



# NEW POSSIBILITIES

THROUGH RESEARCH AND PUBLIC SERVICE





## ANTICIPATING TOMORROW'S CHALLENGES

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The scope and impact of WSU's research far outstretch the confines of these pages. The sampling of research profiles in this report only hints at the greater volume of work conducted by each individual represented and by our many colleagues whose names do not appear in this booklet.

To learn more about the rich tapestry of discovery unfolding throughout the state, visit [wsu.edu](http://wsu.edu).

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WASHINGTON STATE UNIVERSITY has achieved international recognition for the quality, diversity, and impact of its research. The following pages highlight our recent research accomplishments in the realms of agriculture and plant sciences, clean technologies, and health. Among researchers' goals are to ensure a safe and abundant food supply, to create a healthier world for humans and animals, and to advance sustainable agricultural and environmental practices.

The year ahead will be filled with exciting opportunities. WSU is partnering with the Washington wine industry to build a world-class wine research and education program. It will provide viticulture and enology professionals with the technical know-how to support growth of the state's wine industry. In addition, the University has forged a comprehensive plan to expand wine science research programs and facilities statewide.

This year also marks the beginning of an innovative partnership between WSU and the Massachusetts Institute of Technology, with the development of a new Federal Aviation Administration Center of Excellence for Alternative Jet Fuels and the Environment. The Center aims to foster a new job-rich industry focused on developing alternative jet fuels. It will help the nation's aerospace industry evolve a cleaner and more efficient air transportation system.

WSU's robust research agenda aims to meet our society's next generation of challenges. Our discoveries will enhance economic vitality and quality of life throughout Washington—and beyond.

Nancy Magnuson, Ph.D.  
Interim Vice President for Research



# Growing

## AGRICULTURAL AND PLANT SCIENCES



### Fueling the Future

Why do some plants tolerate drought better than others? The answer could help ensure adequate supplies of food and fuel as climate change pushes weather to extremes.

**IN THE SCHOOL OF BIOLOGICAL SCIENCES**, plant biologist Asaph Cousins probes the complex relationship between plants and climate. By monitoring plants' responses to drought, he amasses enough data to predict how plants will withstand future shifts in climatic conditions. This allows him to identify traits and pathways for improving plant productivity and drought resistance, particularly in bioenergy grasses.

Dr. Cousins is part of a nationwide team working to discover the mechanisms that underlie drought responses. Supported by a five-year, \$12 million grant from the U.S. Department of Energy, he and his colleagues at Danforth Plant Science Center in St. Louis; Carnegie Institution for Science; the University of Illinois, Urbana-Champaign; and the University of Minnesota are assembling a full genetic and physiological profile of *Setaria viridis*, a grass closely related to corn and bioenergy feedstocks.

When the analysis is complete, researchers will be able to match physiological features like drought resistance and productivity with their respective genetic controls. Ultimately, it will give researchers a blueprint for breeding new biofuel species—plants that produce high yields in the driest of times.

## Growing the Regional Economy

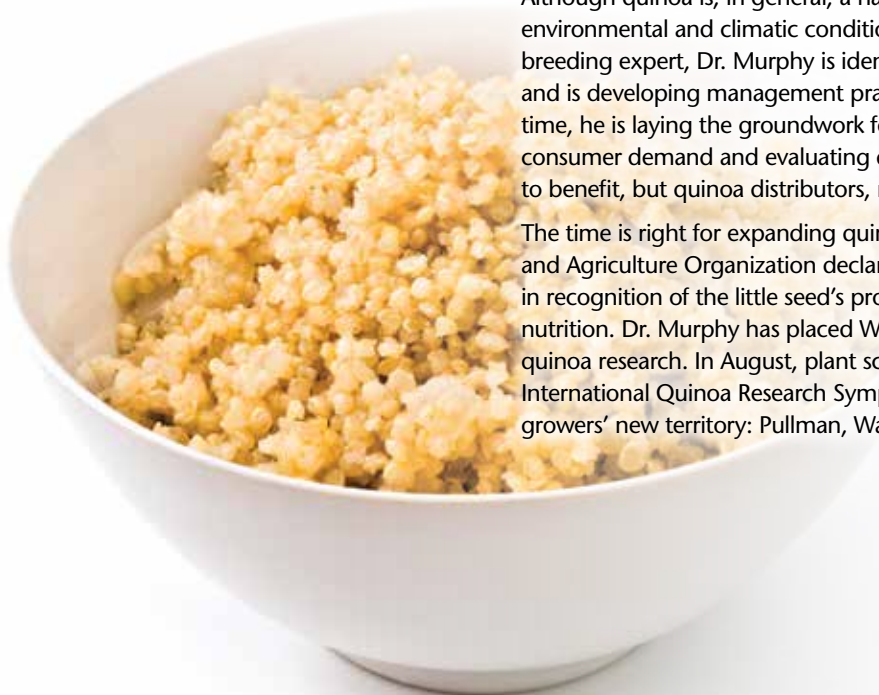
Quinoa is the only plant-derived food that provides all the essential amino acids, as well as important trace elements and vitamins, without a trace of gluten—a protein found in grains that triggers sensitivities in many people. Skyrocketing demand for quinoa far outstrips the production ability of farms in South America, the location where it has traditionally been grown. Crop and Soil Sciences Professor Kevin Murphy sees this shortage as an opportunity for Pacific Northwest farmers.



WITH A \$1.6 MILLION GRANT from the U.S. Department of Agriculture, Dr. Murphy and his team plan to transform the region into a center of domestic quinoa production. At the same time, his research has the potential to make quinoa a more global crop, allowing it to be grown in harsh climates around the world where few other crops thrive.

Although quinoa is, in general, a hardy crop that can adapt to many environmental and climatic conditions, it has limited tolerance for heat. A plant breeding expert, Dr. Murphy is identifying varieties that can flourish in this region and is developing management practices for optimal production. At the same time, he is laying the groundwork for bringing the product to market, assessing consumer demand and evaluating distribution options. Not only do growers stand to benefit, but quinoa distributors, retailers, and consumers as well.

The time is right for expanding quinoa production. The United Nations Food and Agriculture Organization declared 2013 the International Year of Quinoa in recognition of the little seed's promise for providing food security and nutrition. Dr. Murphy has placed Washington State University at the forefront of quinoa research. In August, plant scientists from 23 countries convened at the International Quinoa Research Symposium, which was held at the heart of quinoa growers' new territory: Pullman, Washington.

