University of Wisconsin–Madison
Federal Research Highlights and Impacts 2014

Cutting-edge research aimed at improving lives, communities and our economy is one of University of Wisconsin–Madison’s proudest traditions and represents one of its strongest contributions to society. We are among the very top research universities in the nation and have been consistently in the top five in annual research spending every year over the last two decades. Innovations from research enrich our lives by improving the economy in which we work, the jobs that we perform, the environment where we live, the food we eat, the technology on which we depend, the good health we pursue, and the social structures that guide our lives.

At UW–Madison, research and education are integrally connected. Universities train future scientists and scholars — in addition to maintaining America’s research capabilities — deepening our understanding of the world’s cultures, and helping us understand who we are and what we can achieve. UW–Madison has a robust history of interdisciplinary research and a growing portfolio in the large research projects needed to solve complex societal problems.

UW–Madison is a long-standing, strong supporter of awarding federal research funds on a competitive, peer-reviewed basis. Competitive, scientific peer-review ensures the merit of federally funded research by requiring grant applications to undergo critical, academic review by current scholars. This system of competition and performance determines the best research proposals to fund and guarantees that federal research funding is spent on sound, ethical research that best advances knowledge as a whole.

Continued investment in research and innovation leads to economic prosperity and progress. We have a rich 100-year history of partnering with the Wisconsin Alumni Research Foundation (WARF) to bring technology to the marketplace, stimulate economic growth and create jobs. A 2011 report by NorthStar Economics, Inc., indicated that UW–Madison research has spawned at least 283 start-ups that support more than 21,000 jobs and contribute an estimated $2 billion to Wisconsin’s economy. Not only do research universities spur the development of new companies, but at times, the knowledge created can produce entirely new industries. Furthermore, research universities produce bright, creative, well-educated, well-trained graduates who learn how to think, write, and analyze information critically, and who enter the job market with first-hand knowledge of the latest methods and technologies.

This document highlights examples of the impact of federal research funding and represents a small portion of the world-class research, teaching and outreach initiatives at UW–Madison.
With almost a third of its budget coming from federal funds, UW–Madison is a national leader among public research universities. According to the National Science Foundation, UW–Madison ranks number three nationally for total research expenditures, and has consistently ranked in the top five of all American universities for more than two decades.

**FY 2013 Budget by Source of Funds**

- Federal: 31%
- Gifts and Grants: 18%
- State Labs: 1%
- Tuition: 16%
- State Taxes - General Program: 10%
- State Taxes - Specific Purpose: 7%
- Auxiliaries: 13%
- Op. Receipts: 4%

**Federal Research Awards 2012**

Total Awards: $610 million

- HHS: 49%
- Other: 4%
- Agriculture: 3%
- Commerce: 3%
- Education: 4%
- Energy: 13%
- NASA: 3%
- NSF: 17%
- Defense: 4%
UW–Madison received approximately $610.9 million in federal research funding. (2012)

FOOD AND AGRICULTURE

UW–Madison received $17.5 million in federal research awards from the U.S. Department of Agriculture.

National Institute for Food and Agriculture (NIFA)

- **Sustainable food production**: Researchers are helping Wisconsin vegetable producers and processors get rewarded in the marketplace for producing products in a sustainable manner. The team focuses on processing of vegetables such as sweet corn and green beans, but the methods serve as a model for other crops. Producers and processors are under pressure from buyers—retail and wholesale food distributors—to document the sustainability of production practices.

- **New sources for energy**: Experts in biochemistry, soil science, agricultural and applied economics and biological systems engineering are developing innovative ways to produce energy from animal manure. Several Wisconsin companies have partnered with UW–Madison researchers to pilot conversion of manure into useful product streams. The project is already under way at a 5,000-cow dairy in eastern Wisconsin.

Hatch Act

- **Food product development**: Food science experts have been unraveling the chemical and biological processes that underlie the creation of yogurt and other cultured dairy products. The work is helping U.S. dairy processors introduce new products—notably an “Americanized” Greek yogurt—that have surged in popularity, spurring economic activity and creating new markets for U.S. milk.

