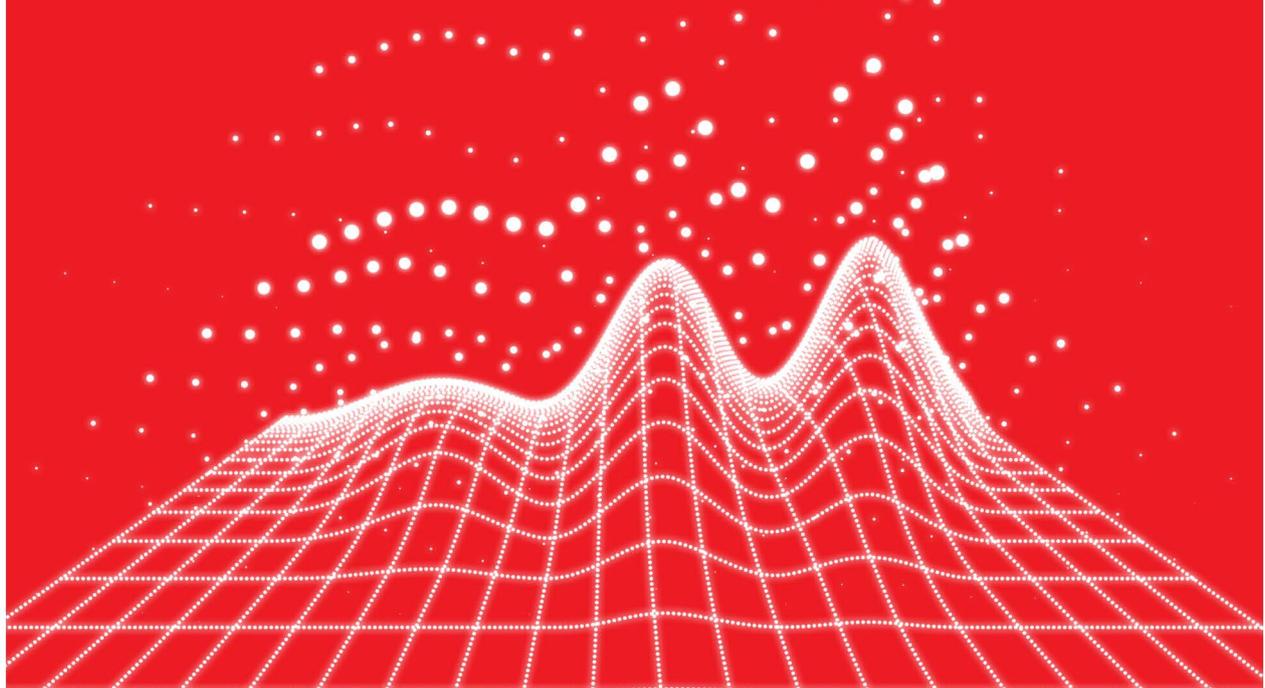


OFFICE OF THE VICE PRESIDENT FOR RESEARCH | 2016 ANNUAL REPORT





DEAR COLLEAGUES & FRIENDS

Texas Tech achieved a major milestone this year when it was listed among the nation's top doctoral universities in the 2016 Carnegie Classification of Institutions of Higher Education. Texas Tech is one of 115 universities – and one of 81 public institutions in the nation – listed in the Highest Research Activity category. Universities in this classification are often referred to as a Tier 1 Research Universities. The classification, announced every five years, is one of the foremost measures of a university's research.

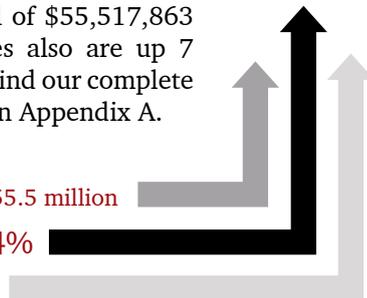
Research is flourishing at Texas Tech. Faculty, staff and students are engaging in varied activities that benefit our society from the discovery of gravitational waves that were predicted a century ago by Einstein, to creative scholarship in the arts and humanities that enriches our cultural experience.

Texas Tech's research metrics show increases again in FY16. Total research expenditures have increased this year to \$166,494,038, up 20.4 percent since FY12. Restricted research expenditures are at a record level of \$55,517,863 up 25.6 and federal research expenditures also are up 7 percent over the same time period. You can find our complete research metrics from 2012 through 2016 in Appendix A.