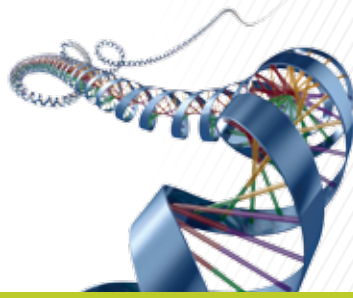




# Growing

AGRICULTURAL AND PLANT SCIENCES





## Seeking New Solutions for Infertility

Pregnancy loss afflicts a whopping 25 to 30 percent of beef cattle. In dairy cattle, fertility drops one percent each year, posing one of the biggest barriers to global competitiveness for American dairy farmers. Uncovering the reasons for fertility failures could not only raise cattle ranchers' profits, but might reveal new ways to help human pregnancies succeed as well, says Thomas Spencer, WSU professor of animal sciences and the Baxter Endowed Chair in Beef Cattle Research.

WITH MORE THAN \$1 MILLION IN FUNDING from the Eunice Kennedy Shriver National Institute of Child Health and Human Development and another \$3 million from the U.S Department of Agriculture's National Institute for Food and Agriculture, Dr. Spencer and his research team are forging new technologies to diagnose, treat, and prevent infertility in beef and dairy cattle.

Dr. Spencer compares the genetic makeup of easily impregnated cattle with that of animals who rarely get pregnant. He aims to identify biomarkers that could be used in clinical settings to anticipate fertility problems. In addition to searching for genetic markers in heifers and cows, he is exploring sires' genetics for factors that may contribute to daughter pregnancy rates.

What Dr. Spencer seeks is a "bench-to-bedside result"—a discovery that will lead to new diagnostic tools and therapies for a large segment of animal agriculture in the United States. Such a discovery could also deliver new hope for want-to-be mothers and fathers in the form of groundbreaking infertility treatments.



# Growing

AGRICULTURAL AND PLANT SCIENCES







## Helping the State's Wine Industry Cultivate Prosperity

With more than 750 wineries, Washington is the second largest wine-producing state in the nation. Washington wines have earned international acclaim for their outstanding quality.

IN 2014, Washington State University will open a new Wine Science Center at the epicenter of wine country—on the WSU Tri-Cities campus in Richland. The 45,000-square-foot research and teaching facility was designed in partnership with leaders of the state's wine industry and local economic development agencies. Discoveries made there will help the industry prosper in the global marketplace. Students will receive ample opportunities to participate in internships and gain employment in the industry. Professionals can attend seminars to build their knowledge of new vineyard management and winemaking techniques.

The University currently prepares the wine industry's workforce through academic programs in viticulture and enology—including the only four-year baccalaureate program in the state. In the past five years, the number of students graduating from that program has tripled, paralleling industry growth and employment demand. WSU also educates future professionals through two-year certificate programs, masters and doctoral degrees in viticulture and enology, and an undergraduate degree in wine business management.

More than 30 WSU faculty members focus on wine-related research. Scholars work with the viticulture industry to overcome the challenges of grape growing. They explore the economics of running a successful winery. And, of course, they work to improve the flavor of Pacific Northwest wines, which helps build international demand.

### ENTRY VIEW

Wine Science Center, Washington State University, Tri-Cities  
Lydig Construction | ALSC Architects

# Strengthening HEALTH SCIENCES

## Marshaling Communities to Stop Substance Abuse

Substance abuse exacts a heavy toll on American Indians and Alaska Natives. John Roll, professor and senior vice chancellor for WSU Spokane, aims to stem that population's tide of addiction by launching a community-based research, training, and outreach center.

**THE BEHAVIORAL HEALTH COLLABORATIVE FOR RURAL AMERICAN INDIAN COMMUNITIES** will examine multiple influences on behavioral health throughout patients' lifespans. It is funded by a \$6.7 million grant from the National Institute on Minority Health and Health Disparities (part of the National Institutes of Health).

Working with co-investigator Sterling McPherson and other investigators at the University of Washington and WSU, the team will build partnerships with members of the American Indian community throughout the Inland Northwest and engage them in key roles in the Center. Scientific research will be combined with a community-based participatory approach. The Center will reach out to people of all ages—children, college students, and adults. Dr. Roll and Dr. McPherson hope to build deep ties to American Indian communities, bringing people together to achieve common goals: improving health and quality of life.







Dr. John Roll, WSU Spokane

# Strengthening HEALTH SCIENCES

## Reducing the Threat of Rabies in Africa

Canine rabies is endemic in the African nation of Tanzania. The bite of an infected dog can be deadly to humans, and the virus it transmits takes the lives of nearly 1,500 Tanzanians each year, according to World Health Organization estimates. Almost half of those bitten are children under the age of 15.

**THE OBVIOUS SOLUTION** is to vaccinate dogs against the disease, but it is a tough proposition in a country with few resources. Guy Palmer, Regents professor and director of the Paul G. Allen School for Global Animal Health, is researching ways to create a sustainable rabies vaccination program in Tanzania. He and his colleagues work with community leaders to arrange dog vaccination clinics.

In January 2013, major league soccer players from the Seattle Sounders Football Club traveled to WSU's Allen School vaccination clinic in Kamba Ya Simba, Tanzania—the site of a recent rabies outbreak—to promote a rabies vaccination program for village dogs. Many dog owners in Tanzania are children. The players' visit, enabled through a partnership with the Washington Global Health Alliance, attracted hundreds of kids to get their dogs vaccinated.

Dr. Palmer wants to spur local communities to offer their own vaccination programs, because it would reduce a major cost: transporting vaccination teams from village to village. What's more, vaccination clinics could be used not only to provide care for dogs, but for the children who own them as well.







# Strengthening HEALTH SCIENCES

## Finding Treatment for Genetic Disorders

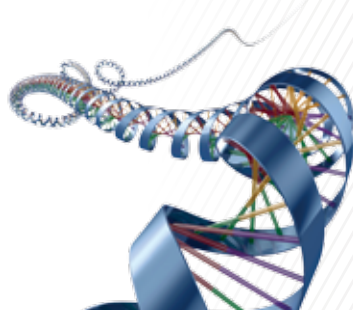
A rare inherited disorder that afflicts children, succinic semialdehyde dehydrogenase (SSADH) deficiency, mimics autism and epilepsy. It triggers seizures, low muscle tone, developmental delays, and a host of neurological problems. There is no treatment beyond simply managing seizures and other symptoms.