- **Saving the honeybee**: Research into the microbial communities associated with healthy honeybee hives may pave the way for new methods to diagnose and treat hives suffering from Colony Collapse Disorder. This work has led to the discovery of a number of promising new antibiotic-like compounds.

- **A stronger soybean**: Plant scientists have identified a set of genes that make soybeans resistant to Soybean Cyst Nematode, the most damaging disease of soybean. This finding opens the door for plant breeders and plant biotechnologists to further improve nematode resistance in this economically important crop.

ECONOMIC DEVELOPMENT

Department of Commerce

UW–Madison received $20.7 million in federal research awards from the Department of Commerce.

- **Growing Wisconsin’s dairy export market**: The Wisconsin Center for Dairy Research was awarded an i6 Challenge grant to develop new products for fast-growing Asian markets; create new, higher-value uses for cheese and dairy by-products such as whey to grow exports; and develop healthier dairy-based alternatives for school lunch menus.
**SCIENCE AND TECHNOLOGY**

**National Science Foundation (NSF)**

UW–Madison received $103.8 million in federal research awards from the National Science Foundation.

- **Detecting answers**: IceCube is a particle detector at the South Pole that records the interactions of a nearly massless subatomic particle called the neutrino. The detector encompasses a cubic kilometer of ice and uses the neutrino as a novel astronomical messenger to probe the universe, helping scientists understand where cosmic rays come from and learn more about gamma ray bursts and supernovae, the identity of dark matter, and the ability of neutrinos to oscillate, or change type. IceCube is a tool for exploration, and has already changed the way science views the universe.

- **Linking research and education**: The Graduate Research Fellowship Program (GRFP) provides three years of support to highly qualified individuals on research projects with faculty mentors at their chosen institution of study. Ten years ago, 46 graduate students at UW–Madison received fellowships through the program. In 2013, that number has tripled to 138 graduate students in 50 programs.

- **Helping asthma patients**: Industrial and systems engineering experts are developing a new information infrastructure for asthma management in which patients can log their symptoms, medicine usage, and vital physiological signals through a website or smartphone app within the Smart Asthma Management (SAM) system. The project may contribute predictive technologies that can reduce the cost and improve the quality of health care, particularly chronic-illness management, throughout the United States.

**National Aeronautics and Space Administration (NASA)**

UW–Madison received $16.3 million in federal research awards from the National Aeronautics and Space Administration (2012).

- **Measuring our atmosphere**: The UW–Madison Space Science and Engineering Center (SSEC) provides new technologies to achieve an irrefutable benchmark measurement of the current state of the earth's climate using spaceborne observations of emitted radiation.

- **Studying our universe**: SSEC studies outer planets in our solar system to characterize the nature of their atmospheric circulations, dynamics, and clouds. This highly successful comparative planetology effort combines data from a wide array of sources (Hubble Space Telescope, planetary space-flight missions, and ground-based telescopes) with specialized tools to pry a wealth of information from what are often very small signals.

**National Oceanic and Atmospheric Administration (NOAA)**

- **Improving weather forecasting**: The Cooperative Institute for Meteorological Satellite Studies, or CIMSS, provides critical information to the atmospheric science community and to the nation through improved use of remote-sensing measurements for weather forecasting, climate analysis, and monitoring of environmental conditions. CIMSS and SSEC scientists have developed numerous satellite data analysis algorithms that are used operationally by agencies such as the National Weather Service (NWS).

- **Exploring our waterways**: The UW Sea Grant program has helped more than 283 students earn doctoral degrees and 399 earn master's degrees through research and project assistantships.

**Department of Transportation**

- **Infrastructure and our economy**: The National Center for Freight and Infrastructure Research and Education (CFIRE) funds research, outreach, and education on multimodal freight. Researchers in the center aim to make multimodal freight systems work for economic recovery and quality of life.
DEFENSE AND NATIONAL SECURITY

Department of Defense (DOD)

UW–Madison received $26.4 million in federal research awards from the U.S. Department of Defense (2012).