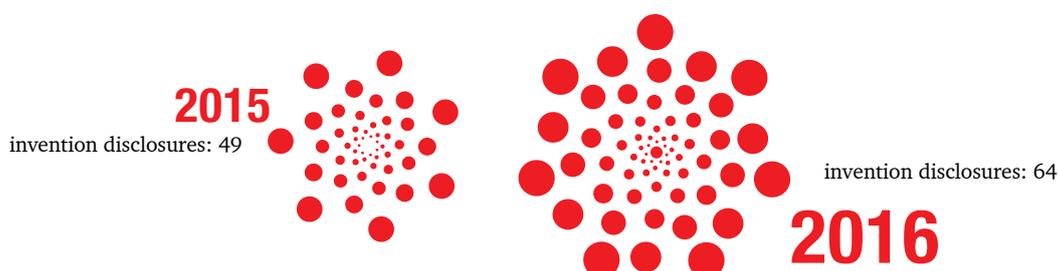
Restricted Research Expenditures record high \$55.5 million

Total Research Expenditures up 20.4%

Federal Research Expenditures up 7%



Another measure of a university's research success is found in its commercialization efforts. The university is showing progress in the number of inventions disclosed and license agreements signed. The number of invention disclosures for Texas Tech jumped from 49 in 2015 to 64 in 2016.



We have also greatly expanded the activities at the Innovation Hub at Research Park under the leadership of Kimberly Gramm. As we had hoped, private – mostly early stage – companies are using much of the leasable space with only a small amount remaining. Ms. Gramm is, with the support of Lubbock Economic Development Alliance, implementing a diverse set of programmatic offerings to help students, staff, faculty and community members interested in entrepreneurship.

The OVPR staff are commended for their contribution to the research endeavors across campus. We are always looking for opportunities to improve how we serve the Texas Tech community. Once our second, state-of-the-art Experimental Sciences Building is completed, it will add valuable and cutting edge laboratories that greatly enhance our research capabilities. A major undertaking to which we are contributing is the development of our strategic plan out to our centenary. This is a great opportunity to assess where we want to be as an institution as we celebrate the centenary of the first class of this great Public Research University.

The OVPR 2016 Annual Report provides a comprehensive look at 2015-2016 academic year research metrics, looks at changes and accomplishments in the OVPR and highlights some of the excellent research, scholarship and creative activity across the campus.

Guy Loneragan
Interim Vice President for Research

On the Cover: The pollen grains that may make you sneeze may also be the basis for a groundbreaking drug and vaccine delivery system. The cover image of this year's OVPR Annual Report represents some of the pollen grains that Harvinder Gill is using in his research to develop alternative drug and vaccine delivery systems. Gill, an associate professor of chemical engineering, is using pollen grains as a drug and vaccine delivery system that could revolutionize vaccination worldwide by ushering in an era of oral vaccines and by creating novel ways to treat cancers. A vaccine given orally, rather than through the currently used intramuscular injection can be painless, child-friendly and self-administrable. Risk of pollen allergies is mitigated in this delivery system, because not only is the pollen shell made of a natural polymer that is non-allergenic, but also the plant proteins that cause allergies are removed during the pollen-cleaning process.

OVPR

Year in Review

Guy H. Loneragan began serving as interim vice president for research in April.



David Snow was named senior managing director of the Office of Research Commercialization after serving as interim director.



Kimberly Gramm was named managing director of the Innovation Hub at Research Park.



Eric Walden, director of data science programs and the James C. Wetherbe Professor in the Rawls College of Business, was named director of the Texas Tech Neuroimaging Institute.



Yehia Mechref, professor of chemistry, was named director of the Center for Biotechnology and Genomics.



Jennifer Horn has moved from director of translational research to director of export and security compliance.

The OVPR continues to fund the [Open Access Publication](#) to increase Texas Tech publications and research found in open access journals as well as promote future collaborations and research advances. The funding available should be used to help authors and colleges/departments defray the cost of open access publication fees.

In cooperation with the Office of the Provost, the number of [Targeted External Awards](#) for which the university will provide incentives to faculty have increased from 29 to more than 200.

