**, including one award for **$10.5 million.** The grants will help faculty and researchers expand their work in meeting the learning and access needs of Arizona students.

Dr. Steven Desch was awarded over **$6 million** from the **NASA Goddard Space Flight Center** to study the detectability of life on exoplanets, planets that orbit a star outside our solar system.

The **U.S. Department of Energy's Advanced Research Projects Agency-Energy (ARPA-E)** program, awarded **$2.9 million** to Dr. Dan Buttry and colleagues to develop efficient and cost-effective carbon-capture technology in what could be an economically enabling breakthrough.

Biomedical engineer Sarah Stabenfeldt has received the **National Institutes of Health Director's New Innovator Award** to support her work to develop a toolkit for detecting signs of brain injury at the molecular and cellular levels. The grant is providing **$2.3 million** to fund her work for five years.

The **U.S. Department of Energy** awarded a total of **$1.3 million** to two ASU engineers, Drs. Mariana Bertoni and Stuart Bowden. They are partnering with industry as part of the DoE's SunShot Solar Manufacturing 2 program.

Dr. Jacqueline Wernimont, with FemTechNet, has been awarded **$1.2 million** from the **Digital Media and Learning Competition** to develop tools for combating anti-feminist violence online.

A team of ASU faculty has been awarded **$1.3 million** from the **U.S. Department of Defense** to research the interaction and impact between social media and terrorist networks.

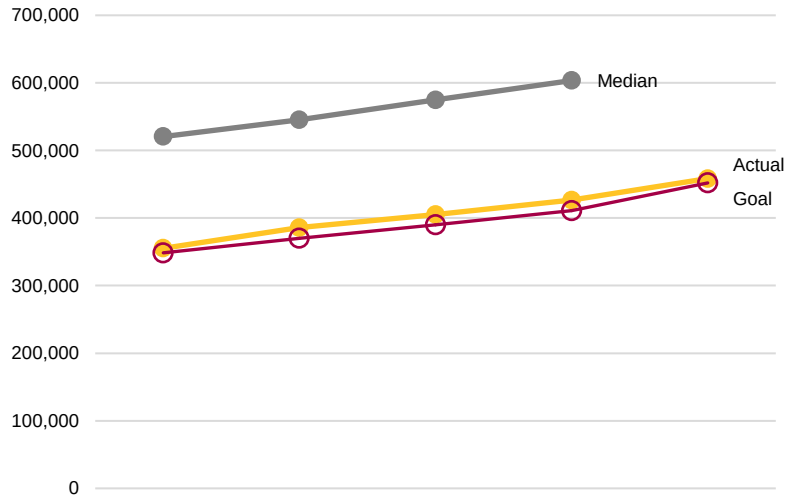
Dr. Jagdev Sharma has received a **$1.4 million** supplement from the **Bill and Melinda Gates Foundation** to fund his project to establish and distribute a specific breed of chicken in Uganda. The chicken provides more meat and eggs than native breeds and is well adapted for the area.

A **$1.7 million grant** renewal from the **National Institute on Drug Abuse** will allow Dr. Janet Neisewander to continue her research on creating a treatment for cocaine addiction.

The **U.S. Department of Health and Human Services Administration for Children, Youth and Families** awarded a five-year, **$1.24 million grant** to Drs. Dominique Roe-Sepowitz and Judy Krysik. The grant will help to better identify children who are victims of sex trafficking in Arizona and provide training to child welfare professionals to improve outcomes.

Enterprise Size

Total Research Expenditures (in Thousands)

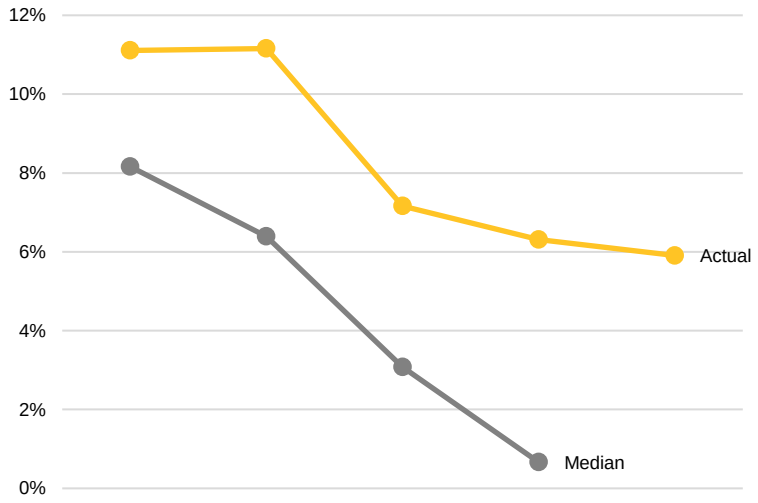


ABOR Enterprise Plan	2011	2012	2013	2014	2015
Actual	355,215	385,959	405,154	426,651	458,412
Goal	348,525	370,000	390,000	411,000	452,000
Difference	6,690	15,959	15,154	15,651	6,412

ABOR Peer Group	Med. Sch.	NSF Adj.	2011	2012	2013	2014	2015	Rank
University of Washington - Seattle	X		1,148,533	1,109,008	1,192,513	1,176,340		1
University of Wisconsin - Madison	X		1,111,642	1,169,779	1,123,501	1,108,564		2
University of California - Los Angeles	X		982,357	1,003,375	966,659	948,197		3
University of Minnesota - Twin Cities	X		847,419	826,173	858,378	876,870		4
Ohio State University - Columbus	X		832,126	766,513	793,373	815,075		5
Pennsylvania State University - University Park		X	692,708	694,778	729,793	697,473		6
Rutgers the State University of NJ - New Brunswick	X	X	432,306	434,901	493,320	644,116		7
University of Illinois - Urbana-Champaign			545,669	583,754	743,487	621,733		8
University of Texas - Austin	X		632,171	621,538	634,132	585,251		9
Michigan State University	X		454,248	507,061	515,707	526,906		10
University of Maryland - College Park			495,382	502,406	491,998	485,051		11
University of Iowa	X		443,893	446,429	435,377	449,147		12
Arizona State University			355,215	385,959	405,154	426,651	458,412	13
Florida State University	X		230,411	225,378	250,877	252,548		14
Indiana University - Bloomington		X	184,096	184,486	197,897	206,039		15
University of Connecticut - Storrs		X	152,554	151,801	143,170	152,511		16
Median			520,526	545,408	574,920	603,492		

Enterprise Size

Average Growth Rate in Total Research Expenditures Over 3 Years

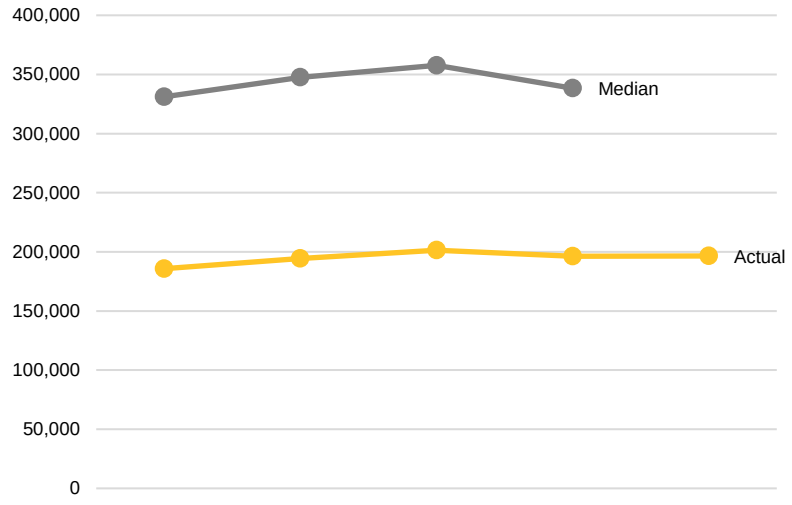


ABOR Enterprise Plan	2011	2012	2013	2014	2015
Actual	11.1%	11.2%	7.2%	6.3%	5.9%

ABOR Peer Group	Med. Sch.	NSF Adj.	2011	2012	2013	2014	2015	Rank
Rutgers the State University of NJ - New Brunswick	X	X	14.1%	11.7%	5.0%	14.9%		1
Arizona State University			11.1%	11.2%	7.2%	6.3%	5.9%	2
University of Illinois - Urbana-Champaign			3.3%	1.4%	13.4%	6.0%		3
Michigan State University	X		8.5%	10.8%	6.2%	5.2%		4
Indiana University - Bloomington		X	7.0%	5.7%	3.7%	3.9%		5
Florida State University	X		8.3%	5.2%	3.5%	3.3%		6
University of Minnesota - Twin Cities	X		7.5%	3.8%	3.1%	1.2%		7
University of Washington - Seattle	X		15.1%	13.4%	5.5%	0.9%		8
University of Iowa	X		15.6%	11.7%	-0.6%	0.4%		9
Pennsylvania State University - University Park		X	3.8%	1.6%	2.3%	0.3%		10
University of Connecticut - Storrs		X	11.6%	5.3%	2.1%	0.1%		11
University of Wisconsin - Madison	X		8.0%	7.1%	3.1%	0.0%		12
Ohio State University - Columbus	X		5.9%	2.6%	1.9%	-0.5%		13
University of Maryland - College Park			7.9%	7.2%	3.0%	-0.7%		14
University of California - Los Angeles	X		4.1%	4.1%	1.1%	-1.1%		15
University of Texas - Austin	X		8.8%	7.3%	2.5%	-2.5%		16
Median			8.2%	6.4%	3.1%	0.7%		

Enterprise Size

Federally Financed Research Expenditures (in Thousands)

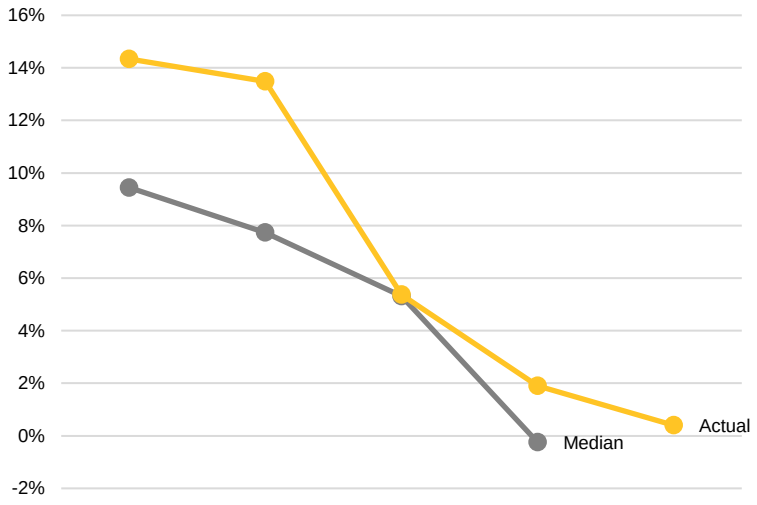


	2011	2012	2013	2014	2015
Actual	185,766	194,376	201,363	196,270	196,528

ABOR Peer Group	Med. Sch.	NSF Adj.	2011	2012	2013	2014	2015	Rank
University of Washington - Seattle	X		948,976	909,652	928,193	909,034		1
University of Wisconsin - Madison	X		593,633	580,661	555,875	548,388		2
University of Minnesota - Twin Cities	X		489,480	485,462	494,206	489,767		3
University of California - Los Angeles	X		563,560	539,054	501,368	465,170		4
Ohio State University - Columbus	X		493,130	445,635	456,590	454,484		5
Pennsylvania State University - University Park		X	404,065	462,868	482,785	449,702		6
Rutgers the State University of NJ - New Brunswick	X	X	239,908	279,161	295,028	360,157		7
University of Illinois - Urbana-Champaign			323,454	359,989	468,798	343,275		8
University of Maryland - College Park			338,780	340,180	342,778	333,409		9
University of Texas - Austin	X		355,437	354,873	372,633	332,758		10
Michigan State University	X		240,837	268,952	260,610	261,826		11
University of Iowa	X		283,627	269,734	255,329	235,527		12
Arizona State University			185,766	194,376	201,363	196,270	196,528	13
Florida State University	X		140,850	140,419	148,413	151,701		14
University of Connecticut - Storrs		X	86,727	90,579	87,853	85,165		15
Indiana University - Bloomington		X	74,143	79,727	85,852	84,592		16
Median			331,117	347,527	357,706	338,342		

Enterprise Size

Average Growth Rate in Federally Financed Research Expenditures Over 3 Years

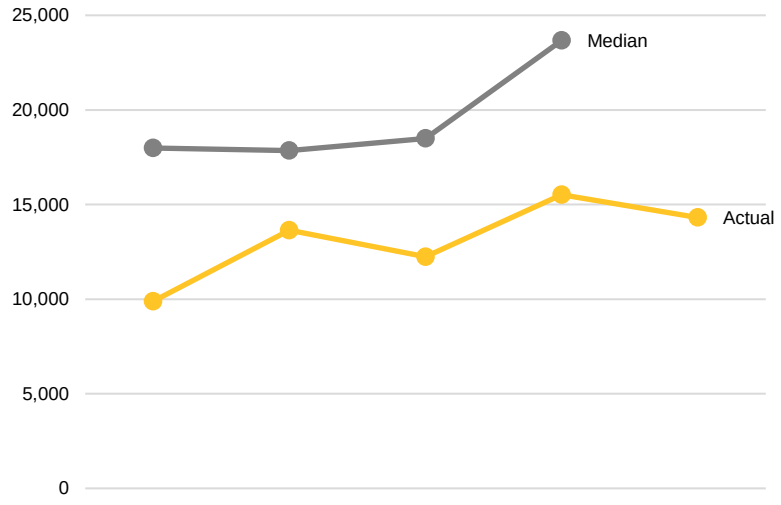


	2011	2012	2013	2014	2015
Actual	14.3%	13.5%	5.4%	1.9%	0.4%

ABOR Peer Group	Med. Sch.	NSF Adj.	2011	2012	2013	2014	2015	Rank
Rutgers the State University of NJ - New Brunswick	X	X	23.6%	23.9%	9.6%	14.7%		1
University of Illinois - Urbana-Champaign			6.6%	7.7%	16.0%	4.9%		2
Indiana University - Bloomington		X	3.2%	0.8%	6.4%	4.6%		3
Pennsylvania State University - University Park		X	4.0%	6.4%	6.0%	4.0%		4
Michigan State University	X		16.8%	18.2%	7.0%	3.0%		5
Florida State University	X		8.5%	6.4%	3.3%	2.5%		6
Arizona State University			14.3%	13.5%	5.4%	1.9%	0.4%	7
University of Minnesota - Twin Cities	X		10.4%	7.7%	5.3%	0.0%		8
University of Maryland - College Park			12.9%	11.6%	5.0%	-0.5%		9
University of Connecticut - Storrs		X	16.4%	21.6%	5.5%	-0.5%		10
University of Washington - Seattle	X		16.4%	14.7%	4.1%	-1.4%		11
University of Texas - Austin	X		3.4%	4.9%	2.1%	-2.0%		12
Ohio State University - Columbus	X		14.1%	10.5%	5.4%	-2.5%		13
University of Wisconsin - Madison	X		7.8%	4.7%	0.8%	-2.6%		14
University of Iowa	X		7.4%	2.5%	-3.3%	-6.0%		15
University of California - Los Angeles	X		6.3%	5.2%	-2.2%	-6.2%		16
Median			9.4%	7.7%	5.3%	-0.2%		

Enterprise Size

Business Financed Research Expenditures (in Thousands)

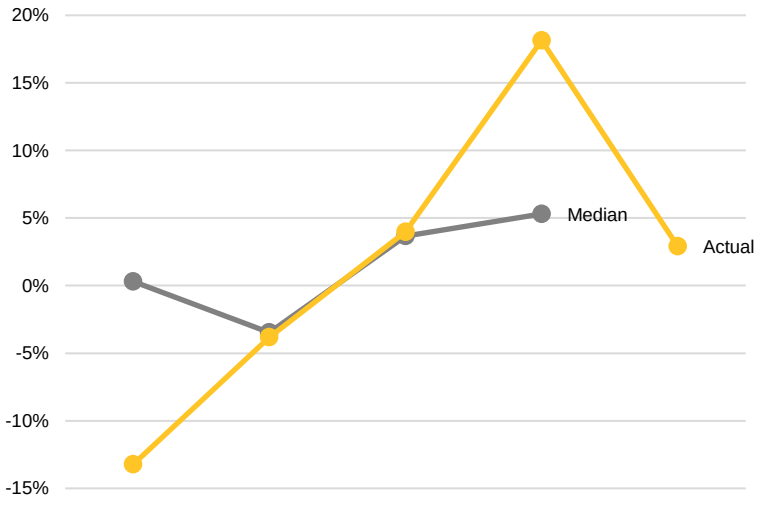


	2011	2012	2013	2014	2015
Actual	9,891	13,643	12,242	15,518	14,312

ABOR Peer Group	Med. Sch.	NSF Adj.	2011	2012	2013	2014	2015	Rank
Ohio State University - Columbus	X		103,564	100,986	110,551	118,297		1
University of Texas - Austin	X		68,479	67,890	71,354	71,349		2
University of Washington - Seattle	X		20,780	19,731	42,296	49,963		3
University of California - Los Angeles	X		48,961	51,311	58,972	45,193		4
University of Illinois - Urbana-Champaign			34,639	37,433	42,101	40,971		5
Pennsylvania State University - University Park		X	56,342	32,203	30,379	29,447		6
University of Minnesota - Twin Cities	X		31,360	29,657	28,795	28,164		7
Rutgers the State University of NJ - New Brunswick	X	X	15,193	15,972	13,982	24,284		8
University of Wisconsin - Madison	X		27,968	23,152	22,168	23,056		9
University of Iowa	X		13,461	13,892	14,812	17,183		10
Arizona State University			9,891	13,643	12,242	15,518	14,312	11
Michigan State University	X		3,566	5,084	7,497	8,077		12
University of Maryland - College Park			6,133	6,353	7,124	6,967		13
University of Connecticut - Storrs		X	4,424	3,744	4,779	5,721		14
Indiana University - Bloomington		X	5,584	4,276	3,303	3,728		15
Florida State University	X		1,518	1,691	1,430	1,790		16
Median			17,987	17,852	18,490	23,670		

Enterprise Size

Average Growth Rate in Business Financed Research Expenditures Over 3 Years

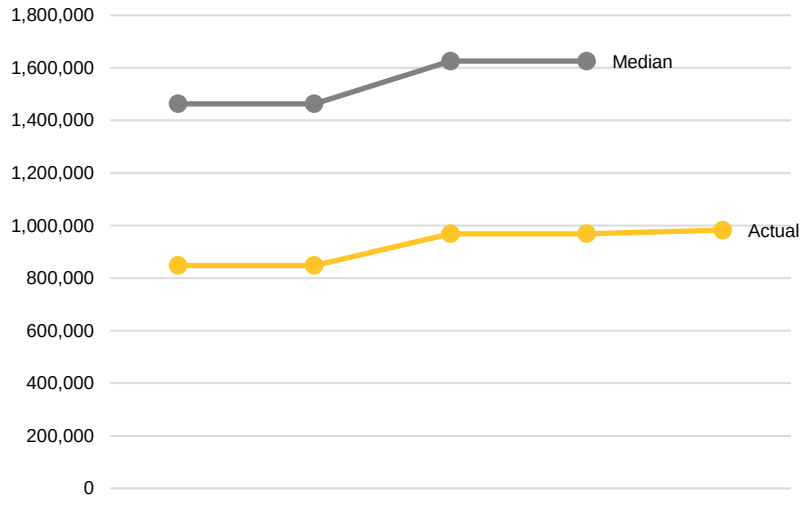


	2011	2012	2013	2014	2015
Actual	-13.2%	-3.8%	4.0%	18.1%	2.9%

ABOR Peer Group	Med. Sch.	NSF Adj.	2011	2012	2013	2014	2015	Rank
University of Washington - Seattle	X		-18.0%	-20.9%	10.6%	42.5%		1
Michigan State University	X		-24.1%	-8.8%	28.7%	32.6%		2
Rutgers the State University of NJ - New Brunswick	X	X	12.0%	12.9%	10.3%	22.1%		3
Arizona State University			-13.2%	-3.8%	4.0%	18.1%	2.9%	4
University of Connecticut - Storrs		X	-1.2%	-6.9%	-0.9%	10.7%		5
University of Iowa	X		42.4%	-3.1%	-1.4%	8.6%		6
Florida State University	X		39.4%	19.9%	19.2%	7.0%		7
University of Illinois - Urbana-Champaign			39.2%	44.1%	58.0%	6.0%		8
Ohio State University - Columbus	X		-6.5%	-5.3%	-2.3%	4.7%		9
University of Maryland - College Park			-16.9%	-16.0%	-5.7%	4.5%		10
University of Texas - Austin	X		17.3%	11.8%	8.5%	1.4%		11
University of California - Los Angeles	X		1.8%	3.2%	3.3%	-1.2%		12
University of Minnesota - Twin Cities	X		3.8%	-2.6%	0.7%	-3.5%		13
University of Wisconsin - Madison	X		30.8%	29.3%	39.9%	-5.8%		14
Indiana University - Bloomington		X	-3.1%	-11.8%	-2.0%	-11.1%		15
Pennsylvania State University - University Park		X	-11.6%	-27.0%	-16.5%	-17.2%		16
Median			0.3%	-3.5%	3.7%	5.3%		

Enterprise Size

Net Assignable Square Feet

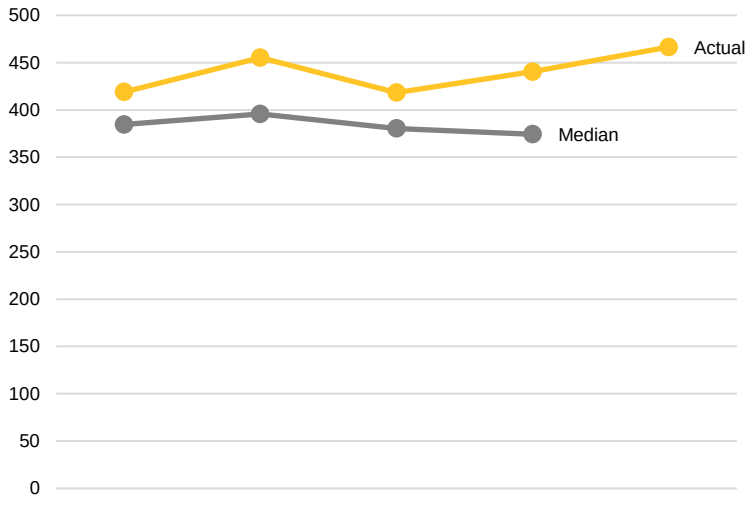


	2011	2012	2013	2014	2015
Actual	847,836	847,836	968,595	968,595	982,738

ABOR Peer Group	Med. Sch.	NSF Adj.	2011	2012	2013	2014	2015	Rank
University of Minnesota - Twin Cities	X		3,531,048	3,531,048	3,672,847	3,672,847		1
University of Illinois - Urbana-Champaign			4,631,400	4,631,400	3,108,558	3,108,558		2
Ohio State University - Columbus	X		1,447,310	1,447,310	2,973,355	2,973,355		3
University of Wisconsin - Madison	X		2,935,571	2,935,571	2,774,278	2,774,278		4
University of California - Los Angeles	X		2,632,450	2,632,450	2,717,533	2,717,533		5
Pennsylvania State University - University Park		X	2,552,837	2,551,372	2,380,552	2,380,552		6
Michigan State University	X		2,274,375	2,274,375	2,253,911	2,253,911		7
University of Washington - Seattle	X		1,874,449	1,874,449	1,796,285	1,796,285		8
University of Texas - Austin	X		1,478,523	1,478,523	1,455,474	1,455,474		9
Rutgers the State University of NJ - New Brunswick	X	X	1,106,675	1,106,675	1,167,010	1,167,010		10
Arizona State University			847,836	847,836	968,595	968,595	982,738	11
University of Maryland - College Park			769,581	769,581	769,581	769,581		12
University of Iowa	X		659,913	659,913	700,757	700,757		13
Indiana University - Bloomington		X	591,765	591,765	637,564	637,564		14
Florida State University	X		511,000	511,000	553,000	553,000		15
University of Connecticut - Storrs		X	540,215	531,138	513,187	513,187		16
Median			1,462,917	1,462,917	1,625,880	1,625,879.5		

Enterprise Size

Total Research Expenditures per Net Assignable Square Foot

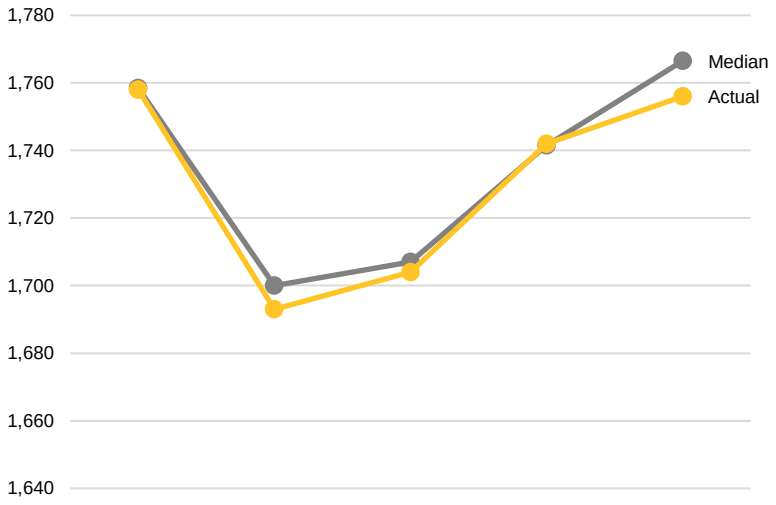


	2011	2012	2013	2014	2015
Actual	419	455	418	440	466

ABOR Peer Group	Med. Sch.	NSF Adj.	2011	2012	2013	2014	2015	Rank
University of Washington - Seattle	X		613	592	664	655		1
University of Iowa	X		673	676	621	641		2
University of Maryland - College Park			644	653	639	630		3
Rutgers the State University of NJ - New Brunswick	X	X	391	393	423	552		4
Florida State University	X		451	441	454	457		5
Arizona State University			419	455	418	440	466	6
University of Texas - Austin	X		428	420	436	402		7
University of Wisconsin - Madison	X		379	398	405	400		8
University of California - Los Angeles	X		373	381	356	349		9
Indiana University - Bloomington		X	311	312	310	323		10
University of Connecticut - Storrs		X	282	286	279	297		11
Pennsylvania State University - University Park		X	271	272	307	293		12
Ohio State University - Columbus	X		575	530	267	274		13
University of Minnesota - Twin Cities	X		240	234	234	239		14
Michigan State University	X		200	223	229	234		15
University of Illinois - Urbana-Champaign			118	126	239	200		16
Median			385	396	380	374.3		

Enterprise Size

Total Faculty Population

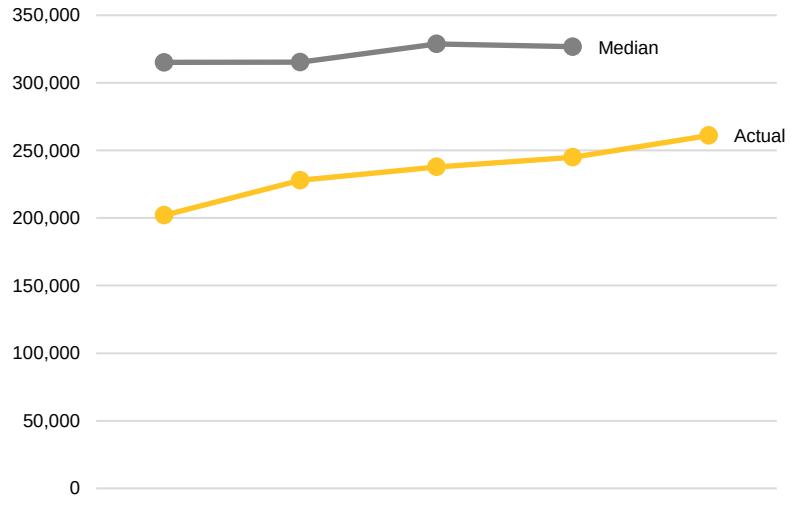


	2011	2012	2013	2014	2015
Actual	1,758	1,693	1,704	1,742	1,756

ABOR Peer Group	Med. Sch.	NSF Adj.	2011	2012	2013	2014	2015	Rank
Ohio State University - Columbus	X		2,560	2,511	2,489	2,508	2,491	1
University of Minnesota - Twin Cities	X		2,277	2,251	2,412	2,408	2,419	2
University of Wisconsin - Madison	X		2,057	2,014	2,067	2,082	2,124	3
University of Texas - Austin	X		1,954	1,910	1,910	1,898	1,899	4
Rutgers the State University of NJ - New Brunswick	X	X	1,518	1,546	1,514	1,919	1,885	5
Michigan State University	X		1,906	1,883	1,732	1,825	1,838	6
University of Illinois - Urbana-Champaign			1,778	1,707	1,710	1,753	1,788	7
Pennsylvania State University - University Park		X	1,759	1,763	1,731	1,741	1,777	8
Arizona State University			1,758	1,693	1,704	1,742	1,756	9
University of California - Los Angeles	X		1,822	1,776	1,747	1,725	1,734	10
University of Washington - Seattle	X		1,536	1,525	1,487	1,498	1,526	11
University of Iowa	X		1,527	1,538	1,576	1,551	1,525	12
University of Maryland - College Park			1,463	1,501	1,483	1,476	1,514	13
University of Connecticut - Storrs		X	1,200	1,235	1,264	1,320	1,377	14
Indiana University - Bloomington		X	1,351	1,356	1,344	1,357	1,373	15
Florida State University	X		1,040	989	1,027	1,039	1,067	16
Median			1,759	1,700	1,707	1,742	1,767	

Enterprise Size

Total Research Expenditures per Faculty



	2011	2012	2013	2014	2015
Actual	202,056	227,973	237,766	244,920	261,055

ABOR Peer Group	Med. Sch.	NSF Adj.	2011	2012	2013	2014	2015	Rank
University of Washington - Seattle	X		747,743	727,218	801,959	785,274		1
University of California - Los Angeles	X		539,164	564,963	553,325	549,679		2
University of Wisconsin - Madison	X		540,419	580,824	543,542	532,451		3
Pennsylvania State University - University Park		X	393,808	394,089	421,602	400,616		4
University of Minnesota - Twin Cities	X		372,165	367,025	355,878	364,149		5
University of Illinois - Urbana-Champaign			306,900	341,977	434,788	354,668		6
Rutgers the State University of NJ - New Brunswick	X	X	284,787	281,307	325,839	335,652		7
University of Maryland - College Park			338,607	334,714	331,759	328,625		8
Ohio State University - Columbus	X		325,049	305,262	318,752	324,990		9
University of Texas - Austin	X		323,527	325,413	332,006	308,351		10
University of Iowa	X		290,696	290,266	276,254	289,585		11
Michigan State University	X		238,325	269,284	297,752	288,716		12
Arizona State University			202,056	227,973	237,766	244,920	261,055	13
Florida State University	X		221,549	227,885	244,281	243,068		14
Indiana University - Bloomington		X	136,266	136,052	147,245	151,834		15
University of Connecticut - Storrs		X	127,129	122,916	113,268	115,539		16
Median			315,214	315,337	328,799	326,808		

Enterprise Size

Other Sponsored Project Expenditures (in Thousands)

	2011	2012	2013	2014	2015
Actual	46,422	52,235	46,097	52,731	54,243

Enterprise Size

Average Growth Rate in Other Sponsored Project Expenditures Over 3 Years

ABOR Enterprise Plan	2011	2012	2013	2014	2015
Actual	5.9%	9.2%	6.8%	5.1%	1.8%

This Page Intentionally Left Blank

Discovery and Scholarly Impact

Our knowledge enterprise fuels a pipeline of fundamental research that translates to real-world solutions and marketplace products that have a profound impact on people's lives. In 2014, two U.S. aid workers infected with the Ebola virus were administered a therapeutic treatment that was produced in tobacco plants using a technique pioneered by Dr. Charles Arntzen at the Biodesign Institute. Both aid workers recovered, and Arntzen was **named the most creative person of the year** by the magazine Fast Company.

Researchers from the Center for Negative Carbon Emissions, led by faculty in the Ira A. Fulton Schools of Engineering, have developed a **new air capture technology for carbon dioxide reduction**. The researchers are also looking at ways to use the captured carbon to expand a sustainable economy.

Working with the prestigious Nature Publishing Group, ASU faculty have **launched the journal npj Microgravity**, designed to be the premier journal covering research that both enables and is enabled by spaceflight. Editor-in-chief Dr. Cheryl Nickerson, a professor in ASU's Biodesign Institute, is internationally recognized for her research using the microgravity environment of spaceflight to study the effects of physical forces on infectious disease mechanisms.

The excitement of discovery is a language understood by the young and old, and ASU takes pride in sharing research, knowledge and inspiration with our community. For example during fiscal year 2015, the ASU Origins Project dialogues hosted **intellectual giant Noam Chomsky** and others for discussions on topics ranging from modern language to the origins of the universe. Each year the Marston Theater at ISTB IV hosts hundreds of middle school students as well as the general public for programs such as narrated video presentations **exploring our universe in 3-D stereographic vision**.

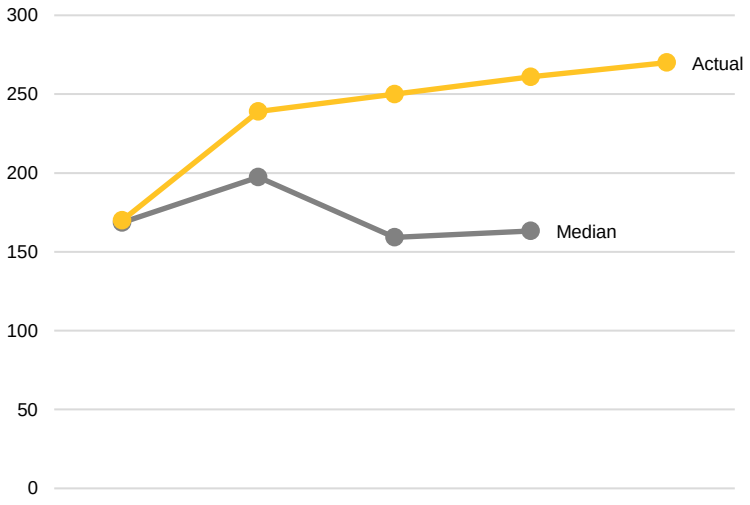
The 2015 Night of the Open Door event welcomed an estimated **15,000 community members** and visitors to the Tempe, West, Downtown and Polytechnic campuses. Visitors came from 50 cities in Arizona as well as from 14 different states. During the event, school-age children and families visited buildings on all campuses, toured facilities normally closed to visitors, and took part in a range of activities. The weeklong Sustainability Solutions Festival also engaged **more than 6,400 people** in sustainability-themed events including film screenings, lectures, a picnic in the park and speakers from the GreenBiz Forum.

Each year, ASU faculty members publish their discoveries and scholarship in the best peer-refereed journals. Examples from the past year include:

- An account of the 2013 discovery of the **earliest evidence of our human genus**, found in Ethiopia by a team of ASU scientists and students, was published in the online version of **Science**.
- In new research published in **PLOS ONE,** Dr. Cheryl Nickerson and collaborators explored a radical approach to the **repair and transplantation of scarred lungs.**
- Research led by Dr. Karl Sieradzki has uncovered **new knowledge about the causes of stress-corrosion cracking.** The research was published online in **Nature Materials.**
- Dr. Devoney Looser and her colleague at the University of Missouri have discovered previously unpublished historic letters that **shed light on the life of novelist Jane Austen**. The letters and an accompanying article were published in the journal **Modern Philology**.
- **New ways to diagnose Alzheimer's** and other neurological diseases were published in the **Journal of Alzheimer's Disease.** Dr. Visar Berisha conducted the research by studying transcripts of news conferences held by former Presidents Ronald Reagan and George H.W. Bush.
- Dr. Carlo Maley and colleagues have published two important papers furthering our understanding of cancer: in **Science Translational Medicine** they described **behavior of acute myeloid leukemia**, the most treatment-resistant and lethal forms of blood cancer; in **Nature Reviews Clinical Oncology** they use a paleontological view of species extinction to **address the challenges of how to drive cancer extinct** and how to achieve better prognoses.
- In a new study headed by Drs. Josh LaBaer and Karen Anderson, three autoantibodies were **identified as promising biomarkers for ovarian cancer.** The research is the first demonstration of Nucleic Acid Protein Programmable Array technology and was published in the **Journal of Proteome Research.**
- Research led by Dr. Dan Buttry explores a new **energy storage technology that could give batteries an even longer life cycle**. The research was recently published in the journal **Nature Communications**.
- In a first-of-its-kind study, Dr. Petra Fromme joined an international team using techniques of **X-ray crystallography to understand opioid receptors**. This research is a foundation for creating powerful new analgesics, capable of blocking pain without generating tolerance or dependency. Their research findings appear in the journal **Nature Structural and Molecular Biology**.