• **State of the art electronics**: Manufacturers’ inability to introduce silicon into flexible electronics has limited their theoretical speed and power to, at most, approximately 15 gigahertz. Thanks to a new production process being pioneered by UW–Madison engineers, that cap could be lifted. Improvement of silicon-based device speed could lead to significant technical and economic advantages.

• **Higher-resolution imaging**: Seeking to address the strategic military need for accurate, high-resolution imaging, a UW–Madison electrical and computer engineer aims to make night vision more accurate and easier for soldiers and pilots to use. Through some key breakthroughs in flexible semiconductors, researchers have created two imaging technologies that have potential applications beyond the 21st–century battlefield.

ENERGY AND NATURAL RESOURCES

Department of Energy (DOE)

UW–Madison received $81 million in federal research awards from the U.S. Department of Energy (2012)

• **Growing new sources of energy**: The Great Lakes Bioenergy and Research Center (GLBRC) performs the basic research that generates technology to convert cellulosic biomass to ethanol and other advanced biofuels. GLBRC is working to meet the nation’s need for a comprehensive suite of clean energy technologies, including next generation and drop-in fuels that can be used in today’s engines. GLBRC’s research supports the development of a robust pipeline from biomass production through pretreatment and final conversion to fuel, with sustainability providing a unifying theme.

• **Transforming fuel**: Professor Ron Raines (biochemistry) developed a technology that has been licensed by Hyrax Energy. This technology, supported by GLBRC, provides a new way to transform cellulosic biomass into renewable fuels and high-value chemicals.

• **Powering our world**: Fusion-related research at UW–Madison spans three departments in two colleges; includes more than 150 faculty, staff, and students; and covers a range of theoretical, experimental and technological aspects of plasma science and fusion. Since the 1960s, fusion-related research in the UW–Madison departments of Physics, Electrical and Computer Engineering, and Engineering Physics has garnered more than $100 million in funding, much of which comes from the U.S. Department of Energy.

• **Going nuclear**: Several engineering physics researchers have received Department of Energy Nuclear Energy University Program grants totaling $2.2 million for projects to improve a nuclear fuel-cycle simulator and to study materials for corrosion resistance.

HUMANITIES AND ARTS

National Historical Publication and Records Commission (NHPRC)

• **Preserving our critical historical records**: The National Historical Publication and Records Commission (NHPRC) provides funding for such national projects as the papers of the Founding Fathers, Abraham Lincoln, Elizabeth Cady Stanton/Susan B. Anthony, Thomas Edison, Albert Einstein, Eleanor Roosevelt, and many others. Hundreds of volumes have been made possible by modest grants from the NHPRC, including The Documentary
History of the Ratification of the Constitution here at the UW–Madison, which has so far published twenty-two volumes in its effort to re-create the great debate that took place when the Constitution and the Bill of Rights were submitted to the people for their approval. Since 1964, the NHPRC has made grants to projects all over Wisconsin, including the UW–Madison Center for the Study of the Upper Midwestern Cultures, and to state, local, tribal, and private archives, such as the Milwaukee Archdiocese, the Manitowoc Maritime Museum, and the Menominee Indian Tribe.

National Endowment for the Humanities (NEH) & National Endowment for the Arts (NEA)

- **Protecting historical films and cultural treasures:** A Preservation and Access Research and Development grant from the National Endowment for the Humanities (NEH) has funded a study at UW–Madison titled “Investigation of Cellulose Nitrate Motion Picture Film Chemical Decomposition & Associated Fire Risk.” It tests cellulose nitrate film stock with the goal of creating guidelines for the handling and long-term storage of this highly unstable medium.

  The study will bring together the Wisconsin Center for Film and Theatre Research, the Wisconsin Historical Society, and the Department of Chemistry's Mahanthappa Research Group. This project will provide archival institutions with better information for cost-benefit analyses of preserving nitrate film holdings, as well as clarify contradictory information circulating in current standards and serve as a model for future collaborations between the archival, chemical, and safety communities.