The OVPR continues to work to find ways to reduce the burdens faced by our faculty members in balancing their teaching, research and service responsibilities. For example, the IRB through its co-chairs of Drs. Kelly Cukrowicz and Scott Burris, members and IRB staff, have meaningfully enhanced service and reduced review times. These enhancements matter and make life easier for researchers.

RESEARCH HIGHLIGHTS

Texas Tech's excellence in research, scholarship and creative activity cannot be measured only in dollar amounts. Our faculty and staff are making impacts in numerous ways, here on earth and in space. From helping to prove

the theory of relativity to chatting with the president and an academy award winning actor, Texas Tech's faculty, staff and students demonstrate why Texas Tech is a true national research university.



HOW WEATHER WORKS

Brian Ancell, an assistant professor in the [Department of Geosciences](#), [Atmospheric Science Group](#), researches weather, particularly how chaos and inadvertent modifications affect weather patterns. As part of his Early CAREER grant from the National Science Foundation, Ancell has developed an exhibition at the [Museum of Texas Tech University](#) that explains in a hands-on fashion how human activity can affect weather patterns.

All weather, including tornadoes, blizzards and hurricanes, can be traced back to two things: the sun and Earth's spin. As the sun heats a spinning Earth, the winds begin to blow, leading to all weather events. The exhibition covers the basic atmospheric principles that create weather as well as how chaos affects weather. Chaos is the reason why small changes to the atmosphere, such as those resulting from irrigation or wind farms, can grow to be large, thus creating larger scale weather features well away from the point of origin.

Why the Color of Fat Matters

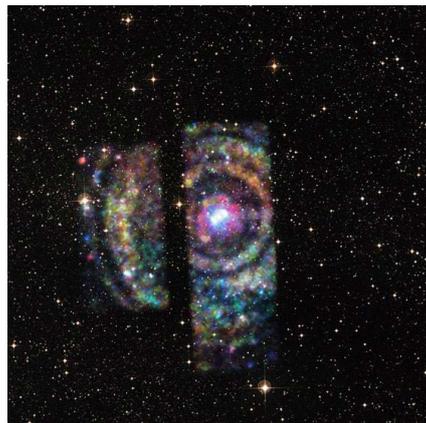


Fat comes in two colors: brown and white. Brown fat burns calories and produces heat, making it more like muscle than white fat. For example, bears bank brown fat to allow them to hibernate, whereas humans have only some brown fat (especially newborns), but accumulate more white fat as they age. White fat can lead to obesity, heart disease and other ailments. While there is a lot known about white fat, the same is not true of brown fat.

Naima Moustaid-Moussa, director of the [Obesity Research Cluster](#) and a professor in the [Department of Nutritional Sciences](#), is working to uncover more about brown fat, how the human body produces it, and what steps people can take to increase the amount of brown fat in their bodies, thus lowering their risk of heart disease, diabetes and obesity. The eventual goal, Moustaid-Moussa said, is to find dietary means as alternatives to pharmacological or medical interventions that will help people improve their health and treat or prevent obesity and related diseases.

Astrophysics Research

Physics researchers are among a team who will receive part of a \$2 million award for their part in a project that resulted in the first direct [detection of gravitational waves](#). Professor Benjamin Owen, Assistant Professor Alessandra Corsi and postdoctoral researchers Santiago Caride, Robert Coyne and Ra Inta were part of an international team that for the first time confirmed Einstein's 1915 theory of relativity. The group was made up of more than 1,000 scientists from around the world.



Also in the [Department of Physics](#), an image from Paul Sell's research was included in [TIME Magazine's list](#) of the Best Space Photos of 2015. Sell is a postdoctoral research fellow in astrophysics and an astronomy instructor. He was involved with multiple studies of Circinus X-1, a binary star system, which has a neutron star feeding on gas from its orbiting companion star. The neutron star was formed from the leftover core of a star that exploded in a supernova.

Texas Tech Adds Companion Animal Program

Alexandra Protopopova and Nathan Hall, both assistant professors, have developed a new companion animal program in the Department of Animal and Food Sciences. Protopopova's research focuses on companion animal well-being, behavior, and human-animal interactions. One aspect of her work looks at what traits are most desirable to potential adopters when they are looking for a new pet at an animal shelter, and then working with shelter staff to train the dogs to exhibit these traits. Shelters allow potential adopters to interact with a dog they are interested in in a private area. She has developed a program that allows shelter volunteers or staff members to help the dog in that private meeting to display the most sought after behaviors, such as lying down near the adopter or making sure the toy the dog likes best is available in the room.