Discovery and Scholarly Impact

Invention Disclosures Transacted

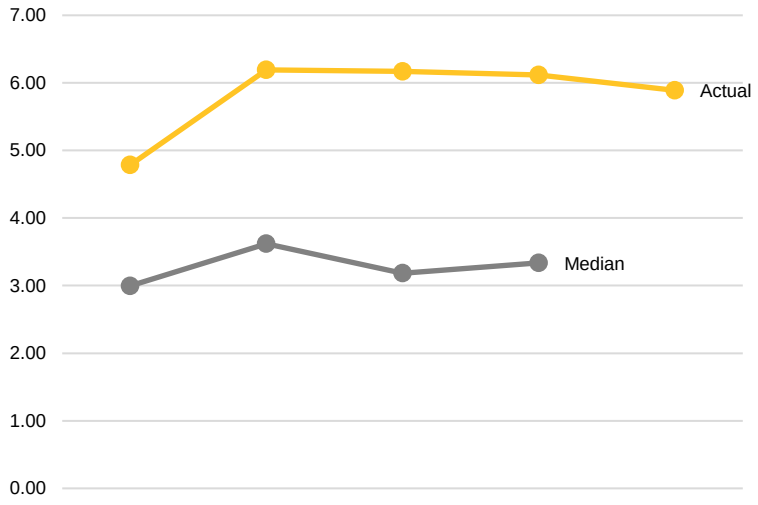


ABOR Enterprise Plan	2011	2012	2013	2014	2015
Actual	170	239	250	261	270

ABOR Peer Group	Med. Sch.	AUTM Adj.	2011	2012	2013	2014	2015	Rank
University of Washington - Seattle	X		356	462	410	421		1
University of Wisconsin - Madison	X		357	373	386	417		2
University of California - Los Angeles	X		299	343	359	371		3
University of Minnesota - Twin Cities	X		250	321	331	343		4
Ohio State University - Columbus	X		216	319	384	305		5
Arizona State University			170	239	250	261	270	6
University of Illinois - Urbana-Champaign			182	223	181	179		7
Rutgers the State University of NJ - New Brunswick	X	X	167	172	127	147		8
University of Iowa	X		68	102	96	139		9
Michigan State University	X		110	127	122	131		10
Pennsylvania State University - University Park		X	124	114	137	101		11
Indiana University - Bloomington		X	63	74	88	87		12
Florida State University	X		64	74	58	61		13
University of Connecticut - Storrs		X	40	48	42	35		14
University of Maryland - College Park								
University of Texas - Austin	X							
Median			169	197	159	163		

Discovery and Scholarly Impact

Invention Disclosures Transacted per $10 Million in Total Research Expenditures

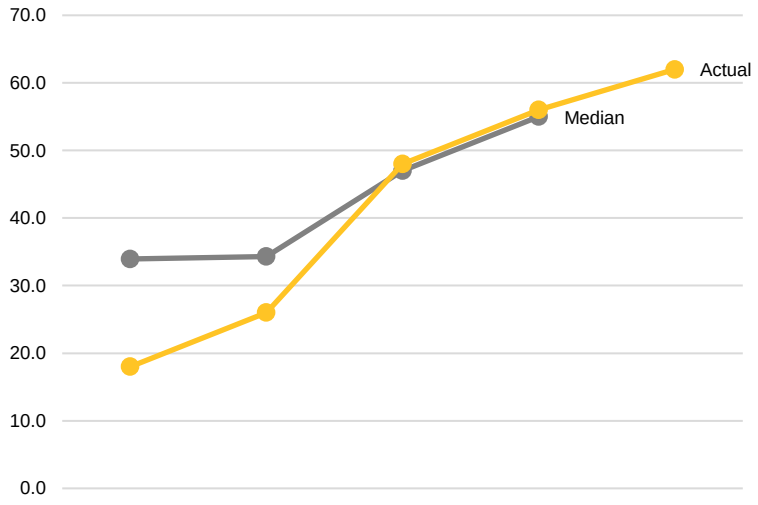


ABOR Enterprise Plan	2011	2012	2013	2014	2015
Actual	4.8	6.2	6.2	6.1	5.9

ABOR Peer Group	Med. Sch.	NSF Adj.	AUTM Adj.	2011	2012	2013	2014	2015	Rank
Arizona State University				4.8	6.2	6.2	6.1	5.9	1
Indiana University - Bloomington		X	X	3.4	4.0	4.5	4.2		2
University of California - Los Angeles	X			3.0	3.4	3.7	3.9		3
University of Minnesota - Twin Cities	X			3.0	3.9	3.9	3.9		4
University of Wisconsin - Madison	X			3.2	3.2	3.4	3.8		5
Ohio State University - Columbus	X			2.6	4.2	4.8	3.7		6
University of Washington - Seattle	X			3.1	4.2	3.4	3.6		7
University of Iowa	X			1.5	2.3	2.2	3.1		8
University of Illinois - Urbana-Champaign				3.3	3.8	2.4	2.9		9
Michigan State University	X			2.4	2.5	2.4	2.5		10
Florida State University	X			2.8	3.3	2.3	2.4		11
Rutgers the State University of NJ - New Brunswick	X	X	X	3.9	3.9	2.6	2.3		12
University of Connecticut - Storrs		X	X	2.6	3.2	2.9	2.3		13
Pennsylvania State University - University Park		X	X	1.8	1.6	1.9	1.4		14
University of Maryland - College Park									
University of Texas - Austin	X								
Median				3.0	3.6	3.2	3.3		

Discovery and Scholarly Impact

U.S. Patents Issued

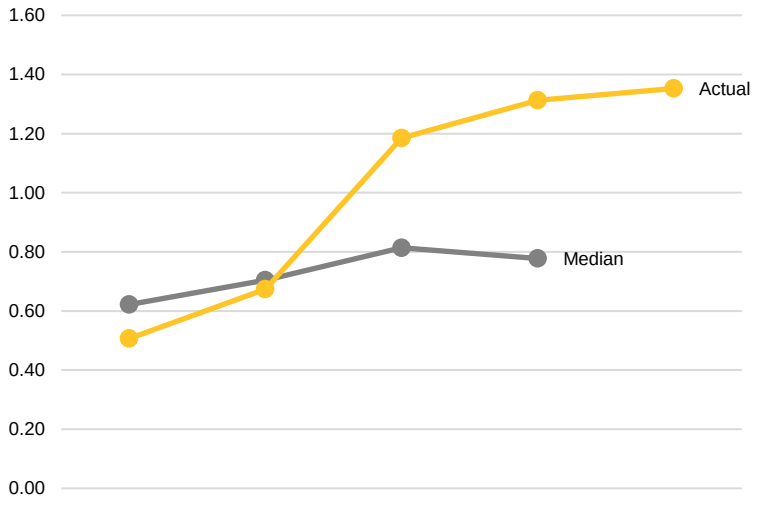


ABOR Enterprise Plan	2011	2012	2013	2014	2015
Actual	18	26	48	56	62

ABOR Peer Group	Med. Sch.	AUTM Adj.	2011	2012	2013	2014	2015	Rank
University of Wisconsin - Madison	X		156	153	157	166		1
University of California - Los Angeles	X		56	74	95	97		2
University of Washington - Seattle	X		70	61	94	82		3
University of Illinois - Urbana-Champaign			68	76	72	78		4
Rutgers the State University of NJ - New Brunswick	X	X	27	35	40	77		5
University of Minnesota - Twin Cities	X		41	59	64	65		6
Arizona State University			18	26	48	56	62	7
Ohio State University - Columbus	X		30	41	62	54		8
Pennsylvania State University - University Park		X	32	34	35	47		9
Florida State University	X		36	27	43	39		10
Michigan State University	X		38	31	46	32		11
University of Iowa	X		31	31	24	25		12
University of Connecticut - Storrs		X	11	21	12	12		13
Indiana University - Bloomington		X	7	4	6	12		14
University of Maryland - College Park								
University of Texas - Austin	X							
Median			34	34	47	55		

Discovery and Scholarly Impact

U.S. Patents Issued per $10 Million in Total Research Expenditures



ABOR Enterprise Plan	2011	2012	2013	2014	2015
Actual	0.5	0.7	1.2	1.3	1.4

ABOR Peer Group	Med. Sch.	NSF Adj.	AUTM Adj.	2011	2012	2013	2014	2015	Rank
Florida State University	X			1.6	1.2	1.7	1.5		1
University of Wisconsin - Madison	X			1.4	1.3	1.4	1.5		2
Arizona State University				0.5	0.7	1.2	1.3	1.4	3
University of Illinois - Urbana-Champaign				1.2	1.3	1.0	1.3		4
Rutgers the State University of NJ - New Brunswick	X	X	X	0.6	0.8	0.8	1.2		5
University of California - Los Angeles	X			0.6	0.7	1.0	1.0		6
University of Connecticut - Storrs		X	X	0.7	1.4	0.8	0.8		7
University of Minnesota - Twin Cities	X			0.5	0.7	0.7	0.7		8
University of Washington - Seattle	X			0.6	0.6	0.8	0.7		9
Pennsylvania State University - University Park		X	X	0.5	0.5	0.5	0.7		10
Ohio State University - Columbus	X			0.4	0.5	0.8	0.7		11
Michigan State University	X			0.8	0.6	0.9	0.6		12
Indiana University - Bloomington		X	X	0.4	0.2	0.3	0.6		13
University of Iowa	X			0.7	0.7	0.6	0.6		14
University of Maryland - College Park									
University of Texas - Austin	X								
Median				0.6	0.7	0.8	0.8		

This Page Intentionally Left Blank

Economic Development

ASU is a major driver of the Arizona economy, consistently developing innovative, game-changing ideas and technologies. By embedding entrepreneurship into every unit at the university, and through partnerships with companies such as Starbucks and the nonprofit venture edX, we ensure that all students are able to take advantage of our programs to reach their full potential and make their own contributions to the 21st century's knowledge-driven markets.

We are proud to lead several initiatives reaching out to minority students and women. Their engagement in essential STEM fields increases the diversity in both research and entrepreneurial arenas. **We lead the nation in hires of women and minority women**, and with projects like CompuGirls and the Women's Entrepreneurship Initiative, we are helping increase gender equity in STEM fields and entrepreneurship.

This year the White House announced that **ASU would lead the National STEM Collaborative**, a consortium of 19 institutions of higher education and nonprofit partners committed to supporting minority girls and women in STEM fields. We are also partnering with Cisco Systems to engage minority youth in entrepreneurship and teaming up with the City of Gilbert and the Southeast Regional Library to create SPARK Space, which supports and empowers local business owners by providing entrepreneurship resources such as mentorship opportunities and the ASU Startup School program.

In addition to stimulating the Arizona economy, ASU helps drive international economic development. For example, President Michael Crow led an ASU delegation on a mission to Mexico City to enhance strategic relations with Mexican higher education institutions, federal agencies and international agencies.

Additionally, ASU partnered with two Pakistani universities to establish the Partnership Center for Advanced Studies in Energy with an **$18 million U.S. Agency for International Development grant**. PCASE will work toward sustainable energy solutions that can be implemented in Pakistan. This will also serve as an innovative way of addressing economic opportunity for youth in the region as well as protecting our national security interests in Pakistan.

The International Economic Development Council awarded the **2015 Silver Excellence in Economic Development Award** to SkySong, the ASU Scottsdale Innovation Center.

The **Biodesign Institute has made an economic impact of $1.5 billion in its first decade** of operation, according to a study from the Seidman Research Institute at ASU's W. P. Carey School of Business.

HealthTell, a spinout company based on research developed at the Biodesign Institute, was named **one of the top five startups** in the San Francisco Business Times. HealthTell is developing a simple blood test designed to measure a person's immune response to cancer, giving patients and their doctors early information about the best course of treatment.

ASU spinout company Thync has raised **$13 million in funding**. Thync is engineering the first lifestyle wearable that uses neurosignaling algorithms – waveforms that signal neural pathways – to shift and optimize people's state of mind in areas related to energy, calm and focus.

Several entrepreneurial ventures led by Herberger Institute for Design and the Arts students, faculty and alumni swept the top prizes at both Art Tank East and Art Tank West, taking home **over $30,000 in seed money** distributed by the Arizona Commission on the Arts**.**

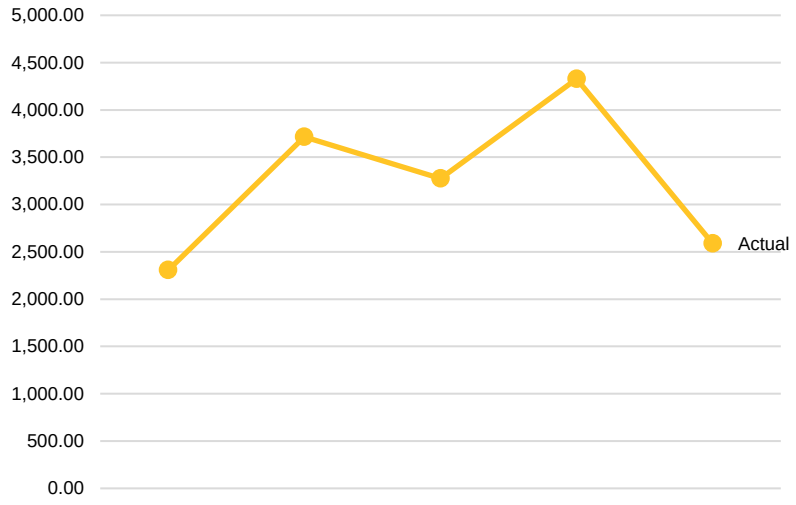
Dr. Jeffrey La Belle will improve and expand the use of tears as a biomarker to detect various ocular disorders with nearly **$500,000** in funding from Advanced Tear Diagnostics.

ASU continues to build a strong and productive partnership with Mayo Clinic and is developing projects with Mayo Clinic Hospital in Phoenix that will **stimulate economic development**.

The ASU Lodestar Center for Philanthropy and Nonprofit Innovation recently received a grant from Public Allies National Office for **over $500,000 with an additional $560,000 in local funding**. This is enabling our Public Allies Arizona program to recruit and engage 43 new participants this year.

Economic Development

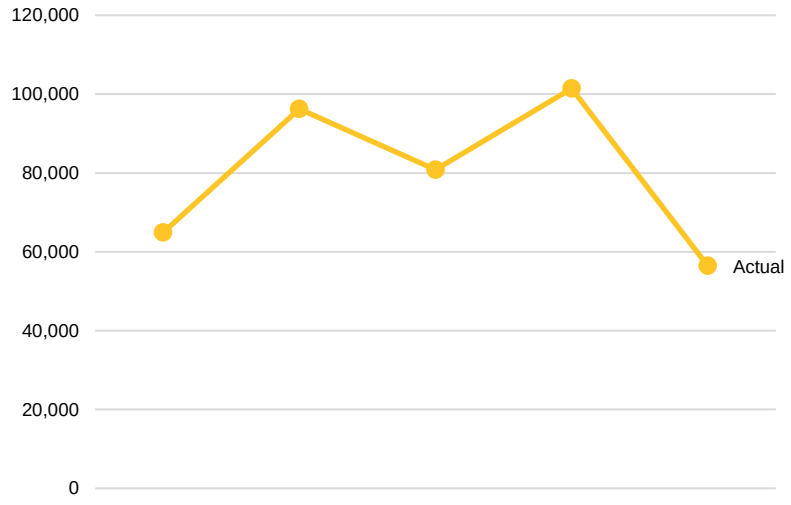
Intellectual Property Income (in Thousands)



ABOR Enterprise Plan	2011	2012	2013	2014	2015
Actual	2,307	3,715	3,275	4,328	2,588

Economic Development

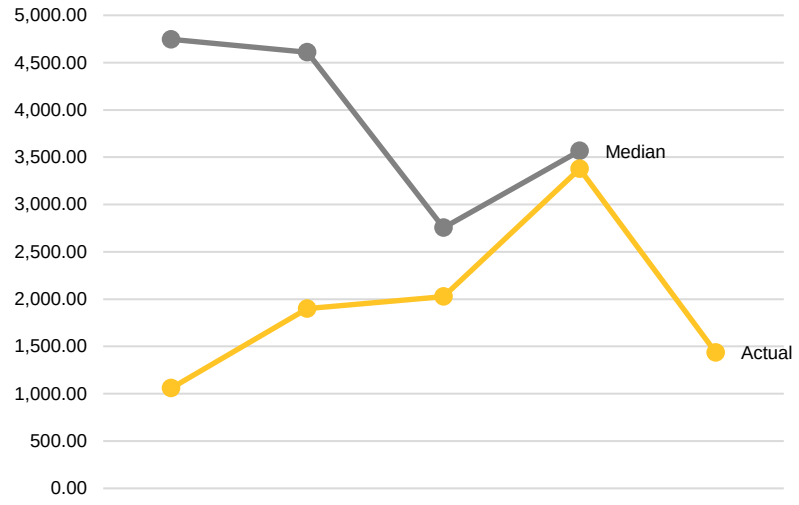
Intellectual Property Income per $10 Million in Total Research Expenditures



ABOR Enterprise Plan	2011	2012	2013	2014	2015
Actual	64,946	96,251	80,840	101,433	56,453

Economic Development

Licenses and Options Income (in Thousands)

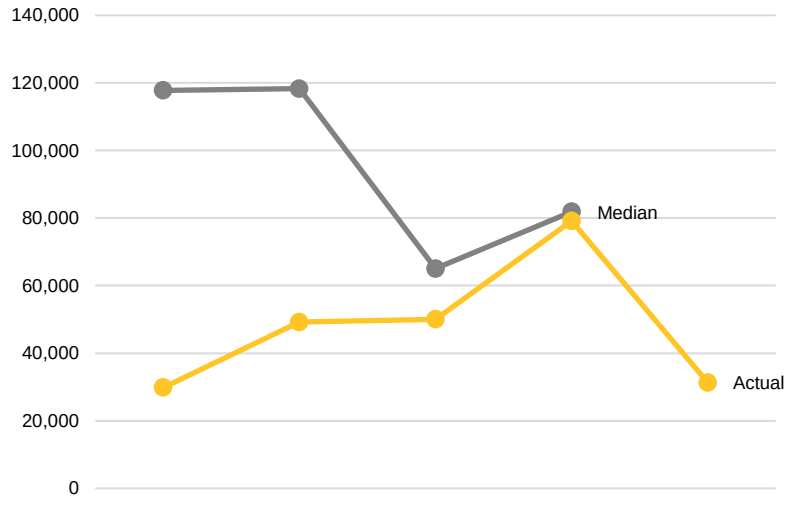


	2011	2012	2013	2014	2015
Actual	1,059	1,900	2,027	3,377	1,436

ABOR Peer Group	Med. Sch.	AUTM Adj.	2011	2012	2013	2014	2015	Rank
University of Washington - Seattle	X		67,362	76,956	99,491	104,767		1
University of Wisconsin - Madison	X		57,730	41,100	94,170	43,400		2
University of California - Los Angeles	X		16,153	17,833	23,423	38,786		3
University of Minnesota - Twin Cities	X		10,079	45,652	38,030	26,075		4
Rutgers the State University of NJ - New Brunswick	X	X	5,463	5,515	7,734	13,413		5
University of Illinois - Urbana-Champaign			6,363	6,410	4,914	5,255		6
Michigan State University	X		3,616	3,704	3,302	3,756		7
Arizona State University			1,059	1,900	2,027	3,377	1,436	8
Ohio State University - Columbus	X		1,420	2,170	2,105	2,199		9
Indiana University - Bloomington		X	4,030	2,607	2,207	2,125		10
University of Iowa	X		6,285	7,234	1,205	1,626		11
Pennsylvania State University - University Park		X	2,541	2,675	1,958	1,316		12
Florida State University	X		1,468	1,133	1,036	1,064		13
University of Connecticut - Storrs		X	455	570	579	1,015		14
University of Maryland - College Park								
University of Texas - Austin	X							
Median			4,746	4,609	2,755	3,566		

Economic Development

Licenses and Options Income per $10 Million in Total Research Expenditures

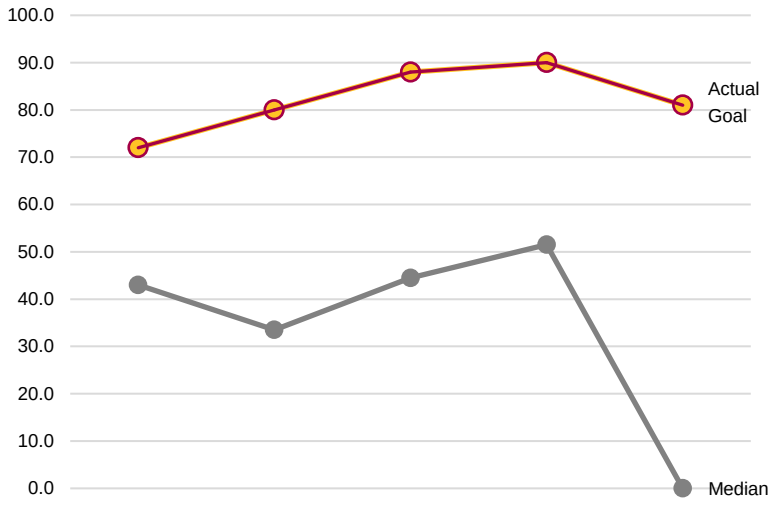


	2011	2012	2013	2014	2015
Actual	29,823	49,237	50,023	79,151	31,333

ABOR Peer Group	Med. Sch.	AUTM Adj.	2011	2012	2013	2014	2015	Rank
University of Washington - Seattle	X		586,506	693,916	834,298	890,620		1
University of California - Los Angeles	X		164,431	177,730	242,309	409,050		2
University of Wisconsin - Madison	X		519,322	351,348	838,183	391,497		3
University of Minnesota - Twin Cities	X		118,932	552,566	443,050	297,360		4
Rutgers the State University of NJ - New Brunswick	X	X	126,363	126,809	156,780	208,244		5
Indiana University - Bloomington		X	218,891	141,288	111,518	103,143		6
University of Illinois - Urbana-Champaign			116,601	109,813	66,088	84,528		7
Arizona State University			29,823	49,237	50,023	79,151	31,333	8
Michigan State University	X		79,596	73,041	64,035	71,281		9
University of Connecticut - Storrs		X	29,842	37,580	40,451	66,578		10
Florida State University	X		63,711	50,274	41,304	42,141		11
University of Iowa	X		141,587	162,043	27,685	36,197		12
Ohio State University - Columbus	X		17,065	28,304	26,534	26,973		13
Pennsylvania State University - University Park		X	36,677	38,497	26,834	18,862		14
University of Maryland - College Park								
University of Texas - Austin	X							
Median			117,766	118,311	65,062	81,839		

Economic Development

Licenses and Options Executed

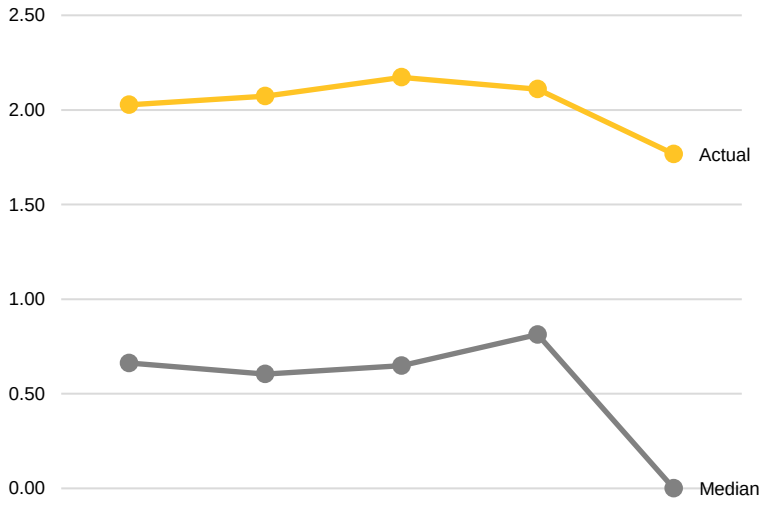


ABOR Enterprise Plan	2011	2012	2013	2014	2015
Actual	72	80	88	90	81
Goal	72	80	88	90	81
Difference	0	0	0	0	0

ABOR Peer Group	Med. Sch.	AUTM Adj.	2011	2012	2013	2014	2015	Rank
University of Washington - Seattle	X		194	209	260	265		1
University of Minnesota - Twin Cities	X		113	75	91	154		2
Arizona State University			72	80	88	90	81	3
Michigan State University	X		40	32	33	70		4
Ohio State University - Columbus	X		25	33	50	68		5
University of Wisconsin - Madison	X		62	60	63	68		5
Rutgers the State University of NJ - New Brunswick	X	X	69	58	59	58		7
University of California - Los Angeles	X		46	34	43	45		8
University of Illinois - Urbana-Champaign			55	46	46	38		9
University of Iowa	X		24	21	29	32		10
Pennsylvania State University - University Park		X	20	18	31	31		11
Florida State University	X		10	13	15	20		12
Indiana University - Bloomington		X	14	14	13	14		13
University of Connecticut - Storrs		X	4	5	11	13		14
University of Maryland - College Park								
University of Texas - Austin	X							
Median			43	34	45	52		

Economic Development

Licenses and Options Executed per $10 Million in Total Research Expenditures

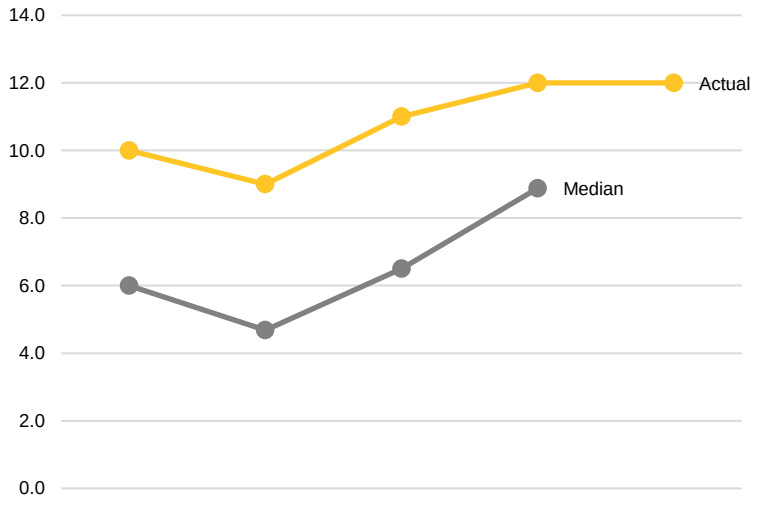


ABOR Enterprise Plan	2011	2012	2013	2014	2015
Actual	2.0	2.1	2.2	2.1	1.8

ABOR Peer Group	Med. Sch.	NSF Adj.	AUTM Adj.	2011	2012	2013	2014	2015	Rank
University of Washington - Seattle	X			1.7	1.9	2.2	2.3		1
Arizona State University				2.0	2.1	2.2	2.1	1.8	2
University of Minnesota - Twin Cities	X			1.3	0.9	1.1	1.8		3
Michigan State University	X			0.9	0.6	0.6	1.3		4
Rutgers the State University of NJ - New Brunswick	X	X	X	1.6	1.3	1.2	0.9		5
University of Connecticut - Storrs		X	X	0.3	0.4	0.8	0.9		6
Ohio State University - Columbus	X			0.3	0.4	0.6	0.8		7
Florida State University	X			0.4	0.6	0.6	0.8		8
University of Iowa	X			0.5	0.5	0.7	0.7		9
Indiana University - Bloomington		X	X	0.8	0.8	0.7	0.7		10
University of Wisconsin - Madison	X			0.6	0.5	0.6	0.6		11
University of Illinois - Urbana-Champaign				1.0	0.8	0.6	0.6		12
University of California - Los Angeles	X			0.5	0.3	0.4	0.5		13
Pennsylvania State University - University Park		X	X	0.3	0.3	0.4	0.4		14
University of Maryland - College Park									
University of Texas - Austin	X								
Median				0.7	0.6	0.6	0.8		

Economic Development

Startup Companies

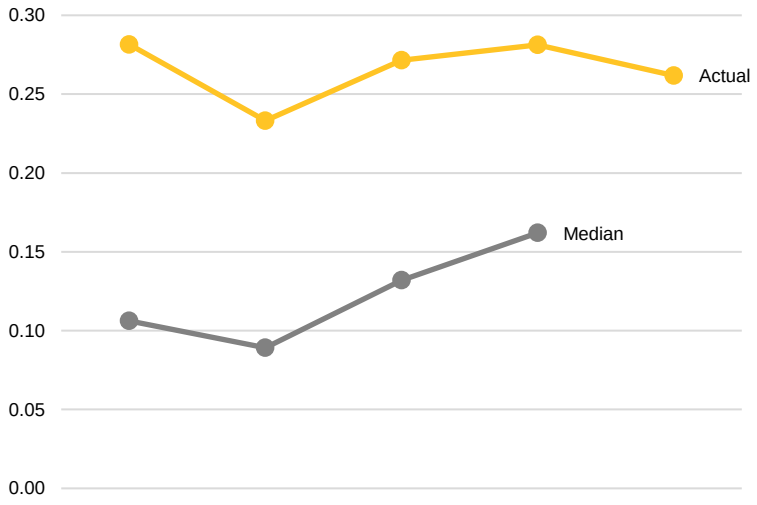


ABOR Enterprise Plan	2011	2012	2013	2014	2015
Actual	10	9	11	12	12

ABOR Peer Group	Med. Sch.	AUTM Adj.	2011	2012	2013	2014	2015	Rank
University of California - Los Angeles	X		19	13	17	19		1
University of Washington - Seattle	X		9	9	17	18		2
University of Minnesota - Twin Cities	X		9	12	14	15		3
Ohio State University - Columbus	X		6	5	10	14		4
Arizona State University			10	9	11	12	12	5
University of Iowa	X		2	4	6	11		6
University of Wisconsin - Madison	X		4	4	7	10		7
Pennsylvania State University - University Park		X	4	4	9	8		8
University of Illinois - Urbana-Champaign			12	5	6	6		9
Indiana University - Bloomington		X	3	5	6	4		10
Rutgers the State University of NJ - New Brunswick	X	X	7	5	2	4		11
University of Connecticut - Storrs		X		3	2	3		12
Florida State University	X		4	2	3	2		13
Michigan State University	X		1	3	1	0		14
University of Maryland - College Park								
University of Texas - Austin	X							
Median			6	5	7	9		

Economic Development

Startup Companies per $10 Million in Total Research Expenditures

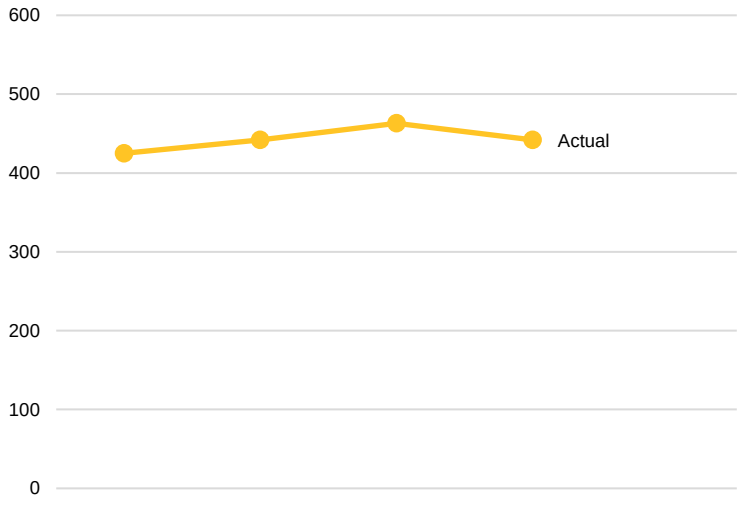


ABOR Enterprise Plan	2011	2012	2013	2014	2015
Actual	0.3	0.2	0.3	0.3	0.3

ABOR Peer Group	Med. Sch.	NSF Adj.	AUTM Adj.	2011	2012	2013	2014	2015	Rank
Arizona State University				0.3	0.2	0.3	0.3	0.3	1
University of Iowa	X			0.0	0.1	0.1	0.2		2
University of California - Los Angeles	X			0.2	0.1	0.2	0.2		3
University of Connecticut - Storrs		X	X		0.2	0.2	0.2		4
Indiana University - Bloomington		X	X	0.1	0.3	0.3	0.2		5
Ohio State University - Columbus	X			0.1	0.1	0.1	0.2		6
University of Minnesota - Twin Cities	X			0.1	0.1	0.2	0.2		7
University of Washington - Seattle	X			0.1	0.1	0.1	0.2		8
Pennsylvania State University - University Park		X	X	0.1	0.1	0.1	0.1		9
University of Illinois - Urbana-Champaign				0.2	0.1	0.1	0.1		10
University of Wisconsin - Madison	X			0.0	0.0	0.1	0.1		11
Florida State University	X			0.2	0.1	0.1	0.1		12
Rutgers the State University of NJ - New Brunswick	X	X	X	0.2	0.1	0.0	0.1		13
Michigan State University	X			0.0	0.1	0.0	0.0		14
University of Maryland - College Park									
University of Texas - Austin	X								
Median				0.1	0.1	0.1	0.2		

Economic Development

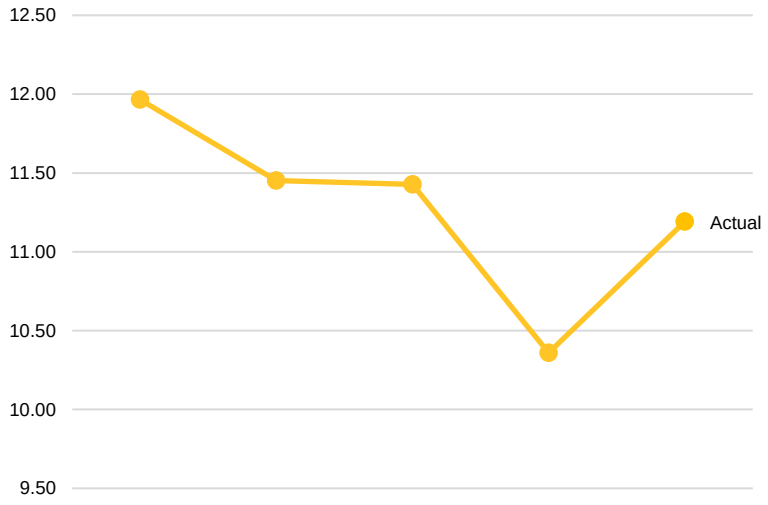
Ph.D. Degrees Conferred



ABOR Enterprise Plan	2011	2012	2013	2014	2015
Actual	425	442	463	442	513

Economic Development

Ph.D. Degrees Conferred per $10 Million in Total Research Expenditures



ABOR Enterprise Plan	2011	2012	2013	2014	2015
Actual	12.0	11.5	11.4	10.4	11.2

This Page Intentionally Left Blank

Leadership and Recognition

ASU's academic and research pursuits garner increasing national and international attention. Examples this year include:

- ASU has been named one of the **nation's most sustainable colleges for the sixth year in a row** by The Princeton Review's "Guide to 353 Green Colleges."
- For the second year, ASU has been selected as **one of 20 leading U.S. universities** to serve as an academic institute for the **Mandela Washington Fellowship for Young African Leaders**, the flagship program of President Obama's Young African Leaders Initiative.
- **Project Humanities received high praise from the Dalai Lama**, who lauded the award-winning initiative for its Humanity 101 community outreach with a letter of recommendation and words of encouragement to continue the work.
- During the **White House Science Fair 2015,** nationwide initiatives aimed at improving citizen science were highlighted, including a new lending library, created through a collaboration between ASU's Center for Engagement and Training in Science and Society and others.
- **Four Leadership in Energy & Environmental Design (LEED) awards** were given to ASU for the outstanding design, planning and construction of campus buildings.

