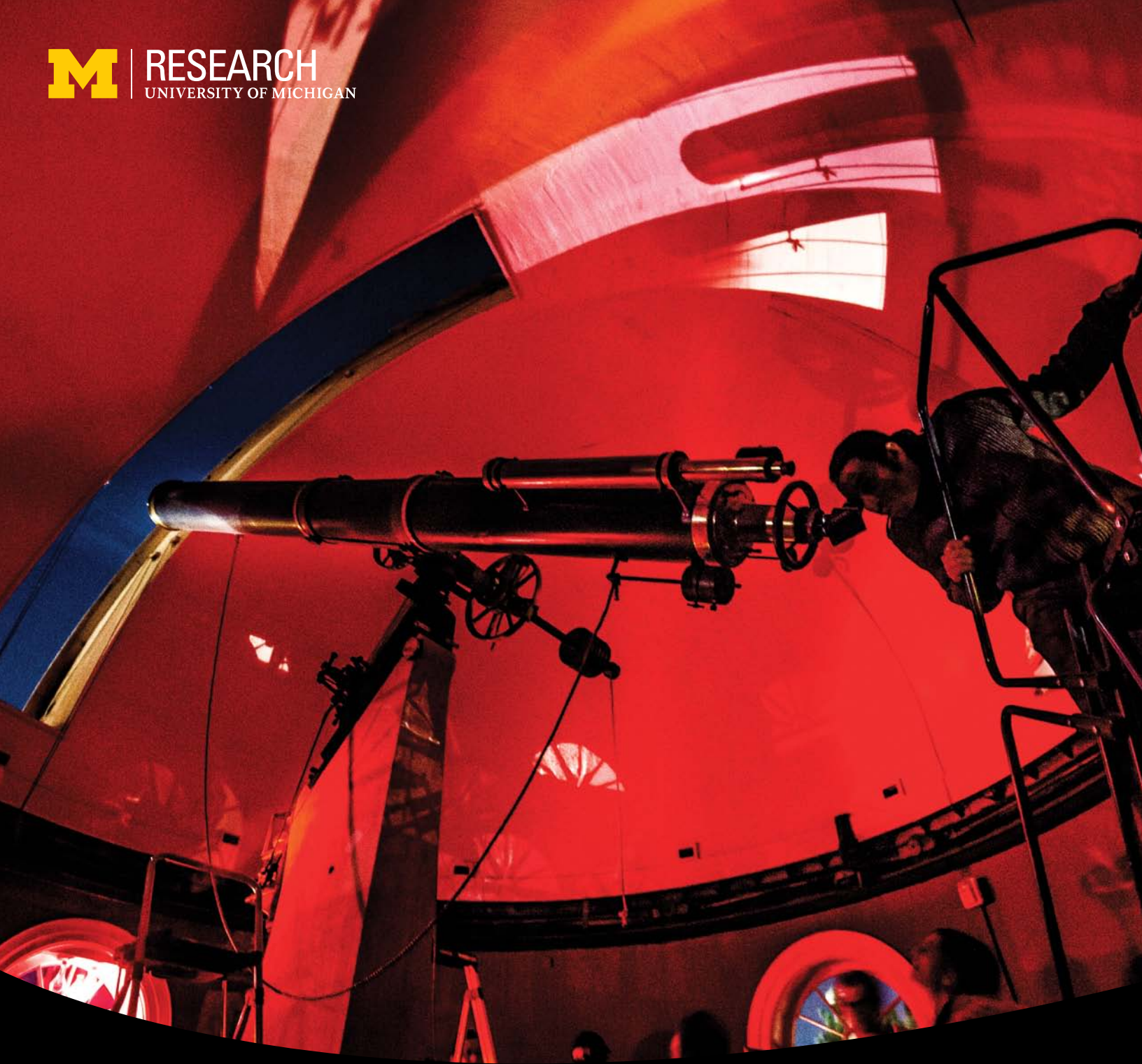


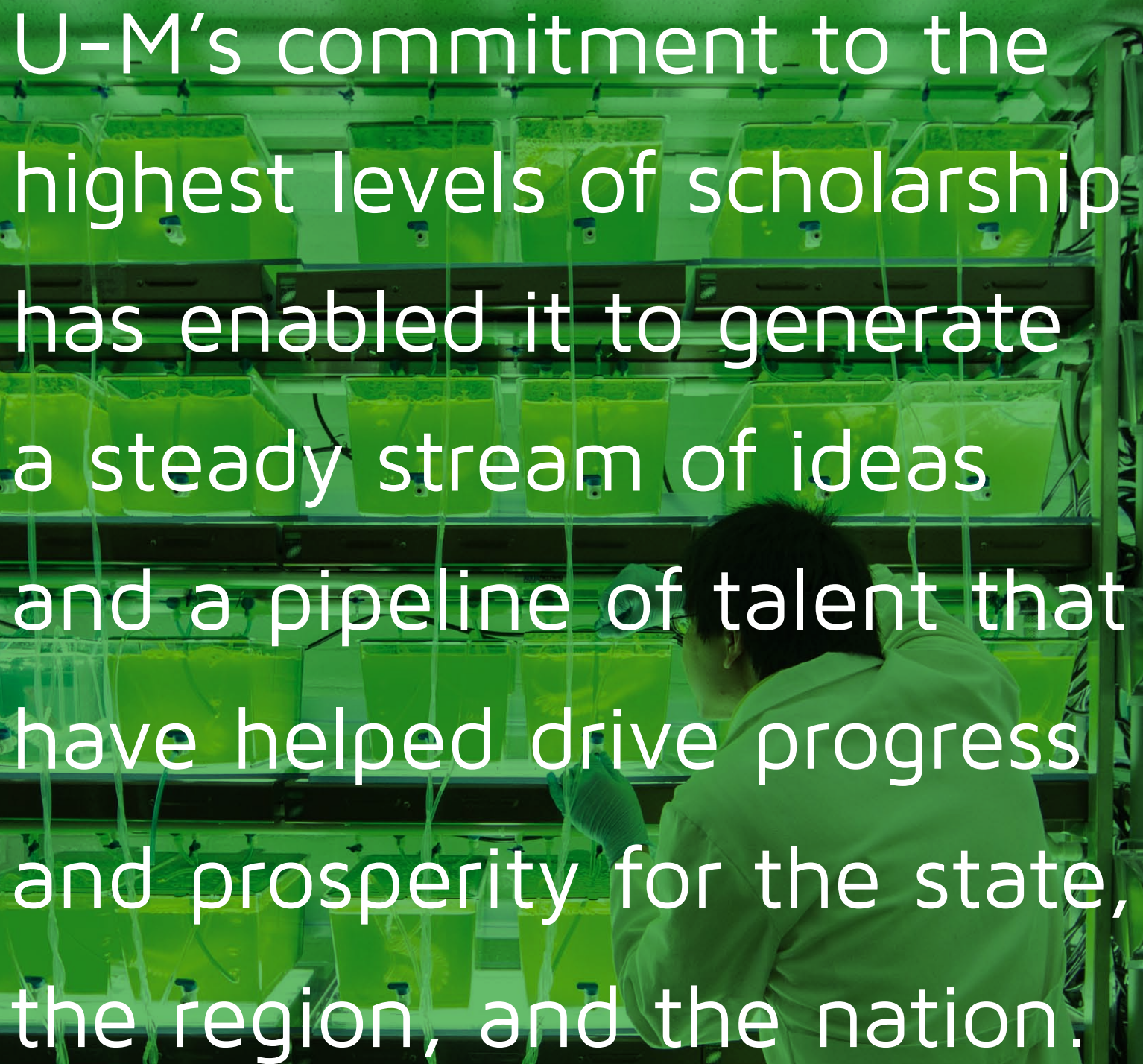


RESEARCH  
UNIVERSITY OF MICHIGAN



# Annual Report on Research

FISCAL YEAR **2017** FINANCIAL SUMMARY

A scientist in a white lab coat and gloves is working with rows of yellow bio-reactors in a laboratory. The scientist is seen from the side, focused on the equipment. The background is filled with more rows of similar reactors, creating a sense of a large-scale research facility.

U-M's commitment to the highest levels of scholarship has enabled it to generate a steady stream of ideas and a pipeline of talent that have helped drive progress and prosperity for the state, the region, and the nation.

*On the Cover*

*Completed in 1854, the Detroit Observatory was part of President Henry Philip Tappan's goal to make U-M one of the leading research universities in the nation. The observatory is now the second oldest building on campus and it is still in use. It was built on a hill half a mile from the campus, which has since expanded to surround the iconic structure.*

*Above*

*A scientist tests algae from one of the tanks housed in the Cardinale Lab. There, scientists grow algae to study its potential to safely fuel vehicles.*

# University of Michigan

## Research at 200

Founded in 1817, the University of Michigan has grown from a single two-story building in Detroit into one of the world's leading public research universities, with campuses in Ann Arbor, Dearborn, and Flint. The University has conducted the largest volume of research of any public university in the nation for the last several years. And as U-M celebrated its bicentennial during fiscal year 2017, total research expenditures reached \$1.48 billion, a record high and 6.4 percent more than the previous year.

Serving the public good through its education and research programs has long been central to the mission of the University. Over the years, our commitment to the highest levels of scholarship has enabled us to generate a steady stream of ideas and a pipeline of talent that have helped drive progress and prosperity for the state, the region, and the nation.

For more than half a century, the federal government has been a major partner in this effort, providing public funds to support research aimed at improving our nation's safety, security, health, economic vitality, and quality of life. In fiscal year 2017, the federal government's investment in U-M research reached a new high of \$832 million, 56 percent of our total research volume and a 5 percent increase over the previous year.

Industry has benefitted greatly from this investment, tapping the talent of the great majority of graduating students to help translate the ideas and expertise that arise on campus into products, processes, and services that have changed virtually all aspects of our lives. Recognizing the critical role universities play in sustaining its success, industry has been stepping up its investments in university research. Last year, industry sponsorship at U-M grew by 14 percent, to a record high of more than \$106 million.