**SSADH DEFICIENCY IS CAUSED** by a mutation in a single gene that leaves a critical enzyme in short supply. K. Michael Gibson, a board-certified clinical biochemical geneticist and director of the Clinical Pharmacology Unit in the College of Pharmacy, discovered the enzyme defect during his doctoral studies. Now, he is searching for ways to treat it.

With a \$743,974 grant from the National Institutes of Health, Dr. Gibson and his collaborators are testing the effectiveness of an experimental drug to treat SSADH deficiency. Positive results would not only deliver relief to sufferers of SSADH, but could accelerate development of effective treatments for other inherited disorders as well.







# Innovating

CLEAN ENERGY TECHNOLOGIES







## Developing New Sources of Transportation Fuel

Tomorrow's airplanes and automobiles may be fueled by today's waste. An abundance of waste material known as cellulosic biomass could supply 27 percent of the world's transportation fuels in the years ahead, according to the International Energy Agency.

**CELLULOSIC BIOMASS**, which is organic material not suitable for use as food, includes forest underbrush, perennial grasses, sawdust, paper pulp, and industrial and municipal waste. Washington State University scientists are working to overcome the barriers to transforming this renewable biomass into biofuel for transportation.

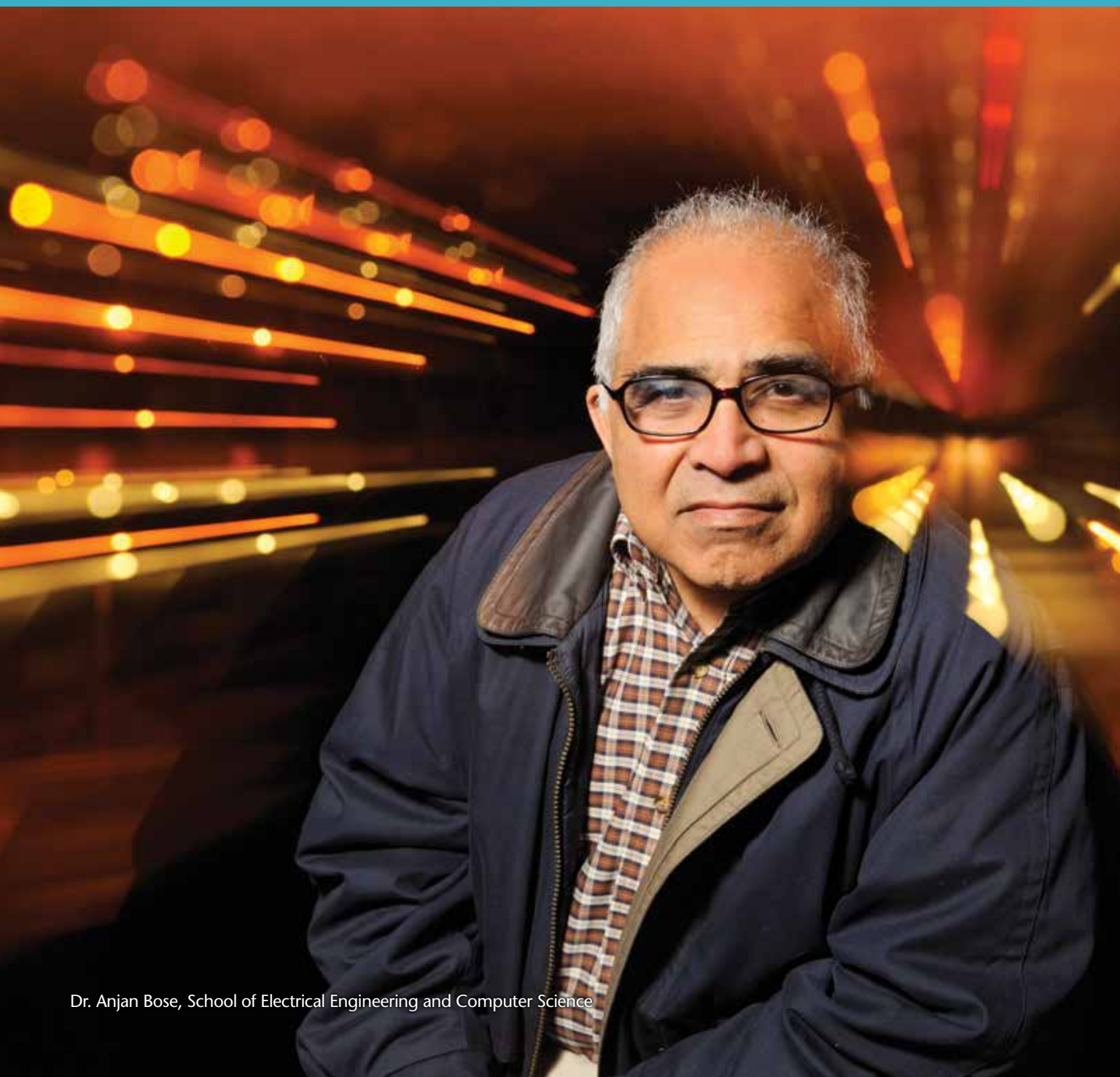
Conversion processes must be efficient, ecofriendly, and affordable. That's why Shulin Chen, director of the University's Bioprocessing & Bioproducts Engineering Laboratory, explores using natural biological systems to deconstruct lignocellulosic biomass (biomass found in plant cell walls). With nearly \$2 million in funding from the National Science Foundation, he probes ways to break down plant cell walls without harsh chemicals by harnessing nature's own arsenal: termites and white rot fungi. Using biomimicry, he hopes to create a new generation of biorefineries that would dramatically improve the efficiency of biofuel production.

In addition, Washington State University faculty lead the Northwest Advanced Renewables Alliance (NARA), a consortium that unites private industry and educational institutions to build a supply chain for aviation biofuel production. Supported by a \$40 million grant from the U.S. Department of Agriculture's National Institute of Food and Agriculture, NARA seeks to create a sustainable industry to produce aviation biofuels and coproducts efficiently from a variety of feedstocks, including forest residues and construction waste.

The Federal Aviation Administration recently selected WSU and Massachusetts Institute of Technology (MIT) to co-lead the new Center of Excellence for Alternative Jet Fuels and the Environment. The Center aims to foster a new industry focused on developing alternative jet fuels. At the same time, it will help address emerging environmental needs of the nation's aerospace industry.

# Innovating

CLEAN ENERGY TECHNOLOGIES



Dr. Anjan Bose, School of Electrical Engineering and Computer Science





## Ensuring a Reliable Power Supply

On a hot August day in 2003, a falling tree branch in Ohio triggered a power outage that rippled across eight U.S. states and into Canada, cutting power to 50 million people. As transportation ground to a halt, food spoiled, and indoor heat soared to intolerable highs, the critical need for a reliable energy supply became irrefutably clear. Today, the electrical grid has the smarts to avert such a disaster, in part because of research conducted at Washington State University.