Recognition of our exceptional faculty is reflected by memberships in prestigious academies such as:

- 18 members of the American Academy of Arts and Sciences
- 18 fellows of the American Academy of Nursing
- 66 fellows of the American Association for the Advancement of Science
- 23 members of the Institute of Electrical and Electronics Engineers
- 6 members of the National Academy of Engineering
- 3 fellows of the National Academy of Inventors
- 22 members of the National Academy of Medicine
- 5 members of the National Academy of Public Administration
- 13 members of the National Academy of Sciences
- 63 members of the National Science Foundation Early Career Development Program

Faculty members inducted to national academies in FY15 include:

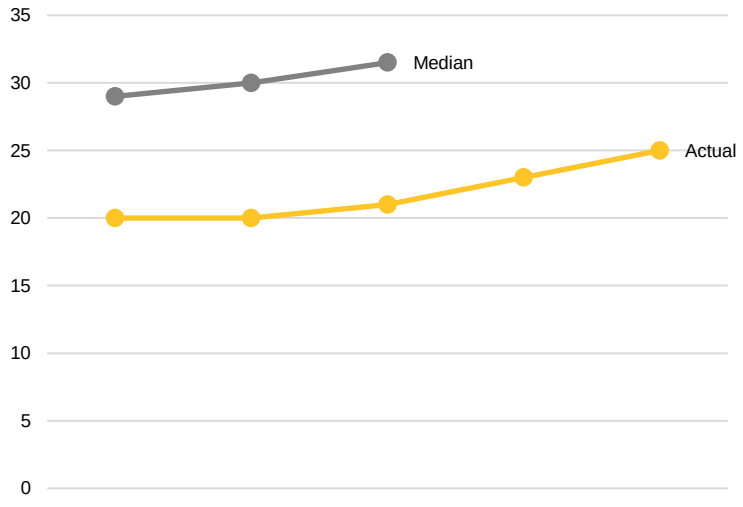
- Dr. Joan Silk, professor in the School of Human Evolution and Social Change, were **inducted into the American Academy of Arts and Sciences.**
- Dr. Daniel Bliss, associate professor, and Dr. Yong-Hang Zhang, professor, in the School of Electrical, Computer and Energy Engineering, were **inducted into the Institute of Electrical and Electronics Engineers.**
- Dr. Jennifer Mensik, faculty associate, and Dr. Adriana Perez, assistant professor, in the College of Nursing and Health Innovation, were **inducted to the American Academy of Nursing**.
- Dr. Stuart Lindsay, professor in the Biodesign Institute, and Dr. Michael Kozicki, professor in the School of Electrical, Computer and Energy Engineering, were **named fellows of the National Academy of Inventors**.

ASU faculty have also earned prestigious national honors and appointments, such as:

- Dr. Nancy Rodriguez, professor in the School of Criminology and Criminal Justice, has been appointed by President Barack Obama to be the **next director of the Department of Justice's National Institute of Justice.**
- Dr. Lawrence Krauss, Foundation Professor in the department of physics, has been named the 2015 **Humanist of the Year by the American Humanists Association**.
- Dr. Michelene "Micki" Chi, professor in the Mary Lou Fulton Teachers College, won the 2015 E. L. Thorndike Award for Lifetime Contribution in Research from the **American Psychological Association**.
- Dr. Barbara Durand, emeritus professor and dean of the College of Nursing & Health Innovation, was recognized as one of the **American Academy of Nursing Living Legends**.
- Dr. Sethuraman "Panch" Panchanathan, professor, executive vice president for the knowledge enterprise, and the university's chief research and innovation officer, became the **chair-elect of the Council on Research at the Association of Public and Land Grant Universities.**
- Dr. T. Agami Reddy, professor in the Design School, was awarded the prestigious 2014 Yellott Award by the Solar Energy Division of the **American Society of Mechanical Engineers.**
- Dr. Barbara Ainsworth, professor in the School of Nutrition and Health Promotion, **received a Lifetime Achievement Award from the President's Council on Fitness.**

Leadership and Recognition

National Academy Members

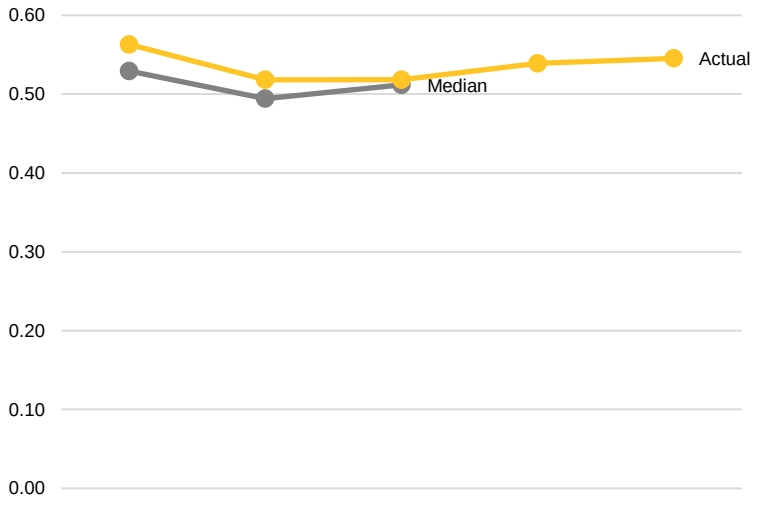


	2011	2012	2013	2014	2015
Actual	20	20	21	23	25

ABOR Peer Group	Med. Sch.	2011	2012	2013	2014	2015	Rank
University of Washington - Seattle	X	104	109	110			1
University of California - Los Angeles	X	95	94	95			2
University of Wisconsin - Madison	X	67	68	70			3
University of Texas - Austin	X	68	67	69			4
University of Illinois - Urbana-Champaign		57	55	57			5
University of Minnesota - Twin Cities	X	39	38	39			6
Rutgers the State University of NJ - New Brunswick	X	35	34	37			7
Ohio State University - Columbus	X	28	30	32			8
University of Maryland - College Park		30	30	31			9
Pennsylvania State University - University Park		23	24	26			10
University of Iowa	X	22	21	22			11
Arizona State University		20	20	21	23	25	12
Michigan State University	X	8	9	10			13
Indiana University - Bloomington		10	10	8			14
Florida State University	X	7	7	6			15
University of Connecticut - Storrs		1	1	1			16
Median		29	30	32			

Leadership and Recognition

National Academy Members per $10 Million in Total Research Expenditures



	2011	2012	2013	2014	2015
Actual	0.6	0.5	0.5	0.5	0.5

ABOR Peer Group	Med. Sch.	NSF Adj.	2011	2012	2013	2014	2015	Rank
University of Texas - Austin	X		1.1	1.1	1.1			1
University of California - Los Angeles	X		1.0	0.9	1.0			2
University of Washington - Seattle	X		0.9	1.0	0.9			3
University of Illinois - Urbana-Champaign			1.0	0.9	0.8			4
Rutgers the State University of NJ - New Brunswick	X	X	0.7	0.7	0.7			5
University of Maryland - College Park			0.6	0.6	0.6			6
University of Wisconsin - Madison	X		0.6	0.6	0.6			7
Arizona State University			0.6	0.5	0.5	0.5	0.5	8
University of Iowa	X		0.5	0.5	0.5			9
University of Minnesota - Twin Cities	X		0.5	0.5	0.5			10
Ohio State University - Columbus	X		0.3	0.4	0.4			11
Pennsylvania State University - University Park		X	0.3	0.3	0.3			12
Florida State University	X		0.3	0.3	0.2			13
Michigan State University	X		0.2	0.2	0.2			14
Indiana University - Bloomington		X	0.2	0.2	0.2			15
University of Connecticut - Storrs		X	0.0	0.0	0.0			16
Median			0.5	0.5	0.5			

This Page Intentionally Left Blank

Technology Transfer

Innovation at ASU is a key part of economic growth in the Phoenix metro area and in the state. In FY15, ASU faculty working with Arizona Technology Enterprises (AzTE), ASU's exclusive intellectual property management and technology transfer organization, set or matched record highs for invention disclosures (270), startup companies (12), and issued U.S. patents (62). AzTE also helped facilitate the funding of $12.3 million in industry-sponsored research. A new report from the National Academy of Inventors and the Intellectual Property Owners Association **ranks ASU among the top 50 international universities for the number of patents** issued to its researchers in 2014.

To date, **more than 80 companies** have been launched based on ASU innovations. These companies and their sub-licensees have **attracted more than $500 million in funding** from venture capital firms and other investors. In FY15 alone, ASU startup companies, including Fluidic Energy, HealthTell, Heliae and Thync, received more than $76 million in venture capital funding. ASU startups currently **employ more than 350 people in Arizona**.

In partnership with ASU's Knowledge Enterprise Development, AzTE launched **ASU's Startup Mill**. This new initiative's focus is to accelerate both internal and external startups with the highest potential. ASU's Startup Mill matches faculty, student and community startups with accomplished entrepreneurs-in-residence who have launched, grown and exited their own businesses. This program is open to startups in any industry. Startup selections are made based on the potential contribution to the economic vitality of the region and ASU.

AzTE continues to operate an office out of the **ASU California Center in Santa Monica** to help build linkages between the Arizona and Southern California innovation ecosystems, including connecting ASU inventors with California-based investors. From FY13 through FY15, AzTE has **negotiated 44 licensing agreements** with entities having offices in California. California investors have also accounted for a hefty portion of the more than $500 million raised by ASU-linked companies.

Technology Transfer

Statistical Exhibits

ARIZONA STATE UNIVERSITY

Technology Transfer Activities	2011	2012	2013	2014	2015	
Invention Disclosures Transacted	170	239	250	261	270	
Invention Disclosures Transacted Percentage Change		41%	5%	4%	3%	
New U.S. Patent Applications	93	106	168	163	175	
New U.S. Patent Applications Percentage Change		14%	58%	-3%	7%	
U.S. Patents Issued	18	26	48	56	62	
U.S. Patents Issued Percentage Change		44%	85%	17%	11%	
Licenses and Options Executed	72	80	88	90	81	1
Licenses and Options Executed Percentage Change		11%	10%	2%	-10%	
Licensing and Other Revenue						
Licensing Revenue (Including Options)	1,059,372	1,900,333	2,026,689	3,376,965	1,436,333	2
Licensee Legal Reimbursements	1,205,679	1,274,577	970,482	941,229	1,133,341	
Other Revenue	41,945	540,000	278,102	9,469	18,204	
Total	2,306,996	3,714,910	3,275,273	4,327,663	2,587,878	
Other Major Agreements	126	160	186	162	151	3
Other Major Agreements Percentage Change		27%	16%	-13%	-7%	
New Startup Companies Created	10	9	11	12	12	
New Startup Companies Created Percentage Change		-10%	22%	9%	0%	
Active Startup Companies that Received Funding					5	
Active Startup Companies that Received Funding Percentage Change						
Active Startup Funding						
Private Equity Funding Received by Active Startup Companies					75,700,000	
Grant Funding Received by Active Startup Companies					0	
Total					75,700,000	
Sponsored Research Facilitated	8,945,930	9,601,072	9,790,451	12,692,880	14,678,882	
Sponsored Research Facilitated Percentage Change		7%	2%	30%	16%	
Royalty Distribution						
Inventors	-242,493	-210,800	-576,056	-1,005,051	-368,171	
Laboratories and Units	-208,090	-180,287	-532,439	-618,461	-138,661	
University	-138,557	-124,835	-517,940	-611,253	-253,487	
Undistributed	169,983	100,694	2,975	86,930	31,898	

NOTES:

1. Includes stand-alone licenses, releases, options and amendments as well as those granted as part of a sponsored project reviewed by AzTE
2. Includes revenue received by ASU
3. AzTE assisted The Connect Center with an additional 256 license agreements that were not included in this total

Integrated Device for Surface-Contact Sampling, Extraction and Electrochemical Measurements – M09-090L, US Patent No. 8,815,178
This patent describes a compact device for non-invasive sensing of biomarkers in bodily fluids. Although originally designed as a simple and pain-free way to measure glucose in tears (for diabetes), this device has also found applications involving saliva and other fluids. This technology has been licensed by Advanced Tear Diagnostics for tear glucose applications, and also by TekCapital plc to measure glucose in saliva. This technology was developed by Dr. Jeffrey La Belle.

Production and Use of Human Butrylcholinesterase – M05-045L, US Patent No. 9,062,321
This patent describes a plant-based system to produce butyrylcholinesterase in plants. Butyrylcholinesterase compounds are important in the medical, homeland security and defense fields, as they are effective antidotes and prophylactics to poisoning by many dangerous compounds, including pesticides, various toxins and non-conventional warfare agents such as nerve gases. This technology was developed by Dr. Tsafrir Mor.

Ultra-Low Dimensional Representation for Face Recognition Under Varying Expressions – M09-136P, US Patent No. 8,842,891
Facial recognition is a type of biometric software application that can be used in a variety of applications, including security and human-computer interaction. Existing techniques do not adequately address practical challenges such as varying facial expressions or lighting. Furthermore, they require large amounts of data that can be cumbersome to handle. This patent describes methods that account for variations in expression, pose and illumination as well as reducing the computational complexity and data storage requirements. The technology was developed by Dr. Baoxin Li.

Capture and Release of Carbon Dioxide – M11-129P, US Patent No. 9,046,275
This patent describes new methods for the capture and controlled release of carbon dioxide. Such control can improve the environment, can be used for improved oil recovery and can also be used to enhance plant growth. Compared with existing approaches, the new technology describes a more energy-efficient and safer (more stable) electrochemical method. This technology was developed by Dr. Daniel Buttry.

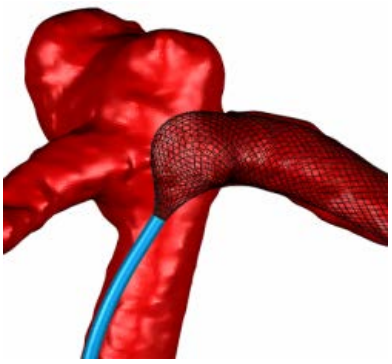
Agilent Technologies Inc.
Agilent, a spinout of Hewlett Packard, is the world's premier measurement company and a leader in chemical analysis and measurement equipment. Agilent has entered into an option agreement for a nozzle technology developed by Dr. Uwe Weierstall, et.al. that produces nanoscale droplets from a virtual gas nozzle without clogging. Agilent is exploring the use of these nozzles in their analytic and diagnostic measuring equipment.

Avipep Pty Ltd
Avipep, an Australian company, has entered into an evaluation and option agreement to test auristatin tyramine phosphate and auristatin aminoquinoline for their anti-cancer properties in form of antibody-drug conjugates (ADCs). These compounds were developed in the laboratory of Dr. George Robert Pettit. Avipep is using proprietary antibody fragments called Avibodies™ to deliver payloads to tumor cells more efficiently than intact antibodies. Avibodies represent a flexible platform for imaging, ADCs, radioimmunotherapy (RIT) and delivery of immunomodulators. Avibodies consist of the key binding domains of an antibody, thereby sharing the same selectivity and avidity for its target. The use of ADCs is expected to translate into higher clinical efficacy with lower systemic toxicity, providing a larger therapeutic window for cancer treatment.

Tekcapital plc
Tekcapital, a United Kingdom-based technology development company, has exclusively licensed a patent for a device that specifically measures glucose levels in saliva, which has a potential to replace current tests that require individuals with Type II diabetes to prick a finger every day to draw blood samples. This non-invasive alternative would be a significant benefit in convenience, comfort and treatment compliance for the more than 340 million people living with diabetes. The technology was developed by Dr. Jeffrey La Belle et al. at ASU.

Aldrich Chemical Company
Aldrich Chemical Company, a division of Sigma-Aldrich, has entered into an exclusive option agreement for commercializing novel catalyst materials developed at ASU by Dr. Ryan Trovitch. This material is a lower-cost and more environmentally friendly catalyst for hydrosilylation or hydrogenation reactions. The Aldrich Company will be providing research quantities of the material under royalty payments with an option for an exclusive license for commercial production.

EndoVantage, Inc.

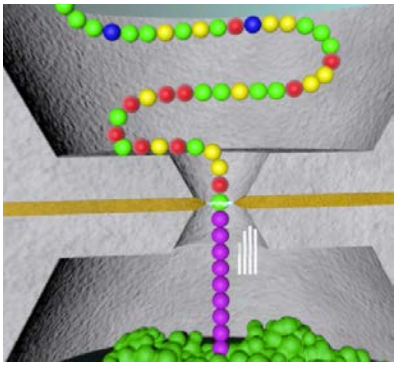


EndoVantage is a personalized medicine company for medical device implant products. EndoVantage Interventional Suite (EVIS) has developed a software modeling system that simulates the endovascular implantation and effect of medical devices in patients. This software allows clinicians, for the first time, to design the optimal treatment strategy for each patient before surgery, thereby improving treatment quality and reducing cost. The technology was jointly developed by ASU's Dr. David Frakes and Dr. Brian Chong from Mayo Clinic. EndoVantage won an Arizona Innovation Challenge award from the Arizona Commerce Authority and a grant for $250,000.

Anivax, Inc.

Anivax is a joint spinout from ASU and The University of Arizona for the treatment of Campylobacter in poultry. The company will be providing a low-cost vaccine that is given to chickens immediately after hatching and again when they are 10 days old – via drinking water – to combat Campylobacter, making chickens much safer to eat throughout with world. The antigens were discovered at the University of Arizona. ASU provided the IP for the delivery mechanism – known as the "vector" – for the Campylobacter antigens that was discovered by Dr. Roy Curtiss.

Recognition Analytix, LLC



Recognition Analytix is developing a commercially viable method to sequence single protein molecules. The company's goal is to deliver cost-effective, simple and powerful DNA and protein diagnostic devices into doctor's offices. This technology could help usher in the age of personalized medicine, where information from an individual's complete DNA and protein profiles could be used to design treatments specific to their individual makeup. The technology was developed by Dr. Stuart Lindsay, who successfully launched another ASU spinout, Molecular Imaging Corp, a company he co-founded in 1993 and sold to Agilent Technologies in 2005.

Built on the result of AzTE startup successes, ASU has launched the new **Startup Mill** to provide Arizona-based entrepreneurs the same acceleration services currently available to ASU students, faculty and post-doctoral researchers. ASU's Startup Mill is led by AzTE and ASU's Knowledge Enterprise Development. The program is open to startups in any industry, with selections made based on the potential strategic value to the economic vitality of the region and ASU. Startup Mill services include:

- acceleration and venture support, including ASU and partner resources for business/growth processes through Startup School training and mentoring
- interim or permanent C-level management drawn from a pool of accomplished entrepreneurs and seasoned executives
- university resources, including facilities, equipment, clinic, strategic partnerships and specialized test-beds for product and market validation
- pitch opportunities to ASU Foundation Angels and venture capital funding partners upon maturation

ASU students do not need to wait until they graduate to turn a great idea into a successful company. The **Edson Student Entrepreneurship Initiative** offers funding, mentorship and office space for accepted student ventures. There are currently 35 companies in the Edson program, including new cohorts for veterans and women.

In FY15, Edson companies raised a total of $888,500 in external grants, investments and awards, including:

- $600,000 from venture capital
- $200,000 from Maricopa County Industrial Development Authority (MCIDA) Manufacturing Venture Fund
- $88,500 from various grant competitions

Additional technology transfer highlights include:

- Force Impact Technologies, a real-time concussion detection company, was named a **finalist in the Bluetooth Best New Product competition**.
- Bosse Tools, an ergonomic tool company, **shipped its first 200 ergonomic shovels**.
- In total, 11 companies are in revenue and **10 have filed patents**.

This Page Intentionally Left Blank

Strategic Initiatives

We have identified several key strategic research areas that will leverage our research and entrepreneurship capabilities and create economic growth and opportunity in the short- and long-term:

Manufacturing
Harnessing emerging manufacturing technologies will create high-quality manufacturing jobs in Arizona, enhancing our global competitiveness. We will invest in diverse technologies, such as information technology, biotechnology, nanotechnology, additive manufacturing, and advanced electronics and sensors.

Materials
Materials innovations will underpin many of the most important modern technologies and high-value products. Advanced materials innovations will be key enabling technologies, novel production technologies and important technology-based application domains.

Food/Water/Energy Nexus
A rapidly growing global population and increasing prosperity are putting unsustainable pressures on resources. Demand for food, water and energy is expected to rise by 30-50% in the next two decades, while economic disparities incentivize short-term responses in production and consumption, undermining long-term sustainability. Research in this area will focus on solutions that take the interconnections of food, water and energy into consideration, maximizing their application and sustainability.

Climate Impact/Adaptation
ASU views climate adaptation through a transdisciplinary lens, allowing us to address multiple adaptation challenges and draw on funding from diverse sources, like the Department of Defense, NASA and Department of Homeland Security. Adaptation to global warming is a cause-agnostic response to global warming that seeks to reduce the vulnerability of social and biological systems to climate change and thus offset the effects of global warming. A significant effect of global climate change is the altering of global rainfall patterns, affecting agriculture and thus markets and human livelihood.

Wellness
ASU is at the forefront of new solutions to educate and optimize the health and well-being of diverse, multi-scale communities. For a decade, the university has been implementing a strategic plan to recruit expert medical researchers and health policy analysts, forge networks and working alliances with institutions regionally and globally, and transform “siloed” departments into new transdisciplinary schools and initiatives. By operating without a medical school, ASU remains nimble and entrepreneurial, forging clinical partnerships with leading providers, while convening thought leaders to explore new approaches.

Space
NASA’s current satellite fleet is past its expected lifetime. Regardless of future NASA budgets, new assets and new capacity in data analytics related to space will be funded. With some added faculty, and current capacities available in the School of Earth and Space Exploration, ASU is well positioned to garner significant amounts of this new external funding.

Urban Security (Megacities)
Megacities are urban regions with populations of at least 10 million, and explosive population growth and potential volatility, and they are considered “high risk” areas. They place heavy demands on housing, infrastructure, food, energy, water and other resources. But megacities also have great potential as global junctions of information and resilience. In particular, they can serve as centers of significant economic growth, technological development and opportunities. ASU has significant capacity in related disciplines such as urban ecology, water, population health, humanitarian aid and disaster relief, big data for smart cities, critical infrastructure, and cybersecurity.

Transportation
The advent of new technologies will drive a revolution in transportation, affecting individuals, businesses, logistics and regional innovation ecosystems. These technologies include driverless vehicles, electric vehicles, drones and complex cyber systems. In addition, the impending failures of rapidly aging infrastructures present challenges that need to be addressed.

This Page Intentionally Left Blank

NORTHERN ARIZONA UNIVERSITY

Annual Research Report - FY2015

Introductory Letter

NORTHERN ARIZONA UNIVERSITY

Northern Arizona University is pleased to provide this summary of our research activity for FY 2015. The university has long been recognized for impactful research in niche disciplines like land management and environmental sciences, astronomy and planetary science, and health sciences. These strengths, combined with the university's commitment to a strong research enterprise, spur innovation and contribute to the intellectual and economic development of the state and beyond. During FY15, NAU achieved its strategic goal to develop "nationally-recognized research excellence" through the increased productivity of research-oriented faculty and growth in research expenditures. NAU increased its overall research expenditures to $35.2 million and its federal research expenditures to $20.3 million—decreasing reliance on state and local government research funding.

Additional accomplishments toward our goal included:

- Recruiting research-intensive faculty in strategic areas to expand research productivity.
- Promoting interdisciplinary collaborations to compete for new external funding sources.
- Expanding our technology transfer activities.
- Expanding an advanced competitive workforce.
- Generating new economic growth opportunities for Arizona.

In addition, NAU accelerated its research enterprise through the creation of new PhD programs in Astronomy, Bioengineering, and Informatics & Computing. We initiated a plan to build a research-oriented school of informatics and computing that combines the new Informatics program with Computer Sciences and Electrical Engineering. The plan eliminates disciplinary silos and organizes itself, for research and graduate programs, around four key 21st Century challenges: cyber security, reconfigurable computing, cyber-physical systems, and big data/data sciences. We are busy planning for the new School of Informatics, Computing, and Cyber Systems (SICCS) and are also expanding partnerships in bioscience and healthcare to complement the program.

We continue to grow successful research centers and identify opportunities to advance new centers of excellence. The Center for Bioengineering Innovation is developing industry partnerships through its work on bio-inspired prosthetics and orthotics, and it has recruited two new professors of practice with entrepreneurial experience and translational research in wound healing and cardiovascular treatments. The Center for Ecosystems Science and Society has expanded its research capacity significantly through new external grant funding and the recruitment of two new major research faculty in ecology systems science. In partnership with TGen and Flagstaff Medical Center, the Center for Microbial Genetics and Genomics has expanded its research program to include new pathogens and the role of microbiomes in healthcare settings.

Overall, NAU is growing its research enterprise and fully expects to accelerate this growth in coming years—challenging old paradigms and advancing solutions-driven research that generates economic growth and social wellbeing.

Rita Hartung Cheng, President

Bill Grabe, Vice President for Research

Table of Contents

NORTHERN ARIZONA UNIVERSITY

Enterprise Size

Introduction	6
Selected Accomplishments	7
Total Research Expenditures	8
Average Growth Rate in Total Research Expenditures Over 3 years	9
Federally Financed Research Expenditures	10
Average Growth Rate in Federally Financed Research Expenditures Over 3 years	11
Business Financed Research Expenditures	12
Average Growth Rate in Business Financed Research Expenditures Over 3 years	13
Net Research Square Feet	14
Total Research Expenditures per Square Foot	15
Total Faculty Population	16
Total Research Expenditures per Faculty	17
Other Sponsored Project Expenditures (Instruction, Service, etc.)	18
Average Growth Rate in Other Sponsored Project Expenditures Over 3 Years	19

Discovery and Scholarly Impact

Introduction	22
Selected Accomplishments	23
Invention Disclosures Transacted	24
Invention Disclosures Transacted per $10 Million in Total Research Expenditures	25
U.S. Patents Issued	26
U.S. Patents Issued per $10 Million in Total Research Expenditures	27

Economic Development

Introduction	30
Selected Accomplishments	31
Intellectual Property Income	32
Intellectual Property Income per $10 Million in Total Research Expenditures	33
Licenses and Options Income	34
Licenses and Options Income per $10 Million in Total Research Expenditures	35
Licenses and Options Executed	36
Licenses and Options Executed per $10 Million in Total Research Expenditures	37
Startup Companies	38
Startup Companies per $10 Million in Total Research Expenditures	39
Doctoral Degrees Conferred	40
Doctoral Degrees Conferred per $10 Million in Total in Research Expenditures	41

Leadership and Recognition

Introduction	44
Selected Accomplishments	45
National Academy Members	46
National Academy Members per $10 Million in Total Research Expenditures	47

Technology Transfer Activity

Introduction	50
Technology Transfer Statistical Exhibits	51
Selected Patents Issued	52
Selected Licenses and Options Executed	53
Selected Startup Companies	54
Other Notable Activities	55

Strategic Initiatives

Summary	58

This Page Intentionally Left Blank

Enterprise Size

In higher education, research enterprise "size" is generally measured by (a) total research expenditures, (b) number of faculty engaged in research and scholarly activity, and (c) the amount of space on campus used for research activity. Over the past several years, Northern Arizona University has placed a greater emphasis on increasing these performance measures, with mixed results. While we have made significant gains in R&D expenditures, our tenured and tenure-eligible faculty population has remained flat, and the amount of campus research space has decreased.

Comparison to peers. Relative to its peers, NAU's performance is also mixed. Of the group of 16 peer institutions, NAU ranks 13th in number of faculty, 11th in research space and 11th in total research expenditures. However, NAU is clearly doing much more with less; we rank 7th in our peer group in growth rate of total research expenditures over the previous 3 years, and 5th in growth rate of federally-financed research expenditures over the same period. This tells us that NAU faculty are, overall, more competitive than their peers for federal research funding.

Research Expenditures. Between FY2014 and FY2015, NAU's research expenditures grew significantly—11% for both total and federally-financed research expenditures. Since FY2011, NAU's research expenditures grew by 14% for both total and federally-financed research expenditures. Industry-funded research expenditures increased by 139% over the same five-year period, while institutionally-funded research expenditures increased by 69%. These increases offset decreases (by design) in state and local government research funding. Overall, NAU is making excellent progress in growth of research expenditures, and we anticipate that investments made in FY2015-16 in new research-intensive faculty will allow us to continue a comparable level of growth over the next decade.

Space. NAU has recently brought new buildings online which (because of timing) are not reflected in FY2015 net assignable square feet. The new Science and Health building, right, contains a number of research labs and will help to increase NAU's research productivity in the life and physical sciences. In FY2017, we plan to repurpose a building currently used for administrative units for the new School of Informatics, Computing and Cyber Systems (SICCS), a research-intensive unit which will add considerable research space to NAU's Flagstaff campus.

NAU's new five-story, 120,000-square-foot Science and Health Building includes new teaching and research laboratories, as well as classrooms for chemistry, biology and health sciences.

Faculty. Northern Arizona University's ability to increase research expenditures is a reflection of the research productivity of our faculty. In FY2015, we began to see the effects of strategic recruiting conducted in FY2014. Two such faculty alone generated 3% of total sponsored projects grants awarded to NAU in FY2015. Other efforts to reverse the downward trend in our faculty numbers continue to be successful.

NAU awarded $4.1 million forestry research grant—largest grant in the history of the NAU School of Forestry. In FY2015, the NAU School of Forestry was awarded a five year, $4.1 million grant to study the threatened southwestern white pine. Under this grant, Principal Investigator Kristen Waring and colleagues will continue studies of epigenetics in the pine and related tree species. By investigating issues related to climate change and non-native disease, the researchers hope to develop an understanding of the trees' adaptive traits. This information can be used to help manage forests under changing conditions, address disease spread, and provide land managers and agencies working to preserve ecosystem health with enhanced tools. The research includes growing southwestern white pines in common gardens, a project that will be ongoing after the five years of NSF funding.

Kristen Waring, Associate Professor, NAU School of Forestry

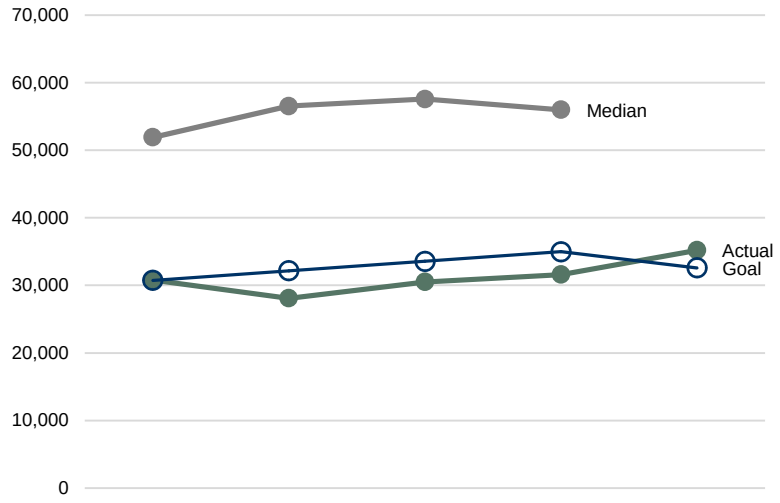
Partnership for Native American Cancer Prevention earns 5-year, $13 million renewal. Northern Arizona University and University of Arizona Cancer Center's Partnership for Native American Cancer Prevention have been awarded a five-year, $13 million grant renewal from the National Cancer Institute to investigate causes and impacts of cancer in Arizona's tribal communities. This grant will provide funding to continue addressing cancer disparities among Native Americans through research, training and outreach programs. NAU will receive $7 million and the UA will receive $6 million. Native American Cancer Prevention programs and projects are jointly developed and implemented by NAU, UA and the Hopi, Navajo and Tohono O'odham tribal communities. The programs are designed to facilitate the entry of Native Americans into biomedical research and health care professions while engaging communities in research and training relevant to their needs.

New Center for Bioengineering Innovation. In FY15, NAU established a new research center that focuses on increasing NAU's capacity to develop intellectual property that can have a direct impact on people's lives. The Center for Bioengineering Innovation (CBI) produces nationally recognized basic science discoveries in the area of bioengineering; transforms these discoveries into applications that represent real-world solutions and foster economic growth in Arizona and beyond; and provides cutting-edge training in bioengineering research for indergraduates, graduate students, and post-doctoral scholars who will join the biotechnology workforce. The field of bioengineering is a productive arena for translational research and development activities.

Prototype foot/ankle prosthetic uses CBI actuator technology.