Hall's research focuses on a dog's sense of smell. Dogs already are trained to find a human scent, drugs or even explosives, but are there better, easier ways to train the dogs? Hall said there is really very little scientific literature on just how well a dog's nose works. One part of his research focuses on discovering the best ways to train working dogs. One question he's looking at involves the correlation between a dog's positive experience with an odor before formal training and if that enables the dog to detect that odor more quickly.

Climate Scientist at the White House



[Katharine Hayhoe](#), a professor of political science and director of the Texas Tech Climate Science Center, served on a panel Oct. 3 with President Obama and Academy Award-winning actor Leonardo DiCaprio as part of the White House's [South by South Lawn](#): A White House Festival of Ideas, Art and Action.

The conversation focused on the importance of protecting the planet for future generations. Hayhoe is one of the world's leading climate scientists.

New Radar Technology Could Reduce Energy Costs



National Wind Institute researchers developed a new radar system capable of measuring wind flow within wind energy plants.

The new system, funded by the U.S. Department of Energy, will enable researchers to understand how wind turbines interact with one another. In large wind farms, turbines create wakes, which impact power performance. The data from the new radar system will allow wind plant operators to improve power generation, thereby reducing the cost of energy

Undergraduate Research Project Chosen for Capital Hill Poster Competition



A research project by [Cody Tucker](#), a senior cell and molecular biology major, was chosen for the 20th annual Posters on the Hill research conference in April in Washington, D.C.

Tucker is investigating two factors that could indicate a person's predisposition to dementia, such as Alzheimer's disease.

Posters on the Hill is an annual conference hosted by the [Council on Undergraduate Research](#). It helps raise awareness of the high-quality research undergraduate students

undertake, the impact of this research on students' professional preparation and the importance of continued investment in the expansion of undergraduate research support. Out of hundreds of applications from throughout the nation, only 60 projects were accepted for presentation at the 2016 event.

Tucker has been working for nearly two years in the lab of [Breanna N. Harris](#), a research assistant professor in the [Department of Biological Sciences](#).

Commercialization Highlights



The Office of Research Commercialization (ORC) helps move research discoveries from the university laboratory to the marketplace by working with researchers and business partners to help translate Texas Tech University System innovations into commercial applications and successfully bring them to market.

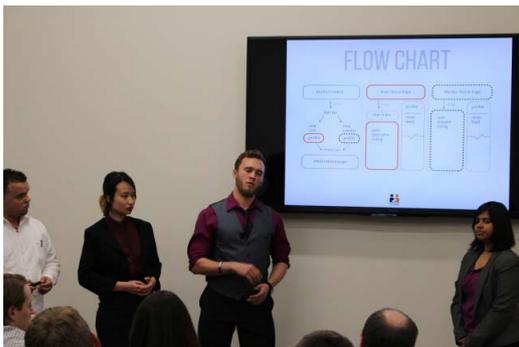
The office helps researchers through the patent process and also licenses inventions to startup companies formed by an inventor or to an established outside company.

Among the successes of the Office of Research Commercialization is the execution of a license agreement on technology developed by Ranadip Pal, associate professor in the Department of Electrical and Computer Engineering.

Supported in part by a National Institutes of Health grant, Pal has created a computational model that predicts drug synergies based on patient biomarker data. The model also specifies which combination of drugs may prevent drug resistance for the particular type of cancer being treated. The technology was validated for commercial use through one of the first I-Corp grants issued to a Texas Tech faculty member.

The license agreement is with First Ascent Biomedical, a Portland, Oregon-based life science company that provides personalized cancer therapy plans for patients who have failed initial chemo treatment or have suffered disease recurrence. The company is currently raising money to support further development and testing of the technology and plans to begin offering services to cancer patients by June 2019. A United States utility patent was filed by the ORC in 2015 and is currently pending.

INNOVATION HIGHLIGHTS



A number of new entrepreneurial and mentor programs have been established at the Innovation Hub at Research Park this year.

The Red Raider Startup program, formerly 3-Day Startup, continues to train students, faculty and community entrepreneurs in an intensive three-day program in the basics of how to start a new company.