This growth arises in part from an on-going effort by the Office of Research, working with faculty across campus, to engage industry in major new interdisciplinary programs that address emerging challenges and opportunities. In recent years, U-M has launched major new initiatives in partnership with industry and government in such areas as connected and automated vehicles, data science, and exercise and sport science.

We have also been successful in generating new ideas with commercial potential and encouraging their application. Our Office of Technology Transfer reported a record 444 new inventions and 172 U.S. patents issued in FY 2017. In addition, we continued a decade-long trend of launching an average of one new company a month based on technologies developed at U-M.

Looking ahead, the dollar value of new external research contracts awarded to U-M in FY 2017 increased by 11.8 percent. And for the longer term, the number of proposals U-M faculty submitted for new awards rose by 4 percent, representing a 25 percent increase in dollar value.

The health of our research enterprise is a reflection of the excellence of our faculty; the strength of our relationships with government, industry, and other partners; and our record of achievement. At the same time, it is central to the quality of the education we provide our students, and the benefit we can bring to society. As we head into our third century, the University of Michigan is well prepared to meet the challenges we face in a world of rapid change, and to continue our contributions to the public good.



**S. Jack Hu**

*Vice President for Research*

*J. Reid and Polly Anderson Professor of Manufacturing*





2.8 million square feet of lab space for research and teaching

\$1.48 billion in annual research expenditures

100 graduate programs ranked in the Top 10 by *U.S. News & World Report*

#1

in research volume among all U.S. public universities, according to the National Science Foundation

*The U-M Herbarium is home to some of the world's finest botanical collections, including 1.7 million specimens of vascular plants, algae, bryophytes, fungi and lichens.*

## Strengthening the Research Enterprise

Even as total research expenditures reached record levels in U-M's bicentennial year, the landscape for university research has become more challenging. Total federal support for research declined for the first time in FY 2017, for example, and the time and resources needed to meet research compliance requirements continues to grow. To meet these challenges, U-M's Office of Research (UMOR) and other leaders across campus have identified a number of steps aimed at diversifying sources of funding, enhancing competitiveness for existing funds, improving the efficiency of its research operations, and making a clearer case for the value of research to our society. Progress on these steps is summarized below.