HUMAN HEALTH

**Department of Health and Human Services (DHHS)**

UW–Madison received $299.6 million in federal research awards from the U.S. Department of Health and Human Services (2012)

**National Institutes of Health (NIH)**

- **Caring for children and families:** The Waisman Center is one of 15 research centers focused on health care for children with intellectual disabilities and related developmental disabilities. Recent research has led to the discovery of the genetic causes of developmental disorders (such as Alexander disease), developed new intervention and treatment strategies for various developmental disabilities (such as autism, fragile X syndrome, and Down syndrome), and advanced novel therapeutics that have the potential to ameliorate the symptoms of neurodegenerative disorders (such as retinitis pigmentosa). It is also a center for stem cell research, which has great promise for advancing science and eventually for treating neurodegenerative diseases.

- **Advancing understanding:** The Wisconsin National Primate Research Center (WNPRC) is a leader in several areas of basic and translational biomedical research, as well as in human care of captive animals, field biology, and conservation of primate species. Within the center's current program are advances in stem cell biology, research on aging, infectious diseases research, neurobiology, and women's health.

- **Healthy hearts:** A team of UW–Madison researchers has discovered important biomechanical changes in human arteries that could increase understanding of how pulmonary hypertension leads to heart failure. The researchers studied whether there is a link between the arterial changes caused by pulmonary arterial hypertension and the dysfunction of the heart’s right ventricle. The team, led by associate professor Naomi Chesler, received funding from the National Institutes of Health and the American Heart Association Midwest Affiliate Postdoctoral Fellowship.
• **Support the aging**: The Wisconsin Alzheimer’s Institute was awarded a five-year, $4.3 million award to support core activities in the Wisconsin Registry for Alzheimer’s Prevention (WRAP) and its many sub-studies. The registry earned a “high program relevance” designation, meaning it serves a national interest worth protecting. The grant comes from National Institute on Aging (NIA) discretionary funds.

• **Healthy babies**: A new technique to diagnose and treat dangerous heart rhythms in the womb is being developed by UW–Madison researchers. Funded by a grant from the NIH, the study is the first to document characteristics of Long QT syndrome and evaluate the diagnostic accuracy of a magnetocardiogram (MCG). Long QT syndrome is an abnormal heart rhythm found in about one in every 2,000 newborns and has been linked to stillbirths and sudden infant death syndrome (SIDS); ultrasounds and EKGs are not effective in diagnosing this abnormality.

• **Treating Multiple Sclerosis**: New findings from a team of UW’s School of Medicine and Public Health researchers indicate that immune cells can be engineered to create a new type of treatment for people with Multiple Sclerosis (MS). Currently, there are few good medications for MS, an autoimmune inflammatory disease that affects some 400,000 people in the United States, and none that reverse progress of the disease. A VA Merit Award from the Biomedical Laboratory Research and Development service of the Department of Veterans Affairs and National MS Society research grant supported the research.

• **Attacking cancer**: A research team at the UW Carbone Cancer Center developed a model that can more accurately pinpoint the risk of aggressive prostate cancer. The model, called Biopsy-Integrated Algorithm for Determining Gleason Upgrading Risk (BADGR), provides the patient with a percentage assessment for risk of upgrading and is a significant improvement over single variables alone.

Medical researchers in the UW School of Medicine and Public Health discovered a previously unknown mechanism within human cells that may explain how many cancers develop a resistance to common cancer therapies. They examined the relationships between epidermal growth factor, its receptors, and the biological process for regulating cellular growth.

Research to examine the link between when the human body interprets genetic code and the development of breast cancer is under way at the UW–Madison’s Carbone Cancer Center. An essential aspect of the study involves comparing the genes of more than 7,000 Wisconsin women to identify how differences might affect the incidence of cancer. Collaborating with local stakeholders, the team will then map out which environmental factors could be triggers. Funding for the studies came primarily from the National Cancer Institute of the NIH.