The Hub staff launched the Red Raider Idea Competition, in cooperation with the Texas Tech Alumni Association. The program is an American Idol-style competition for entrepreneurs from the community as well as students and faculty. Participants record a 60-second pitch of their idea which is then put onto a website and voted on by the public.

Planning for a new Hub Camp program is underway. Participants with a business or product idea will attend a boot camp designed to help entrepreneurs understand the NSF I-Corps business canvas model, revenue and how to create a business plan. Once they have a business plan the Hub offers numerous funding opportunities.

The Hub also is serving as host for the Chamber of Commerce [Young Entrepreneur Academy](#), a 30-week after school program for middle and high school students interested in entrepreneurship.

What We Do

The Office of the Vice President for Research facilitates excellent research, scholarship, and creative activities for all and promotes an academic environment embracing curiosity, innovation, debate, diversity, ethics and integrity.



Research Development

We facilitate the development of multidisciplinary collaborations across campus, the state, the nation and internationally. We also help with the development and management of proposal submissions of significant strategic importance and prestige, and we provide grant editing services for any and all proposal submissions. We also analyze the reviewer comments of declined proposals and meet with faculty to strategize for a successful resubmission. We also assist new faculty in getting started on the road to research by providing a roadmap to OVRP resources, including external funding opportunities.

Faculty Development

We administer numerous programs to provide faculty support in winning competitive research grants. We administer internal funding opportunities for early-stage proposal development and to provide funding for faculty in the creative arts, humanities and social sciences to increase their national competitiveness. We also promote deserving faculty for targeted fellowships and other awards that garner national prestige for the faculty member and the university.



Research Services

We provide administrative and management services for sponsored projects. Sponsored projects include grants, contracts and cooperative agreements—from both the public and private sectors—which support research, instructional and service projects. We provide budgeting assistance to researchers submitting proposals and are the final submission mechanism for the university.



Responsible Research

We work collaboratively with the academic community to promote safe, responsible and productive research practices and promote dialogue about ethical concerns that arise naturally from creative endeavors. The area of responsible research incorporates all divisions and committees that support safety, responsible research and compliance at Texas Tech including Environmental Health and Safety, Human Research Protection Program and Animal Care Services.



Technology Transfer

We work with researchers and business partners to translate research discoveries into commercial applications and successfully bring them to the marketplace. We identify, protect, market and license Texas Tech intellectual property, as well as promote entrepreneurship, start-up ventures and economic development for the West Texas community.



Innovation

We establish programs that create an entrepreneurial mindset, connect innovators across all disciplines and support the expansion of a knowledge-based economy based upon Texas Tech's research capabilities. We operate a number of programs to assist faculty, staff and students who want to take their ideas and inventions and create viable businesses.