- **Build the pipeline of research contracts**—Faculty stepped up their efforts to win new awards for research in FY 2017, submitting 4 percent more proposals than in the prior year, representing an increase in dollar value of 25 percent.
- **Create major research projects that build on U-M's strengths**—Drawing on its interdisciplinary culture and its partnerships with industry and government, U-M recently launched substantial new programs in data science, connected and automated vehicles, and exercise and sport science. New efforts under way include an initiative in precision health, which brings together biomedical and genomic expertise with emerging techniques in big data and social science to create personalized approaches to the health challenges of individuals.
- **Encourage cross-disciplinary innovation**—MCubed, a unique program established in 2012 to quickly provide seed funding to kick-start novel interdisciplinary research, has so far funded 487 projects that have led to \$94 million in further funding. Work is now under way to explore ways to efficiently build communities of common interest around larger cross-disciplinary initiatives that address key challenges. Another initiative seeks to expand MCubed to include partnerships with other universities.
- **Strengthen ties to industry**—The Business Engagement Center maintains relationships with more than 1,200 companies. With support from the Center, total industry-sponsored research expenditures grew by 14 percent, to a record \$106.3 million in FY 2017. At the same time, new research awards from industry rose by 31 percent.
- **Expand clinical trials**—In FY 2017, awards for clinical trials rose by 6.38 percent to \$79.3 million. To further facilitate this expansion, U-M recently established seven Clinical Trials Support Units to help with the development and administration of clinical trials in key areas, allowing investigators to focus more directly on the research.
- **Increase research funding from foundations**—U-M's Office of Foundation Relations, working with UMOR, coordinated \$53.4 million in research awards in FY 2017, up 10.3 percent from the previous year.
- **Pursue philanthropic gifts for research**—In partnership with the Office of University Development, UMOR is boosting efforts to seek research funding from philanthropic sources, including both individuals and corporations. The Business Engagement Center helped raise \$41.8 million in philanthropic contributions from industry for education and research in FY 2017.
- **Streamline research administration**—UMOR's Office of Research and Sponsored Projects has an on-going program that is integrating and streamlining the entire research award process, from proposal to closeout. On another front, U-M completed an overhaul of the structure and processes for managing animal care and use, with the aim of boosting administrative and operation efficiency, while ensuring compliance with the highest standards.
- **Reduce faculty administrative burden**—UMOR's Office of Research Ethics & Compliance is refining a plan to consolidate and rationalize processes and IT systems to improve adherence, while reducing the amount of faculty time needed to meet regulatory requirements.
- **Advocate broadly for university research**—UMOR's Business Engagement Center, Office of Federal Relations for Research, and research communications staff have been stepping up their efforts to show the value and impact of university research to industry, government, the media, and the general public. During FY 2017, the Office of the President also launched an initiative aimed at encouraging more U-M faculty to draw on their expertise to engage with the public on issues of concern to society.

# 2017 Research Highlights

## Mastodon in Michigan

The most complete ice age mastodon skeleton found in Michigan since the 1940s was recovered from the state's Thumb region by a team led by U-M researchers. More than 75 complete or nearly complete bones, accounting for 60-70 percent of the extinct mammal's skeletal mass, were recovered during the October 2016 dig at the Fowler Center for Outdoor Learning near Mayville, Mich. The bones were donated to the U-M Museum of Paleontology for further study.



## Hurricane Tracker

NASA successfully launched a constellation of eight hurricane-tracking microsattellites in a \$151 million mission being led by U-M. The Cyclone Global Navigation Satellite System, launched in December 2016, provides scientists with the ability to see inside hurricanes as never before. The system is designed to improve forecasts of hurricane intensity and storm surge, the swells of water that do the most damage when hurricanes make landfall.



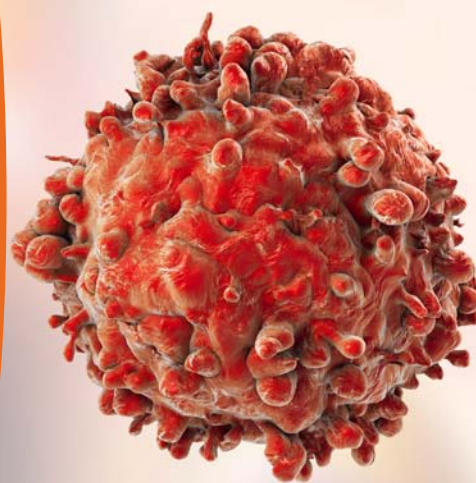
## Driverless Cars

Mobility researchers at U-M devised a new way to test autonomous vehicles that bypasses the billions of miles they would need to log for consumers to consider them road-ready. The process, which was developed using data from more than 25 million miles of real-world driving, can cut the time required to evaluate robotic vehicles' handling of potentially dangerous situations by 300 to 100,000 times. And it could save 99.9 percent of testing time and costs.



## Personalized Cancer Therapy

Researchers at U-M had initial success in mice using nanodiscs to deliver a customized therapeutic vaccine for the treatment of colon and melanoma cancer tumors. The therapeutic cancer vaccine employs nanodiscs loaded with tumor neoantigens, which are unique mutations found in tumor cells. By generating T-cells that recognize these specific neoantigens, the technology targets cancer mutations and fights to eliminate cancer cells and prevent tumor growth.



## Water-repellant Coating

A self-healing, water-repellent, spray-on coating developed at U-M is hundreds of times more durable than its counterparts. It could enable waterproofing of vehicles, clothing, rooftops and countless other surfaces in which current waterproofing treatments are too fragile. The coating also could lower the resistance of ship hulls, a step that would reduce the fuel consumption of the massive vessels that transport 90 percent of the world's cargo.



## Making Memories Tick

Scientists have known that a lack of sleep can interfere with the ability to learn and make memories. But they weren't sure what function of the hippocampus—two seahorse-shaped structures located in the temporal lobe of the brain where many long-term memories are made—was kept from doing its job. U-M research now shows that interfering with sleep-associated oscillations in one subsection of the hippocampus likely inhibits the brain's ability to make memories.