**WSU LEADS THE NATION'S EFFORTS** to increase the reliability and efficiency of the "smart grid," the computer-automated network that distributes electricity nationwide. In partnership with the U.S. Department of Energy, WSU scholars explore new technologies to advance power grid operation and control, dependability, and security. They seek ways to automate power distribution, integrate renewably generated power, and prevent blackouts.

Anjan Bose, distinguished professor in power engineering and National Academy member, works to develop a software platform for testing the smart grid. Dr. Bose serves as a senior advisor to the U.S. Department of Energy, where he leads an effort to coordinate research on electric power grid technologies. His work is part of a greater body of research conducted at the University's Energy Systems Innovation Center. The Center's multidisciplinary studies on electric energy and its social and economic impacts support development of public policy at the state and federal levels.

Educating tomorrow's power engineers is a top University priority. Backed by a \$2.5 million grant from the Department of Energy's National Energy Technology Laboratory (NETL), scholars in the University's Smart Grid Demonstration and Research Investigation Laboratory are developing a workforce training program. Its goal: to prepare the clean energy and smart grid engineers of tomorrow.

# Reaching

INTERNATIONAL IMPACT



Dr. Kulvinder Gill, Department of Crop and Soil Sciences





## Developing High-Yielding Wheat Cultivars that Withstand Heat and Climate Change

On the North Indian River Plain, just south of the Himalayas, nearly one billion people face challenges of limited water and rising temperatures. As climate change progresses, soaring heat will test the productivity of crops that feed the world's burgeoning population.

**UNDER THE DIRECTION** of Kulvinder Gill, the Vogel Endowed Chair for Wheat Breeding and Genetics, Washington State University is leading a \$16.2 million effort to develop wheat varieties that can tolerate high temperatures. While withering heat pervades most of the world's growing regions, Dr. Gill focuses his study on the North Indian River Plain—where he worked on his family's Punjab farm as a child. But his discoveries will reach far beyond his homeland, benefitting all wheat-growing regions of the world.

Researchers will combine conventional and newly developed breeding tools to identify genes associated with heat tolerance, a rarely studied trait with an outsized importance in yields. A wheat plant's productivity falls off dramatically when temperatures rise above 82°F, and the effects are particularly dramatic in the flowering stage when the plant sets the seed that is ultimately harvested and milled for food. In the flowering stage, a temperature increase of just a few degrees above 82°F cuts yields by three to four percent. Some parts of the North Indian River Plain can reach 95°F during flowering.

The research is part of the U.S. government's global hunger and food security initiative, Feed the Future. It is supported by the U.S. Agency for International Development (USAID), the Indian Council of Agricultural Research (ICAR), and the Directorate of Wheat Research (DWR).



# Reaching

INTERNATIONAL IMPACT



Saffron farm in Afghanistan





## Fostering Agricultural Productivity in Afghanistan

Farmers in arid, war-torn Afghanistan lack the resources needed to meet increasing demand for food. The nation is short on agricultural research and experts who can steer farmers in new directions. In addition, climate change challenges longstanding farming practices and hampers productivity.

**WASHINGTON STATE UNIVERSITY SCHOLARS** are applying science and technology to increase Afghan agricultural productivity and income. The University is leading a team of institutions—University of California Davis, Texas A&M University, and Roots of Peace, a California-based private voluntary organization—to implement the USAID Agricultural Research and Extension Development (AGRED) program.

With a five-year, \$7.1 million grant, Chris Pannkuk, WSU director of international research and development, leads a team helping Afghan officials build applied research and agricultural extension services that they can sustain themselves. Training programs enable researchers and extension officers to better address the needs of farmers and agribusinesses. Dr. Pannkuk's team devises ways to deliver new technologies and improved agricultural practices to thousands of farmers to raise production and farm incomes. The resulting restructuring of seven regional research and extension centers around the country will increase their benefit to local farmers.

Also in the works is development of a competitive research funding program that will identify, assess, and test improved technologies and practices that increase farm incomes. The program will stimulate teamwork among the nation's agricultural officials, universities, and the private sector, creating an engine for agricultural innovation.

# Honoring EXCEPTIONAL SCHOLARSHIP

## The Nation's #1 Online MBA Programs

The College of Business' online Masters of Business Administration and Executive MBA programs are the best online graduate business programs in the nation, according to the *U.S. News & World Report* Top Online Education rankings (January 2013). These degree programs equip students with leadership skills and industry connections that are vital to advancing careers.