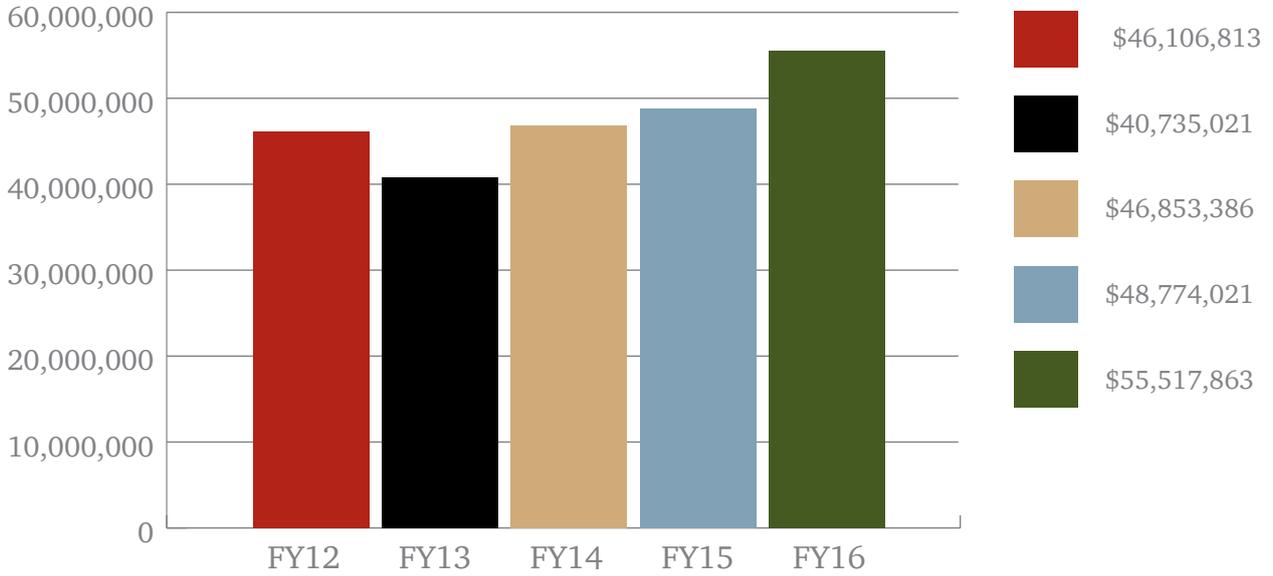


Research Communications

We promote Texas Tech research, scholarship and creative activity to a variety of internal and external audiences including alumni, community leaders and other institutions of higher education using a variety of print, electronic and social media.

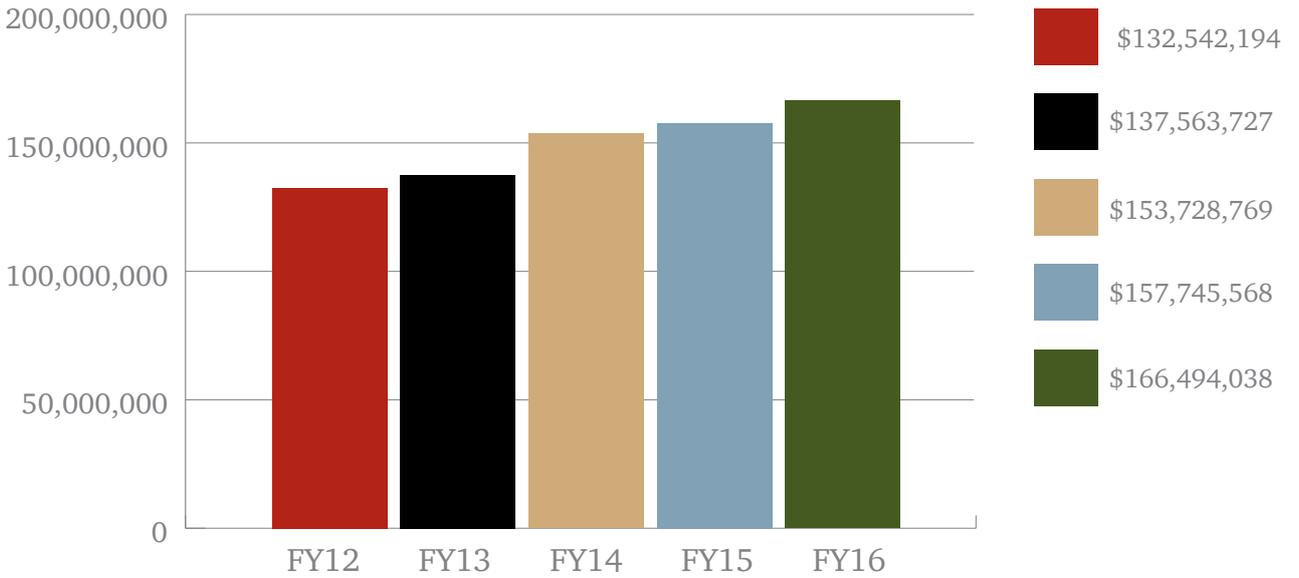
Restricted Research Expenditures

(As Reported to the Texas Higher Education Coordinating Board)