**Agency for Healthcare Research & Quality (AHRQ)**

• **Health care at home**: To gain insight into the factors that influence a person’s ability to manage a health condition at home, researchers from the UW School of Medicine and Public Health, School of Nursing, School of Human Ecology, and College of Engineering have developed an approach that combines data from real household environments, home health care expertise, and virtual reality technology. A $2.5 million grant from the Agency for Healthcare Research & Quality will fund data collection by capturing 360-degree, detailed images of homes of people living with diabetes — afterward translating the images into 3-D with an immersive, virtual reality CAVE (Cave Automatic Virtual Environment) at the Wisconsin Institute for Discovery (WID) Living Environments Laboratory (LEL).

• **Team-based health care**: In what is believed to be the first study that compares the effectiveness of doctor-only care with team care that includes doctors and nurse
practitioners (NPs) or physician assistants (PAs), UW researchers reported that such multidisciplinary teams can produce equivalent or better outcomes for patients with chronic illness, particularly for patients with lower-complexity health conditions. Funding for the study came from AHRQ.

**Patient-Centered Outcomes Research Institute (PCORI)**

**Caring for women and children**: As a result of multi-million dollar awards from the Patient-Centered Outcomes Research Institute (PCORI), UW–Madison School of Medicine and Public Health researchers will study patient-centered approaches to follow up care for breast cancer survivors and improving quality of life for kids with Type 1 diabetes.

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**EDUCATION**

**Department of Education (ED)**

UW–Madison received $22.9 million in federal research awards from the Department of Education (2012).

- **Preparing first-generation and minority college students**: The Ronald E. McNair Post-baccalaureate Achievement Program, named after an African-American astronaut and physicist killed in the 1986 Challenger explosion, is funded by the Department of Education TRIO grant. The purpose of the Ronald E. McNair program is to prepare first-generation college students from low-income families and underrepresented minorities for Ph.D. programs. The ultimate objective is to increase diversity within the academy as well as the number of low-income and minority students with doctoral degrees. Across the UW System, the McNair program has helped more than 1,370 undergraduates over the past two decades. Of the 267 McNair Scholars since 1996, 210 have enrolled in graduate studies. To date, 16 percent of the scholars have completed Ph.D.’s and 72 percent are in science, technology, engineering and mathematics (STEM) fields.

- **Closing the achievement gap**: The Institute of Education Sciences (IES) is the federal government’s principal agency for conducting research on education. Even in an atmosphere of constrained federal funding, the Wisconsin Center for Education Research (WCER) remains very successful in attracting IES and other Department of Education funding for its broad-based research agenda. In the past year, WCER received more than $5 million in IES funds supporting 16 projects. Other Department of Education funding accounted for another $5 million per year for nine projects. For example, with Wisconsin’s achievement gap among the largest in the nation, efficacy trials of interventions to reduce stereotyping could have a significant impact on education policy and practice in the state. Researchers are in the final year of a $1.5 million project developing cost-effective intervention strategies that could easily be replicated and implemented in school systems across the country.

- **Global and international expertise and skill development**: Title VI and Fulbright Hays, funded by the Department of Education under the Higher Education Act, support the development of the higher education infrastructure that produces the nation’s international expertise, trains our citizens for the global workplace, and disseminates international knowledge. The UW–Madison campus currently has one of the largest numbers of merit-based Title VI funded National Resource Centers (NRCs) of any university in the nation. These eight regionally focused National Resource Centers (NRCs) specialize in: African Studies; East Asian Studies; European Studies; Global Studies; Latin American, Caribbean and Iberian Studies; Russia, Eastern Europe and Central Asia; South Asian Studies; and Southeast Asian Studies. Title VI also provides support for the complementary Center for International Business Education and Research (CIBER) program.
For more information, please contact UW–Madison’s Office of Federal Relations (www.federalrelations.wisc.edu).

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