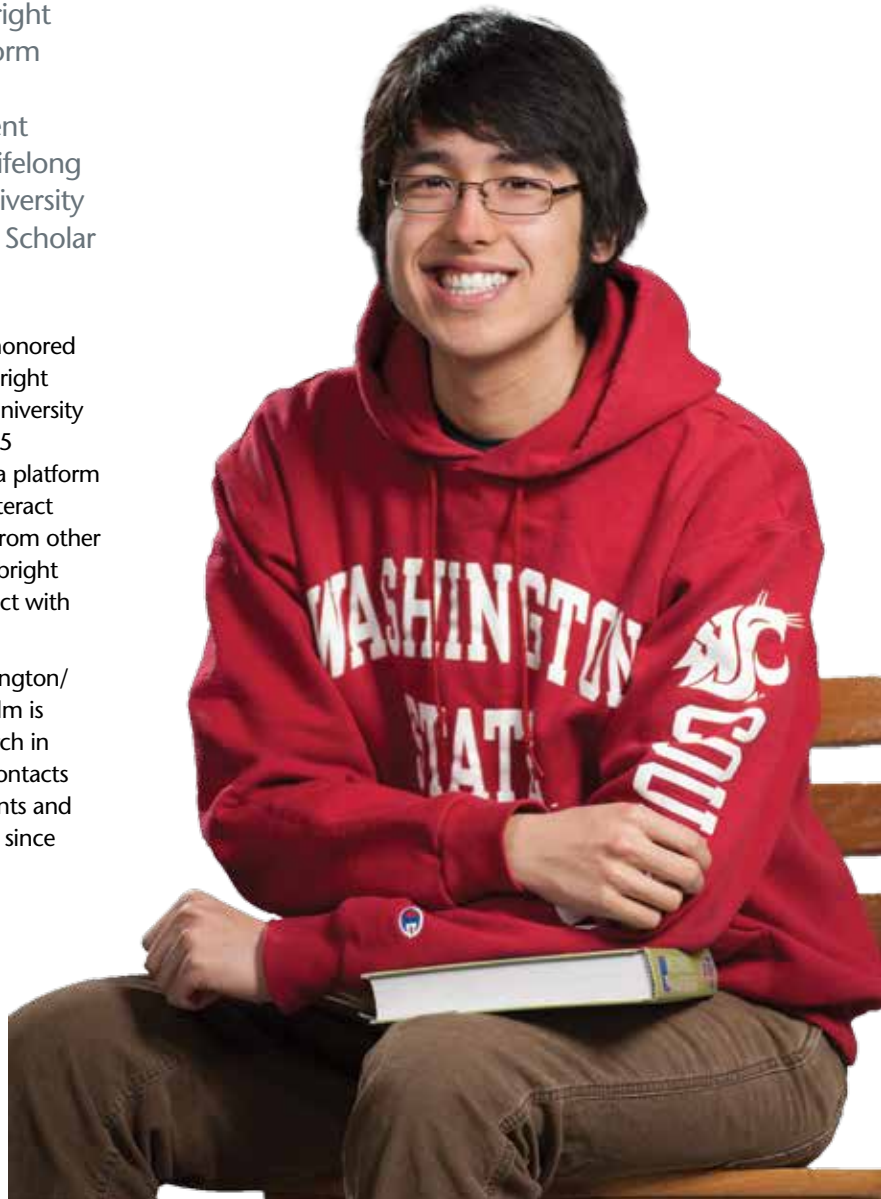
## Supporting Fulbright Scholars

One of the world's most prestigious faculty and student programs for professional development and international collaboration is the Fulbright Scholar award. The award "... can transform your professional career and propel your research agenda in new directions, augment your international recognition, and forge lifelong collaborations," says Washington State University English professor and three-time Fulbright Scholar Susan Dente Ross.

**SINCE 1976**, 99 WSU faculty members have been honored with Fulbright Scholar awards. To promote the Fulbright program and advise those seeking the award, the University has created the Fulbright Academy. Composed of 15 previous Fulbright Scholars, the Academy provides a platform for faculty, students, and staff to exchange ideas, interact socially, and elevate their understanding of people from other countries. The Academy also helps international Fulbright faculty and students who are visiting WSU to connect with others in the community.

The Academy recently established an Eastern Washington/Northern Idaho Fulbright alumni chapter. At the helm is Mustaq Memon, who taught and conducted research in Oman as a 2006-07 Fulbright Scholar. Because of contacts he made during his fellowship, more than 51 students and faculty from Oman's Sultan Qaboos University have since completed degrees at WSU.

Graduate student Julian Reyes,  
a 2011 Fulbright recipient,  
studied engineering in Germany.



# Advancing FEDERAL TRAINING GRANTS AT WSU

Federal training grants help create a diverse pool of highly trained scientists to address critical challenges facing the nation. WSU maintains numerous federally funded programs that prepare students to navigate shifting tides of science and policy.

## Integrative Graduate Education and Research Traineeship Program (IGERT)

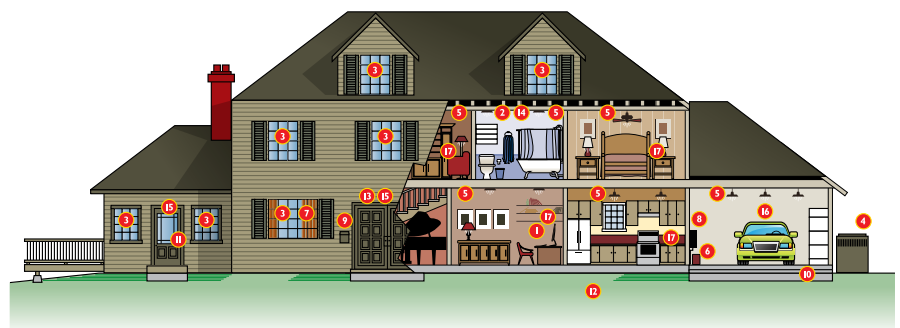
The National Science Foundation's interdisciplinary training program teaches students to stretch their ideas beyond disciplinary boundaries. Today's IGERT trainees become tomorrow's leading scientists and engineers. In 2013 there were three active IGERT programs at WSU.

## Smart Environments

**THIS IGERT PROGRAM** provides doctoral students with integrated training in computer science, electrical engineering, mechanical engineering, psychology, sociology, and health care to support the design of smart environments. IGERT participants conduct research to address the questions of whether technology can automatically monitor and analyze human health and behavior, whether it can simulate human behavior and activities, whether it can enhance human physical and cognitive abilities, and whether these technologies can be accepted by society.

Project faculty include primary investigator Diane Cook (Huie-Rogers Chair and professor of electrical engineering and computer science [EECS]), Larry Holder (EECS), Sankar Jayaram (materials and mechanical engineering), Maureen Schmitter-Edgecombe (psychology), and Behrooz Shirazi (EECS).

 [igert.eecs.wsu.edu](http://igert.eecs.wsu.edu)



- |  |                        |                                   |
|--|------------------------|-----------------------------------|
| 1 Ambient Intelligence Agent (Aml) Control | 6 Automatic Pet Feeder | 12 Lawn Moisture Sensor           |
| 2 Light Sensor                             | 7 Motorized Drapes     | 13 Face Recognition Sensor        |
| 3 Windows and Door Control                 | 8 Automatic Watering   | 14 Motion Sensors                 |
| 4 HVAC Control                             | 9 Mailbox Sensor       | 15 Door Sensors                   |
| 5 Lighting Control                         | 10 Driveway Sensor     | 16 Aml Interface with Car         |
|  | 11 Security System     | 17 Aml Interface with Smart Phone |

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## Policy Oriented Integrated Research and Education (NSPIRE)

THE NSPIRE IGERT PROGRAM is a multidisciplinary student doctoral training program designed to create a new generation of scientists with broad and rigorous training in nitrogen cycling. These scientists should be able to seamlessly integrate nitrogen cycle science into effective communication with public policy makers.

Core NSPIRE participants include civil and environmental engineering faculty Jennifer Adam, Shane Brown, and principal investigator Brian Lamb; earth and environmental sciences faculty Andrew Ford, Kent Keller, Shelley Pressley, and William Budd (assistant director, Division of Governmental Studies & Services [DGSS]); R. David Evans (biological sciences); Kristen Johnson (animal sciences); Nicholas Lovrich (professor, political science; director, DGSS), WSU's faculty representative to the legislature; William Pan (crop and soil sciences); and Steven Stehr (chair, political science).