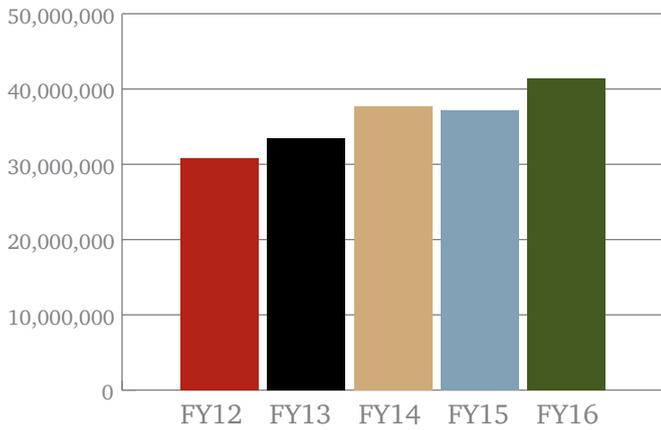


Total Research Expenditures

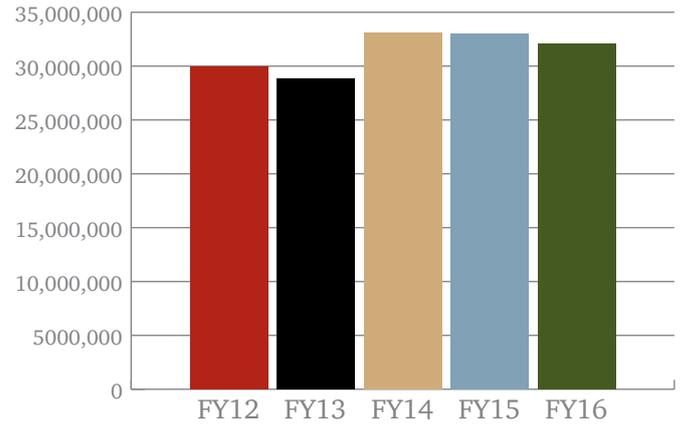
(As Reported to the Texas Higher Education Coordinating Board)