Enterprise Size

Total Research Expenditures (in Thousands)

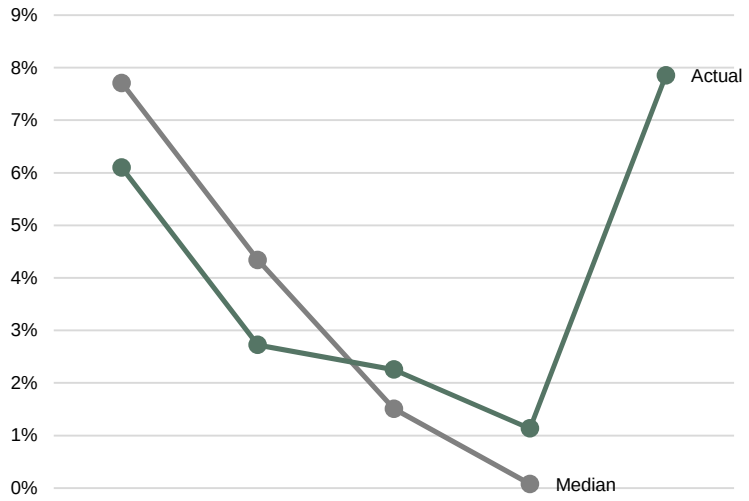


ABOR Enterprise Plan	2011	2012	2013	2014	2015	
Actual	30,785	28,100	30,516	31,590	35,206	
Goal	30,751	32,160	33,569	34,978	32,600	
Difference	34	-4,060	-3,053	-3,388	2,606	

ABOR Peer Group	Med. Sch.	NSF Adj.	2011	2012	2013	2014	2015	Rank
Georgia State University			92,725	91,148	111,999	123,915		1
University of Maine			111,600	92,135	77,583	101,247		2
George Mason University			88,089	90,198	95,913	98,680		3
University of Akron			65,536	66,413	69,640	69,528		4
Old Dominion University			102,192	104,579	99,138	67,037		5
Southern Illinois University - Carbondale	X		71,130	71,097	70,854	65,256		6
Ohio University	X		57,643	57,203	59,734	60,800		7
Wichita State University			50,194	61,279	61,388	58,859		8
University of Alabama - Tuscaloosa			53,633	55,885	55,443	53,140		9
University of Nevada - Las Vegas			39,526	34,543	35,935	39,448		10
Northern Arizona University			30,785	28,100	30,516	31,590	35,206	11
Kent State University			27,455	26,507	23,149	25,666		12
University of North Carolina - Greensboro			26,121	19,080	16,590	20,723		13
Western Michigan University	X		25,051	21,073	18,979	18,942		14
Northern Illinois University			21,748	21,823	23,027	16,427		15
Bowling Green State University			8,999	8,566	13,157	8,861		16
Median			51,914	56,544	57,589	56,000		

Enterprise Size

Average Growth Rate in Total Research Expenditures Over 3 Years

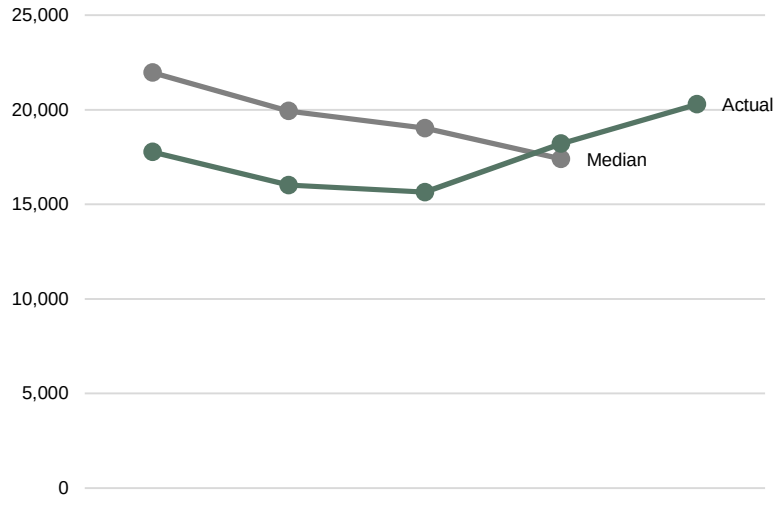


ABOR Enterprise Plan	2011	2012	2013	2014	2015
Actual	6.1%	2.7%	2.3%	1.1%	7.9%

ABOR Peer Group	Med. Sch.	NSF Adj.	2011	2012	2013	2014	2015	Rank
Georgia State University			8.7%	15.5%	11.9%	10.6%		1
Wichita State University			4.5%	-0.8%	6.6%	6.0%		2
Bowling Green State University			-4.7%	0.9%	19.9%	5.4%		3
George Mason University			6.7%	4.8%	4.5%	3.9%		4
University of Akron			34.7%	26.2%	10.0%	2.0%		5
Ohio University	X		14.9%	11.9%	6.0%	1.8%		6
Northern Arizona University			6.1%	2.7%	2.3%	1.1%	7.9%	7
University of Nevada - Las Vegas			-6.8%	-3.4%	-6.6%	0.4%		8
University of Alabama - Tuscaloosa			18.1%	15.8%	11.7%	-0.2%		9
University of Maine			5.6%	-2.2%	-11.0%	-0.9%		10
Kent State University			5.6%	2.0%	-4.0%	-1.7%		11
Southern Illinois University - Carbondale	X		2.0%	2.4%	0.4%	-2.8%		12
University of North Carolina - Greensboro			54.8%	35.1%	-7.9%	-5.0%		13
Northern Illinois University			16.5%	3.9%	-4.6%	-7.6%		14
Western Michigan University	X		28.1%	25.8%	-10.3%	-8.7%		15
Old Dominion University			16.1%	14.2%	0.8%	-11.7%		16
Median			7.7%	4.3%	1.5%	0.1%		

Enterprise Size

Federally Financed Research Expenditures (in Thousands)

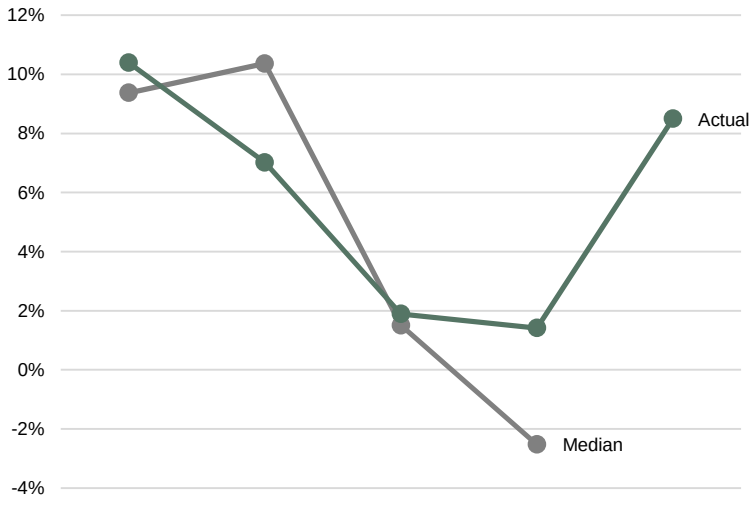


	2011	2012	2013	2014	2015
Actual	17,765	16,015	15,638	18,209	20,285

ABOR Peer Group	Med. Sch.	NSF Adj.	2011	2012	2013	2014	2015	Rank
George Mason University			65,301	63,786	65,096	61,877		1
University of Maine			59,800	39,661	34,252	50,589		2
Georgia State University			28,210	34,075	37,521	42,259		3
Old Dominion University			39,534	38,555	39,963	41,270		4
University of Nevada - Las Vegas			30,457	25,068	24,502	26,950		5
University of Alabama - Tuscaloosa			32,999	33,023	28,375	26,161		6
University of Akron			12,130	16,768	19,658	20,263		7
Northern Arizona University			17,765	16,015	15,638	18,209	20,285	8
Ohio University	X		23,051	20,780	20,203	16,597		9
Southern Illinois University - Carbondale	X		23,696	22,055	18,398	16,288		10
University of North Carolina - Greensboro			20,868	16,530	13,658	13,489		11
Western Michigan University	X		18,736	14,378	12,322	11,334		12
Kent State University			15,085	14,882	11,506	11,181		13
Wichita State University			12,972	19,078	13,434	10,424		14
Northern Illinois University			11,807	12,861	12,415	9,174		15
Bowling Green State University			6,164	7,005	9,323	6,576		16
Median			21,960	19,929	19,028	17,403		

Enterprise Size

Average Growth Rate in Federally Financed Research Expenditures Over 3 Years

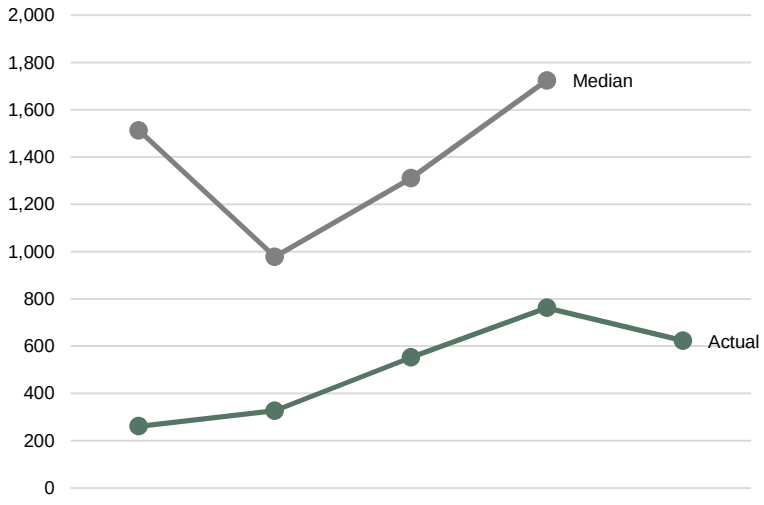


	2011	2012	2013	2014	2015
Actual	10.4%	7.0%	1.9%	1.4%	8.5%

ABOR Peer Group	Med. Sch.	NSF Adj.	2011	2012	2013	2014	2015	Rank
University of Akron			9.6%	16.3%	18.6%	19.5%		1
Georgia State University			2.8%	12.5%	11.7%	14.5%		2
Bowling Green State University			4.1%	17.9%	23.6%	5.8%		3
Old Dominion University			12.4%	12.3%	5.0%	1.5%		4
Northern Arizona University			10.4%	7.0%	1.9%	1.4%	8.5%	5
University of Maine			13.6%	-2.8%	-9.4%	0.1%		6
Wichita State University			-0.9%	17.9%	3.9%	-1.6%		7
George Mason University			9.1%	4.8%	1.1%	-1.7%		8
University of Nevada - Las Vegas			-9.0%	-6.7%	-8.7%	-3.3%		9
Northern Illinois University			5.8%	-7.2%	-8.8%	-6.9%		10
University of Alabama - Tuscaloosa			12.5%	11.8%	3.7%	-7.3%		11
Kent State University			6.6%	4.0%	-6.9%	-9.0%		12
Ohio University	X		9.1%	8.9%	4.1%	-10.2%		13
Southern Illinois University - Carbondale	X		10.7%	5.1%	-5.6%	-11.7%		14
University of North Carolina - Greensboro			56.7%	38.1%	-10.3%	-13.1%		15
Western Michigan University	X		44.4%	38.6%	-14.2%	-15.2%		16
Median			9.4%	10.4%	1.5%	-2.5%		

Enterprise Size

Business Financed Research Expenditures (in Thousands)

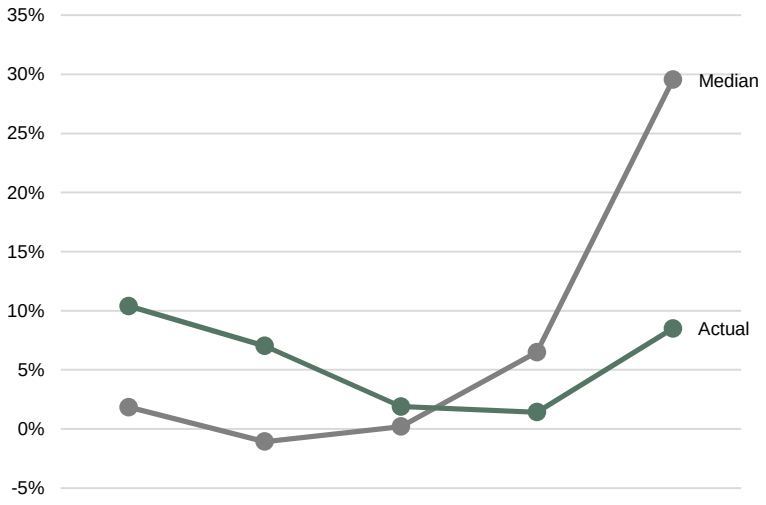


	2011	2012	2013	2014	2015
Actual	261	327	552	762	623

ABOR Peer Group	Med. Sch.	NSF Adj.	2011	2012	2013	2014	2015	Rank
Wichita State University			26,348	26,724	27,534	30,942		1
Southern Illinois University - Carbondale	X		6,988	7,273	7,467	7,453		2
Ohio University	X		4,770	5,028	5,174	5,887		3
University of Akron			2,415	2,833	3,238	3,576		4
University of Maine			4,460	3,299	2,933	3,470		5
George Mason University			561	946	1,368	2,447		6
University of Alabama - Tuscaloosa			3,392	2,657	2,040	2,060		7
Old Dominion University			2,270	1,336	1,975	1,772		8
Western Michigan University	X		1,529	1,010	1,253	1,676		9
Northern Arizona University			261	327	552	762	623	10
University of Nevada - Las Vegas			562	425	536	651		11
Kent State University			499	698	665	619		12
Northern Illinois University			1,496	936	1,096	476		13
Georgia State University			716	597	285	394		14
Bowling Green State University			24	532	124	372		15
University of North Carolina - Greensboro			730	672	594	131		16
Median			1,513	978	1,311	1,724		

Enterprise Size

Average Growth Rate in Business Financed Research Expenditures Over 3 Years

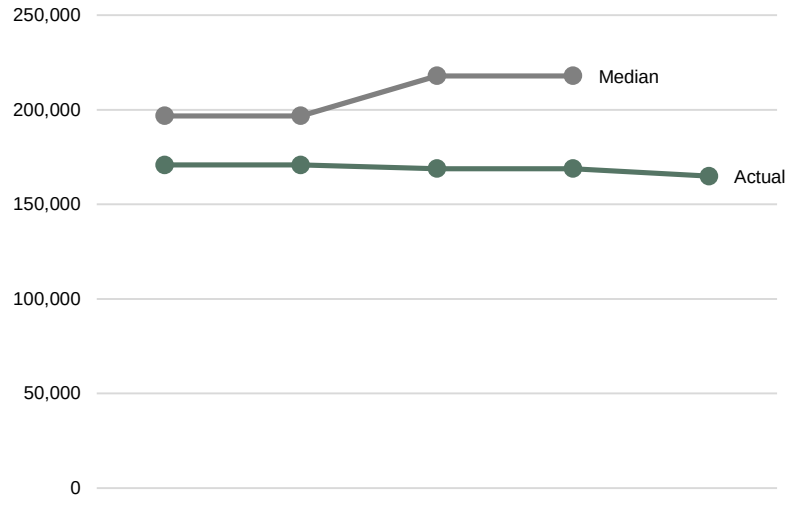


	2011	2012	2013	2014	2015
Actual	10.4%	7.0%	1.9%	1.4%	8.5%

ABOR Peer Group	Med. Sch.	NSF Adj.	2011	2012	2013	2014	2015	Rank
Northern Arizona University			-43.5%	-38.3%	12.8%	44.0%	29.5%	1
Bowling Green State University			-62.7%	648.1%	653.7%	746.7%		
George Mason University			-11.0%	10.0%	35.3%	64.0%		
Georgia State University			6.8%	-2.7%	-8.9%	-10.2%		
Kent State University			22.6%	21.0%	31.9%	9.4%		
Northern Illinois University			36.7%	16.5%	4.9%	-25.6%		
Ohio University	X		10.9%	0.9%	9.4%	7.4%		
Old Dominion University			-6.0%	-38.5%	-7.0%	-1.2%		
Southern Illinois University - Carbondale	X		-3.4%	-4.4%	-4.5%	2.2%		
University of Akron			2.5%	1.1%	25.0%	14.0%		
University of Alabama - Tuscaloosa			1.2%	-2.7%	-7.0%	-14.6%		
University of Maine			11.4%	0.5%	-6.9%	-6.3%		
University of Nevada - Las Vegas			-7.8%	-31.7%	-7.5%	7.7%		
University of North Carolina - Greensboro			47.7%	-5.1%	-10.4%	-32.5%		
Western Michigan University	X		-13.4%	-15.9%	-7.4%	8.0%		
Wichita State University			161.7%	11.6%	7.0%	5.6%		
Median			1.8%	-1.1%	0.2%	6.5%	0.3	

Enterprise Size

Net Assignable Square Feet

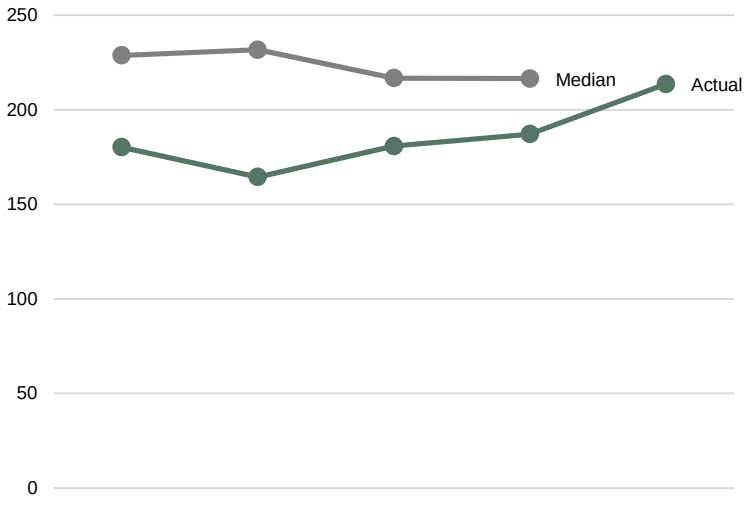


	2011	2012	2013	2014	2015
Actual	170,831	170,831	168,829	168,829	164,872

ABOR Peer Group	Med. Sch.	NSF Adj.	2011	2012	2013	2014	2015	Rank
University of Maine			625,692	625,692	585,049	585,049		1
Wichita State University			273,072	273,072	466,134	466,134		2
Southern Illinois University - Carbondale	X		328,265	328,265	328,265	328,265		3
Old Dominion University			298,718	298,718	260,270	260,270		4
Ohio University	X		239,382	239,382	253,560	253,560		5
Georgia State University			214,269	214,269	251,222	251,222		6
University of Nevada - Las Vegas			192,977	192,977	219,428	219,428		7
University of Akron			221,282	221,282	218,357	218,357		8
University of Alabama - Tuscaloosa			192,311	192,311	217,398	217,398		9
George Mason University			200,572	200,572	194,894	194,894		10
Northern Arizona University			170,831	170,831	168,829	168,829	164,872	11
Bowling Green State University			160,592	160,592	166,234	166,234		12
University of North Carolina - Greensboro			125,616	125,616	146,500	146,500		13
Northern Illinois University			122,986	122,986	122,986	122,986		14
Kent State University			105,565	105,565	106,372	106,372		15
Western Michigan University	X		83,055	83,055	80,862	80,862		16
Median			196,775	196,775	217,878	217,878		

Enterprise Size

Total Research Expenditures per Net Assignable Square Foot

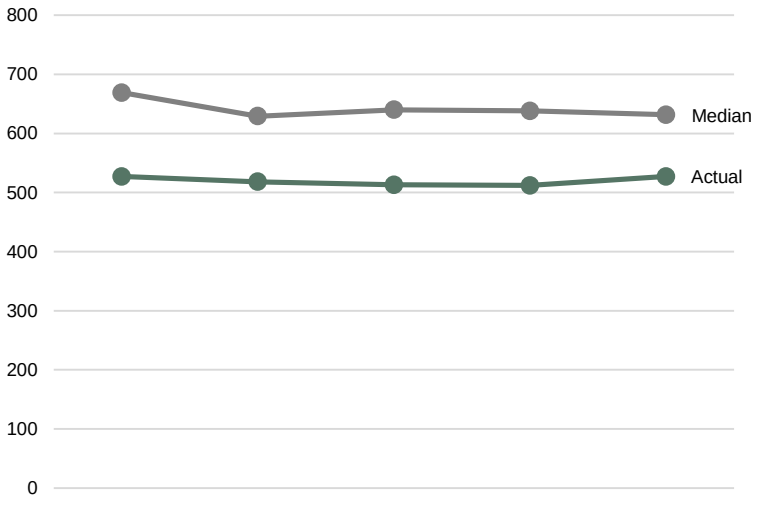


	2011	2012	2013	2014	2015	
Actual	180	164	181	187	214	

ABOR Peer Group	Med. Sch.	NSF Adj.	2011	2012	2013	2014	2015	Rank
George Mason University			439	450	492	506		1
Georgia State University			433	425	446	493		2
University of Akron			296	300	319	318		3
Old Dominion University			342	350	381	258		4
University of Alabama - Tuscaloosa			279	291	255	244		5
Kent State University			260	251	218	241		6
Ohio University	X		241	239	236	240		7
Western Michigan University	X		302	254	235	234		8
Southern Illinois University - Carbondale	X		217	217	216	199		9
Northern Arizona University			180	164	181	187	214	10
University of Nevada - Las Vegas			205	179	164	180		11
University of Maine			178	147	133	173		12
University of North Carolina - Greensboro			208	152	113	141		13
Northern Illinois University			177	177	187	134		14
Wichita State University			184	224	132	126		15
Bowling Green State University			56	53	79	53		16
Median			229	232	217	216.5		

Enterprise Size

Total Faculty Population

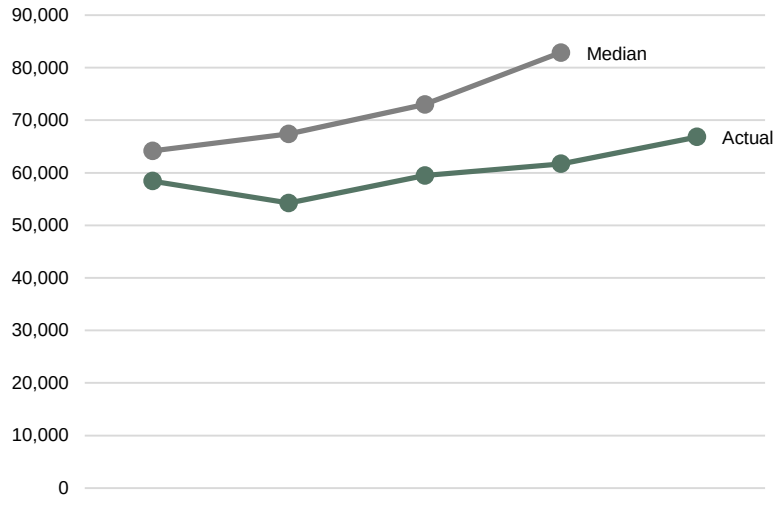


	2011	2012	2013	2014	2015
Actual	527	518	513	512	527

ABOR Peer Group	Med. Sch.	NSF Adj.	2011	2012	2013	2014	2015	Rank
George Mason University			882	888	915	908	895	1
University of Alabama - Tuscaloosa			848	845	867	609	827	2
Western Michigan University	X		829	808	811	808	781	3
Ohio University	X		886	833	728	718	735	4
Georgia State University			736	745	763	772	729	5
University of Nevada - Las Vegas			672	616	648	661	684	6
Southern Illinois University - Carbondale	X		841	795	789	698	666	7
Northern Illinois University			732	714	699	677	643	8
Kent State University			666	642	632	615	620	9
Old Dominion University			553	567	582	569	603	10
University of Akron			636	616	619	858	586	11
University of North Carolina - Greensboro			593	583	530	542	534	12
Northern Arizona University			527	518	513	512	527	13
Bowling Green State University			508	527	530	514	495	14
University of Maine			449	447	427	405	404	15
Wichita State University			360	361	373	387	404	15
Median			669	629	640	638	632	

Enterprise Size

Total Research Expenditures per Faculty

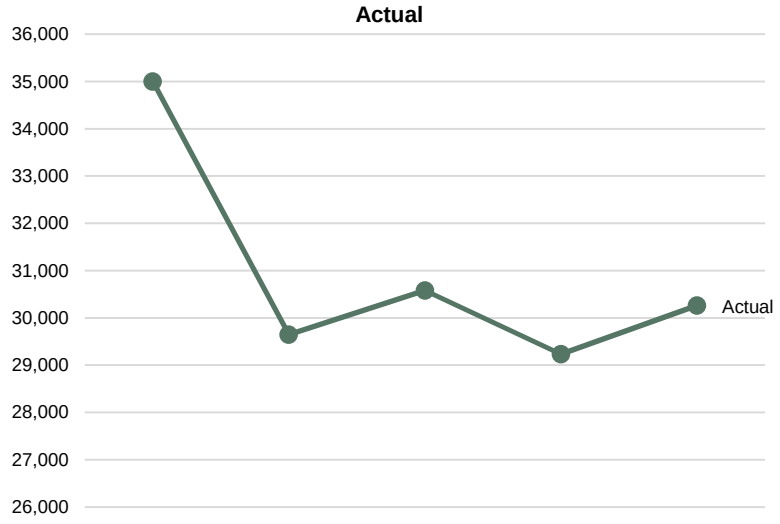


	2011	2012	2013	2014	2015
Actual	58,416	54,247	59,485	61,699	66,805

ABOR Peer Group	Med. Sch.	NSF Adj.	2011	2012	2013	2014	2015	Rank
University of Maine			248,552	206,119	181,693	249,993		1
Georgia State University			125,985	122,346	146,788	160,512		2
Wichita State University			139,428	169,748	164,579	152,090		3
Old Dominion University			184,796	184,443	170,340	117,815		4
George Mason University			99,874	101,574	104,823	108,678		5
Southern Illinois University - Carbondale	X		84,578	89,430	89,802	93,490		6
University of Alabama - Tuscaloosa			63,246	66,136	63,948	87,258		7
Ohio University	X		65,060	68,671	82,052	84,680		8
University of Akron			103,044	107,813	112,504	81,035		9
Northern Arizona University			58,416	54,247	59,485	61,699	66,805	10
University of Nevada - Las Vegas			58,818	56,076	55,455	59,679		11
Kent State University			41,224	41,288	36,628	41,733		12
University of North Carolina - Greensboro			44,049	32,727	31,302	38,234		13
Northern Illinois University			29,710	30,564	32,943	24,264		14
Western Michigan University	X		30,218	26,080	23,402	23,443		15
Bowling Green State University			17,715	16,254	24,825	17,239		16
Median			64,153	67,404	73,000	82,857		

Enterprise Size

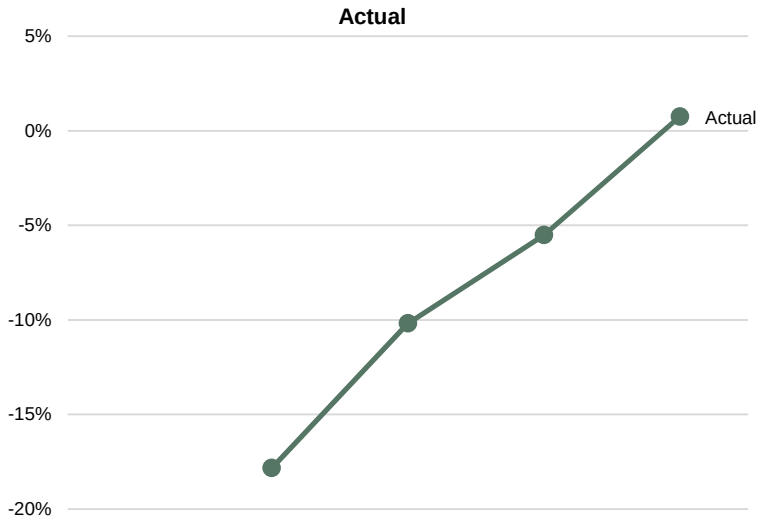
Other Sponsored Project Expenditures (in Thousands)



ABOR Enterprise Plan	2011	2012	2013	2014	2015
Actual	34,998	29,645	30,580	29,231	30,260

Enterprise Size

Average Growth Rate in Other Sponsored Project Expenditures Over 3 Years



ABOR Enterprise Plan	2011	2012	2013	2014	2015
Actual		-17.8%	-10.2%	-5.5%	0.8%

This Page Intentionally Left Blank

Discovery and Scholarly Impact

Invention Disclosures. As the research culture at NAU matures, university researchers are becoming more engaged in discovery and innovation that has commercial potential. As a result, the number of invention disclosures submitted annually climbs steadily. Moreover, the quality of invention disclosures is improving substantially, resulting in more U.S. patent applications filed. In FY2015, we again met our enterprise metrics goal for invention disclosures transacted (27).

Patents Issued. In FY2015, we also met our enterprise goal for U.S. patents issued (3). NAU Innovations has implemented more aggressive patent strategies which includes filing more provisional applications and fast-tracking selected applications. In doing so we will be able to bring NAU innovations to the marketplace more quickly, giving us an edge needed in the highly competitive global innovation landscape.

Publication and Citation. The extent to which the knowledge generated by university faculty is recognized and referenced by their peers (through peer review and citation) is a strong indicator of the impact that the institution has in a given academic discipline. Here again, NAU faculty are having a higher impact than their peers (at NAU peer institutions) in many areas. In FY2015, NAU ranked 15th in number of total documents published over the previous five-year period, we ranked third overall in IMPACT—citations per document. In Ecology and Microbiology, NAU ranked first amongst its peer institutions in citations per document; in multidisciplinary Geosciences, Forestry and Linguistics NAU ranked second. NAU also ranked high in Environmental sciences (4th), Zoology (4th), Plant Sciences (5th) and History (7th). This is especially significant since NAU ranks near the bottom of its peer group in total number of faculty (see Enterprise Size – Total Faculty Population).

Sorted by Citations

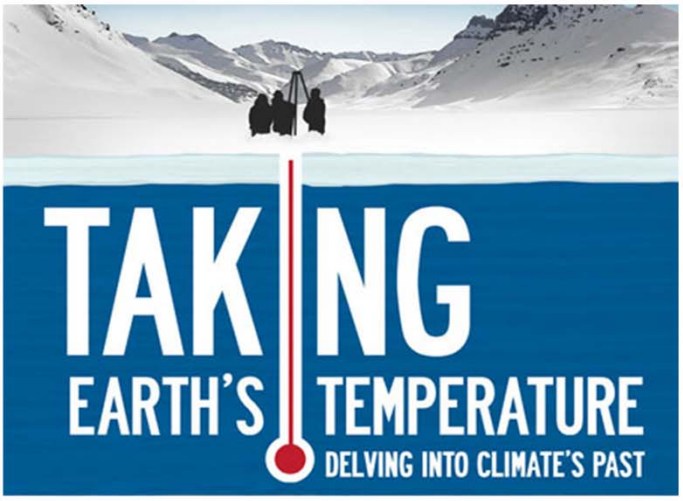
	Institution	Total Cites to Docs Published 2010-2014
1	U of Alabama Tuscaloosa	37,184
2	George Mason Univ	34,838
3	Northern Illinois Univ	27,230
4	Georgia State Univ	24,733
5	Kent State Univ	19,443
6	Southern Illinois Univ	18,182
7	Old Dominion Univ	17,504
8	Univ of Nevada Las Vegas	16,445
9	Ohio Univ	16,426
10	Univ of Akron	15,254
11	Univ of Maine	13,384
12	Northern Arizona Univ	11,034
13	UNC Greensboro	9,648
14	Bowling Green State Univ	7,672
15	Western Michigan Univ	6,303
16	Wichita State Univ	3,896

Sorted by Impact (Cites/Docs)

	Institution	Impact of Docs Published 2010-2014
1	Northern Illinois Univ	8.81
2	U of Alabama Tuscaloosa	6.21
3	Northern Arizona Univ	5.54
4	George Mason Univ	5.15
5	Old Dominion Univ	5.00
6	Kent State Univ	4.85
7	Univ of Maine	4.63
8	Univ of Akron	4.28
9	Ohio Univ	4.17
10	Univ of Nevada Las Vegas	4.12
11	Georgia State Univ	4.03
12	Southern Illinois Univ	3.94
13	Bowling Green State Univ	3.57
14	UNC Greensboro	3.46
15	Wichita State Univ	3.28
16	Western Michigan Univ	3.06

NAU study may help explain link between uranium exposure and skin cancer

While the varying health risks from exposure to natural uranium are well established, biochemistry professor Diane Stearns and her team are investigating a possible link between uranium exposure and skin cancer, a disease that is prevalent on the Navajo Nation, a site of historically high levels of uranium mining and processing. Utilizing epidemiological data and cellular study, the team is exploring the possibility that photoactivation of uranium increases its toxicity and ability to damage DNA, thus increasing cancer risk. They also propose that photoactivated uranium exposure could be even more harmful in cells that can't repair the damage on their own. Such cases are found in individuals with Xeroderma Pigmentosum or XP, a disease that causes extreme sensitivity to sunlight.

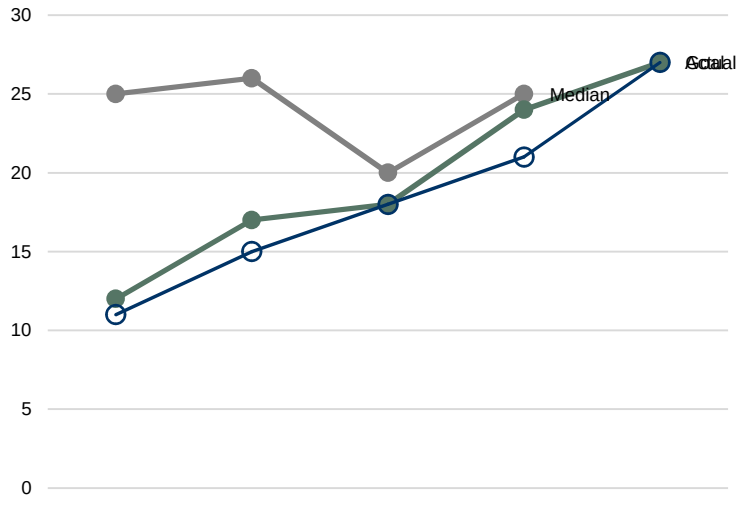


NAU produces documentary film about climate change. *Taking Earth's Temperature: Delving into Climate's Past* is a one-hour documentary following NAU Regents' professor Darrell Kaufman and his research team as they explore records of past climate changes found in lake sediment from arctic lakes. Kaufman's team is part of a larger movement by researchers globally to develop a detailed picture of the last two millennia of the Earth's temperature history using evidence from coral reefs, caves, tree rings, glaciers and more. If those models can accurately explain past changes, then they may also provide a look at what will happen to Earth's climate in the future. The documentary film provides a glimpse into the research required to increase certainty and reliability in our understanding of these longer-term climate fluctuations.

NAU Researcher finds multiple ways to get a fix on near-Earth asteroids. Astronomer David Trilling is developing new tactics to locate near-earth asteroids. Utilizing three unique approaches, his research seeks to quantify risk, composition, and location of these objects. Using the infrared capabilities of the Spitzer Space Telescope, Trilling's research focuses on asteroids that may be difficult to view or even locate using other methods. The findings of this project, when combined with other asteroid observations, will result in about 15 percent of all near Earth asteroids having been characterized, a significant increase from the one percent already identified. Trilling is collaborating with astronomers in Hawaii and Mexico to develop rapid-response systems to observe asteroids shortly after they are identified, sometimes within a few hours of discovery. A third project involves using NASA's InfraRed Telescope Facility in Hawaii to measure the diameter and albedo of asteroids with brief observation windows. The observations, which will include about 750 near earth asteroids that are not being studied through any other telescopes, will take place through February 2019.

Discovery and Scholarly Impact

Invention Disclosures Transacted

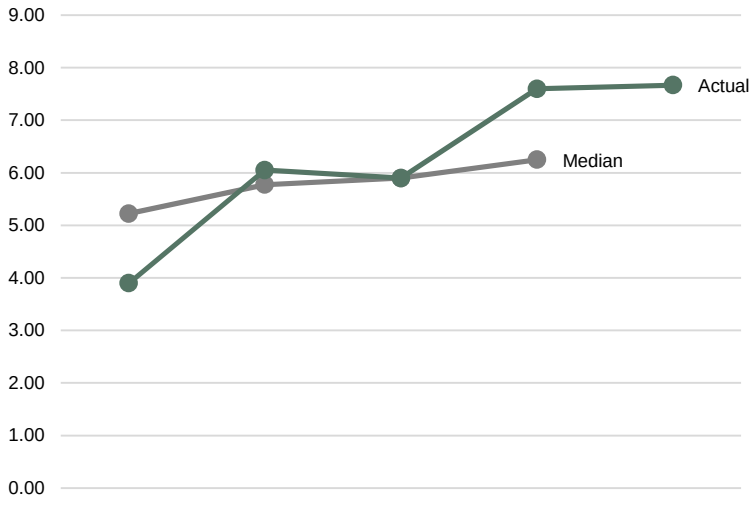


ABOR Enterprise Plan	2011	2012	2013	2014	2015
Actual	12	17	18	24	27
Goal	11	15	18	21	27
Difference	1	2	0	3	0

ABOR Peer Group	Med. Sch.	AUTM Adj.	2011	2012	2013	2014	2015	Rank
University of Akron			82	63	69	85		1
University of Alabama - Tuscaloosa			30	36	48	58		2
Ohio University	X			30	26	38		3
Southern Illinois University - Carbondale	X		25	21		25		4
Northern Arizona University			12	17	18	24	27	5
University of North Carolina - Greensboro			30	24	18	11		6
Northern Illinois University			7	12	8	4		7
Bowling Green State University			2					
George Mason University			46	28				
Georgia State University								
Kent State University			18					
Old Dominion University					20			
University of Maine								
University of Nevada - Las Vegas								
Western Michigan University	X							
Wichita State University								
Median			25	26	20	25		

Discovery and Scholarly Impact

Invention Disclosures Transacted per $10 Million in Total Research Expenditures

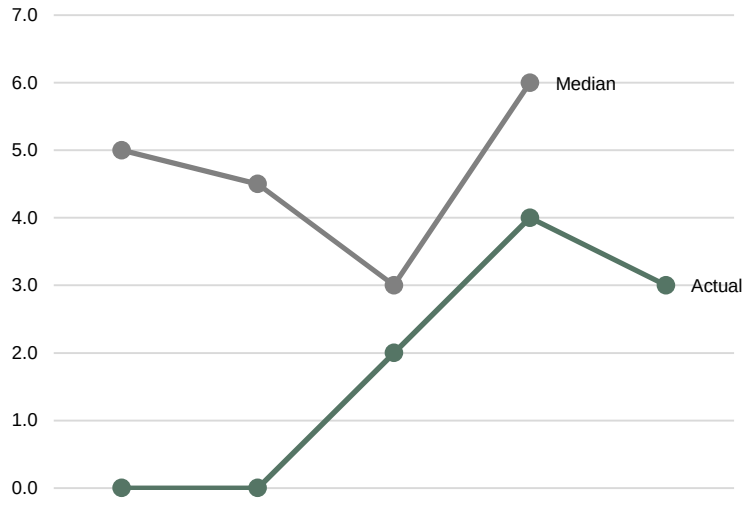


ABOR Enterprise Plan	2011	2012	2013	2014	2015
Actual	3.9	6.0	5.9	7.6	7.7

ABOR Peer Group	Med. Sch.	NSF Adj.	AUTM Adj.	2011	2012	2013	2014	2015	Rank
University of Akron				12.5	9.5	9.9	12.2		1
University of Alabama - Tuscaloosa				5.6	6.4	8.7	10.9		2
Northern Arizona University				3.9	6.0	5.9	7.6	7.7	3
Ohio University	X				5.2	4.4	6.3		4
University of North Carolina - Greensboro				11.5	12.6	10.8	5.3		5
Southern Illinois University - Carbondale	X			3.5	3.0		3.8		6
Northern Illinois University				3.2	5.5	3.5	2.4		7
Bowling Green State University				2.2					
George Mason University				5.2	3.1				
Georgia State University									
Kent State University				6.6					
Old Dominion University						2.0			
University of Maine									
University of Nevada - Las Vegas									
Western Michigan University	X								
Wichita State University									
Median				5.2	5.8	5.9	6.3		

Discovery and Scholarly Impact

U.S. Patents Issued

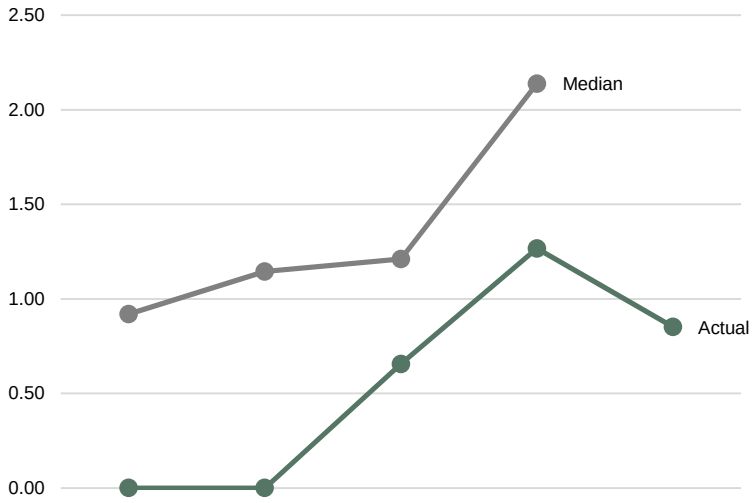


ABOR Enterprise Plan	2011	2012	2013	2014	2015
Actual	0	0	2	4	3

ABOR Peer Group	Med. Sch.	AUTM Adj.	2011	2012	2013	2014	2015	Rank
University of Akron			10	16	21	34		1
Ohio University	X			9	13	13		2
University of Alabama - Tuscaloosa			3	4	2	13		2
Southern Illinois University - Carbondale	X		5	4		6		4
Northern Arizona University			0	0	2	4	3	5
Northern Illinois University			2	5	3	4		5
University of North Carolina - Greensboro			0	1	1	1		7
Bowling Green State University			5					
George Mason University			29	22				
Georgia State University								
Kent State University			10					
Old Dominion University					12			
University of Maine								
University of Nevada - Las Vegas								
Western Michigan University	X							
Wichita State University								
Median			5	5	3	6		

Discovery and Scholarly Impact

U.S. Patents Issued per $10 Million in Total Research Expenditures



ABOR Enterprise Plan	2011	2012	2013	2014	2015
Actual	0.0	0.0	0.7	1.3	0.9

ABOR Peer Group	Med. Sch.	NSF Adj.	AUTM Adj.	2011	2012	2013	2014	2015	Rank
University of Akron				1.5	2.4	3.0	4.9		1
University of Alabama - Tuscaloosa				0.6	0.7	0.4	2.4		2
Northern Illinois University				0.9	2.3	1.3	2.4		3
Ohio University	X				1.6	2.2	2.1		4
Northern Arizona University				0.0	0.0	0.7	1.3	0.9	5
Southern Illinois University - Carbondale	X			0.7	0.6		0.9		6
University of North Carolina - Greensboro				0.0	0.5	0.6	0.5		7
Bowling Green State University				5.6					
George Mason University				3.3	2.4				
Georgia State University									
Kent State University				3.6					
Old Dominion University						1.2			
University of Maine									
University of Nevada - Las Vegas									
Western Michigan University	X								
Wichita State University									
Median				0.9	1.1	1.2	2.1		

This Page Intentionally Left Blank

NORTHERN ARIZONA UNIVERSITY

Economic Development

Public Service. An important aspect of Northern Arizona University's contribution to economic development in Arizona is the direct impact of public service activities on communities across the state. In FY2015, NAU was awarded $15.2 million in external funds to conduct public service activities, including $4.6 million from the U.S. Department of Education for the university's Gear Up program, and $6.9 million from various agencies to support projects that benefit Native American students and tribal communities. These public service dollars, just like research dollars, contribute to the university's impact as an economic development entity—an impact that is important to the rural regions and small metropolitan areas we serve.