# Pillars of Excellence

Based in 19 schools and colleges in Ann Arbor, and campuses in Flint and Dearborn, the University of Michigan faculty represent a wealth of expertise across an exceptional range of academic disciplines. Over the years, U-M has developed particular strengths in a number of research areas that cut across—and draw their strength from—many disciplines. Four of those pillars of excellence, which are also areas of continuing growth and change, are mobility, biosciences, data science, and sustainability.

## Mobility

### Toward a driverless future

U-M offered its first class on automotive technology in 1910. Over the next century, automotive research and education flourished alongside the dramatic growth of the automotive industry itself. Not only have a wealth of ideas emerged from U-M's research, but literally thousands of alumni now work in the industry worldwide in every area from research and development to management. Expertise and on-going research at U-M spans such diverse areas as powertrain design, vehicle control, alternative fuels, engine design, electric vehicles, advanced materials, driver behavior, traffic safety, and ergonomics. Along with more than 300 independent automotive research facilities in the region, U-M has established Michigan as the global epicenter of automotive innovation. U-M positioned itself for continuing leadership with the launch of Mcity in 2014. This collaboration with the federal, state, and local government, as well as industry partners from around the world, is working to lay the foundations of an economically viable system of connected and automated vehicles. To address the full complexity of the mobility challenges of the future, Mcity brings together U-M experts in such fields as policy, economics, urban planning, management, law, and cybersecurity to complement its expertise in science and engineering.

## Biosciences

### From basic science to lifesaving treatments

In 1850, U-M's Medical School opened as the University's second academic college. And in 1869, U-M became the first university in the nation to own and operate its own hospital, setting the stage for improved health care, as well as basic and clinical research. Today, about half of all of the University's research expenditures are in the biosciences, with activity under way in medicine, pharmacy, dentistry, public health, nursing, engineering, kinesiology, biology, psychology, computer science, chemistry, and physics. Many of the important advances in the biosciences over the last several decades—ranging from genetic engineering to advanced medical devices—have come from creative collaborations across these disciplines. Emerging developments in such areas as personalized health care and neurosciences show that this trend is stronger than ever. U-M President Mark S. Schlissel recently launched a new Biosciences Initiative to build on U-M's broad strengths and its culture of interdisciplinary cooperation to take its capabilities and achievements to a new level. With an investment of \$150 million over five years, the initiative aims to improve administrative efficiencies, encourage further collaborations, support new research initiatives, strengthen core resources for the biosciences community, and hire 30 new faculty in strategic areas of high potential.



## Data Science

### A new approach to scientific discovery

Data science has been recognized as a fourth fundamental approach to scientific discovery, in addition to experimentation, modeling, and computation. One of the central challenges facing researchers today in fields ranging from engineering and medicine to the humanities is to gather, store, search and analyze collections of data so vast that they challenge current approaches. Building on U-M's strengths in this area, and recognizing the potential for application across the entire campus, U-M's Data Science Initiative is investing \$100 million to spur advances in the techniques of data science, as well as to encourage their creative use in research. Key goals include expanding research computing capacity and strengthening data management, storage, analytics and training resources, as well as adding faculty in promising areas of research and education. At present, the initiative is supporting interdisciplinary data-related research in connected and automated vehicles, personalized health care, online survey research, and learning analytics—with more areas to come.

## Sustainability

### Addressing a global challenge

More than 800 faculty from schools and colleges across U-M conduct a rich variety of research projects related to sustainability—from engineering to social sciences. In December 2016, for example, NASA successfully launched a network of satellites designed and built by a team of U-M students and faculty. The network will improve the ability to monitor developing hurricanes, and help forecast the potential damage they may cause. On another front, U-M's Water Center engages multidisciplinary teams of researchers, practitioners, policymakers, and non-profit groups to better understand and manage the challenges facing our scarce water resources, from the Great Lakes region to other areas around the globe. Planet Blue is a university-wide effort to promote sustainability education, research, and community engagement, as well as sustainable practices in U-M's operations. And on July 1, 2017, U-M laid the groundwork for further progress by forming the School for Environment and Sustainability (SEAS), which broadens the mission of the former School of Natural Resources and Environment. The new School is structured to engage faculty and students from across the university to address the complexities of global challenges at the intersection of environment and society.



## Research Financial Summary

In Fiscal Year 2017, total research expenditures across the Ann Arbor, Dearborn, and Flint campuses of the University of Michigan grew by 6.4 percent over the previous year to \$1,482,852,116. This sum includes externally and internally funded direct and indirect expenses and disbursements in support of research, including research initiative and startup expenses, research-related facilities and administrative expenses, and research equipment purchases.

As shown in **TABLE 1**, the federal government is the largest sponsor of U-M research. Research conducted under contract with the various agencies of the federal government reached \$831.8 million, an increase of 5 percent and 56.1 percent of the total. Research funded by non-federal external sponsors rose sharply by 14.1 percent, led by a 24.7 percent rise in expenditures from direct contracts from industry. Expenditures from internal sources were up by 6.5 percent.

**FIGURE 1** illustrates the overall trends in research expenditures from these sources over the decade from FY 2007 through FY 2017. Expenditures from the federal government have long made up the largest portion, but their contribution to the total has decreased as their rate of growth has slowed down. The slower growth at U-M mirrors the leveling off of the total federal investment in university research in recent years.

At the same time, however, the contributions from the internal and non-federal sources at U-M have increased enough to sustain overall growth. Internal sources, which include endowment funds that are restricted to or designated for research, funds from auxiliary operations, and the university's general fund, are about 32.7 percent of the total.

**FIGURE 2** highlights the fact that about 65.5 percent of total federal expenditures, or \$544.7 million, come from the Department of Health and Human Services, which includes the National Institutes of Health. This represents an increase of 10 percent over the previous year, and it continues the pattern of growth prior to 2009. The sharp rise and gradual fall of expenditures over the period from 2009 to 2015 are primarily the result of the short-term infusion of funds under the American Recovery and Reinvestment Act of 2009.