 [igert.nspire.wsu.edu](http://igert.nspire.wsu.edu)



## IGERT: Program in Evolutionary Modeling (IPEM)

ONGOING SINCE 2006, the IPEM program bridges the gap between anthropology and biology. It provides students in both disciplines with a common curriculum that emphasizes evolutionary processes of adaptation and diversification in genetic, behavioral, and cultural domains. Students learn state-of-the-art methods including computational modeling, game theory, and phylogenetic analysis to study evolutionary processes across fields.

Core IPEM faculty include WSU anthropologists Ed Hagan, Barry S. Hewlett, Brian Kemp (who has a joint appointment in biological sciences), principal investigator Timothy Kohler, Karen Lupo, and Robert J. Quinlan and University of Washington anthropologists Ben Fitzhugh, Darryl J. Holman, and Donna Leonetti.

# Advancing

FEDERAL TRAINING GRANTS AT WSU



Dr. Amit Dhingra, Department of Horticulture Genomics Lab



## PARTICIPATING FACULTY



NEHAL ABU-LAIL  
 HECTOR AGUILAR-CARRENO  
 JOHN ALDERETE  
 WENFENG AN  
 PAUL BENNY  
 CLIFF BERKMAN  
 HALUK BEYENAL  
 MARGARET BLACK  
 KELLY BRAYTON  
 JOHN BROWSE  
 DOUGLAS CALL  
 AMIT DHINGRA  
 WEN-JI DONG  
 DAVID GANG  
 MICHAEL GRISWOLD  
 CYNTHIA HASELTINE  
 CORNELIUS IVORY  
 MICHAEL KAHN  
 CHULHEE KANG  
 KWAN HEE KIM  
 MICHAEL KONKEL  
 ALLA KOSTYUKOVA  
 LEIGH KNODLER  
 B. MARK LANGE  
 NORMAN LEWIS  
 MICHAEL NEFF  
 ANTHONY NICOLA  
 JOHN NILSON  
 GUY PALMER  
 DEVENDRA SHAH  
 MICHAEL SMERDON  
 VIVEKA VADYVALOO  
 SUSAN WANG  
 JOHN WYRICK  
 PING YE

## National Institutes of Health (NIH) Biotechnology Training Program

The NIH Biotechnology Training Program seeks to prepare the next generation of scientists and engineers with expertise in biotechnology. At WSU, the program has been continuously funded for 24 years. Thirty-five faculty members from seven departments (and four different colleges) provide interdisciplinary academic and industrial training in biotechnology research at the graduate level. The rigorous program emphasizes the fundamentals and complexities

of protein chemistry and draws heavily on faculty members' past and current research accomplishments. Student members of the Training Program gain experience in conducting biotechnological research in government and industrial settings and learn how to bring ideas to market.

 [sciences.wsu.edu/Biotech/info.html](http://sciences.wsu.edu/Biotech/info.html)

# Advancing FEDERAL TRAINING GRANTS AT WSU

## U.S. Department of Education Graduate Assistance in Areas of National Need (GAANN)

The Graduate Assistance in Areas of National Need (GAANN) program, administered by the U.S. Department of Education, provides stipends to help departments recruit top doctoral students in fields of critical national importance. The program funds students with demonstrated financial need. WSU's GAANN fellowships in two disciplines—physics, as well as material science and engineering—prepare awardees to become exceptional educators.

STEVE TOMSOVIC, professor of physics in the Department of Physics and Astronomy, points out that his graduate student roster has jumped from 44 to 60 in just two years. He attributes the increase to successful competition for a GAANN grant. The department won five GAANN fellowships per year for three years. Fellows receive instruction in a variety of learning methods from an assigned faculty mentor.

Student Grant Eastland worked with instructor Michael Allen to update the department's 100-level astronomy lab courses using computer-based exercises. He received special training in syllabus preparation, computer-based conceptual aids, testing and grading methods, and other instructional tools. Eastland acknowledged that the "program has really helped me to develop the skills I need to become what I want to be—a teacher."

GAANN fellowships also help attract talented scholars into the material science and engineering program, which has been awarded funding for four students. Doctoral program director Indranath Dutta seeks to double enrollment of minority students. He leverages connections with other institutions—forged through the GAANN program—to recruit top Hispanic and African-American scholars. Fellows have opportunities for summer internships with national labs and leading corporations. Each GAANN student also has the chance to mentor undergraduate students. A course on seminar-giving shows fellows the nuts and bolts of successful lectures and conference presentations, ensuring that their initial teaching efforts are a success for themselves and their students.

➡ [materials.wsu.edu/GAANN.html](https://materials.wsu.edu/GAANN.html)

➡ [physics.wsu.edu/research/QuantumChaos/funding.html](https://physics.wsu.edu/research/QuantumChaos/funding.html)



Dr. Steve Tomsovic (right),  
GAANN grant awardee



# Collaborating

## RESEARCH TO BUILD PROSPERITY



Dr. O. Lynne Nelson,  
Department of Veterinary Clinical Sciences

### University-Industry Research Teams

Research collaboration with private industry is on the rise at WSU. In 2013, 3.7 percent of the University's research funds came from industry partners—whose contributions have increased by about 10 percent in the last five years. In addition, 5.3 percent of publications by WSU faculty are university-industry co-publications. \*

\* Center for Science and Technology Studies at Universiteit Leiden, University-Industry Research Connections UIRC 2013

➡ [www.socialsciences.leiden.edu/cwts/research/uirc-scoreboard-2013.html](http://www.socialsciences.leiden.edu/cwts/research/uirc-scoreboard-2013.html)

### Top Industry-Sponsored Projects in 2013

Industry Sponsor	Research Project	Principal investigator
United Airlines	United Airlines: Guam Island Hopper Alertness Study	Gregory Belenky
Integrated Lipid Biofuel LLC	Astaxanthin Producing Algal Strain Research	Shulin Chen
AMGEN	Investigating the Natural Extreme Metabolic State of Hibernation Bears	O. Lynne Nelson, et. al.
Packerland Whey Products	Lacto-Whey Field Trial	John McNamara
TOCAGEN	A Multi-Center Study of the Safety and Effectiveness of Toca 511	Annie Chen-Allen
Boeing	Fuel Compatibility of BMS8-256 and 8-139 for 787 Section 11 Shim Change	Lloyd Smith
Ocean Spray	The Effect of Chronic Consumption of a Cranberry Powder Reconstituted Beverage on Inflammation and Oxidative Stress in Healthy but Overweight/Obese Subjects: A Randomized Clinical Trial	Boon Chew
GENUS	In Vitro Expansion of Bovine Spermatogonial Stem Cells	Jon Oatley
Avista	Avista SGIG Project	Anurag Srivastava

# Collaborating

RESEARCH TO BUILD PROSPERITY

## Commission Support for WSU

The Washington State Department of Agriculture and its many industry-supported commissions fund research to address issues that affect grower productivity. The research and services provided by WSU help advance local industry as well as development of strategies and technologies for application worldwide.