NAU was recognized as a top college for Native Americans in the American Indian Science and Engineering Society's 2014-15 College Guide.

Intellectual Property Income and Start-up Companies. The translation of university innovations into commercial products/services and business activity is another important element of the university's economic impact. We are pleased to report that NAU significantly exceeded (by more than 300%) its 2020 enterprise goal for intellectual property income generated in FY2015. However, as is customary at this early stage of development, our performance associated with patents issued, intellectual property income, and start-up companies—will fluctuate up and down while our patent portfolio grows and matures.

In FY2015, NAU's most challenging enterprise goal associated with technology transfer remained that of forming start-up companies. Flagstaff's small size and remote location, and the university's relatively recent move towards hiring high productivity researchers, challenges us to generate new companies. In FY2015, while we did not meet our goal for this metric, we did grant an option to a new company formed specifically to commercialize university-owned intellectual property. Under AUTM definitions, however, this company cannot be considered a "start-up" company until a license is executed.

Doctoral Degrees Granted

Northern Arizona University is doubling the number of its PhD-granting degree programs, adding programs in Astronomy, Bioengineering and Informatics. It will be five years before the numbers of NAU doctoral graduates increase as a result. However, the university did meet its goal for number of PhD degrees granted in FY2015, improving our performance over FY2014.

NAU joined Tribes' discourse on the Environment.
In May, 2015, the Institute for Tribal Environmental Professionals co-hosted the 16th Annual National Tribal Forum on Air Quality with the National Tribal Air Association and the Environmental Protection Agency (EPA). The tribal host for the event was the Nottawaseppi Huron Band of Potawatomi located in Battle Creek, Michigan, where the Forum was also held. The event provided opportunities for tribes to address high-level EPA officials about concerns and priorities, while top native environmentalists challenged attendees to think outside the box to address problems in their communities. The 2015 National Tribal Forum set a new record with over 220 attendees. Participants represented more than 100 tribes, the EPA and other government agencies, academics, environmental organizations and private industry.

NAU and Northern Arizona Healthcare make first hire under joint initiative in Medical Informatics.
In FY2015, Dr. Crystal Hepp was hired as an Assistant Professor in the Informatics and Computing Program at NAU as the first step in a developing program that will bridge the gap between cutting edge research and the applied needs of Northern Arizona Healthcare (NAH), parent company of Flagstaff Medical Center. Dr. Hepp will work with NAH to address questions that can be explored by applying innovative skills in data extraction and analytics, such as "what is the most effective health management response to a specific chronic health condition?", or "what are the biggest after-discharge challenges for chronic health conditions, and why?" Dr. Hepp's position was funded through a $300,000 grant from NAH combined with a matching commitment from NAU.

NAU Service Center secures award to offer assistive technology loans.
The Institute for Human Development at NAU received a $633,133 award from the U.S. Department of Education to offer low-interest loans for people in need of assistive technology. The Arizona Loans for Assistive Technology funds are available to people throughout the state and are targeted to individuals who may not have other funding options. The loans, which will range from $500 to $20,000, are targed to low- and middle-income borrowers, and can be used for items such as mobility devices (e.g., scooters), hearing aids, computer adaptations and lifts on vehicles to carry wheelchairs. This award expands the Institutes offerings beyond Maricopa County.

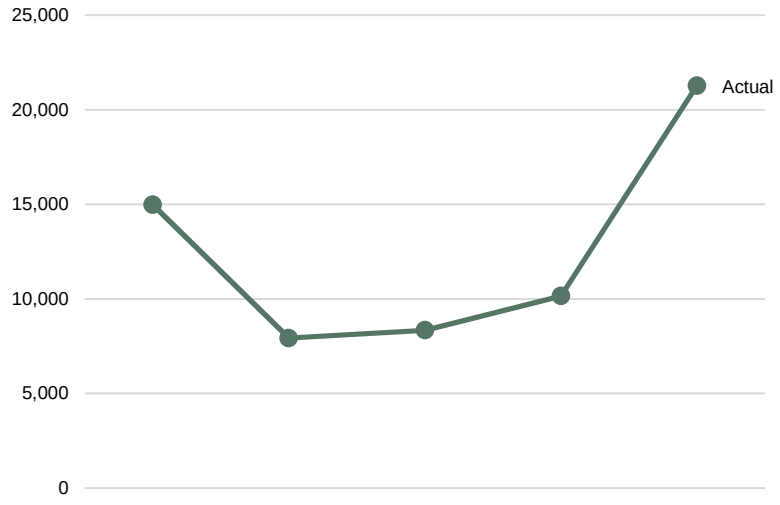
Economic Development

Intellectual Property Income (in Thousands)

ABOR Enterprise Plan	2011	2012	2013	2014	2015
Actual	46	22	25	32	75

Economic Development

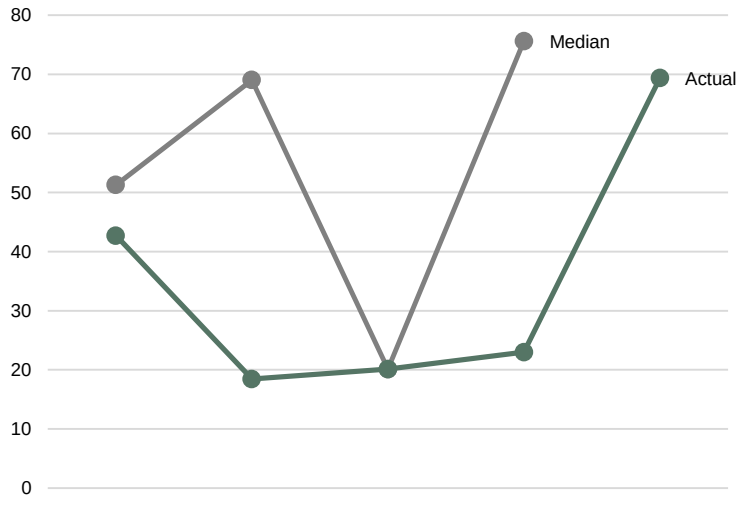
Intellectual Property Income per $10 Million in Total Research Expenditures



ABOR Enterprise Plan	2011	2012	2013	2014	2015
Actual	14,974	7,928	8,344	10,154	21,277

Economic Development

Licenses and Options Income (in Thousands)

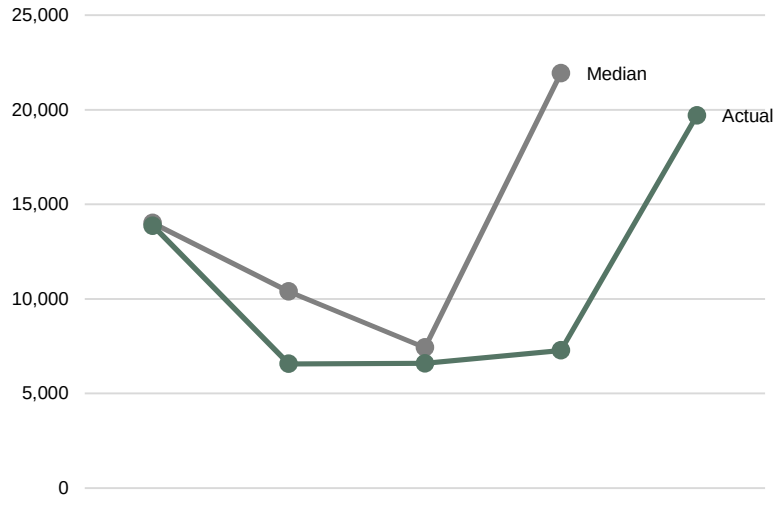


	2011	2012	2013	2014	2015	
Actual	43	18	20	23	69	

ABOR Peer Group	Med. Sch.	AUTM Adj.	2011	2012	2013	2014	2015	Rank
Ohio University	X			9,400	9,926	10,669		1
Southern Illinois University - Carbondale	X		677	711		624		2
University of Akron			279	336	226	153		3
University of North Carolina - Greensboro			51	14	12	76		4
Northern Arizona University			43	18	20	23	69	5
Northern Illinois University			30	16	24	15		6
University of Alabama - Tuscaloosa			9	18	8	6		7
Bowling Green State University			2					
George Mason University			123	120				
Georgia State University								
Kent State University			360					
Old Dominion University					19			
University of Maine								
University of Nevada - Las Vegas								
Western Michigan University	X							
Wichita State University								
Median			51	69	20	76		

Economic Development

Licenses and Options Income per $10 Million in Total Research Expenditures

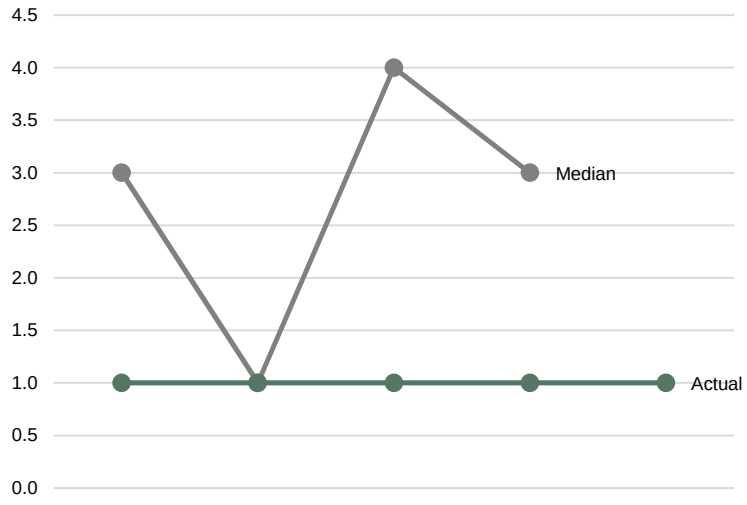


	2011	2012	2013	2014	2015
Actual	13,865	6,562	6,592	7,273	19,703

ABOR Peer Group	Med. Sch.	NSF Adj.	AUTM Adj.	2011	2012	2013	2014	2015	Rank
Ohio University	X				1,643,270	1,661,700	1,754,821		1
Southern Illinois University - Carbondale	X			95,207	99,988		95,673		2
University of North Carolina - Greensboro				19,629	7,517	7,427	36,489		3
University of Akron				42,518	50,616	32,469	21,934		4
Northern Illinois University				13,966	7,273	10,305	9,151		5
Northern Arizona University				13,865	6,562	6,592	7,273	19,703	6
University of Alabama - Tuscaloosa				1,602	3,274	1,531	1,168		7
Bowling Green State University				2,545					
George Mason University				14,005	13,263				
Georgia State University									
Kent State University				131,137					
Old Dominion University						1,866			
University of Maine									
University of Nevada - Las Vegas									
Western Michigan University	X								
Wichita State University									
Median				14,005	10,390	7,427	21,934		

Economic Development

Licenses and Options Executed

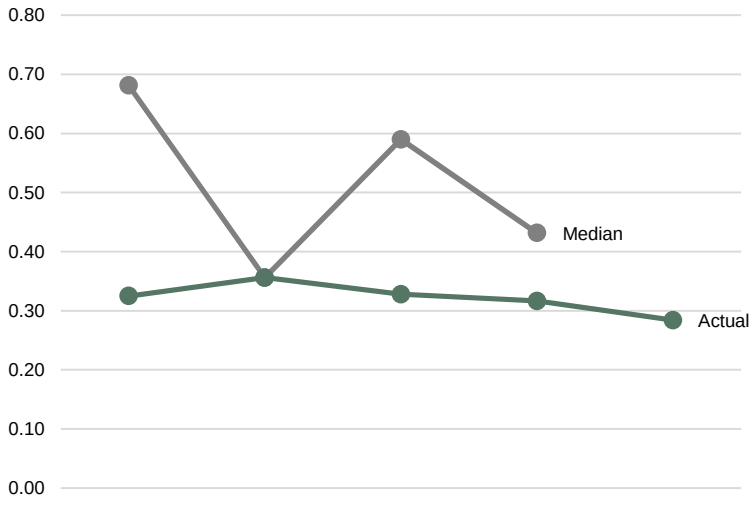


	2011	2012	2013	2014	2015
Actual	1	1	1	1	1

ABOR Peer Group	Med. Sch.	AUTM Adj.	2011	2012	2013	2014	2015	Rank
University of Alabama - Tuscaloosa			3	4	4	4		1
University of North Carolina - Greensboro			3	2	10	4		1
Southern Illinois University - Carbondale	X		5	0		3		3
University of Akron			5	6	4	3		3
Ohio University	X					2		5
Northern Arizona University			1	1	1	1	1	6
Northern Illinois University			0	0	1	0		7
Bowling Green State University			0					
George Mason University			6	1				
Georgia State University								
Kent State University			3					
Old Dominion University					6			
University of Maine								
University of Nevada - Las Vegas								
Western Michigan University	X							
Wichita State University								
Median			3	1	4	3		

Economic Development

Licenses and Options Executed per $10 Million in Total Research Expenditures

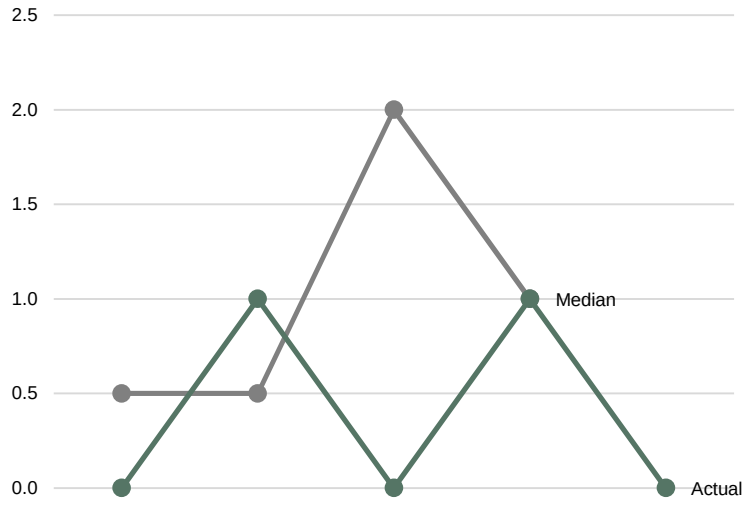


	2011	2012	2013	2014	2015
Actual	0.3	0.4	0.3	0.3	0.3

ABOR Peer Group	Med. Sch.	NSF Adj.	AUTM Adj.	2011	2012	2013	2014	2015	Rank
University of North Carolina - Greensboro				1.1	1.0	6.0	1.9		1
University of Alabama - Tuscaloosa				0.6	0.7	0.7	0.8		2
Southern Illinois University - Carbondale	X			0.7	0.0		0.5		3
University of Akron				0.8	0.9	0.6	0.4		4
Ohio University	X						0.3		5
Northern Arizona University				0.3	0.4	0.3	0.3	0.3	6
Northern Illinois University				0.0	0.0	0.4	0.0		7
Bowling Green State University				0.0					
George Mason University				0.7	0.1				
Georgia State University									
Kent State University				1.1					
Old Dominion University						0.6			
University of Maine									
University of Nevada - Las Vegas									
Western Michigan University	X								
Wichita State University									
Median				0.7	0.4	0.6	0.4		

Economic Development

Startup Companies

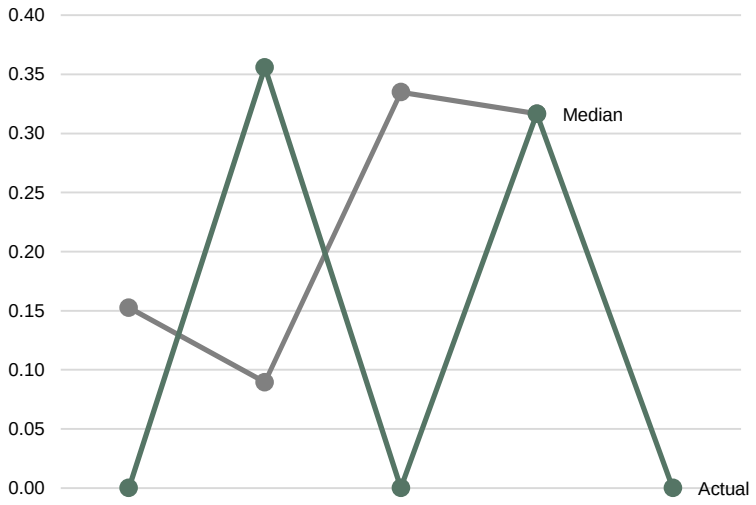


ABOR Enterprise Plan	2011	2012	2013	2014	2015
Actual	0	1	0	1	0

ABOR Peer Group	Med. Sch.	AUTM Adj.	2011	2012	2013	2014	2015	Rank
Southern Illinois University - Carbondale	X			0		3		1
University of Akron			2	2	6	3		1
Northern Arizona University			0	1	0	1	0	3
University of North Carolina - Greensboro			1	0	1	1		3
Northern Illinois University			0	0	0	0		5
Ohio University	X			4	2	0		5
University of Alabama - Tuscaloosa			0	1	2	0		5
Bowling Green State University			0					
George Mason University			4	0				
Georgia State University								
Kent State University			2					
Old Dominion University					2			
University of Maine								
University of Nevada - Las Vegas								
Western Michigan University	X							
Wichita State University								
Median			1	1	2	1		

Economic Development

Startup Companies per $10 Million in Total Research Expenditures



ABOR Enterprise Plan	2011	2012	2013	2014	2015
Actual	0.0	0.4	0.0	0.3	0.0

ABOR Peer Group	Med. Sch.	NSF Adj.	AUTM Adj.	2011	2012	2013	2014	2015	Rank
University of North Carolina - Greensboro				0.4	0.0	0.6	0.5		1
Southern Illinois University - Carbondale	X				0.0		0.5		2
University of Akron				0.3	0.3	0.9	0.4		3
Northern Arizona University				0.0	0.4	0.0	0.3	0.0	4
Northern Illinois University				0.0	0.0	0.0	0.0		5
Ohio University	X				0.7	0.3	0.0		5
University of Alabama - Tuscaloosa				0.0	0.2	0.4	0.0		5
Bowling Green State University				0.0					
George Mason University				0.5	0.0				
Georgia State University									
Kent State University				0.7					
Old Dominion University						0.2			
University of Maine									
University of Nevada - Las Vegas									
Western Michigan University	X								
Wichita State University									
Median				0.2	0.1	0.3	0.3		

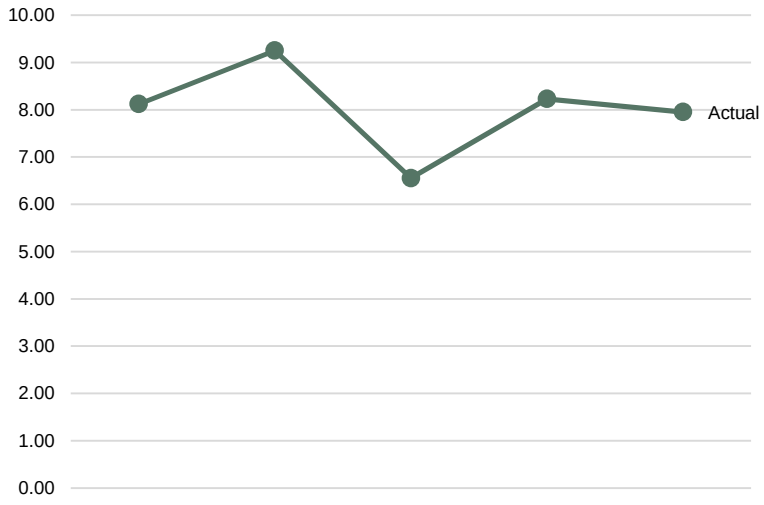
Economic Development

Ph.D. Degrees Conferred

ABOR Enterprise Plan	2011	2012	2013	2014	2015
Actual	25	26	20	26	28

Economic Development

Ph.D. Degrees Conferred per $10 Million in Total Research Expenditures



ABOR Enterprise Plan	2011	2012	2013	2014	2015
Actual	8.1	9.3	6.6	8.2	8.0

This Page Intentionally Left Blank

NORTHERN ARIZONA UNIVERSITY

Leadership and Recognition

Northern Arizona University seeks to provide regional, national and international leadership through the activities of and outcomes generated by its researchers. The metrics typically used by the nation's largest research institutions rarely provide useful insights for our peer group; ultimately, publication and citation by the research community, awarded research grants, issued patents and licensed technologies, and awards bestowed upon our researchers are important indicators that reflect the quality and impact of university scholarship.

National Academy Members. As reported last year, we do not currently have members of the National Academies of Science or of Engineering on our faculty. This is the case for most of our peer group as well.

Team led by NAU Astronomer received NASA Group Achievement award for asteroid observations.

A team led by David Trilling, associate professor of astronomy, has been selected to receive a NASA Group Achievement Award. According to NASA, the Spitzer Near Earth Asteroid Team is being recognized "for exemplary science implementation, analysis and execution of the Spitzer 2011 MD and 2009 BD near-Earth Asteroid Observations for NASA's Asteroid Redirect Mission." Trilling, NAU post-doctoral researcher Michael Mommert and colleagues from four other institutions participated in the research. The project involved the observation of two small asteroids in support of NASA's proposed Asteroid Redirect Mission. Trilling explained that NASA originally planned to capture a small asteroid and bring it back to Earth orbit, and the team's observations helped determine whether either of the two best candidate asteroids would allow for a successful mission. Based on the research by Trilling and his team NASA has decided not to proceed with capturing an asteroid due to hazards revealed in the research process. Now the plan is to pick up a boulder off of a larger asteroid instead.

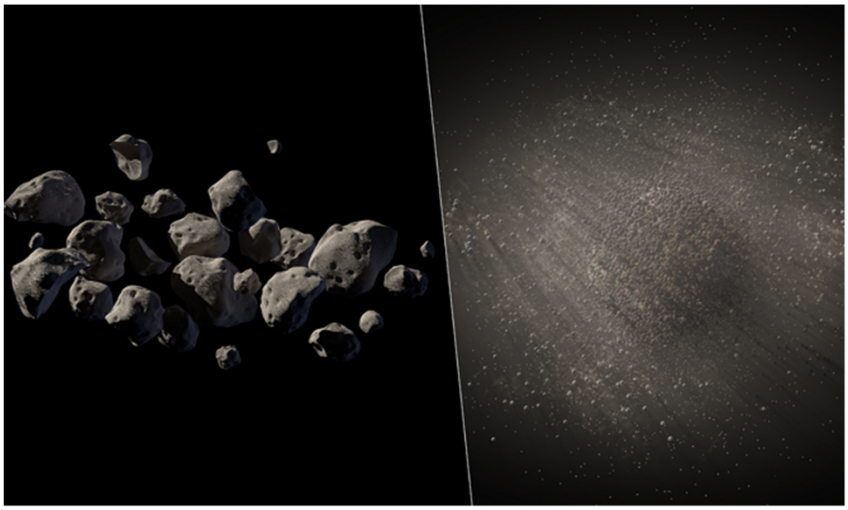
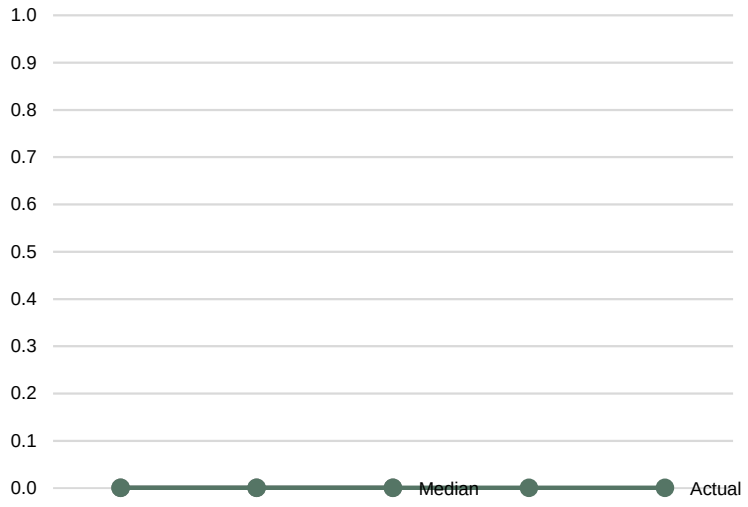


Image courtesy of NASA Jet Propulsion Laboratory.

Leadership and Recognition

National Academy Members

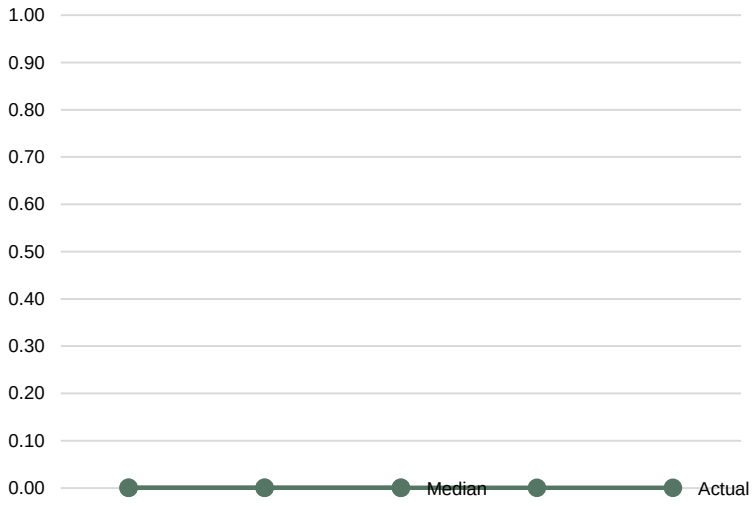


	2011	2012	2013	2014	2015
Actual	0	0	0	0	0

ABOR Peer Group	Med. Sch.	2011	2012	2013	2014	2015	Rank
George Mason University		2	2	2			1
Kent State University		1	1	1			2
University of Akron		2	2	1			2
University of Maine		2	1	1			2
Bowling Green State University		0	0	0			5
Georgia State University		0	0	0			5
Northern Arizona University		0	0	0	0	0	5
Northern Illinois University		0	0	0			5
Ohio University	X	0	0	0			5
Old Dominion University		0	0	0			5
Southern Illinois University - Carbondale	X	0	0	0			5
University of Alabama - Tuscaloosa		0	0	0			5
University of Nevada - Las Vegas		0	0	0			5
University of North Carolina - Greensboro		0	0	0			5
Western Michigan University	X	0	0	0			5
Wichita State University		0	0	0			5
Median		0	0	0			

Leadership and Recognition

National Academy Members per $10 Million in Total Research Expenditures



	2011	2012	2013	2014	2015
Actual	0.0	0.0	0.0	0.0	0.0

ABOR Peer Group	Med. Sch.	NSF Adj.	2011	2012	2013	2014	2015	Rank
Kent State University			0.4	0.4	0.4			1
George Mason University			0.2	0.2	0.2			2
University of Akron			0.3	0.3	0.1			3
University of Maine			0.2	0.1	0.1			4
Bowling Green State University			0.0	0.0	0.0			5
Georgia State University			0.0	0.0	0.0			5
Northern Arizona University			0.0	0.0	0.0	0.0	0.0	5
Northern Illinois University			0.0	0.0	0.0			5
Ohio University	X		0.0	0.0	0.0			5
Old Dominion University			0.0	0.0	0.0			5
Southern Illinois University - Carbondale	X		0.0	0.0	0.0			5
University of Alabama - Tuscaloosa			0.0	0.0	0.0			5
University of Nevada - Las Vegas			0.0	0.0	0.0			5
University of North Carolina - Greensboro			0.0	0.0	0.0			5
Western Michigan University	X		0.0	0.0	0.0			5
Wichita State University			0.0	0.0	0.0			5
Median			0.0	0.0	0.0			

This Page Intentionally Left Blank

NORTHERN ARIZONA UNIVERSITY

Technology Transfer

Northern Arizona University faculty, staff and students transform creativity and discovery into knowledge and innovations in ways that benefit the region and the state. Through its technology transfer program, NAU aims to foster a university-wide entrepreneurial spirit in research and technology, and best leverage its research assets to contribute to innovation and economic development.

Technology transfer benefits the NAU research enterprise in a number of ways. At NAU, researchers can receive funding to help develop ideas that may lead to commercially valuable outcomes. Often, these funds allow researchers to involve graduate and undergraduate students in meaningful research activity. Relationships built with potential licensees can facilitate industry support of continuing research. In addition, revenues received from the commercialization of IP developed by researchers are shared with those researchers, and some funds that the university retains goes back to the academic units to support other research and development.

Assistant Professor Omar Badreldin, with students Duke Ayers and Ian Humphrey (l-r), developed a computer-based application that works with hand sanitizers to reduce the spread of infection in clinical settings.

Commercialization of research outcomes is also an important mechanism through which we disseminate research results—by providing goods and services through the commercialization of intellectual property. In fact, technology licensing and commercialization is sometimes the best method for sharing knowledge with society. In instances where revenues are earned through commercialization, income is returned to the university and is invested back into the university's research enterprise.

In FY2015, we met our technology transfer enterprise metrics for invention disclosures transacted, patents issued, and intellectual property income received. While our goal was to generate two start-up companies in FY2015, we did not meet this goal. However, we are excited at having optioned an NAU-created technology to one start-up company in FY2015 and to have the opportunity to support their efforts to commercialize this technology.

Intellectual property created by NAU faculty, staff, and students are assets of the university and State of Arizona that represent the fruits of valuable investments and research efforts. As a public institution, NAU has an obligation and responsibility to manage these assets in the best interest of the State and for the benefit of all Arizonans.

Technology Transfer

Statistical Exhibits

NORTHERN ARIZONA UNIVERSITY

Technology Transfer Activities	2011	2012	2013	2014	2015
Invention Disclosures Transacted	12	17	18	24	27
Invention Disclosures Transacted Percentage Change		42%	6%	33%	13%
New U.S. Patent Applications	5	2	2	7	6
New U.S. Patent Applications Percentage Change		-60%	0%	250%	-14%
U.S. Patents Issued	0	0	2	4	3
U.S. Patents Issued Percentage Change				100%	-25%
Licenses and Options Executed	1	1	1	1	1
Licenses and Options Executed Percentage Change		0%	0%	0%	0%
Licensing and Other Revenue					
Licensing Revenue (Including Options)	42,684	18,439	20,115	22,975	69,365
Licensee Legal Reimbursements	3,414	3,838	5,347	9,100	5,542
Other Revenue	0	0	0	0	0
Total	46,098	22,277	25,462	32,075	74,907
Other Major Agreements	0	0	0	0	0
Other Major Agreements Percentage Change					
New Startup Companies Created	0	1	0	1	0
New Startup Companies Created Percentage Change			-100%		-100%
Active Startup Companies that Received Funding	0	0	0	0	0
Active Startup Companies that Received Funding Percentage Change					
Active Startup Funding					
Private Equity Funding Received by Active Startup Com	0	0	0	0	0
Grant Funding Received by Active Startup Companies					
Total	0	0	0	0	0
Sponsored Research Facilitated	0	0	599,804	0	1,000,000
Sponsored Research Facilitated Percentage Change				-100%	
Royalty Distribution					
Inventors	0	0	0	0	21,240
Laboratories and Units	0	0	0	0	0
University	0	0	0	0	21,240
Undistributed	0	0	0	0	6,383

US 8,808,993 B2, "Methods and Kits to Detect New H1N1 "Swine Flu" Variants". Issued August 19, 2014. This patent protects compositions and methods associated with an assay that detects antiviral resistant forms of H1N1/09 and is easily translatable for clinical and public health diagnostic use. This patent is jointly owned with The Translational Genomics Institute.

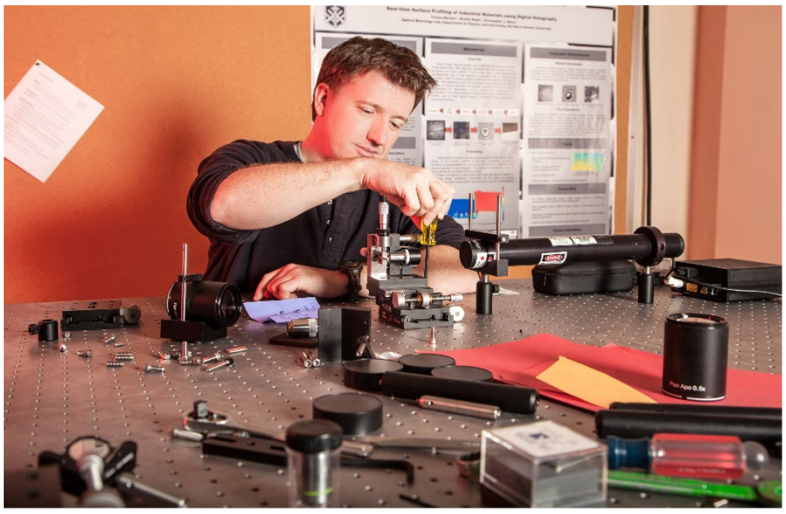
US 8,828,733 B2, "Microsensor Material and Methods for Analyte Detection". Issued September 9, 2014. This patent protects a polymer-particle sensor which detects chemical (e.g., toxic gases) or biological (e.g., proteins) analytes.

US 8,997,167,B1, "Live-Streaming Video Sharing System and Related Methods". Issued March 31, 2015. This patent protects a live streaming video sharing system where a video camera (worn by one user) sends a live stream of video and audio wirelessly through a smart phone to a web server where it can then be watched by others in real time. This patent is jointly owned with a small Flagstaff company, Deep Blue Intention, LLC.