Expenditures from other federal agencies are presented in **FIGURE 3**. The second largest federal government sponsor, the National Science Foundation, showed an increase of 7 percent to \$92 million. Expenditures from the Department of Energy were up by 3.9 percent. The most dramatic change was a 38.8 percent drop in expenditures from the National Aeronautics and Space Administration due to the successful completion of a multi-year \$94.8 million contract to design and build a network of hurricane tracking satellites that were launched in December 2016.

Further details on the volume of research from all sources are presented in Appendix I.

**FIGURE 4** shows how the university's research expenditures were distributed across campus. The Medical School (MED) led with 41 percent of the university total, followed by the College of Engineering (COE); the College of Literature, Science, and the Arts (LSA); the Institute for Social Research (ISR); and the School of Public Health (SPH). Appendix II provides more detail on the level of expenditures in FY 2017 and FY 2016, and the percent change from the previous year for each unit of the Ann Arbor campus and for the Dearborn and Flint campuses.

The segment labeled Office of Research Units represents the sum of expenditures by units reporting directly to the U-M Office of Research instead of a school or college. These units include Advanced Research Computing, the Center for Human Growth and Development, the U-M Energy Institute, Functional Magnetic Resonance Imaging, the Institute for Research on Women & Gender, Mcity, the U-M Transportation Research Institute, and the Economic Growth Institute.

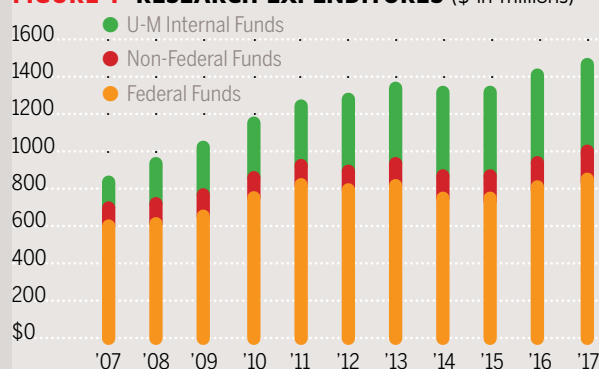
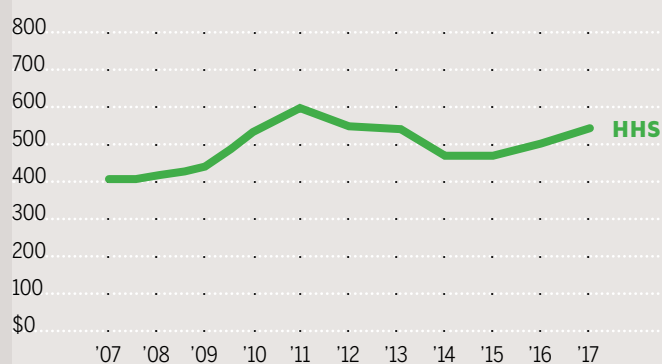
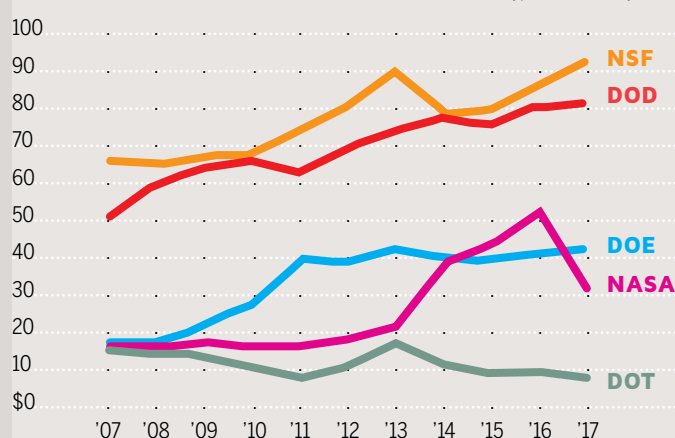
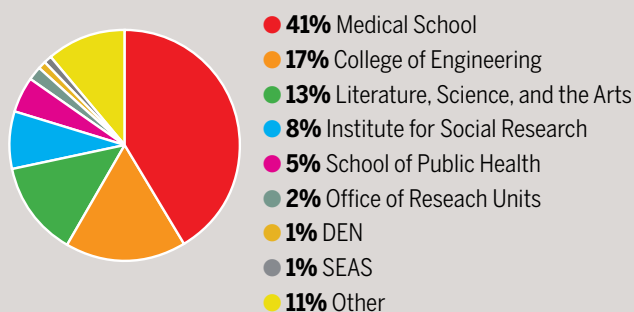
**TABLE 2** and **TABLE 3** highlight the pipeline for new externally funded research expenditures. Although total number of new external research contracts awarded to U-M in FY 2017 fell by 1.9 percent, their total dollar value rose by 11.8 percent, as highlighted in Table 2. These new awards will show up as expenditures over a period of years, depending on the terms of each contract. Looking further ahead, Table 3 shows that faculty submitted 4 percent more proposals for new awards in FY 2017, with a 25 percent increase in dollar value.

UMOR also helps spur research and scholarship across the university through its Faculty Grants and Awards Program. The program provides bridging funds for projects, seed funding for faculty, and support in areas where available external funding is limited. As shown in **FIGURE 5**, about 33 percent of the total supports the arts and humanities.

# Research Financial Summary Graphs

**TABLE 1 MAJOR RESEARCH SPONSORS**

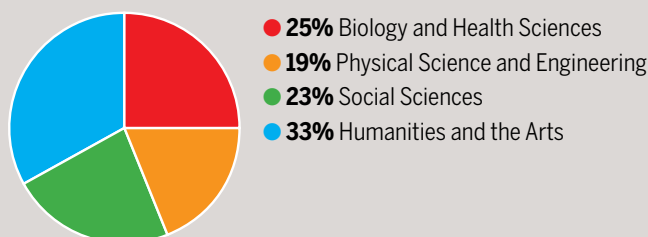
Sponsor Group	FY17	FY16	% Change
Total Federal Government	\$831,843,878	\$792,052,275	5.0%
Total Non-Federal Sponsors	\$165,450,193	\$145,030,671	14.1%
Industry (direct)	\$85,401,688	\$68,463,085	24.7%
Foundations	\$30,010,328	\$26,784,688	12.0%
Other	\$50,038,176	\$49,782,898	0.5%
Total U-M Funds	\$485,558,046	\$456,022,261	6.5%
<b>Total Research Expenditures</b>	<b>\$1,482,852,116</b>	<b>\$1,393,105,207</b>	<b>6.4%</b>