Federal Research Awards



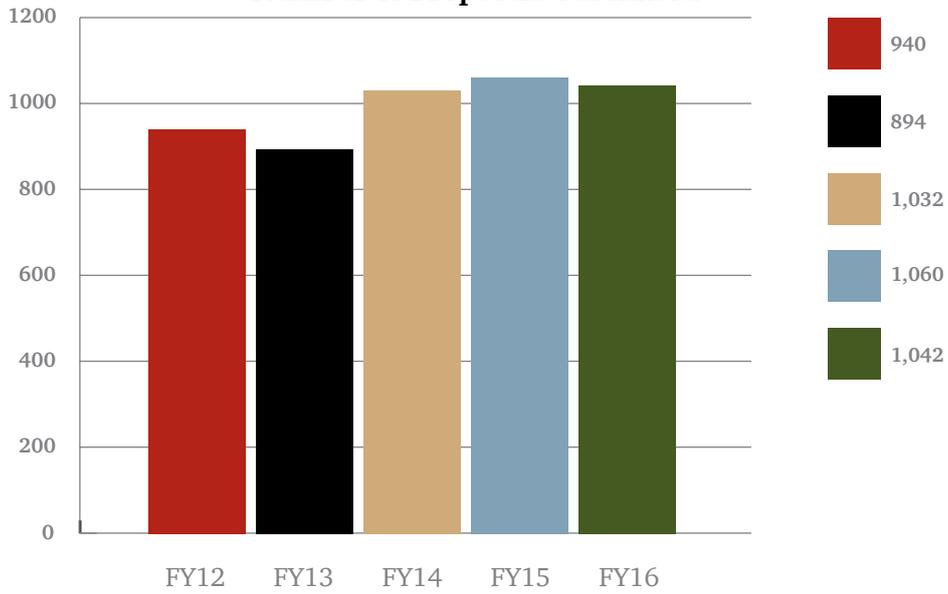
Federal Research Expenditures



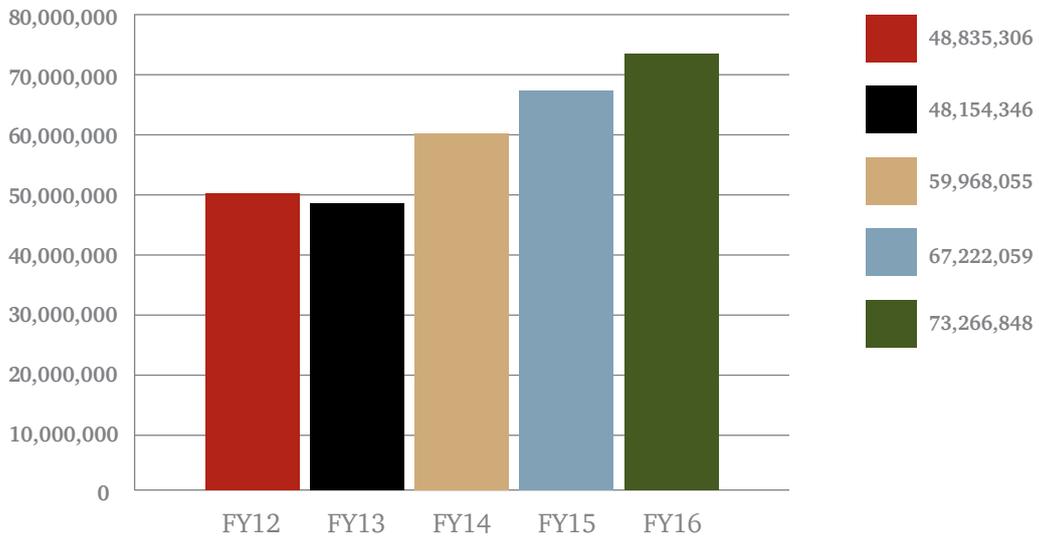
■ Federal	\$ 24,101,495
Federal Pass Through	\$ 6,698,911
Total	\$ 30,800,406
■ Federal	\$ 25,365,498
Federal Pass Through	\$ 8,149,041
Total	\$ 33,514,539
■ Federal	\$ 28,203,075
Federal Pass Through	\$ 9,490,657
Total	\$ 37,693,732
■ Federal	\$ 28,853,594
Federal Pass Through	\$ 8,289,591
Total	\$ 37,143,185
■ Federal	\$ 33,280,501
Federal Pass Through	\$ 8,092,276

■ \$ 29,968,704
■ \$ 28,831,113
■ \$ 33,137,057
■ \$ 32,986,538
■ \$ 32,092,894

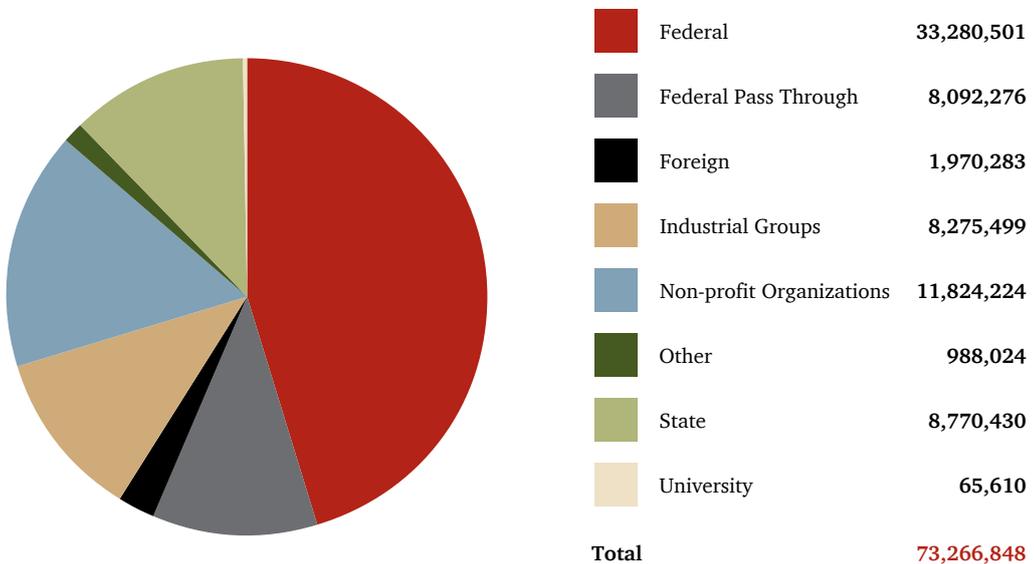
Number of Proposals Submitted



Award Value



Award By Sponsor Type



Texas Tech University Commercialization Metrics

Fiscal Year	2014	2015	2016
Invention Disclosures	47	49	64
U.S. Patent Applications Filed	36	29	50
License/Option Agreements Signed	8	9	11

Texas Tech University System Commercialization Metrics

Fiscal Year	2014	2015	2016
Invention Disclosures	96	102	97
U.S. Patent Applications Filed	73	65	83
License/Option Agreements Signed	15	14	16