Serenta Biotechnology, LLC, is a start-up company based in Potomac, Maryland. Their goal is to commercialize technologies associated with preventing Staphylococcus Aureus biofilm infections, especially in hospital settings. Serenta entered into an exclusive commercial evaluation license with UMB to evaluate an invention jointly owned by NAU and the University of Maryland, Baltimore: "Protective Vaccine Against Staphylococcus Auerus Biofilms Comprising Cell Wall-Associated Immunogens".

Serenta Biotechnology, LLC, is a start-up company based in Potomac, Maryland. Their goal is to commercialize technologies associated with preventing Staphylococcus Aureus biofilm infections, especially in hospital settings. Serenta entered into an exclusive commercial evaluation license with UMB to evaluate an invention jointly owned by NAU and the University of Maryland, Baltimore: "Protective Vaccine Against Staphylococcus Auerus Biofilms Comprising Cell Wall-Associated Immunogens".

Unique guano innovation gives straight poop on bat populations. Postdoctoral research scholar **Faith Walker** and Professor **Carol Chambers** have created a tool to identify bat species using the DNA found in guano. *Species from Feces* is a non-invasive tool that can aid in the preservation of endangered species. Because bats disperse seeds, pollinate plants and control insect populations, officials regularly consider bats when making decisions that could affect their habitats. Using *Species from Feces,* data can be provided to national park officials, mining companies, land managers and organizations such as Bat Conservation International, who seek to identify endangered bat species inhabiting caves in regions of interest. Species from Feces will help researchers create a baseline of regional bat populations. The Species from Feces tool is one component of a larger ambition: to create a bat institute housing genomic information and projects vital to bat conservation worldwide.



NAU researcher develops way to streamline crime scene investigations. Forensic ballistics, which includes the study of bullet cartridges from crime scenes, may soon benefit from new technologies developed at NAU. Assistant professor Christopher Mann (left) has developed an alternative to the current methods – comparing photographs of bullet cartridges to match weapons to a crime scene – that instead creates a three dimensional image. That image provides significantly more data, not just in terms of striations caused by firing, but also depth and size information for those striations. Current methods are often challenged in court, but with Mann's technology, the evidence is based on data rather than opinion. As his research continues, Mann expects to generate patents and eventually see his ideas transferred to law enforcement activities.

Researchers develop new mechanism to combat serious skin infections. NAU assistant professor of Chemistry and Biochemistry Andy Koppish is part of a team of researchers who have identified members of a unique class of materials, known as ionic liquids, which can disrupt biofilms to enhance the delivery of antibiotics and serve as transdermal treatments for serious skin infections. Koppisch and his colleagues identified choline-geranate as the optimal ionic liquid having biofilm disruptive properties and antimicrobial activity without irritating the skin. The team demonstrated that the compound could both traverse the skin and reduce biofilm-associated bacteria in a model of an infected wound. The compound also was able to deliver an antibiotic through skin. Several patents relating to this work are pending.

This Page Intentionally Left Blank

NORTHERN ARIZONA UNIVERSITY

Strategic Initiatives

Native Americans Exploring Global Health Disparities

Twelve students. Six countries. The opportunity of a lifetime.

NAU students from minority, rural, and low socio-economic backgrounds now have the opportunity to travel to one of six foreign research sites under the NAU Minority Health and Health Disparities International Research Training (MHIRT) program, a $1.25 million grant awarded by the National Institutes of Health (NIH) to Leslie Schulz, Professor and former Executive Dean of the College of Health and Human Services and Catherine Propper, Professor of Biological Sciences.

NAU was one of nineteen institutions awarded the MHIRT grant in FY2015, a group that included Johns Hopkins and Harvard. "We're in very good company with this award," says Schulz, whose experience heading a MHIRT at the University of El Paso several years ago prompted her to explore the possibility at NAU with the help of Technology and Research Initiative Funds (TRIF) from the Office of the Vice President for Research.

The NAU MHIRT is unique in that it is one of the only programs nationally to focus on Native American students. "There are so few Native Americans involved in research in the sciences," Schulz said, citing a gap that NAU is determined to bridge.

The numbers are troubling: though underrepresented in research, Native Americans and other indigenous populations throughout the world are disproportionately affected by diseases like diabetes and cancer. What's more, these health disparities are strikingly similar no matter where you go.

Above: MHIRT "frog squad"-(left to right) Jonathan Credo, Joseph Landavaso, and Marsha Bitsui prior to conducting amphibian surveys in rice paddies at the International Rice Research Institute, the Philippines.

"Indigenous peoples throughout the world have a common profile of disease. Australian aborigines have exactly the same profile as Native Americans—right down to suicide, depression, alcoholism, the whole thing. That's the case in South America, it's the case for the Pacific Islanders, and it's the case for the Maori in New Zealand," says Schulz. "But no one knows why that's the case."

Schulz hopes that by bringing more Native Americans into health research, programs like MHIRT will catalyze a generation of scientists committed to tackling this global mystery. "Our goal is to educate our students on the fact that there are similar health disparities in other indigenous groups," says Schulz. "We want to create a population of indigenous people throughout the world who are interested in examining what creates the kinds of health disparities they experience."

Students have the chance to travel to research sites in Indonesia, Malaysia, New Zealand, the Philippines, Palau, and Myanmar. Shelby Delgai, a Biomedical Science major from the White Mountain Apache and Navajo tribes, was a sophomore when she traveled to New Zealand to study health disparities in the Maori tribe. She was amazed by similarities she found between the Maori culture and her own.

“I felt I could relate to them because their ceremonies and language reminded me of my own culture,” she says. “I was able to connect with the struggles their people face, because they are so similar to the struggles the Native American population faces.”

Delgai recalls feeling nervous before the start of the program because she had no previous research experience. However, the intensive two-week training classes on research methodology, statistics, ethical conduct, and Institutional Review Board (IRB) practices prepared her and her colleagues for a summer--and a lifetime--of research. “Everyone had different backgrounds and experience levels which allowed us to learn from each other and help one another succeed,” she says. “I would definitely recommend this program to any student interested in pursuing a science-related career, especially minority students.”

Shawn Clavell, a doctoral candidate in the Physical Therapy program, traveled to New Zealand to study the relationship between cortisol, insulin sensitivity, and socioeconomic status of affected populations. “As a student in the healthcare field, and a racial minority in the US, I understand the disparities in education and health status in our current social environment,” says Clavell. “The MHIRT program has encouraged me to be an admirable representative of my community through service and scientific research.”

The intensive training is just as transformative to the young scientists as the international experience is. “They gain a lot of experience,” says Schulz. “It’s a lot of effort that goes into those few students, but you see these huge changes: students who thought they had their plans for their future, and then came back and thought, ‘You know, that’s not really what I want to do—I want to go into public health.’ It’s an eye-opening experience.”

MHIRT is much more than a ten-week study abroad experience--Schulz and her team strive to maintain a close mentorship with the students long after they return, encouraging them to participate in health disparity research. “We expect them to go to graduate school, or medical school, or some sort of research institution,” she says. “We plan to follow them for the rest of their lives.”

The emphasis for the MHIRT program is on undergraduate Native American students, but graduate students and students from other minority, rural, and low socio-economic backgrounds are also encouraged to apply. For more information, please contact Kathleen Freel at Kathleen.Freel@nau.edu or MHIRT@nau.edu.

This Page Intentionally Left Blank

Annual Research Report - FY2015

Introductory Letter

The University of Arizona is pleased to offer this report summarizing research activity in fiscal year 2015.

By continuing to work under the University of Arizona's *Never Settle* strategic academic and business plan, we saw a significant growth in our expenditures even with tightening federal and state dollars. Our research reflects the foundation of why universities do research and development (R&D): to attract outside resources to our state, expand economic opportunities for Arizonans and benefit the well-being of our citizens.

FY2015 was my first year as Senior Vice President for Research at UA and I am extremely proud of our collective accomplishments. In FY2015, the UA remained among the top public institutions for research and development expenditures, surpassing last year's expenditures by nearly $20 million. This year, UA saw over $606 million in research expenditures, spanning across thousands of active research projects.

Among the more significant awards in FY2015: $5.6 million from NASA to search for planets similar to Earth, $3.8 million from the U.S. Army Medical Research Acquisition Activity to identify non-pharmacologic methods for enhancing sleep in those with PTSD, and $3.1 million from the National Cancer Institute to study biomarkers in ovarian cancer.

FY2015 was a year of remarkable growth at the UA, hiring new researchers, implementing initiatives by hiring our first director for the Defense and Security Research Institute, forming a research communications team to promote and market the university's research accomplishments and watching the building of the OSIRIS-REx spacecraft, a UA-led space mission that will bring particles from an asteroid back to Earth.

We were also honored to welcome National Science Foundation Director France Cordova to campus in FY2015 and appreciated the opportunity to show her some of the amazing research and facilities that we have to offer as Arizona's flagship university.

In order to meet our benchmark of $756 million in research expenditures by FY2025, the University of Arizona is building on its core research strengths, improving our internal infrastructure, and continuing to invest in our creative, collaborative, productive faculty, who also increased in individual research activity this year.

In addition to contributing new knowledge to their respective fields, our faculty turn research discoveries into products and services with tremendous social and economic impact. In FY2015, Tech Launch Arizona saw an increase in new patent applications and invention disclosures.

At its core, the research enterprise at the UA develops solutions that impact far beyond laboratories to make our community—and our state—a better place

Warm Regards,

Kimberly Andrews Espy

Table of Contents

Enterprise Size

Introduction	6
Selected Accomplishments	7
Total Research Expenditures	8
Average Growth Rate in Total Research Expenditures Over 3 years	9
Federally Financed Research Expenditures	10
Average Growth Rate in Federally Financed Research Expenditures Over 3 years	11
Business Financed Research Expenditures	12
Average Growth Rate in Business Financed Research Expenditures Over 3 years	13
Net Research Square Feet	14
Total Research Expenditures per Square Foot	15
Total Faculty Population	16
Total Research Expenditures per Faculty	17
Other Sponsored Project Expenditures (Instruction, Service, etc.)	18
Average Growth Rate in Other Sponsored Project Expenditures Over 3 Years	19

Discovery and Scholarly Impact

Introduction	22
Selected Accomplishments	23
Invention Disclosures Transacted	24
Invention Disclosures Transacted per $10 Million in Total Research Expenditures	25
U.S. Patents Issued	26
U.S. Patents Issued per $10 Million in Total Research Expenditures	27

Economic Development

Introduction	30
Selected Accomplishments	31
Intellectual Property Income	32
Intellectual Property Income per $10 Million in Total Research Expenditures	33
Licenses and Options Income	34
Licenses and Options Income per $10 Million in Total Research Expenditures	35
Licenses and Options Executed	36
Licenses and Options Executed per $10 Million in Total Research Expenditures	37
Startup Companies	38
Startup Companies per $10 Million in Total Research Expenditures	39
Ph.D. Degrees Conferred	40
Ph.D. Degrees Conferred per $10 Million in Total in Research Expenditures	41

Leadership and Recognition

Introduction	44
Selected Accomplishments	45
National Academy Members	46
National Academy Members per $10 Million in Total Research Expenditures	47

Technology Transfer Activity

Introduction	50
Technology Transfer Statistical Exhibits	51
Selected Patents Issued	52
Selected Licenses and Options Executed	53
Selected Startup Companies	54
Other Notable Activities	55

Strategic Initiatives

Summary	58

This Page Intentionally Left Blank

Enterprise Size

The University of Arizona continued to build on our exceptional research and development expenditures. Even with shrinking federal resources and the tightening of state dollars, we were still able to see significant growth in new awards and our partnering with industry. We grew our total research expenditures from last year's $587 million to more than $606 million in fiscal year 2015.

UA continues to focus on research as a cornerstone of its *Never Settle* strategic plan, wherein we have identified six key areas to target for research growth: optics; informatics; energy, water, and the environment, translational biomedicine; imaging; and space systems. Our goals are to increase research funding and expenditures in these areas, provide opportunities throughout the state by helping to launch new companies based on UA research, and develop solutions that better our community, and our state.

We are focused on some core strategies to achieve these goals, including:

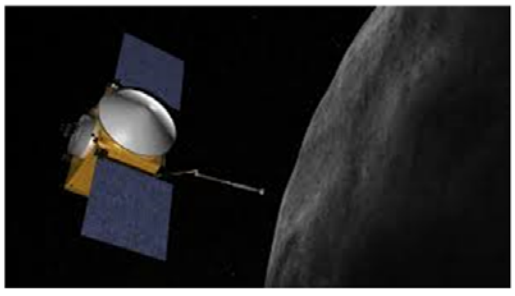
- Increase research expenditures in established areas of focus
- Strengthen the research infrastructure by creating and bolstering units that give researchers the ability to spend more time on their research
- Continue to collaborate with internal and external partners, including federal agencies and private industry

- Vice President Joe Biden announced that a public-private partnership, including the University of Arizona, was selected to receive more than $600 million in federal, state, and funding **to advance U.S. leadership in the development and manufacturing of photonic integrated circuits, technology expected to revolutionize Internet communication and impact multiple commercial technology sectors across the nation.** The American Institute for Manufacturing Integrated Photonics, or AIM Photonics, team includes faculty from the UA, Columbia University, and MIT, and the dean of the UA's College of Optical Sciences serves as the group's technology advisory board chair.

- The University of Arizona **received a $20M gift from Richard F. Caris** in support of its commitment to the Giant Magellan Telescope project, which will ensure that UA astronomers will have access to valuable observing time on the landmark telescope. The UA is one of 11 institutions that have joined forces to build the GMT, slated for completion in 2021. Located in Chile's Atacama Desert, the GMT will have more than six times the light-gathering area of the largest telescopes in existence today, and 10 times the resolution of NASA's Hubble Space Telescope. In recognition of the gift, the UA's Steward Observatory Mirror Lab, which will provide GMT with all eight of its primary mirror segments, will be renamed the "Richard F. Caris Mirror Lab."

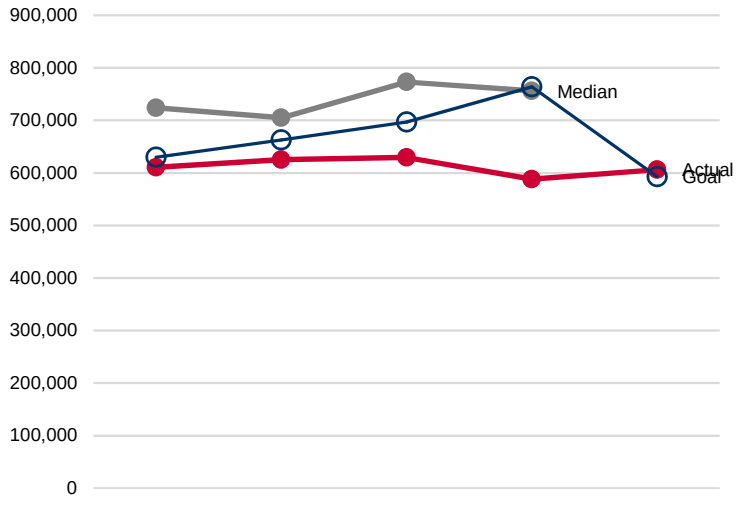
- The UA announced it will launch a new **Doctor of Veterinary Medicine degree program**. The program's innovative curriculum, scheduled to begin in 2016, will address rural veterinarian shortages while offering unique practical experience and holding down student costs. The UA program, which will be the state's only public veterinary medical education program, was approved by the Arizona Board of Regents in September on the heels of a $9 million gift from the Kemper and Ethel Marley Foundation.

- The University of Arizona has been selected by **NASA to lead the United States' first mission to an asteroid.** OSIRIS-REx will fly to, study and retrieve a pristine sample from an asteroid and return it to Earth for analysis. In September, the spacecraft will begin its journey. In FY 2015, the OSIRIS-REx mission hit a major milestone. The first of OSIRIS-REx's five instruments that will map and analyze Bennu was completed and delivered to the Lockheed Martin Space Systems facility for integration onto the spacecraft. The Thermal Emission Spectrometer, or OTES, will conduct surveys to map mineral and chemical abundances and to take the asteroid Bennu's temperature.



Enterprise Size

Total Research Expenditures (in Thousands)

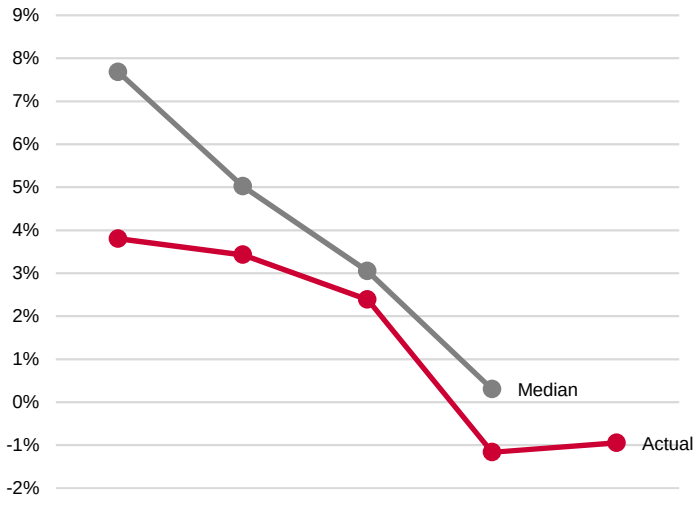


ABOR Enterprise Plan	2011	2012	2013	2014	2015
Actual	610,565	625,365	629,466	588,088	606,219
Goal	630,000	663,000	697,000	764,000	592,818
Difference	-19,435	-37,635	-67,534	-175,912	13,401

ABOR Peer Group	Med. Sch.	NSF Adj.	2011	2012	2013	2014	2015	Rank
University of Washington - Seattle	X		1,148,533	1,109,008	1,192,513	1,176,340		1
University of Wisconsin - Madison	X		1,111,642	1,169,779	1,123,501	1,108,564		2
University of North Carolina - Chapel Hill	X		869,174	884,791	973,007	989,766		3
University of California - Los Angeles	X		982,357	1,003,375	966,659	948,197		4
University of Minnesota - Twin Cities	X		847,419	826,173	858,378	876,870		5
Texas A&M U. - College Station and Hlth. Science Ctr.	X		705,720	693,421	820,015	854,214		6
The Ohio State University	X		832,126	766,513	793,373	815,075		7
Penn State Univ. - Univ. Park and Hershey Medical Ctr.	X		794,846	797,679	837,880	800,773		8
University of California - Davis	X		707,896	713,292	752,734	711,721		9
University of Florida	X		739,931	696,985	695,063	708,526		10
University of Illinois - Urbana - Champaign			545,669	583,754	743,487	621,733		11
The University of Arizona	X		610,565	625,365	629,466	588,088	606,219	12
University of Texas - Austin			632,171	621,538	634,132	585,251		13
Michigan State University	X		454,248	507,061	515,707	526,906		14
University of Maryland - College Park			495,382	502,406	491,998	485,051		15
University of Iowa	X		443,893	446,429	435,377	449,147		16
Median			723,914	705,139	773,054	756,247		

Enterprise Size

Average Growth Rate in Total Research Expenditures Over 3 Years

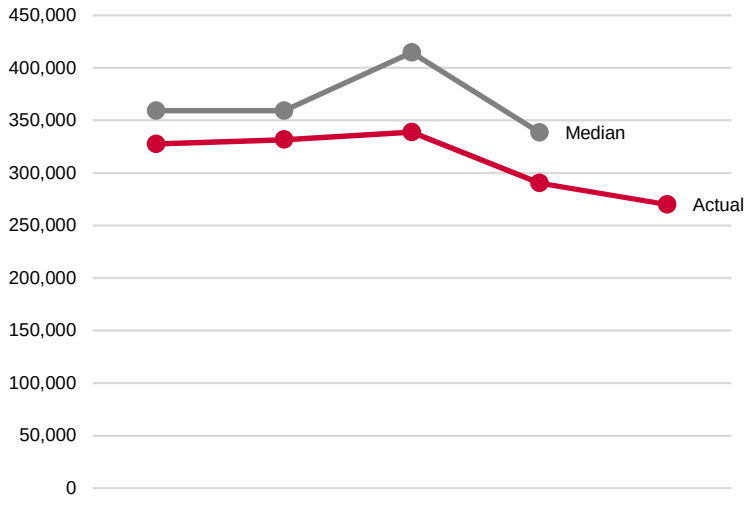


ABOR Enterprise Plan	2011	2012	2013	2014	2015
Actual	3.8%	3.4%	2.4%	-1.2%	-0.9%

ABOR Peer Group	Med. Sch.	NSF Adj.	2011	2012	2013	2014	2015	Rank
Texas A&M U. - College Station and Hlth. Science Ctr.	X		6.7%	3.3%	6.3%	6.9%		1
University of Illinois - Urbana - Champaign			3.3%	1.4%	13.4%	6.0%		2
Michigan State University	X		8.5%	10.8%	6.2%	5.2%		3
University of North Carolina - Chapel Hill	X		18.3%	11.3%	8.9%	4.5%		4
University of Minnesota - Twin Cities	X		7.5%	3.8%	3.1%	1.2%		5
University of Washington - Seattle	X		15.1%	13.4%	5.5%	0.9%		6
University of Iowa	X		15.6%	11.7%	-0.6%	0.4%		7
Penn State Univ. - Univ. Park and Hershey Medical Ctr.	X		4.3%	1.9%	2.9%	0.3%		8
University of California - Davis	X		3.3%	1.5%	3.5%	0.3%		9
University of Wisconsin - Madison	X		8.0%	7.1%	3.1%	0.0%		10
The Ohio State University	X		5.9%	2.6%	1.9%	-0.5%		11
University of Maryland - College Park			7.9%	7.2%	3.0%	-0.7%		12
University of California - Los Angeles	X		4.1%	4.1%	1.1%	-1.1%		13
The University of Arizona	X		3.8%	3.4%	2.4%	-1.2%	-0.9%	14
University of Florida	X		8.3%	6.0%	0.8%	-1.4%		15
University of Texas - Austin			8.8%	7.3%	2.5%	-2.5%		16
Median			7.7%	5.0%	3.0%	0.3%		

Enterprise Size

Federally Financed Research Expenditures (in Thousands)

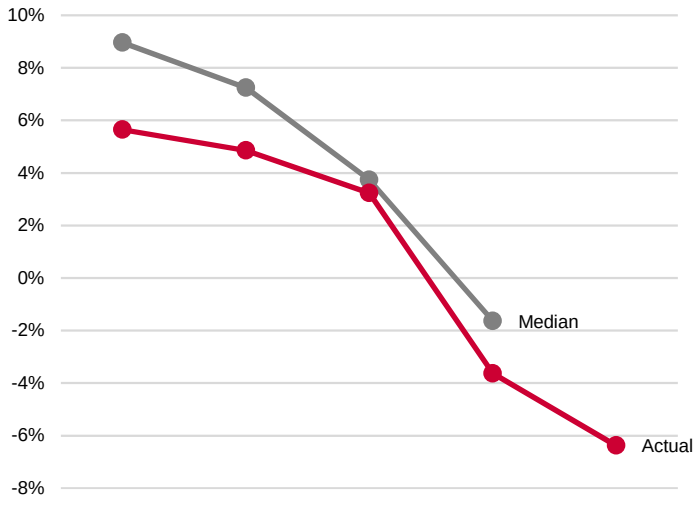


	2011	2012	2013	2014	2015
Actual	327,565	331,578	338,790	290,370	269,959

ABOR Peer Group	Med. Sch.	NSF Adj.	2011	2012	2013	2014	2015	Rank
University of Washington - Seattle	X		948,976	909,652	928,193	909,034		1
University of North Carolina - Chapel Hill	X		600,843	606,348	623,237	610,664		2
University of Wisconsin - Madison	X		593,633	580,661	555,875	548,388		3
Penn State Univ. - Univ. Park and Hershey Medical Ctr.	X		468,705	531,421	558,871	520,574		4
University of Minnesota - Twin Cities	X		489,480	485,462	494,206	489,767		5
University of California - Los Angeles	X		563,560	539,054	501,368	465,170		6
The Ohio State University	X		493,130	445,635	456,590	454,484		7
University of Illinois - Urbana - Champaign			323,454	359,989	468,798	343,275		8
University of Maryland - College Park			338,780	340,180	342,778	333,409		9
University of Texas - Austin			355,437	354,873	372,633	332,758		10
University of California - Davis	X		362,976	358,577	347,038	330,367		11
Texas A&M U. - College Station and Hlth. Science Ctr.	X		291,812	269,460	314,104	311,920		12
The University of Arizona	X		327,565	331,578	338,790	290,370	269,959	13
University of Florida	X		306,349	305,067	296,199	289,327		14
Michigan State University	X		240,837	268,952	260,610	261,826		15
University of Iowa	X		283,627	269,734	255,329	235,527		16
Median			359,207	359,283	414,612	338,342		

Enterprise Size

Average Growth Rate in Federally Financed Research Expenditures Over 3 Years

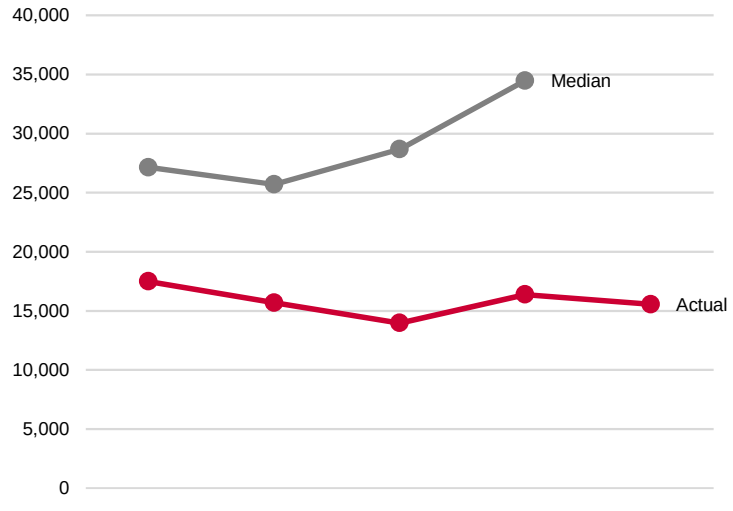


	2011	2012	2013	2014	2015
Actual	5.6%	4.9%	3.2%	-3.6%	-6.4%

ABOR Peer Group	Med. Sch.	NSF Adj.	2011	2012	2013	2014	2015	Rank
University of Illinois - Urbana - Champaign			6.6%	7.7%	16.0%	4.9%		1
Penn State Univ. - Univ. Park and Hershey Medical Ctr.	X		4.9%	6.7%	6.5%	3.9%		2
Michigan State University	X		16.8%	18.2%	7.0%	3.0%		3
Texas A&M U. - College Station and Hlth. Science Ctr.	X		6.0%	1.3%	3.4%	2.7%		4
University of North Carolina - Chapel Hill	X		17.4%	12.5%	4.6%	0.6%		5
University of Minnesota - Twin Cities	X		10.4%	7.7%	5.3%	0.0%		6
University of Maryland - College Park			12.9%	11.6%	5.0%	-0.5%		7
University of Washington - Seattle	X		16.4%	14.7%	4.1%	-1.4%		8
University of Florida	X		10.2%	9.8%	2.1%	-1.9%		9
University of Texas - Austin			3.4%	4.9%	2.1%	-2.0%		10
The Ohio State University	X		14.1%	10.5%	5.4%	-2.5%		11
University of Wisconsin - Madison	X		7.8%	4.7%	0.8%	-2.6%		12
University of California - Davis	X		10.5%	6.8%	1.6%	-3.1%		13
The University of Arizona	X		5.6%	4.9%	3.2%	-3.6%	-6.4%	14
University of Iowa	X		7.4%	2.5%	-3.3%	-6.0%		15
University of California - Los Angeles	X		6.3%	5.2%	-2.2%	-6.2%		16
Median			9.0%	7.2%	3.7%	-1.6%		

Enterprise Size

Business Financed Research Expenditures (in Thousands)

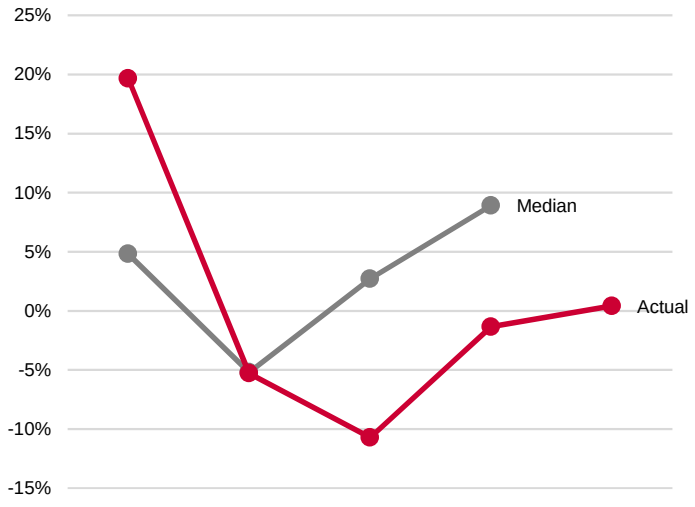


	2011	2012	2013	2014	2015
Actual	17,485	15,693	13,964	16,372	15,558

ABOR Peer Group	Med. Sch.	NSF Adj.	2011	2012	2013	2014	2015	Rank
The Ohio State University	X		103,564	100,986	110,551	118,297		1
University of Texas - Austin			36,712	40,392	43,636	71,349		2
Texas A&M U. - College Station and Hlth. Science Ctr.	X		48,961	51,311	58,972	70,607		3
University of Washington - Seattle	X		23,031	24,662	25,032	49,963		4
University of California - Los Angeles	X		6,133	6,353	7,124	45,193		5
University of Illinois - Urbana - Champaign			68,479	67,890	71,354	40,971		6
University of California - Davis	X		13,461	13,892	14,812	39,598		7
University of Florida	X		31,360	29,657	28,795	35,107		8
University of North Carolina - Chapel Hill	X		17,485	15,693	13,964	33,854		9
Penn State Univ. - Univ. Park and Hershey Medical Ctr.	X		64,650	36,973	34,878	33,808		10
University of Minnesota - Twin Cities	X		54,880	49,392	52,299	28,164		11
University of Wisconsin - Madison	X		26,310	26,722	28,529	23,056		12
University of Iowa	X		20,780	19,731	42,296	17,183		13
The University of Arizona	X		17,485	15,693	13,964	16,372	15,558	14
Michigan State University	X		3,566	5,084	7,497	8,077		15
University of Maryland - College Park			27,968	23,152	22,168	6,967		16
Median			27,139	25,692	28,662	34,481		

Enterprise Size

Average Growth Rate in Business Financed Research Expenditures Over 3 Years

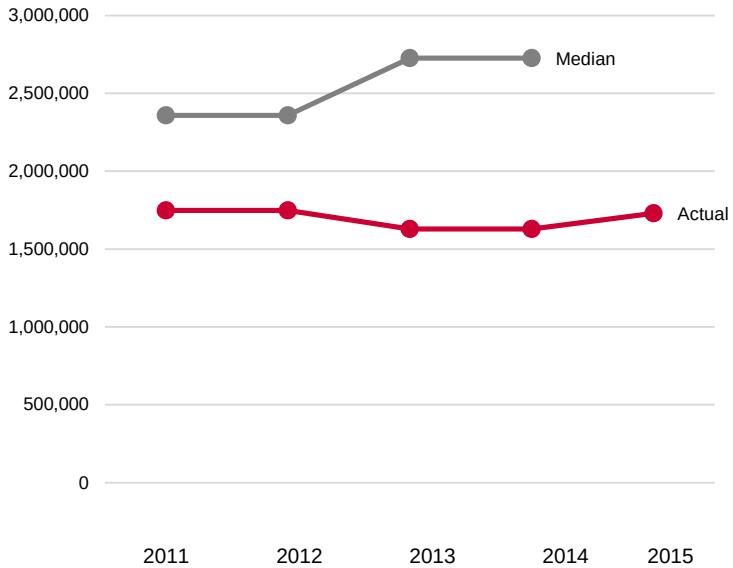


	2011	2012	2013	2014	2015
Actual	19.7%	-5.3%	-10.7%	-1.3%	0.4%

ABOR Peer Group	Med. Sch.	NSF Adj.	2011	2012	2013	2014	2015	Rank
University of California - Los Angeles	X		-37.7%	-36.6%	-5.7%	183.4%		1
University of California - Davis	X		-21.5%	-22.2%	-1.4%	59.1%		2
University of North Carolina - Chapel Hill	X		24.4%	13.3%	-10.7%	40.4%		3
University of Washington - Seattle	X		-22.5%	-21.4%	2.3%	36.1%		4
Michigan State University	X		-24.1%	-8.8%	28.7%	32.6%		5
University of Texas - Austin			-3.4%	-5.1%	5.6%	27.2%		6
University of Iowa	X		186.1%	137.8%	10.6%	16.6%		7
Texas A&M U. - College Station and Hlth. Science Ctr.	X		8.9%	17.2%	3.3%	13.2%		8
The Ohio State University	X		-6.5%	-5.3%	-2.3%	4.7%		9
University of Florida	X		0.8%	-5.3%	0.7%	4.5%		10
The University of Arizona	X		19.7%	-5.3%	-10.7%	-1.3%	0.4%	11
University of Wisconsin - Madison	X		10.6%	15.5%	3.1%	-3.6%		12
University of Illinois - Urbana - Champaign			68.9%	70.9%	8.5%	-12.8%		13
University of Minnesota - Twin Cities	X		24.9%	17.0%	4.4%	-16.8%		14
Penn State Univ. - Univ. Park and Hershey Medical Ctr.	X		-11.0%	-26.6%	-16.0%	-17.2%		15
University of Maryland - College Park			48.4%	42.4%	39.9%	-30.0%		16
Median			4.8%	-5.2%	2.7%	8.9%		

Enterprise Size

Net Assignable Square Feet

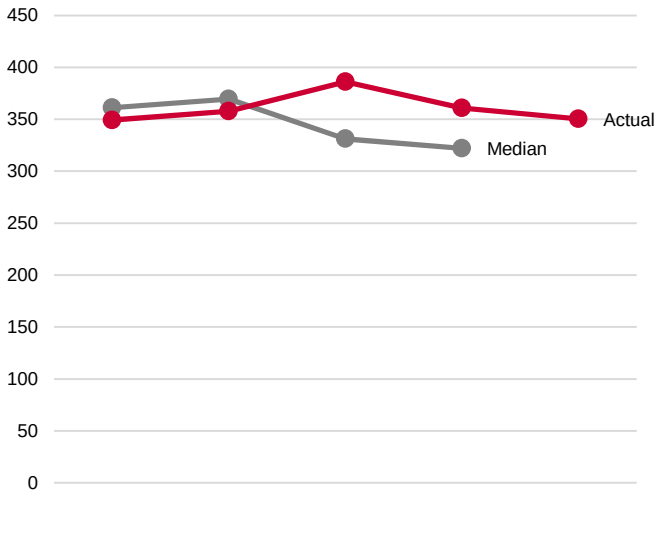


	2011	2012	2013	2014	2015
Actual	1,748,035	1,748,035	1,629,762	1,629,762	1,730,431

ABOR Peer Group	Med. Sch.	NSF Adj.	2011	2012	2013	2014	2015	Rank
University of Minnesota - Twin Cities	X		3,531,048	3,531,048	3,672,847	3,672,847		1
University of Florida	X		3,038,164	3,038,164	3,109,643	3,109,643		2
University of Illinois - Urbana - Champaign			4,631,400	4,631,400	3,108,558	3,108,558		3
The Ohio State University	X		1,447,310	1,447,310	2,973,355	2,973,355		4
University of California - Davis	X		2,927,180	2,927,180	2,930,437	2,930,437		5
Texas A&M U. - College Station and Hlth. Science Ctr.	X		2,443,234	2,443,234	2,895,450	2,895,450		6
University of Wisconsin - Madison	X		2,935,571	2,935,571	2,774,278	2,774,278		7
Penn State Univ. - Univ. Park and Hershey Medical Ctr.	X		2,929,245	2,929,245	2,733,125	2,733,125		8
University of California - Los Angeles	X		2,632,450	2,632,450	2,717,533	2,717,533		9
Michigan State University	X		2,274,375	2,274,375	2,253,911	2,253,911		10
University of Washington - Seattle	X		1,874,449	1,874,449	1,796,285	1,796,285		11
The University of Arizona	X		1,748,035	1,748,035	1,629,762	1,629,762	1,730,431	12
University of Texas - Austin			1,478,523	1,478,523	1,455,474	1,455,474		13
University of North Carolina - Chapel Hill	X		1,223,219	1,223,219	1,294,963	1,294,963		14
University of Maryland - College Park			769,581	769,581	769,581	769,581		15
University of Iowa	X		659,913	659,913	700,757	700,757		16
Median			2,358,805	2,358,805	2,725,329	2,725,329.0		