**FIGURE 1 RESEARCH EXPENDITURES (\$ in millions)**

**FIGURE 2 FEDERAL FUNDING FROM HHS (\$ in millions)**

**FIGURE 3 FEDERAL FUNDING BY AGENCY (\$ in millions)**

**FIGURE 4 RESEARCH EXPENDITURES BY UNIT**

**TABLE 2 AWARD TOTALS**

	Number of Awards	Value of Awards
FY 2017	2,049	\$1,167,161,264
FY 2016	2,089	\$1,044,072,462
Difference	-40	\$123,088,802
<b>% Change</b>	<b>-1.9%</b>	<b>11.8%</b>

**TABLE 3 SUBMISSION TOTALS**

	Submissions	Submission Value
FY 2017	5,469	\$5,424,529,569
FY 2016	5,257	\$4,339,065,396
Difference	212	\$1,085,464,173
<b>% Change</b>	<b>4.0%</b>	<b>25.0%</b>

**FIGURE 5 UMOR GRANTS AND AWARDS**


## Business Engagement

U-M's Business Engagement Center (BEC), which celebrated its tenth year in FY 2017, plays a central role in building strong strategic relationships between industry and the University. Reporting jointly to the U-M Office of Research and the U-M Office of University Development, the BEC is a central gateway for companies to access the expertise and resources in the U-M community, including research, educational programs, and student talent. The BEC and its affiliated corporate relationship managers across campus maintain relationships with more than 1,200 companies, and play a key role in helping industry find opportunities to invest in research and philanthropic support at the university.

**TABLE 4** provides a detailed look at the full range of industry research expenditures at U-M, which reached \$106.3 million in FY 2017, up 14.1 percent from the previous year. This total includes direct contracts, as well as subcontracts from federal contracts awarded to industry. It also includes contracts from industry-funded trade and professional associations.

Industry funding is now 10.8 percent of all externally sponsored research expenditures. Looking ahead, corporate awards received for new research stood at \$202.4 million at the close of FY 2017, up 31.2 percent from the previous year.

Philanthropic contributions for the year were \$41.8 million, contributing to a total industry investment of \$148.1 million.

## Technology Transfer

The Office of Technology Transfer (OTT), a unit of the U-M Office of Research, plays a central role in ensuring that society can realize the benefits of ideas that arise from U-M research. As shown in **TABLE 5**, U-M researchers submitted a new record 444 new inventions in FY 2017. This is a 3.7 percent increase from the previous year and the fifth straight year that faculty have reported more than 400 inventions.

OTT also reported a record 172 U.S. patents issued last year, up 27.4 percent from the previous year, and equaled the previous year's record of 173 signed license and option agreements.

OTT's Venture Center brings together talent, funding, and other resources to help launch startup companies based on intellectual property developed at U-M. In FY 2017, the Center launched 12 new startups, sustaining an average of one new company every four weeks over the last decade. The year's startups span a wide spectrum of areas, including brain-computer interfaces, nano-vaccine technology for cancer therapy, advanced battery technology, tools for building engagement and social capital for organizations, and a curriculum and framework for managing depression.

*Below: This year's startups include Neurable, a company that's developed a brain wave interpretation system that allows one to move devices such as toys, cars, wheelchairs, TVs and video games.*

**TABLE 4 INDUSTRY RESEARCH EXPENDITURES**

Industry Research	FY17	FY16	% Change
Direct Contract	\$84,812,778	\$68,373,948	24.0%
Subcontract (on Federal Prime)	\$12,661,477	\$12,130,716	4.4%
Trade and Professional Associations	\$6,491,123	\$9,416,683	-31.1%
Corporate Foundations (est.)	\$2,102,195	\$2,624,465	-19.9%
Other Industry Research	\$263,230	\$669,648	-60.7%
<b>Total Research Expenditures</b>	<b>\$106,330,803</b>	<b>\$93,215,460</b>	<b>14.1%</b>

**TABLE 5 TECHNOLOGY TRANSFER RESULTS**

	FY17	FY16	% Change
New Inventions	444	428	3.7%
U.S. Patents Issued	172	135	27.4%
License and Option Agreements	173	173	0.0%



## Faculty Recognition

From a Pulitzer Prize to elections to the National Academies, many U-M researchers were rewarded for their efforts throughout fiscal year 2017. Below is a selection of honors U-M faculty received from July 1, 2016 to June 30, 2017.

### Pulitzer Prize

Professor and historian **Heather Ann Thompson**'s book "Blood in the Water: The Attica Prison Uprising of 1971 and Its Legacy" won the 2017 Pulitzer Prize for history. Thompson, a professor of Afroamerican and African Studies and a professor in the U-M Residential College, won "for a narrative history that sets high standards for scholarly judgment and tenacity of inquiry in seeking the truth about the 1971 Attica prison riots," according to a statement on the Pulitzer website.

### American Academy of Arts and Sciences (AAAS)

**Frank Yates**, Arthur F. Thurnau Professor; professor of psychology; professor of business administration

**Juanita Merchant**, H. Marvin Pollard Professor of Gastrointestinal Sciences; professor of internal medicine; professor of molecular and integrative physiology

### National Academy of Education

**Edward A. Silver**, William A. Brownell Collegiate Professor of Education; associate dean for research and graduate studies; professor of education; professor of mathematics

### National Academy of Engineering

**Ellen Arruda**, Maria Comninou Collegiate Professor of Mechanical Engineering; professor of mechanical engineering; professor of biomedical engineering; professor of macromolecular science and engineering

**Mark Daskin**, Clyde W. Johnson Collegiate Professor of Industrial and Operations Engineering; chair of the Department of Industrial and Operations Engineering; professor of industrial and operations engineering; professor of operations and management science