In 2013, commissions contributed more than \$9.6 million to WSU research. The University greatly appreciates the support and collaboration of many commissions throughout the Pacific Northwest:

- Washington Grain Commission
- Washington Tree Fruit Commission
- California Cherry Advancement Board
- Fresh Pear Commission
- Idaho Barley Commission
- Idaho Wheat Commission
- Mint Industrial Research Council
- Oregon Sweet Cherry Commission
- Oregon Wheat Commission
- Washington Alfalfa Seed Commission
- Washington Blueberry Commission
- Washington Canola Commission
- Washington Cranberry Commission
- Washington Hop Commission
- Washington Seed Potato Commission
- Washington Strawberry Commission





## SAMPLE COMMISSION AWARDS

### WASHINGTON GRAIN COMMISSION

Improving Spring Wheat Varieties for the Pacific Northwest; Field Breeding Hard White Red Winter Wheat; Barley Improvement; Precision Breeding (i.e., The Application of Biotechnology to Spring Wheat Variety Improvement); Management of Nematode Diseases with Genetic Resistance; A Genetic Arsenal for Wheat Production Under Drought

### WASHINGTON TREE FRUIT RESEARCH COMMISSION

Developing New Natural Enemy and Pest Models; Forecasting the Demand and Supply for Tree Fruit Farm Labor; Overhead Cooling Influences on Microbial Food Safety

### WASHINGTON POTATO COMMISSION

In-Field Testing to Identify New Potato Varieties and Best Management Practices for Washington Growers; Postharvest Quality of Clones in the Western Regional Potato Variety Development Program

### WASHINGTON RED RASPBERRY COMMISSION

Controlling Resistant *Botrytis* on Washington Raspberries; Integration of Factors to Improve Soil Health in Red Raspberry Production; Evaluation of Resistance to *Verticillium dahlia* and *Phytophthora rubi* in Red Raspberry

### WASHINGTON MINT COMMISSION

Mint Yield and Water Use in Drip vs. Furrow Irrigated Mint in the Pacific Northwest; Improved Profits for Mint Growers Using Water Stress



# Funding

## RESEARCH, DEVELOPMENT, AND PUBLIC SERVICE

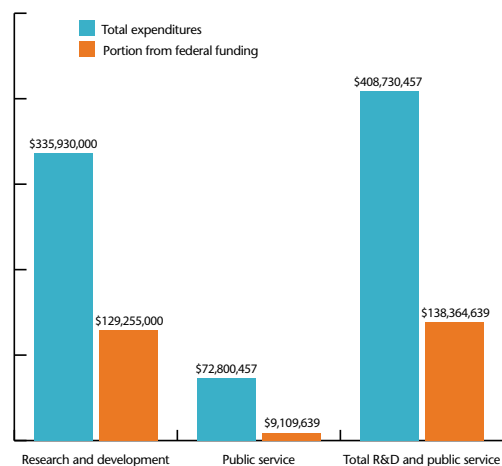
### Discoveries that Pay Dividends

Washington State University research relies upon the financial support of government, industry, organizations, friends, and alumni. Their generous sponsorship fuels a growing research agenda.

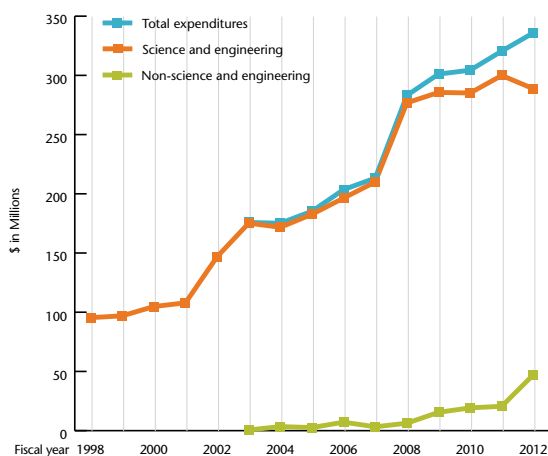
Each year, WSU faculty bring a greater number of innovations to market. The discoveries, creativity, and entrepreneurial spirit of these scholars drive economic development throughout the Pacific Northwest.