Enterprise Size

Total Research Expenditures per Net Assignable Square Foot

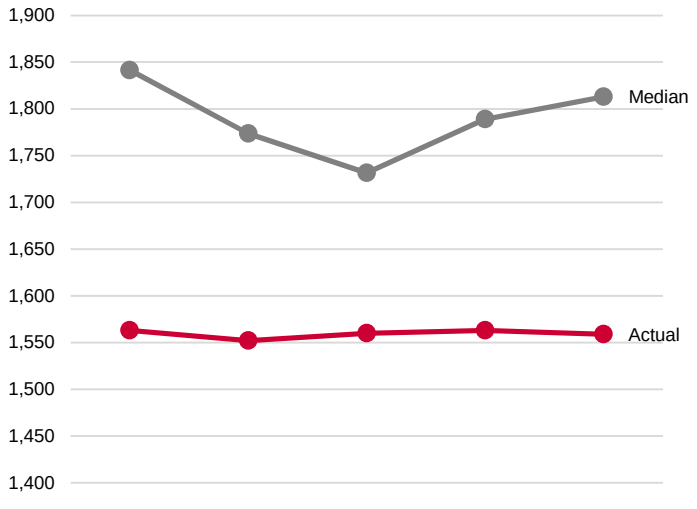


	2011	2012	2013	2014	2015
Actual	349	358	386	361	350

ABOR Peer Group	Med. Sch.	NSF Adj.	2011	2012	2013	2014	2015	Rank
University of North Carolina - Chapel Hill	X		711	723	751	764		1
University of Washington - Seattle	X		613	592	664	655		2
University of Iowa	X		673	676	621	641		3
University of Maryland - College Park			644	653	639	630		4
University of Texas - Austin			428	420	436	402		5
University of Wisconsin - Madison	X		379	398	405	400		6
The University of Arizona	X		349	358	386	361	350	7
University of California - Los Angeles	X		373	381	356	349		8
Texas A&M U. - College Station and Hlth. Science Ctr.	X		289	284	283	295		9
Penn State Univ. - Univ. Park and Hershey Medical Ctr.	X		271	272	307	293		10
The Ohio State University	X		575	530	267	274		11
University of California - Davis	X		242	244	257	243		12
University of Minnesota - Twin Cities	X		240	234	234	239		13
Michigan State University	X		200	223	229	234		14
University of Florida	X		244	229	224	228		15
University of Illinois - Urbana - Champaign			118	126	239	200		16
Median			361	369	331	322.0		

Enterprise Size

Total Faculty Population

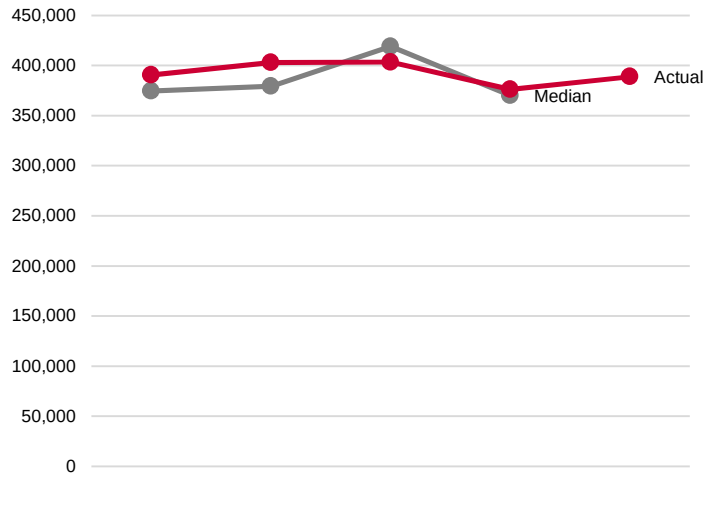


	2011	2012	2013	2014	2015
Actual	1,563	1,552	1,560	1,563	1,559

ABOR Peer Group	Med. Sch.	NSF Adj.	2011	2012	2013	2014	2015	Rank
The Ohio State University	X		2,560	2,511	2,489	2,508	2,491	1
University of Minnesota - Twin Cities	X		2,277	2,251	2,412	2,408	2,419	2
University of Florida	X		2,701	2,647	2,493	2,439	2,382	3
University of Wisconsin - Madison	X		2,057	2,014	2,067	2,082	2,124	4
Texas A&M U. - College Station and Hlth. Science Ctr.	X		1,871	1,771	1,710	1,838	1,995	5
University of Texas - Austin			1,954	1,910	1,910	1,898	1,899	6
University of North Carolina - Chapel Hill	X		1,861	1,876	1,948	1,852	1,842	7
Michigan State University	X		1,906	1,883	1,732	1,825	1,838	8
University of Illinois - Urbana - Champaign			1,778	1,707	1,710	1,753	1,788	9
Penn State Univ. - Univ. Park and Hershey Medical Ctr.	X		1,759	1,763	1,731	1,741	1,777	10
University of California - Los Angeles	X		1,822	1,776	1,747	1,725	1,734	11
The University of Arizona	X		1,563	1,552	1,560	1,563	1,559	12
University of Washington - Seattle	X		1,536	1,525	1,487	1,498	1,526	13
University of Iowa	X		1,527	1,538	1,576	1,551	1,525	14
University of Maryland - College Park			1,463	1,501	1,483	1,476	1,514	15
University of California - Davis	X		1,467	1,421	1,423	1,417	1,440	16
Median			1,842	1,774	1,732	1,789	1,813	

Enterprise Size

Total Research Expenditures per Faculty

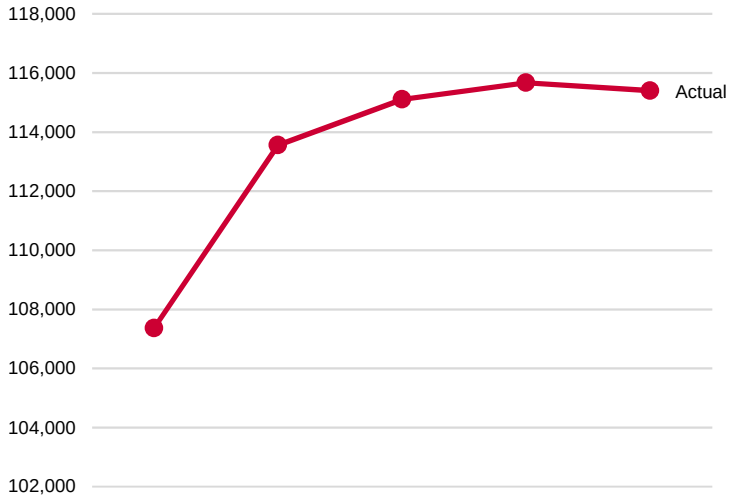


	2011	2012	2013	2014	2015
Actual	390,637	402,941	403,504	376,256	388,851

ABOR Peer Group	Med. Sch.	NSF Adj.	2011	2012	2013	2014	2015	Rank
University of Washington - Seattle	X		747,743	727,218	801,959	785,274		1
University of California - Los Angeles	X		539,164	564,963	553,325	549,679		2
University of North Carolina - Chapel Hill	X		467,047	471,637	499,490	534,431		3
University of Wisconsin - Madison	X		540,419	580,824	543,542	532,451		4
University of California - Davis	X		482,547	501,965	528,977	502,273		5
Texas A&M U. - College Station and Hlth. Science Ctr.	X		377,189	391,542	479,541	464,752		6
Penn State Univ. - Univ. Park and Hershey Medical Ctr.	X		451,874	452,455	484,044	459,950		7
The University of Arizona	X		390,637	402,941	403,504	376,256	388,851	8
University of Minnesota - Twin Cities	X		372,165	367,025	355,878	364,149		9
University of Illinois - Urbana - Champaign			306,900	341,977	434,788	354,668		10
University of Maryland - College Park			338,607	334,714	331,759	328,625		11
The Ohio State University	X		325,049	305,262	318,752	324,990		12
University of Texas - Austin			323,527	325,413	332,006	308,351		13
University of Florida	X		273,947	263,311	278,806	290,499		14
University of Iowa	X		290,696	290,266	276,254	289,585		15
Michigan State University	X		238,325	269,284	297,752	288,716		16
Median			374,677	379,283	419,146	370,202		

Enterprise Size

Other Sponsored Project Expenditures (in Thousands)



ABOR Enterprise Plan	2011	2012	2013	2014	2015
Actual	107,365	113,559	115,105	115,666	115,399

Enterprise Size

Average Growth Rate in Other Sponsored Project Expenditures Over 3 Years

ABOR Enterprise Plan	2011	2012	2013	2014	2015
Actual	13.9%	13.6%	12.2%	2.5%	0.5%

This Page Intentionally Left Blank

Discovery and Scholarly Impact

The University of Arizona is committed to not only generating new knowledge, but also sharing discoveries with Arizona and the world where they will improve well-being. From published findings to national broadcasts, UA research and scholarship is showcased around the globe.

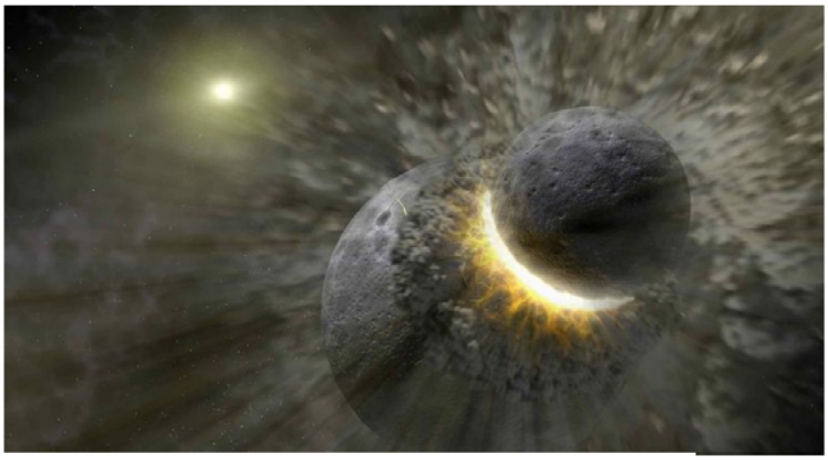
Researchers have engaged with industry, foundations, governmental organizations, and citizens to assess needs, generate novel solutions, and develop technology.

As a first step, to be effective, discoveries must be communicated to wide public, professional, and research audiences. To that end, the UA utilizes a number of vehicles to share the news about UA discoveries in order for them to become a part of the national dialogue.

Faculty members have always communicated their research results in professional publications, but, beyond this, inventions must be put to practical use through technology transfer and commercialization. UA will advance research that innovates, engages students to increase recruitment and retention, and partners with our local and global community to address social, cultural, and economic needs.

Through Tech Launch Arizona, inventions, technologies, and intellectual property are moved from the laboratory out into the marketplace. TLA brings together the faculty and researchers of the UA with the business community to maximize the impact of our research and innovation efforts, as well as to optimize the benefits gained from our tech park's resources.

- Through a combination of data analysis and numerical modeling work, a team of researchers including Tim Swindle, director of the University of Arizona's Lunar and Planetary Laboratory, **found a record of the ancient Moon-forming giant impact observable in stony meteorites.** The work was published in the April 2015 issue of the journal Science.



- An international research team led by UA geoscientist Alexis Licht **found that the Asian monsoon already existed 40 million years ago during a period of high atmospheric carbon dioxide and warmer temperatures.** Previously, scientists thought the climate pattern known as the Asian monsoon began 22-25 million years ago as a result of the uplift of the Tibetan Plateau and the Himalaya Mountains. The team's paper was published in the journal Nature in September 2014.

- A decade-long effort led by University of Arizona scientists Monica Schmidt and Eliot Herman **yielded a soybean with significantly reduced levels of three key proteins responsible for both its allergenic and anti-nutritional effects.** The work is described in a paper published in the journal Plant Breeding. The new, low-allergenic soybean could have a positive impact on items such as baby formula and animal feed.

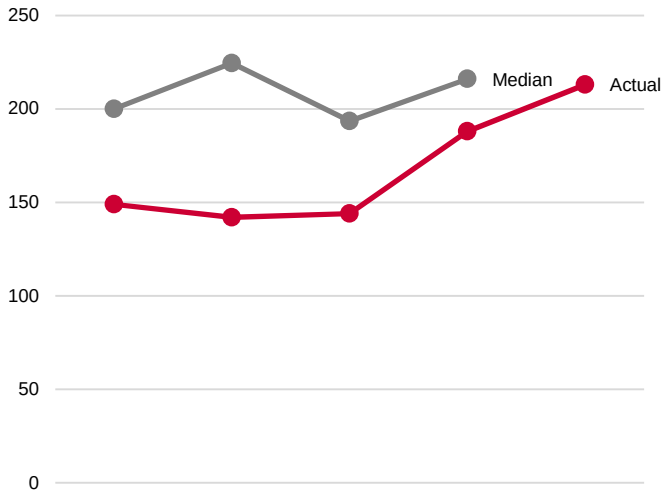
- A UA-led team including Richard Bennett and Kathleen Compton reported in the journal Geophysical Research Letters that the Earth's crust under Iceland is rebounding as global warming melts the island's great ice caps. **The paper was the first to show** the current fast uplift of the Icelandic crust is a result of accelerated melting of the island's glaciers and coincides with the onset of warming that began about 30 years ago.

- Andrei Sanov, a professor in the UA's Department of Chemistry and Biochemistry, and two of his students **reported the first definitive observation and spectroscopic characterization of ethylenedione,** a molecule so elusive that chemists have argued for more than a century over whether it actually exists.

- Astronomers from the UA and Leiden University **successfully commissioned a new type of optic that can reveal the image of an exoplanet next to its parent star.** The "vector Apodizing Phase Plate," or vector-APP, coronagraph was installed at the 6.5-m Magellan Clay telescope in Chile in May 2015, and the first observations demonstrated an unprecedented contrast performance.

Discovery and Scholarly Impact

Invention Disclosures Transacted

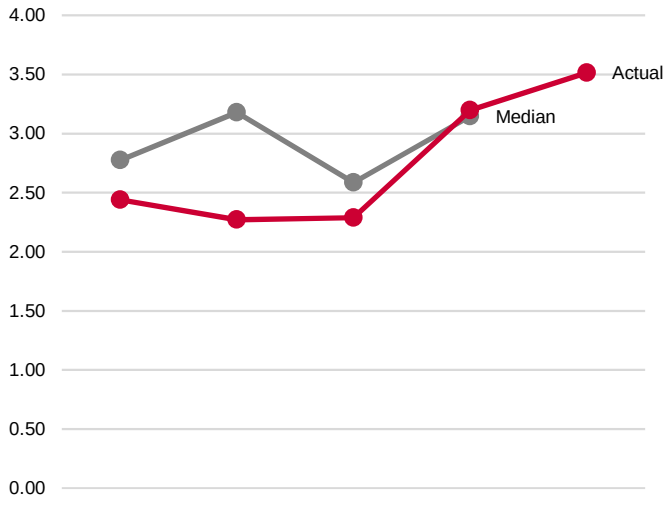


ABOR Enterprise Plan	2011	2012	2013	2014	2015
Actual	149	142	144	188	213

ABOR Peer Group	Med. Sch.	AUTM Adj.	2011	2012	2013	2014	2015	Rank
University of Washington - Seattle	X		356	462	410	421		1
University of Wisconsin - Madison	X		357	373	386	417		2
University of California - Los Angeles	X		299	343	359	371		3
University of Florida	X		322	345	335	352		4
University of Minnesota - Twin Cities	X		250	321	331	343		5
The Ohio State University	X		216	319	384	305		6
Texas A&M U. - College Station and Hlth. Science Ctr.	X		284	212	159	219		7
University of California - Davis	X		184	226	206	213		8
The University of Arizona	X		149	142	144	188	213	9
University of Illinois - Urbana - Champaign			182	223	181	179		10
University of North Carolina - Chapel Hill	X		142	160	138	156		11
University of Iowa	X		68	102	96	139		12
Michigan State University	X		110	127	122	131		13
Penn State Univ. - Univ. Park and Hershey Medical Ctr.	X		144	132	159	117		14
University of Maryland - College Park								
University of Texas - Austin								
Median			200	225	194	216		

Discovery and Scholarly Impact

Invention Disclosures Transacted per $10 Million in Total Research Expenditures

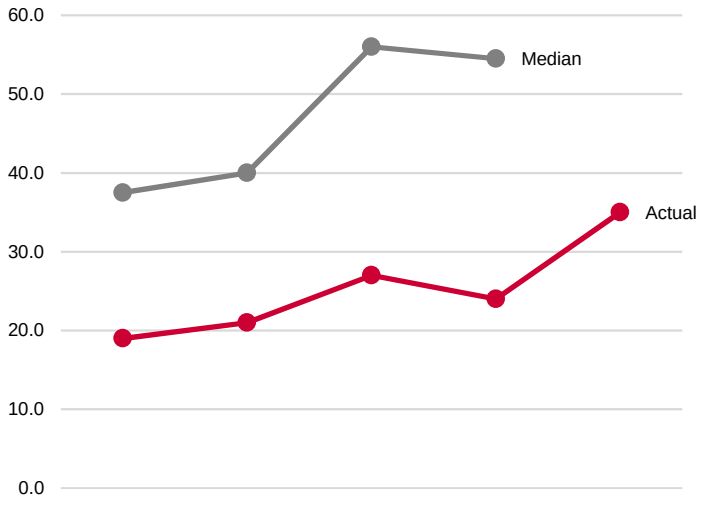


ABOR Enterprise Plan	2011	2012	2013	2014	2015
Actual	2.4	2.3	2.3	3.2	3.5

ABOR Peer Group	Med. Sch.	NSF Adj.	AUTM Adj.	2011	2012	2013	2014	2015	Rank
University of Florida	X			4.4	4.9	4.8	5.0		1
University of California - Los Angeles	X			3.0	3.4	3.7	3.9		2
University of Minnesota - Twin Cities	X			3.0	3.9	3.9	3.9		3
University of Wisconsin - Madison	X			3.2	3.2	3.4	3.8		4
The Ohio State University	X			2.6	4.2	4.8	3.7		5
University of Washington - Seattle	X			3.1	4.2	3.4	3.6		6
The University of Arizona	X			2.4	2.3	2.3	3.2	3.5	7
University of Iowa	X			1.5	2.3	2.2	3.1		8
University of California - Davis	X			2.6	3.2	2.7	3.0		9
University of Illinois - Urbana - Champaign				3.3	3.8	2.4	2.9		10
Texas A&M U. - College Station and Hlth. Science Ctr.	X			4.0	3.1	1.9	2.6		11
Michigan State University	X			2.4	2.5	2.4	2.5		12
University of North Carolina - Chapel Hill	X			1.6	1.8	1.4	1.6		13
Penn State Univ. - Univ. Park and Hershey Medical Ctr.	X			1.8	1.7	1.9	1.5		14
University of Maryland - College Park									
University of Texas - Austin									
Median				2.8	3.2	2.6	3.1		

Discovery and Scholarly Impact

U.S. Patents Issued

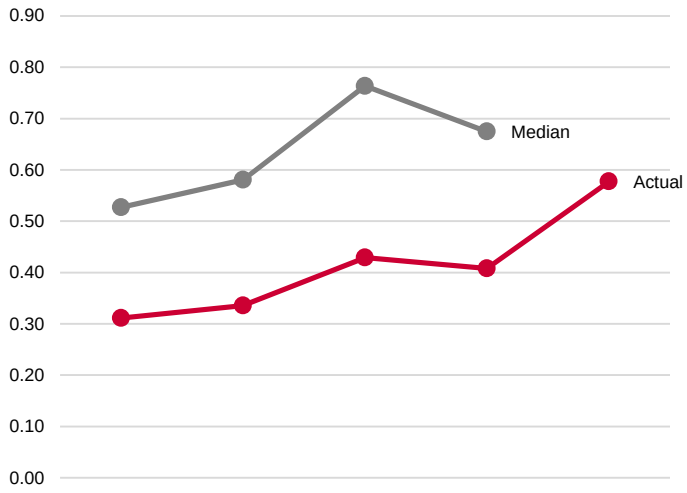


ABOR Enterprise Plan	2011	2012	2013	2014	2015
Actual	19	21	27	24	35

ABOR Peer Group	Med. Sch.	AUTM Adj.	2011	2012	2013	2014	2015	Rank
University of Wisconsin - Madison	X		156	153	157	166		1
University of Florida	X		86	60	107	110		2
University of California - Los Angeles	X		56	74	95	97		3
University of Washington - Seattle	X		70	61	94	82		4
University of Illinois - Urbana - Champaign			68	76	72	78		5
University of Minnesota - Twin Cities	X		41	59	64	65		6
Penn State Univ. - Univ. Park and Hershey Medical Ctr.	X		37	39	41	55		7
The Ohio State University	X		30	41	62	54		8
University of North Carolina - Chapel Hill	X		33	31	25	36		9
Michigan State University	X		38	31	46	32		10
Texas A&M U. - College Station and Hlth. Science Ctr.	X		18	29	50	31		11
University of Iowa	X		31	31	24	25		12
The University of Arizona	X		19	21	27	24	35	13
University of California - Davis	X		23	26	22	20		14
University of Maryland - College Park								
University of Texas - Austin								
Median			38	40	56	55		

Discovery and Scholarly Impact

U.S. Patents Issued per $10 Million in Total Research Expenditures



ABOR Enterprise Plan	2011	2012	2013	2014	2015
Actual	0.3	0.3	0.4	0.4	0.6

ABOR Peer Group	Med. Sch.	NSF Adj.	AUTM Adj.	2011	2012	2013	2014	2015	Rank
University of Florida	X			1.2	0.9	1.5	1.6		1
University of Wisconsin - Madison	X			1.4	1.3	1.4	1.5		2
University of Illinois - Urbana - Champaign				1.2	1.3	1.0	1.3		3
University of California - Los Angeles	X			0.6	0.7	1.0	1.0		4
University of Minnesota - Twin Cities	X			0.5	0.7	0.7	0.7		5
University of Washington - Seattle	X			0.6	0.6	0.8	0.7		6
Penn State Univ. - Univ. Park and Hershey Medical Ctr.	X			0.5	0.5	0.5	0.7		7
The Ohio State University	X			0.4	0.5	0.8	0.7		8
Michigan State University	X			0.8	0.6	0.9	0.6		9
University of Iowa	X			0.7	0.7	0.6	0.6		10
The University of Arizona	X			0.3	0.3	0.4	0.4	0.6	11
University of North Carolina - Chapel Hill	X			0.4	0.4	0.3	0.4		12
Texas A&M U. - College Station and Hlth. Science Ctr.	X			0.3	0.4	0.6	0.4		13
University of California - Davis	X			0.3	0.4	0.3	0.3		14
University of Maryland - College Park									
University of Texas - Austin									
Median				0.5	0.6	0.8	0.7		

This Page Intentionally Left Blank

Economic Development

The University of Arizona serves as a major economic driver and exerts a profound impact on the indicators of economic well-being for the region. The University's research strengths drive economic development activities through leading edge research initiatives, new inventions, technology commercialization, and innovative public-private partnerships.

Through the *Never Settle* strategic plan, the University of Arizona is continuing to rework the process for recognizing interdisciplinary research in the promotion and tenure process. With revised processes and guidelines, the UA recognizes and values engagement in partnerships with industry and community-based research and knowledge application, and Tech Launch Arizona is fulfilling a central role in the UA's overall mission of creating a positive impact on the Tucson and Southern Arizona economies.

Tech Parks Arizona Impact

Tech Parks Arizona is a significant economic engine for Tucson, Pima County, and the state of Arizona. It attracts new businesses, grows existing ones, launches new companies, commercializes new technologies and create high-paying jobs. In FY 2015, the UA Tech Park generated a total economic impact of more than $2.33 billion in Pima County. As described in its latest economic impact report published in January 2015, the Tech Park is home to 45 tenant companies from over 15 industries that employ nearly 6,500 people; with an average annual salary of $91,145, almost double the Pima County average of $46,363; created an additional 8,095 regional jobs (indirect and induced) and generated $42.5 million in regional tax revenues.

The Commercialization Network

In FY 2015, TLA continued to grow its domain expert network, which connects UA investigators and their inventions with interested, informed, committed individuals who are drawn on to advance technology opportunities. The network underpins commercialization capabilities by extending the expertise base from a limited staff to a virtually limitless community. This reach is necessary to be prepared to assess the vast range of UA science. The network has grown over the past year, and now has over 1,300 qualified domain experts and relevant business and community members. Connections are based on common interests, shared expectations, and understanding of goals. Network members help assess, understand, and position technologies based on commercial and social relevance. As a largely alumni represented network, the reach is global—but with deep regional roots. To better engage and strengthen the commercialization network, TLA launched the Commercialization Partner program, a team of 12 resident executives, entrepreneurs and investors who provide ongoing support for commercialization activities from invention disclosure through to startup launch.

SBIR/STTR Competitiveness Initiative — SBIR/STTR Tech House

In 2014, TLA launched SBIR/STTR Tech House, an initiative focused on increasing the activity and effectiveness of new and small businesses applying for SBIR (Small Business Innovation Research) and STTR (Small Business Technology Transfer) funding. Through Tech House, TLA helps to connect UA researchers with small businesses, prime contractors and supportive resources to build strategic teams that can respond to SBIR and STTR solicitations put forth by federal agencies such as the Department of Energy, the Department of Defense, NASA and others. These awards represent a great opportunity of funding for Southern Arizona companies, and TLA has engaged community partners such as the Arizona Commerce Authority in the work of helping all of these different entities connect with one another. With its community partners facilitating these connections, TLA focuses its work on directly supporting UA researchers and their direct partners in the community in the pursuit of SBIR/STTR funding.

Economic Development Accomplishments

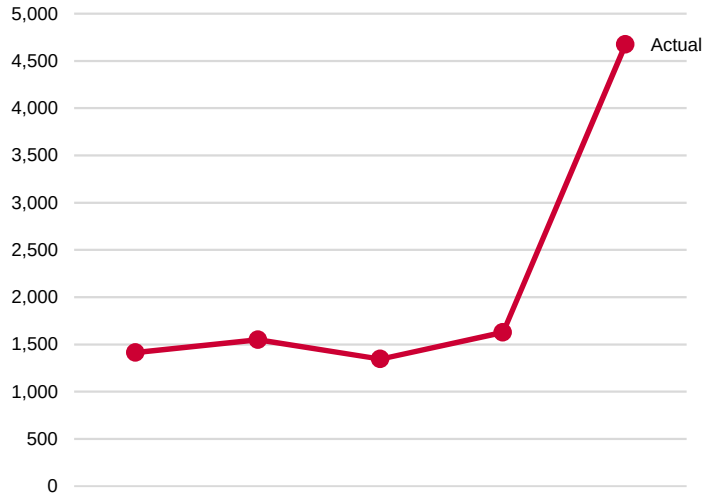
- **Innovation Frontier Southwest:** TPA received a grant from the Economic Development Administration, US Department of Commerce to develop a strategy for advanced manufacturing in the region. TPA has developed Innovation Frontier Southwest (IFS), which is a region extending along the US Mexico border from Yuma, Arizona to Las Cruces, New Mexico and extends up to Casa Grande in Pinal County. IFS is a collaboration of municipalities, economic development organizations, universities and workforce entities. To date, the group has completed mapping of innovation assets and the supply chain as it relates to security and defense in the region, establishing a baseline of data that will show improvement or loss in the region.

- **New Companies Recruited to the UA Tech Park:** The Tech Park was successful in recruiting two new companies this year. The first, Crystal Green Energy Corporation, is creating a compact combined heat and power solar optic module system designed to produce high-efficiency thermal and electrical output for direct consumer energy use. The fully integrated system is engineered to provide optimal safe, non-toxic and biodegradable battery and thermal storage for future use. The second company, Hamilton Innovations, provides innovative research, software development and technical support for the diversified business lines of its parents company, Hamilton Telecommunications – based in Aurora, Nebraska – whose product allows hearing impaired individuals to use the telephone.

- **Startup Company Support:** The Arizona Center for Innovation (AzCI) has helped 15 companies achieve their next level of success. AzCI has fostered DemeteRx Pharmaceuticals, Universal Bio Mining, GlycoSurf, Expert Zero, iNVENSHION, Codelucida, Grafted Growers, Infinurja, Edible Optics, Agent Sage, EpiSci, My Social Sitter, EOI Tech, GoGo Karma, and Sharing Tribes. They have brought their ideas, discoveries and next evolution of product forward through customized programs and access to investment funding. AzCI also partnered with a patent attorney firm, Perkins Coie, and University of Arizona club Innovate UA, to link UA students with business savvy mentors and help fund innovation with the Innovative Minds Challenge program for University of Arizona students. The University of Arizona student teams presented their innovative ideas and market applications, competing for three Perkins Coie-sponsored cash prizes and Mentored Launch services sponsored by the Arizona Center for Innovation.

Economic Development

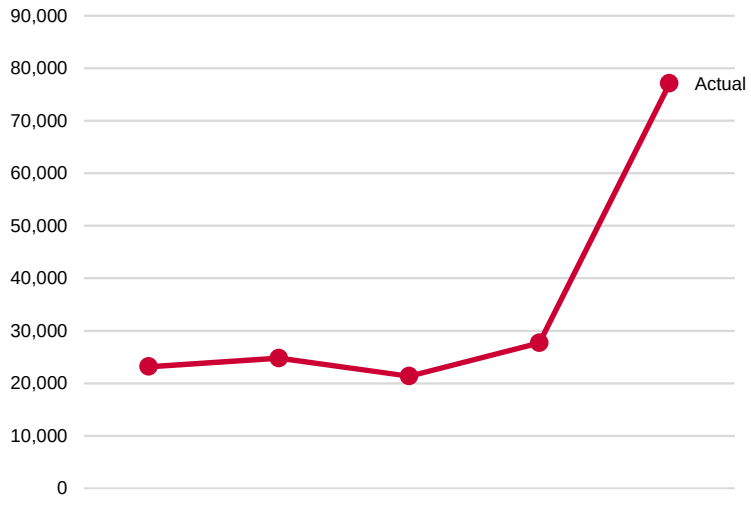
Intellectual Property Income (in Thousands)



ABOR Enterprise Plan	2011	2012	2013	2014	2015
Actual	1,414	1,550	1,345	1,628	4,675

Economic Development

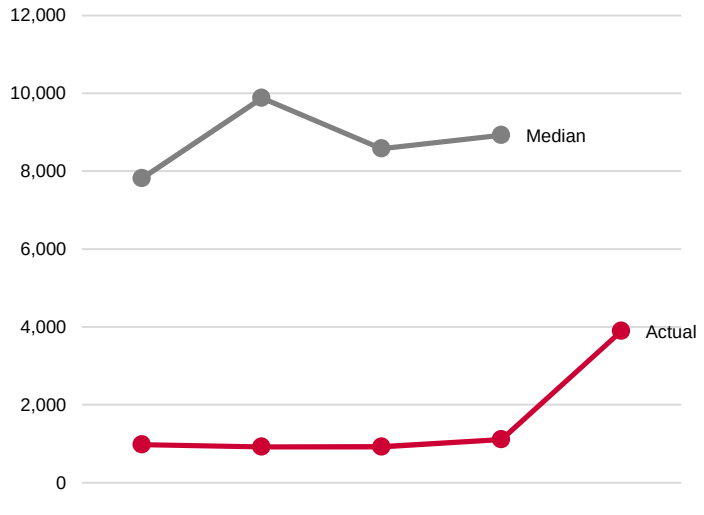
Intellectual Property Income per $10 Million in Total Research Expenditures



ABOR Enterprise Plan	2011	2012	2013	2014	2015
Actual	23,164	24,778	21,364	27,675	77,115

Economic Development

Licenses and Options Income (in Thousands)

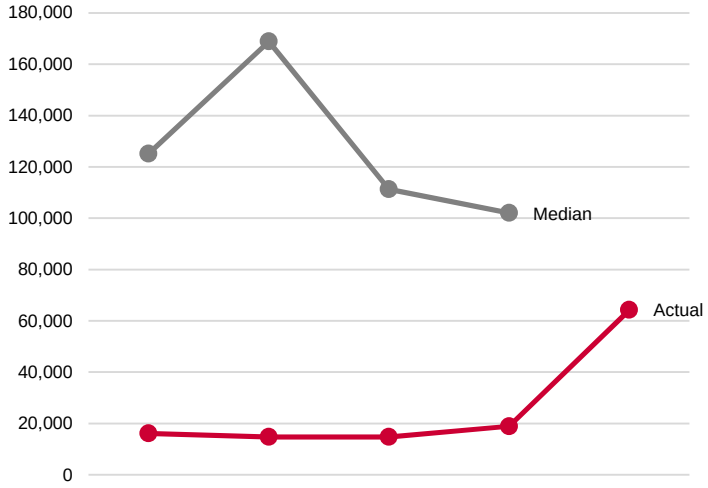


	2011	2012	2013	2014	2015
Actual	981	922	926	1,112	3,896

ABOR Peer Group	Med. Sch.	AUTM Adj.	2,011	2,012	2,013	2,014	2,015	Rank
University of Washington - Seattle	X		67,362	76,956	99,491	104,767		1
University of Wisconsin - Madison	X		57,730	41,100	94,170	43,400		2
University of California - Los Angeles	X		16,153	17,833	23,423	38,786		3
University of Florida	X		29,494	33,922	28,068	32,865		4
University of Minnesota - Twin Cities	X		10,079	45,652	38,030	26,075		5
University of California - Davis	X		10,233	12,525	12,241	11,537		6
Texas A&M U. - College Station and Hlth. Science Ctr.	X		9,264	13,074	12,826	10,206		7
University of North Carolina - Chapel Hill	X		1,483	2,414	3,784	7,649		8
University of Illinois - Urbana - Champaign			6,363	6,410	4,914	5,255		9
Michigan State University	X		3,616	3,704	3,302	3,756		10
The Ohio State University	X		1,420	2,170	2,105	2,199		11
University of Iowa	X		6,285	7,234	1,205	1,626		12
Penn State Univ. - Univ. Park and Hershey Medical Ctr.	X		2,947	3,095	2,267	1,526		13
The University of Arizona	X		981	922	926	1,112	3,896	14
University of Maryland - College Park								
University of Texas - Austin								
Median			7,813	9,880	8,577	8,928		

Economic Development

Licenses and Options Income per $10 Million in Total Research Expenditures

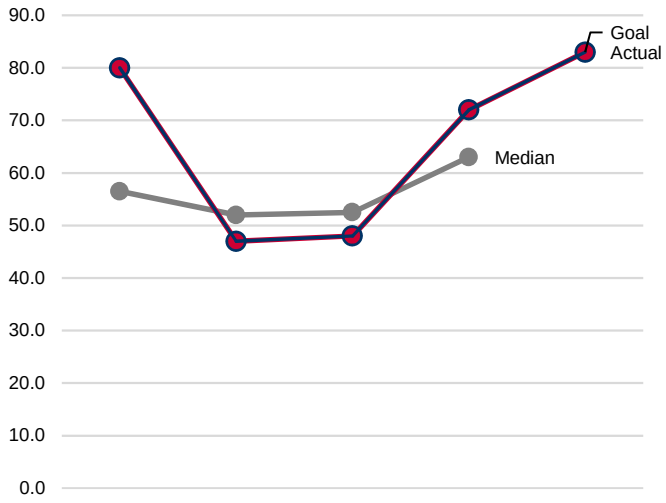


	2011	2012	2013	2014	2015
Actual	16,075	14,743	14,711	18,914	64,265

ABOR Peer Group	Med. Sch.	NSF Adj.	AUTM Adj.	2011	2012	2013	2014	2015	Rank
University of Washington - Seattle	X			586,506	693,916	834,298	890,620		1
University of Florida	X			398,598	486,700	403,819	463,855		2
University of California - Los Angeles	X			164,431	177,730	242,309	409,050		3
University of Wisconsin - Madison	X			519,322	351,348	838,183	391,497		4
University of Minnesota - Twin Cities	X			118,932	552,566	443,050	297,360		5
University of California - Davis	X			144,555	175,594	162,621	162,100		6
Texas A&M U. - College Station and Hlth. Science Ctr.	X			131,271	188,538	156,417	119,473		7
University of Illinois - Urbana - Champaign				116,601	109,813	66,088	84,528		8
University of North Carolina - Chapel Hill	X			17,057	27,286	38,885	77,286		9
Michigan State University	X			79,596	73,041	64,035	71,281		10
University of Iowa	X			141,587	162,043	27,685	36,197		11
The Ohio State University	X			17,065	28,304	26,534	26,973		12
Penn State Univ. - Univ. Park and Hershey Medical Ctr.	X			37,080	38,800	27,057	19,056		13
The University of Arizona	X			16,075	14,743	14,711	18,914	64,265	14
University of Maryland - College Park									
University of Texas - Austin									
Median				125,101	168,819	111,253	102,001		