**Noboru Kikuchi**, professor emeritus of mechanical engineering

### National Academy of Medicine

**Kathleen Collins**, associate director of the Cellular and Molecular Biology Program; professor of internal medicine; professor of microbiology and immunology

**Roger Cone**, vice provost and director of the Biosciences Initiative; Asa Gray Collegiate Professor of the Life Sciences; Mary Sue Coleman Director of the Life Sciences Institute; research professor in the Life Sciences Institute; professor of molecular, cellular and developmental biology; professor of molecular and integrative physiology

### National Academy of Sciences

**Donald Kinder**, Philip E. Converse Distinguished University Professor of Political Science; professor of political science, professor of psychology; research professor in the Center for Political Studies

### Fellows of the American Association for the Advancement of Science

**Lynn Conway**, professor emeritus of electrical engineering and computer science

**Steven Cundiff**, Harrison M. Randall Collegiate Professor of Physics; professor of physics; professor of electrical engineering and computer science

**Martin Myers Jr.**, Marilyn H. Vincent Professor of Diabetes Research; professor of internal medicine; professor of molecular and integrative physiology

**Henry Paulson**, Lucile Groff Chair of Neurology for Alzheimer's Disease and Related Disorders; professor of neurology

**Kamal Sarabandi**, Rufus S. Teesdale Professor of Engineering; professor of electrical engineering and computer science

**Santiago Schnell**, John A. Jacquez Collegiate Professor of Physiology; interim chair of the Department of Molecular and Integrative Physiology; professor of molecular and integrative physiology; professor of computational medicine and bioinformatics

**Michael Solomon**, professor of chemical engineering; professor of macromolecular science and engineering; interim dean of the Horace H. Rackham School of Graduate Studies

**Abigail Stewart**, Sandra Schwartz Tangri Distinguished University Professor of Psychology and Women's Studies; professor of psychology; professor of women's studies; director and senior counselor to the provost

**Donald R. Zak**, Arthur F. Thurnau Professor; Burton V. Barnes Collegiate Professor; professor of natural resources; associate dean for academic affairs in the School for Environment and Sustainability; professor of ecology and evolutionary biology

### Guggenheim Fellowships

**Paolo Squatriti**, professor of history; professor of romance languages and literatures; professor of environment

**Adela Pinch**, professor of English language and literature; professor of women's studies

### Alfred P. Sloan Research Fellows

**Monica Dus**, assistant professor of molecular, cellular and developmental biology

**Wei Ho**, assistant professor of mathematics

**Kerri Pratt**, assistant professor of chemistry; assistant professor of earth and environmental sciences

**Corinna Schindler**, assistant professor of chemistry

**Randy Stockbridge**, assistant professor of biophysics; assistant professor of molecular, cellular and developmental biology

**Ambuj Tewari**, associate professor of statistics; associate professor of electrical engineering and computer science

**Qiong Yang**, assistant professor of biophysics; assistant professor of physics

**APPENDIX I****University of Michigan Volume of Research Expenditures**

For the Year Ended June 30,

Fiscal Year Change

**2017****2016****Dollar (\$) Percentage (%)****INTERNALLY FUNDED RESEARCH**

Designated Fund	\$32,592,335	\$68,544,007	\$(35,951,672)	-52.5%
Expendable Restricted Fund	73,659,163	69,460,454	4,198,709	6.0%
General Fund	248,379,630	228,034,929	20,344,701	8.9%
Auxiliary Fund (Med School)	130,926,918	89,982,871	40,944,047	45.5%
<b>Subtotal University Funds</b>	<b>485,558,046</b>	<b>456,022,261</b>	<b>29,535,785</b>	<b>6.5%</b>

**EXTERNALLY FUNDED (SPONSORED) RESEARCH****FEDERAL**

Agriculture, Department of	2,837,002	2,665,631	171,372	6.4%
Commerce, Department of	8,166,592	6,787,705	1,378,887	20.3%
Corporation for National and Community Service	-	253,024	(253,024)	
Defense, Department of				
Air Force, Department of the	13,339,647	13,148,318	191,329	1.5%
Army, Department of the	30,087,167	35,624,225	(5,537,059)	-15.5%
Navy, Department of the	13,917,609	13,203,117	714,493	5.4%
Other	23,681,492	18,535,785	5,145,707	27.8%
Director of National Intelligence, Office of the	702,134	40,350	661,784	1640.1%
Education, Department of				
Office of Student Financial Assistance Programs	1,422,433	1,178,864	243,569	20.7%
Other	4,165,336	4,663,915	(498,579)	-10.7%
Energy, Department of	42,414,999	40,797,779	1,617,221	4.0%
Environmental Protection Agency	2,820,177	3,025,047	(204,871)	-6.8%
Federal Reserve System	153,708	31,697	122,010	384.9%
Health and Human Services, Department of				
Centers for Disease Control and Prevention	13,627,323	13,931,714	(304,391)	-2.2%
Centers for Medicare and Medicaid Services	15,068,688	10,656,030	4,412,658	41.4%
Food and Drug Administration	2,805,762	1,956,218	849,543	43.4%
Health Resources and Services Administration	1,130,119	641,283	488,836	76.2%
National Institutes of Health	502,471,194	457,334,701	45,136,493	9.9%
Substance Abuse and Mental Health Services Administration	153,653	285,132	(131,480)	-46.1%
Other	9,459,334	9,685,596	(226,262)	-2.3%
Homeland Security, Department of	1,437,171	1,517,456	(80,286)	-5.3%
Housing and Urban Development, Department of	158,467	5,057	153,410	3033.7%
Institute of Museum and Library Services	142,064	105,553	36,512	34.6%
Interior, Department of the	165,256	976,787	(811,531)	-83.1%
Justice, Department of	2,518,820	2,523,520	(4,700)	-0.2%
Labor, Department of	25,550	-	25,550	
Library of Congress	164,687	16,614	148,074	891.3%
National Aeronautics and Space Administration	31,580,805	51,592,596	(20,011,791)	-38.8%
National Endowment for the Humanities	542,382	(10,413)	552,794	
National Science Foundation	92,038,216	86,016,859	6,021,357	7.0%