### A Commitment to Discovery and Outreach

Fiscal year 2012 research and public service expenditures

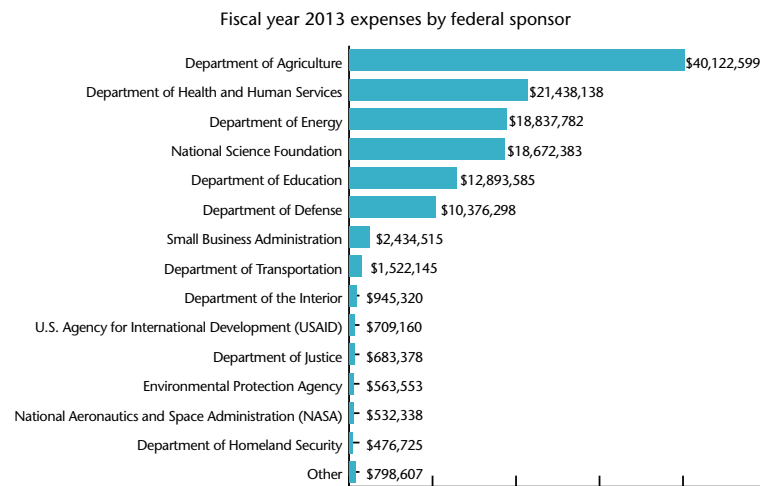


### Consistent Growth in Research and Development Expenditures

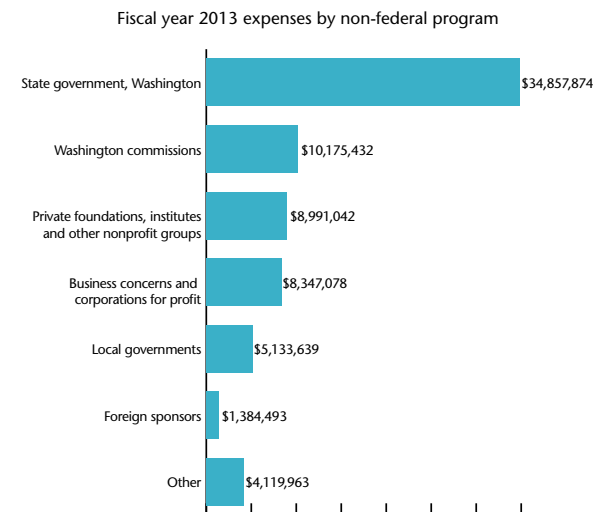




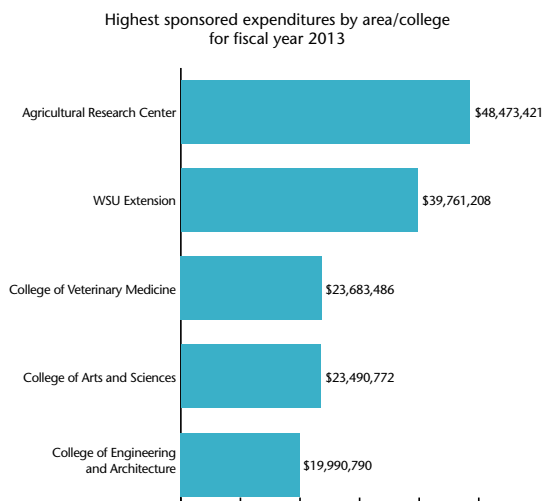
## Significant Federal Funding for Research



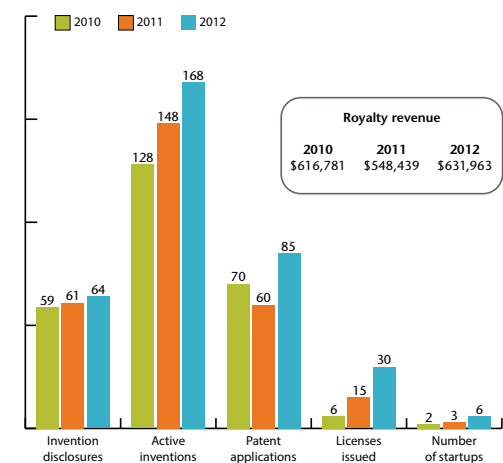
## Broad Support from Many Non-Federal Sources

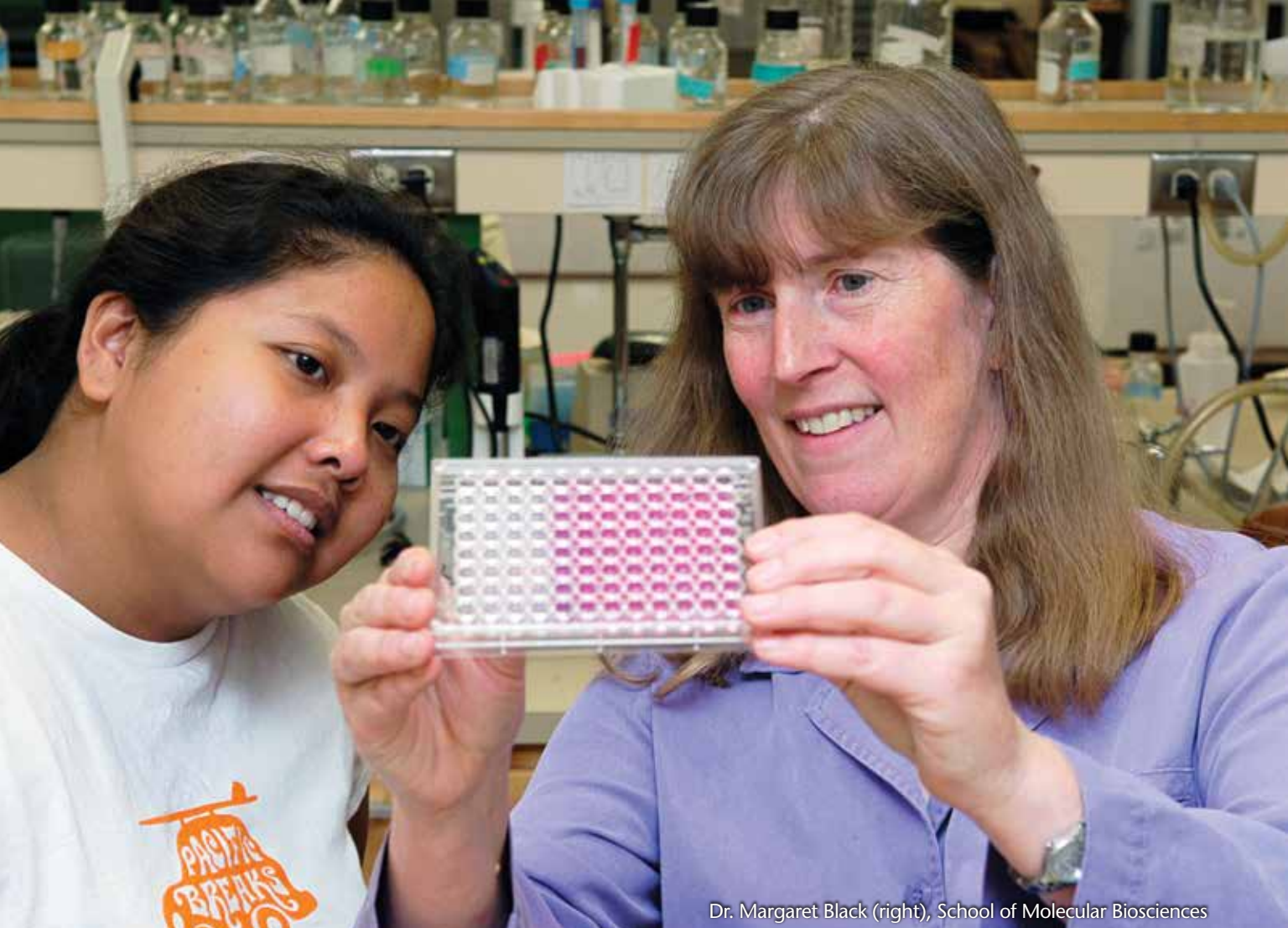


## Research and Public Service that Spans Many Disciplines



## Commercialization on the Rise





Dr. Margaret Black (right), School of Molecular Biosciences

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