Discovery and Scholarly Impact

Licenses and Options Executed

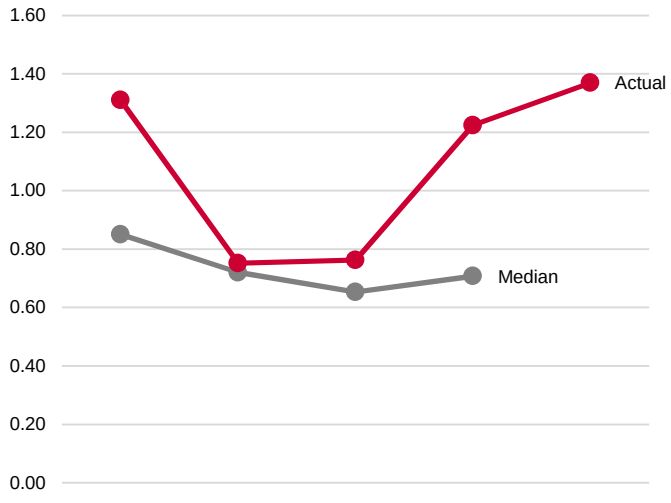


ABOR Enterprise Plan	2011	2012	2013	2014	2015
Actual	80	47	48	72	83
Goal	80	47	48	72	83
Difference	0	0	0	0	0

ABOR Peer Group	Med. Sch.	AUTM Adj.	2011	2012	2013	2014	2015	Rank
University of Washington - Seattle	X		194	209	260	265		1
University of Minnesota - Twin Cities	X		113	75	91	154		2
University of Florida	X		131	129	140	147		3
The University of Arizona	X		80	47	48	72	83	4
Michigan State University	X		40	32	33	70		5
The Ohio State University	X		25	33	50	68		6
University of Wisconsin - Madison	X		62	60	63	68		6
Texas A&M U. - College Station and Hlth. Science Ctr.	X		67	71	55	58		8
University of California - Davis	X		58	57	68	50		9
University of California - Los Angeles	X		46	34	43	45		10
University of North Carolina - Chapel Hill	X		45	61	56	43		11
University of Illinois - Urbana - Champaign			55	46	46	38		12
Penn State Univ. - Univ. Park and Hershey Medical Ctr.	X		23	21	36	36		13
University of Iowa	X		24	21	29	32		14
University of Maryland - College Park								
University of Texas - Austin								
Median			57	52	53	63		

Discovery and Scholarly Impact

Licenses and Options Executed per $10 Million in Total Research Expenditures

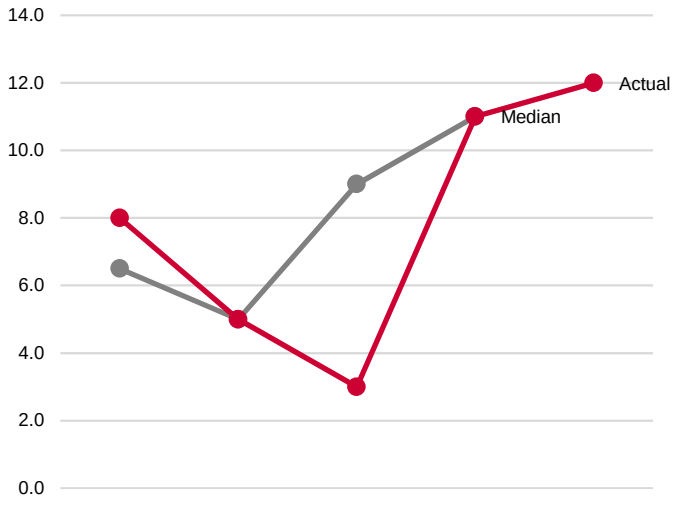


ABOR Enterprise Plan	2011	2012	2013	2014	2015
Actual	1.3	0.8	0.8	1.2	1.4

ABOR Peer Group	Med. Sch.	NSF Adj.	AUTM Adj.	2011	2012	2013	2014	2015	Rank
University of Washington - Seattle	X			1.7	1.9	2.2	2.3		1
University of Florida	X			1.8	1.9	2.0	2.1		2
University of Minnesota - Twin Cities	X			1.3	0.9	1.1	1.8		3
Michigan State University	X			0.9	0.6	0.6	1.3		4
The University of Arizona	X			1.3	0.8	0.8	1.2	1.4	5
The Ohio State University	X			0.3	0.4	0.6	0.8		6
University of Iowa	X			0.5	0.5	0.7	0.7		7
University of California - Davis	X			0.8	0.8	0.9	0.7		8
Texas A&M U. - College Station and Hlth. Science Ctr.	X			0.9	1.0	0.7	0.7		9
University of Wisconsin - Madison	X			0.6	0.5	0.6	0.6		10
University of Illinois - Urbana - Champaign				1.0	0.8	0.6	0.6		11
University of California - Los Angeles	X			0.5	0.3	0.4	0.5		12
Penn State Univ. - Univ. Park and Hershey Medical Ctr.	X			0.3	0.3	0.4	0.4		13
University of North Carolina - Chapel Hill	X			0.5	0.7	0.6	0.4		14
University of Maryland - College Park									
University of Texas - Austin									
Median				0.8	0.7	0.7	0.7		

Economic Development

Startup Companies

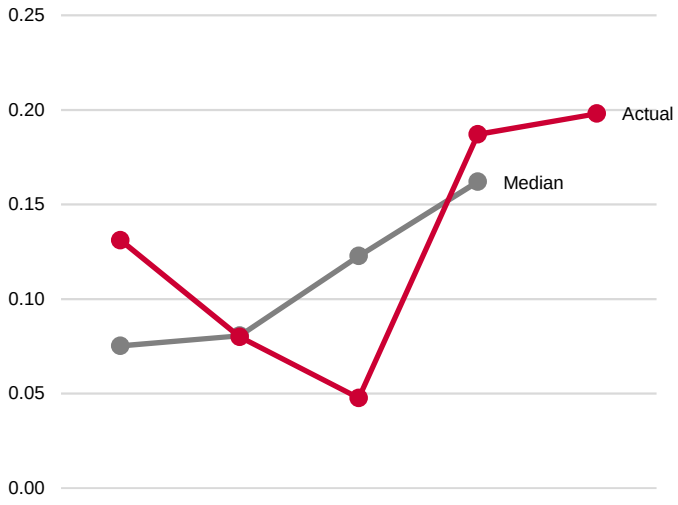


ABOR Enterprise Plan	2011	2012	2013	2014	2015
Actual	8	5	3	11	12

ABOR Peer Group	Med. Sch.	AUTM Adj.	2011	2012	2013	2014	2015	Rank
University of California - Los Angeles	X		19	13	17	19		1
University of Washington - Seattle	X		9	9	17	18		2
University of Florida	X		12	15	16	16		3
University of California - Davis	X		5	2	8	15		4
University of Minnesota - Twin Cities	X		9	12	14	15		4
The Ohio State University	X		6	5	10	14		6
The University of Arizona	X		8	5	3	11	12	7
University of Iowa	X		2	4	6	11		7
University of North Carolina - Chapel Hill	X		7	9	14	10		9
University of Wisconsin - Madison	X		4	4	7	10		9
Penn State Univ. - Univ. Park and Hershey Medical Ctr.	X		5	5	10	9		11
Texas A&M U. - College Station and Hlth. Science Ctr.	X		4	5	3	9		11
University of Illinois - Urbana - Champaign			12	5	6	6		13
Michigan State University	X		1	3	1	0		14
University of Maryland - College Park								
University of Texas - Austin								
Median			7	5	9	11		

Economic Development

Startup Companies per $10 Million in Total Research Expenditures

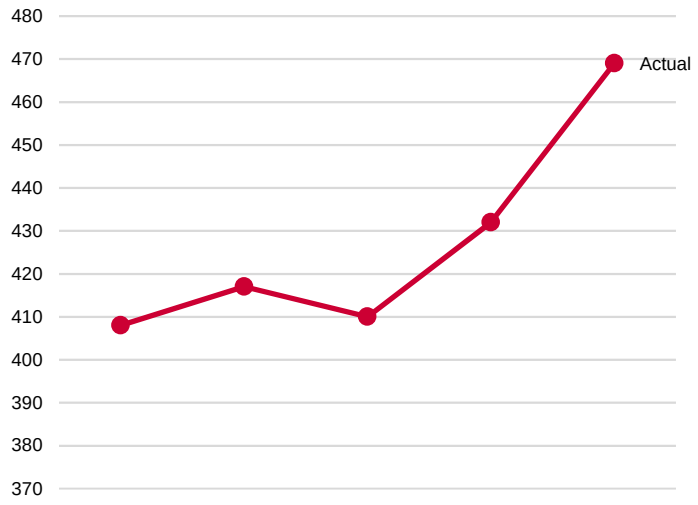


ABOR Enterprise Plan	2011	2012	2013	2014	2015
Actual	0.1	0.1	0.0	0.2	0.2

ABOR Peer Group	Med. Sch.	NSF Adj.	AUTM Adj.	2011	2012	2013	2014	2015	Rank
University of Iowa	X			0.0	0.1	0.1	0.2		1
University of Florida	X			0.2	0.2	0.2	0.2		2
University of California - Davis	X			0.1	0.0	0.1	0.2		3
University of California - Los Angeles	X			0.2	0.1	0.2	0.2		4
The University of Arizona	X			0.1	0.1	0.0	0.2	0.2	5
The Ohio State University	X			0.1	0.1	0.1	0.2		6
University of Minnesota - Twin Cities	X			0.1	0.1	0.2	0.2		7
University of Washington - Seattle	X			0.1	0.1	0.1	0.2		8
Penn State Univ. - Univ. Park and Hershey Medical Ctr.	X			0.1	0.1	0.1	0.1		9
Texas A&M U. - College Station and Hlth. Science Ctr.	X			0.1	0.1	0.0	0.1		10
University of North Carolina - Chapel Hill	X			0.1	0.1	0.1	0.1		11
University of Illinois - Urbana - Champaign				0.2	0.1	0.1	0.1		12
University of Wisconsin - Madison	X			0.0	0.0	0.1	0.1		13
Michigan State University	X			0.0	0.1	0.0	0.0		14
University of Maryland - College Park									
University of Texas - Austin									
Median				0.1	0.1	0.1	0.2		

Economic Development

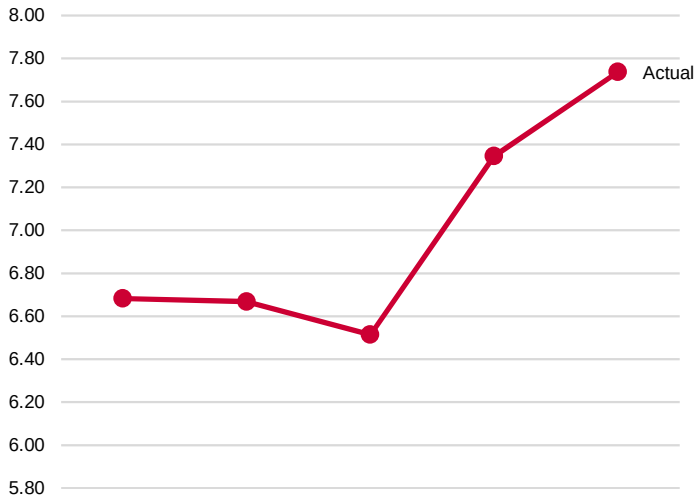
Ph.D. Degrees Conferred



ABOR Enterprise Plan	2011	2012	2013	2014	2015
Actual	408	417	410	432	469

Economic Development

Ph.D. Degrees Conferred per $10 Million in Total Research Expenditures



ABOR Enterprise Plan	2011	2012	2013	2014	2015
Actual	6.7	6.7	6.5	7.3	7.7

This Page Intentionally Left Blank

Leadership and Recognition

Recognition for leadership and innovation in knowledge discovery are among the highest accolades that a university can receive. International and national academic awards honor achievements that change how we view and make sense of the world.

UA researchers once again demonstrated great leadership and innovation, and were recognized in their respective fields.

Additionally, the University of Arizona as a whole has been identified as a national leader in the research arena. In fiscal year 2015, an interdisciplinary research team lead by the UA began a long-term research project called NExSS. NASA awarded a major grant to the team—called Nexus for Exoplanet System Science—allowing it to explore how Earthlike planets form and which nearby stars are most likely to host Earth's twins.

- **Adela Licona**, associate professor and director of the UA English department's graduate program in Rhetoric, Composition, and the Teaching of English, was selected as the National Women's Studies Association national conference co-chair with NWSA president Vivian M. May for the 2015 conference in Milwaukee, Wisconsin, and the 2016 conference in Montréal, Quebec. Licona was recognized for her "innovative contributions to the intellectual, creative, and political traditions crafted by women of color feminists." As co-chair, she helps provide the intellectual leadership for the annual meetings. NWSA has nearly 2,500 members representing the field of women's studies in educational and social transformation.

- Two University of Arizona professors, **Bruce Tabashnik and Julia Clancy-Smith,** received appointments as Regents' Professors, the highest honor bestowed on faculty in the Arizona state university system. The honor is reserved for faculty scholars who have achieved national and international distinction for their work. Tabashnik, professor and head of entomology in the UA's College of Agriculture and Life Sciences, has served as head of the Department of Entomology since 1996 and is a member of the BIO5 Institute. Clancy-Smith, an award-winning history professor, teaches about modern and early modern Africa and the Middle East.

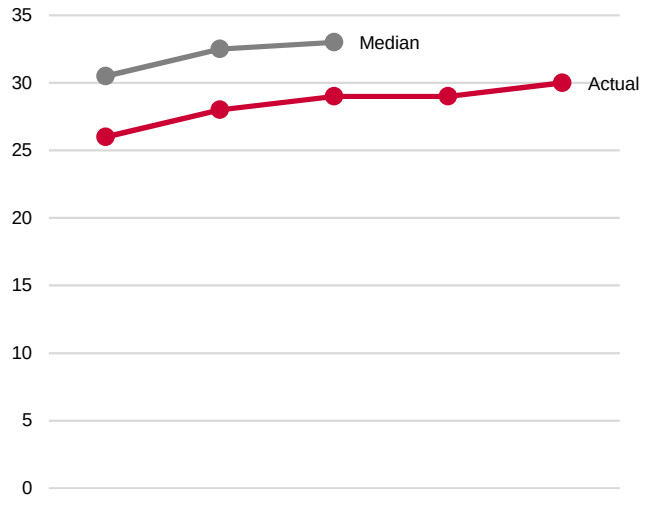
- University of Arizona professor **Alison Hawthorne Deming** received a 2015 Guggenheim Fellowship Award, which she is using to work on a new book of essays about two lost industries. Deming, whose work often explores nature and science, is the author of four books of poetry and four of nonfiction and is the editor of two anthologies. This year, Deming was also named an inaugural chair of the Agnese Nelms Haury Program in Environment and Social Justice at the UA.

- **John Paul Jones III**, dean of the UA's College of Social and Behavioral Sciences, received the 2015 Lifetime Achievement Award from the Association of American Geographers. Awarded annually, this honor recognizes individuals for outstanding contributions to the advancement or welfare of geography. Jones, a professor of geography and development, was selected in recognition of his innovative teaching, service as an editor of multiple journals, and his inspirational leadership.

- **Muriel Fisher**, research scientist in the UA's Department of Linguistics, was awarded the Excellence in Community Linguistics award from the Linguistic Society of America. Fisher was selected in recognition of her significant contributions to language communities. Fisher is a native speaker of Scottish Gaelic from the Isle of Skye in Scotland. She investigates grammatical properties of Gaelic as part of a team at the UA.

Leadership and Recognition

National Academy Members

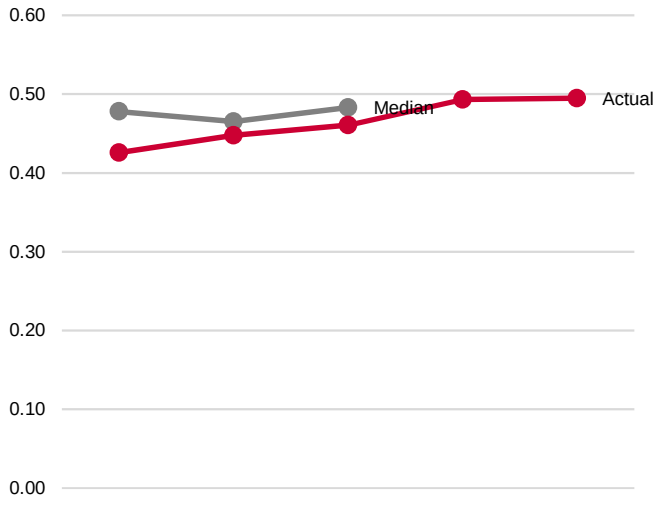


	2011	2012	2013	2014	2015
Actual	26	28	29	29	30

ABOR Peer Group	Med. Sch.	2011	2012	2013	2014	2015	Rank
University of Washington - Seattle	X	104	109	110			1
University of California - Los Angeles	X	95	94	95			2
University of Wisconsin - Madison	X	67	68	70			3
University of Texas - Austin		68	67	69			4
University of Illinois - Urbana - Champaign		57	55	57			5
University of California - Davis	X	39	41	44			6
University of Minnesota - Twin Cities	X	39	38	39			7
University of North Carolina - Chapel Hill	X	31	35	34			8
The Ohio State University	X	28	30	32			9
University of Maryland - College Park		30	30	31			10
The University of Arizona	X	26	28	29	29	30	11
Penn State Univ. - Univ. Park and Hershey Medical Ctr.	X	23	24	26			12
University of Florida	X	23	24	24			13
Texas A&M U. - College Station and Hlth. Science Ctr.	X	22	23	22			14
University of Iowa	X	22	21	22			14
Michigan State University	X	8	9	10			16
Median		31	33	33			

Leadership and Recognition

National Academy Members per $10 Million in Total Research Expenditures



	2011	2012	2013	2014	2015
Actual	0.4	0.4	0.5	0.5	0.5

ABOR Peer Group	Med. Sch.	NSF Adj.	2011	2012	2013	2014	2015	Rank
University of Texas - Austin			1.1	1.1	1.1			1
University of California - Los Angeles	X		1.0	0.9	1.0			2
University of Washington - Seattle	X		0.9	1.0	0.9			3
University of Illinois - Urbana - Champaign			1.0	0.9	0.8			4
University of Maryland - College Park			0.6	0.6	0.6			5
University of Wisconsin - Madison	X		0.6	0.6	0.6			6
University of California - Davis	X		0.6	0.6	0.6			7
University of Iowa	X		0.5	0.5	0.5			8
The University of Arizona	X		0.4	0.4	0.5	0.5	0.5	9
University of Minnesota - Twin Cities	X		0.5	0.5	0.5			10
The Ohio State University	X		0.3	0.4	0.4			11
University of North Carolina - Chapel Hill	X		0.4	0.4	0.3			12
University of Florida	X		0.3	0.3	0.3			13
Penn State Univ. - Univ. Park and Hershey Medical Ctr.	X		0.3	0.3	0.3			14
Texas A&M U. - College Station and Hlth. Science Ctr.	X		0.3	0.3	0.3			15
Michigan State University	X		0.2	0.2	0.2			16
Median			0.5	0.5	0.5			

This Page Intentionally Left Blank

Technology Transfer

When TLA began in 2012, the unit laid out a Roadmap with 55 objectives that would determine its direction and serve to measure success. In pursuit of those goals, TLA has continued to integrate the functions of technology transfer, business development, commercialization networks and Tech Parks Arizona.

Team Growth and Leadership: As TLA has continued to evolve and grow, a few new positions have been brought on to fulfill key roles. New personnel hires brought on in FY 2015 include:

Name	Title	Start Date
John Jackson	Business Intelligence Manager	7/21/2014
John Geikler	Assistant Director, Physical Sciences & Engineering	9/2/2014
Sabrina Duarte	Administrative Associate	4/20/2015
Stephanie Zawada	Student Outreach Coordinator (0.50 FTE)	4/27/2015

During the report period, TLA accomplished the following: executed 83 agreements, including 45 exclusive licenses and options; continued service to the faculty to maintain increases in key metrics (including 213 invention disclosures and 35 patents issued) that fuel the technology transfer process; created 12 new companies based on UA technologies (for a total of 44 startups over the past five fiscal years).

Technology transfer statistics for the last five years are reflected in the table (following page) and in the charts earlier in this report (Discovery and Scholarly Impact; Economic Development).

Transactions
Licenses, options, and other major agreements represent key steps in the technology transfer pipeline of idea creation, technology translation, product realization, and royalty generation. In FY 2015, Tech Transfer Arizona executed 83 licenses and options, 45 of which were exclusive licenses, which involve considerable effort and produce the most impact. Conversely, nonexclusive licenses are typically executed for freedom to operate issues.

Revenues & Distributions
Total revenues from licensing activity and related legal reimbursements in FY 2015 were $4.7 million; $2.4 M came from royalties and patent reimbursements, representing a 45% increase over FY 2014. TLA also received a one-time settlement payment of $2.3 M.

We maintain our diligent management of the patent portfolio; a continued strong deal flow has resulted in an increase of patent expenditures in advance of licensing opportunity. In FY 2015, the Tech Launch Arizona’s legal expenditures to legal reimbursements ratio was 40%, reflecting a disciplined approach to patent asset management; the median ratio for UA's peer institutions is 33%.

Technology Transfer

Statistical Exhibits

THE UNIVERSITY OF ARIZONA.

Technology Transfer Activities	2011	2012	2013	2014	2015
Invention Disclosures Transacted	149	142	144	188	213
Invention Disclosures Transacted Percentage Change		-5%	1%	31%	13%
New U.S. Patent Applications	104	98	76	81	91
New U.S. Patent Applications Percentage Change		-6%	-22%	7%	12%
U.S. Patents Issued	19	21	27	24	35
U.S. Patents Issued Percentage Change		11%	29%	-11%	46%
Licenses and Options Executed	80	47	48	72	83
Licenses and Options Executed Percentage Change		-41%	2%	50%	15%
Licensing and Other Revenue					
Licensing Revenue (Including Options)	981,495	921,965	926,023	1,112,331	3,895,882
Licensee Legal Reimbursements	432,790	627,572	418,743	515,211	778,984
Other Revenue	0	0	0	0	0
Total	1,414,285	1,549,537	1,344,766	1,627,542	4,674,866
Other Major Agreements	8	13	6	8	6
Other Major Agreements Percentage Change		63%	-54%	33%	-25%
New Startup Companies Created	8	5	3	11	12
New Startup Companies Created Percentage Change		-38%	-40%	267%	9%
Active Startup Companies that Received Funding					11
Active Startup Companies that Received Funding Percentage Change					
Active Startup Funding					
Private Equity Funding Received by Active Startup Companies					1,800,000
Grant Funding Received by Active Startup Companies					6,100,000
Total					7,900,000
Sponsored Research Facilitated	5,918,193	5,100,000	1,677,000	1,670,293	2,243,257
Sponsored Research Facilitated Percentage Change		-14%	-67%	0%	34%
Royalty Distribution					
Inventors	-346,698	-322,687	-271,071	-364,627	-1,380,435
Laboratories and Units	-231,132	-276,590	-233,554	-314,162	-1,296,680
University	-192,609	-184,779	-155,016	-208,156	-990,526
Undistributed	211,056	137,909	266,382	225,026	228,241

In FY 2015, 35 patents were issued to the UA, and the UA filed 200 new patent applications representing a 21% increase from the previous fiscal year. Examples of the 35 patents that were granted or filed in FY 2015 include:

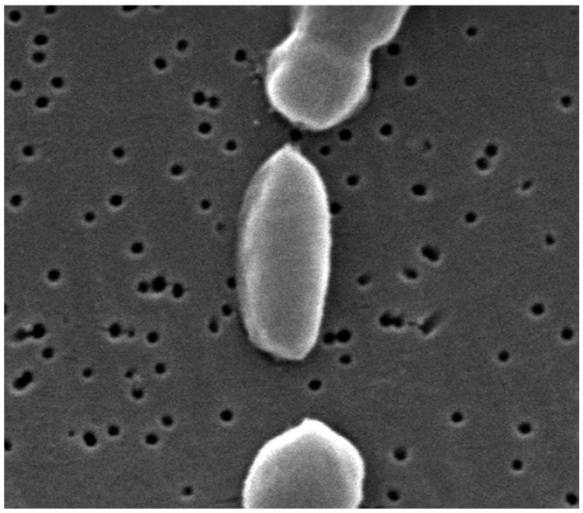
- **U.S. Patent issued No. 8,744,734 and 8,855,903 "Active Traffic and Demand Management System"** Vehicular traffic congestion is a condition on traffic networks such as highways that occurs as use increases, and is characterized by slower speeds, longer trip times, increased vehicular queuing, and decreased fuel efficiency. The most common example of traffic congestion is the physical over- capacity use of roadways by vehicles. When traffic demand is great enough, the interaction between vehicles slows the speed of the traffic stream, congestion results. As demand exceeds the capacity of a roadway, extreme traffic congestion occurs. The condition resulting when vehicles are fully stopped for periods of time is colloquially known as a traffic jam. Attempts at solving traffic congestion have included adding more highways, widening highways, adding various traffic controls, providing flexible work hours for employees, incentivizing carpooling, providing real-time traffic monitoring, and tolling highways. However, each of these proposed solutions have one or more defects in terms of their effective- ness, feasibility, cost, and the like. This invention integrates systems and methods for providing incentives for the public to travel during time windows and routes that help alleviate traffic congestion. The server computes a route for the trip and provides the user with available incentives for traveling the route at one or more departure time windows.

- **U.S. Patent issued No. 8,669,997, "Process to Fabricate Micro-Polarizers and Waveplates on Sensor Array"** A fabrication process to create patterned polarizers for various visible wavelengths using dichroic dye in a liquid crystal polymer (LCP) host directly on an array of optical sensors. This invention demonstrates the use of multiple layers of an LPP/LCP system to create more complex polarization elements such as color circular polarizers. Waveplates of arbitrary retardance and linear and circular polarizers can be fabricated using multiple layers of LCP. The process is simple and inexpensive compared to other micropolarizer systems.

- **U.S. Patent issued No. 8,879,352, "Ultrasonic/Photoacoustic Imaging Devices and Methods"** An optical system consisting of a right angle prism, or thin parallel plate, in conjunction with water, an index matching fluid, or some other liquid, completely reflects acoustic waves to and from an array ultrasound transducer while being optically transparent. The geometry allows simultaneous direct illumination, with high-energy laser pulses, of the region imaged by the ultrasound transducer array. This extends the existing capabilities of an ultrasound transducer with the ability to acquire photoacoustic data. This device addresses the challenge of illuminating thick samples with relatively large transducer arrays impeding the direct illumination of the imaging area. This is the first known method of directly illuminating thick media for imaging with array transducers without redirecting the light around the transducer or custom designing the transducer.

In addition to startup companies, a large portion of TLA's portfolio is licensed or optioned to a wide variety of companies, from large corporations to smaller organizations. Example innovations transferred under licenses or options include:

- **PCR Detection of Acute Hepatopancreatic Necrosis Disease**, licensed to **GeneReach Corporation**: This solution detects the bacteria that causes early mortality syndrome in shrimp stocks, allowing infected populations to be separated from healthy ones. The solution is a rapid diagnostic test capable of detecting the genetic differences between the pathogenic and non-pathogenic versions of the common marine bacterium, called Vibrio parahaemolyticus, which causes the disease. This method will enable specific detection of affected shrimp, currently only identified through the use of histology, which is time consuming and expensive.



- **Diffractive Trifocal Intraocular or Contact Lens**, licensed to **Alcon Research**: Conventional diffractive lenses have a series of concentric rings with discrete steps in their profile. In general, the spacing between those steps gets progressively closer together from the center of the lens towards the edge. Bifocal diffractive lenses use this type of design to provide two different focal lengths, but current intraocular and contact lenses don't offer the ability to provide an intermediate distance vision region for the user. This technology offers a configuration for contact and intraocular lenses that can provide an intermediate foci region. The design maintains the same diffractive levels for distance, intermediate, and near vision.
- **Effect of Omni-Gen on Stress Reduction in Lactating Dairy Cows**, licensed to **Phibro Animal Health Corporation:** Environmental stress has been shown to have a detrimental effect on the health, production and reproduction of a variety of livestock species. Dairy cattle and other production animals are especially vulnerable to heat stress, as feed intake, milk production, and reproduction are all decreased during heat stress, while disease prevalence increases. The technology provides for a novel method of supplemental nutrition to improve health and production for livestock animals under environmental stress, especially in lactating dairy cattle. The technology can be used as part of a sound management and nutrition strategy in dairy cattle subject to environmental stress, and may be an appropriate, cost-effective preventative measure for use in combination with animal vaccination and/or health treatment programs for livestock that are at risk for or have suffered from disease.

Neuro-ID, Inc., real-time detection of suspicious responses in online forms and questionnaires, Joe Valacich, Ph.D., professor in the UA Eller College of Management's Department of Management Information Systems, and former UA graduate student and current assistant professor at Brigham Young University Jeff Jenkins. The company is commercializing software that can identify suspicious behaviors based on a computer or smartphone user's typing, touch, scrolling or mouse movements. The technology could be invaluable to government and a wide range of industries including insurance, pharmacy, healthcare and e-commerce.

Iron Shell, LLC, a company commercializing Ferrock™, a material that uses waste steel dust from industrial processes to create a cement-like material that is environmentally superior, sustainable and stronger than conventional cement, David Stone, Ph.D., while a Ph.D. student in the Department of Soil, Water, and Environmental Science.
While conventional Portland cement emits one ton of CO2 for every ton created Ferrock, along with being superior to cement due to its mechanical qualities, absorbs CO2 as it hardens. The greenhouse gas diffuses into the web mixture and reacts with iron, creating iron carbonate and becoming part of the material's mineral matrix. Stone is working with the Tohono O'odam Reservation to use Ferrock as a building material for community structures, and is also co-teaching a course with CAPLA Assistant Professor Chris Trumble in which students are designing and building structures with the material on the reservation.

Synactix Pharmaceuticals, Inc., targeted cancer treatment technology, Hong-yu Li, Ph.D., president and professor, UA College of Pharmacy, and Brendan Frett, Ph.D., vice president and previous postdoctoral researcher in Li's lab. Arising out of studies focusing on highly targeted treatments, Synactix has zeroed in on a dual kinase inhibitor that blocks two factors involved in cancer survival: oncogene addiction and vascular growth. In essence, the drug simultaneously starves and obstructs tumor growth by preventing blood vessel formation and oncogene signaling.

Tech Parks Arizona

Tech Parks Arizona generates, attracts and retains technology companies and talent in alignment with the research, mission and goals of the University of Arizona. Tech Parks Arizona is the unit that directs the UA Tech Park, the UA Tech Park – The Bridges, and the Arizona Center for Innovation, placing the highest priority on recruiting companies desiring connectivity to the UA. The UA Tech Park on Rita Road is home to 45 companies employing nearly 6,500 individuals. The facility executed $3.25 million in improvements and expansions. Tech Parks Arizona also transformed its business model for the Arizona Center for Innovation, placing greater emphasis on product development, testing and evaluation activities. Tech Parks Arizona also successfully rebranded the Bio Park as the UA Tech Park – The Bridges, and financed and executed the land option to expand the park by 11 acres.

In line with the *Never Settle* plan, Tech Parks Arizona is aggressively implementing its new strategy which focuses on active recruitment of firms eager to collaborate with the University of Arizona. Global Advantage, the Tech Parks' business attraction program, was launched last year to provide customized solutions for companies that seek a unique combination of services and connections with the University of Arizona. The program attracts technology companies from across the U.S. and around the world to the Arizona-Sonora region, offering them a significant array of services and programs to give each a business advantage with market access, product development, manufacturing assistance and business development.

Proof-of-Concept

In FY 2015, total award expenditures for POC projects funded was $554,950. These funds were spread among projects coming from the College of Optical Sciences (12%), the College of Science (16%), AHSC (15%), the College of Engineering (37%), the College of Agriculture and Life Sciences (18%), and Facilities Management (2%).

TLA I-Squared Awards

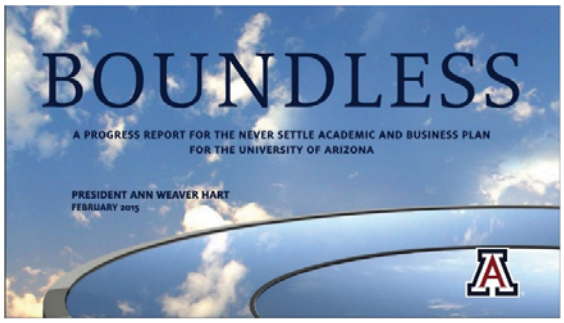
TLA planned and hosted its second awards event, the I-Squared Awards (formerly known as the TLA Catapult Awards), to recognize excellence in and commitment to University technology commercialization. Honors were given as follows:

- Award for Chemistry: Victor Hruby, Ph.D., Regents' Professor Emeritus of Chemistry and Biochemistry, UA College of Science
- Award for Biomedical: Eugene Gerner, Ph.D., professor emeritus of cellular and molecular medicine, UA College of Medicine
- Award for Information Technology: Yi-Chang Chiu, Ph.D., associate professor of civil engineering, UA College of Engineering
- Award for Engineering: Linda Powers, Ph.D., professor and Thomas Brown Chair, Department of Electrical and Computer Engineering, UA College of Engineering
- Award for Agriculture & Life Sciences: Joel Cuello, Ph.D., Department of Agricultural and Biosystems Engineering, UA College of Agriculture and Life Sciences
- Award for Campus Collaboration: University Libraries Business Intelligence Team, consisting of Jason Dewland, Cindy Elliott, Sandra Karmer and Jennifer Martin

This Page Intentionally Left Blank

Strategic Initiatives

In 2013, the University of Arizona introduced its Never Settle Strategic Plan, spearheaded by UA President Dr. Ann Weaver Hart, with extensive input from faculty, staff, students, business, and community leaders.



The plan details four strategic pillars—engaging, innovating, partnering, and synergy—that the UA exemplifies in order to reach our goals. Specifically, the UA targets research and development spending at $756.6 million by 2025, which will aid in our goal to remain a top research institution in the United States.

In order to achieve this, we have identified the following opportunities for research development and growth.

1. Increase research expenditures in established areas of focus. One of the cornerstones of the Never Settle strategic plan was the identification of the strengths of the UA research portfolio that align with real opportunities for sponsored expenditure growth, in order to advance our role as a "super land grant" university. These six organizing themes are as follows:

- Optics: The UA has demonstrated strength in the areas of optical engineering, optical physics, photonics, and image sciences, all of which have produced discoveries and inventions earning our Southern Arizona region the nickname of "Optics Valley."

- Informatics: Informatics is absolutely fundamental to today's research environment. The ability to store, transfer, and analyze mass amounts of data is a requisite for scientific discovery, and informatics spans across many disciplines at the UA.
- Energy, Water, and the Environment: Located in the Sonoran Desert, a living laboratory, the UA is uniquely positioned to offer advanced solutions to some of the grand environmental challenges facing society today.
- Translational Biomedicine: By investing in research in translational biomedicine, the UA is focused on addressing unmet needs in health care, and identifying how the advancement of science and technology can meet those needs.
- Imaging: The UA is engaged in interdisciplinary imaging research for applications as diverse as medical imaging, homeland security, and earth sciences.
- Space Systems: The UA is home to world-renowned observatories, state-of-the-art telescopes, and the operation of large-scale exploration missions.

2. Strengthen the research infrastructure by creating and bolstering units that give researchers the ability to spend more time on their research. Our main goal is to offer support to researchers, from advising about future funding opportunities, to helping researchers secure opportunities, to promoting their successes. The Office for Research & Discovery has become a more dynamic, diverse office with a "customer service" focus on researchers. We strive to continue in this direction in the years to come.

3. Continue to collaborate with internal and external partners, including federal agencies and private industry. Creating strategic partnerships to advance the research enterprise is one of the four pillars of the Never Settle plan. We intend to continue seeking out strategic partners in federal agencies and private industry.