<i>Externally Funded Research, continued</i>	For the Year Ended June 30,		Fiscal Year Change	
	2017	2016	Dollar (\$)	Percentage (%)
Nuclear Regulatory Commission	759,345	827,634	(68,289)	-8.3%
President, Executive Office of the	22,109	-	22,109	
Smithsonian Institution	482,687	426,154	56,533	13.3%
Social Security Administration	2,013,686	1,802,460	211,226	11.7%
State, Department of	1,104,047	999,658	104,389	10.4%
Transportation, Department of				
Federal Highway Administration	2,535,626	3,539,699	(1,004,073)	-28.4%
National Highway Traffic Safety Administration	2,250,348	1,731,166	519,182	30.0%
Other	2,852,036	3,708,261	(856,225)	-23.1%
United States Agency for International Development	2,056,982	1,067,698	989,285	92.7%
United States Postal Service	133,486	-	133,486	
Veterans Affairs, Department of	435,740	759,385	(323,645)	-42.6%
<b>Subtotal Federal</b>	<b>831,843,878</b>	<b>792,052,275</b>	<b>39,791,603</b>	<b>5.0%</b>
<b>NON-FEDERAL</b>				
Foreign Corporations	19,543,855	16,301,095	3,242,760	19.9%
Foreign Foundations	921,011	499,208	421,802	84.5%
Foreign National Government	1,717,035	2,186,010	(468,975)	-21.5%
Foreign Other (Univ/Gifts)	3,393,722	3,001,070	392,652	13.1%
Foreign Public Charities	255,654	4,625	251,029	5427.7%
Foreign Trade/Profes Assn	84,006	5,667	78,339	1382.5%
International Organizations	317,938	696,525	(378,587)	-54.4%
Local Authorities in Mich.	1,311	14,069	(12,757)	-90.7%
US Corporations	65,857,833	52,161,990	13,695,843	26.3%
US Foundations	30,194,346	27,939,688	2,254,658	8.1%
US Other (Incl Univ + Gifts)	14,038,017	11,382,967	2,655,051	23.3%
US Public Charities (+ Hosps)	20,259,017	18,317,022	1,941,995	10.6%
US State of Michigan	2,375,325	3,104,053	(728,728)	-23.5%
US Trade/Professional Assns	6,491,123	9,416,683	(2,925,560)	-31.4%
<b>Subtotal Non-Federal</b>	<b>165,450,193</b>	<b>145,030,671</b>	<b>20,419,521</b>	<b>14.1%</b>
<b>Subtotal Sponsored Research</b>	<b>997,294,070</b>	<b>937,082,946</b>	<b>60,211,124</b>	<b>6.4%</b>
<b>Total Volume of Research Expenditures</b>	<b>\$1,482,852,116</b>	<b>\$1,393,105,207</b>	<b>\$89,746,909</b>	<b>6.4%</b>

**Notes**

The university receives sponsored research funds directly and indirectly from industry, which totaled approximately \$106 million in 2017 and \$85 million in 2016, an 18% increase.

Federal sponsored research includes federal projects received by the university via corporations, which totaled approximately \$13 million in 2017 and \$12 million in 2016, a 5% increase.

Nonfederal sponsored research funded by U.S. and Foreign Foundations includes amounts received by the university via corporate foundations, which totaled approximately \$2 million in 2017 and \$3 million in 2016.

Nonfederal sponsored research funded by U.S. Trade/Professional Assns and the State of Michigan includes projects received by the university via corporations, which totaled approximately \$1 million in 2017 and \$2 million in 2016.

## APPENDIX II

## Volume of Research Expenditures by Major University Units

Unit	FY 2017	FY 2016	2016-2017 CHANGE \$	2016-2017 CHANGE %
Architecture & Urban Planning, Taubman	2,026,219	1,838,475	187,743	10.2%
Art and Design, Stamps School of	254,757	147,467	107,291	72.8%
Business, Ross School of	13,833,985	12,624,063	1,209,922	9.6%
Dentistry	16,819,514	16,399,567	419,947	2.6%
Education	10,619,563	8,382,909	2,236,654	26.7%
Engineering	247,652,740	253,345,302	-5,692,562	-2.2%
Environment and Sustainability	15,273,037	16,065,464	-792,427	-4.9%
Information	6,107,162	4,788,712	1,318,450	27.5%
Institute of Social Research	143,078,699	118,572,427	24,506,271	20.7%
Kinesiology	10,127,620	8,790,278	1,337,341	15.2%
Law	4,973,174	4,353,280	619,893	14.2%
Life Sciences Institute	30,743,274	27,583,448	3,159,826	11.5%
Literature Science, and the Arts	194,171,909	179,890,323	14,281,586	7.9%
Medical School	589,994,064	566,634,767	23,359,296	4.1%
Music, Theatre & Dance	548,096	656,201	-108,106	-16.5%
Nursing	9,336,546	8,118,687	1,217,859	15.0%
Pharmacy	18,028,304	13,819,512	4,208,792	30.5%
Public Health	73,956,147	65,574,565	8,381,582	12.8%
Public Policy, G Ford School of	4,002,348	4,589,938	-587,590	-12.8%
Social Work	5,367,239	5,207,071	160,167	3.1%
UM Office of Research	35,454,986	38,116,677	-2,661,690	-7.0%
UM Dearborn	7,861,487	7,940,930	-79,443	-1.0%
UM Flint	1,343,812	920,964	422,849	45.9%
Other Units	20,444,436	16,938,179	3,506,257	20.7%
Unassignable Funds	20,833,000	11,806,000	9,027,000	76.5%
<b>Grand Total</b>	<b>1,482,852,116</b>	<b>1,393,105,207</b>	<b>89,746,909</b>	<b>6.4%</b>



227 research centers and  
institutes across campus

3,638 tenured and tenure-track faculty

788 research faculty

1,252 research fellows

\$106 million in annual industry-  
sponsored research

444 new inventions reported by  
U-M researchers in FY 2017

*An aerospace engineering student tests  
a composite motor blade in the Active  
Aeroelasticity and Structures Research Lab.*



*U-M researchers are working closely with Michigan Athletics and industry partners to optimize physical performance and health for people of all ages and abilities.*