2010:2011
Office of the Vice President
for Research Annual Report

GLOBAL *footprint*»

PURDUE
UNIVERSITY

Inside »

2 Meeting grand challenges
Boosting agriculture in Afghanistan, saving maize from mold, turning flora into fuel

10 Discovery with delivery
Saving time in spectrometry, reducing radiation loads, making health care holistic

18 Launching new leaders
Sampling soil for genomes, turning computers into tutors, sending energy back to the grid

26 Metrics
$420 million in awards, insights from Purdue's President, Provost and Vice President for Research

On the cover »

Purdue's researchers come from around the globe and travel around it each year performing life-changing research.

Graphic representation of the geographic origins of Purdue University faculty, staff and students from outside the contiguous United States. Orange markers indicate the number of students from each country in attendance at Purdue during FY 2011.

Source: Data Digest FY 2011

Map the origins of Purdue University faculty, staff and students, and you'll see the vibrant geography that enriches our collective experiences: 125 countries and 6 continents represented among 55,000 individuals.

But erase the dots and examine our paths outward from West Lafayette, Indiana, and the image is just as rich. And rightly so, because as a land grant university of the 21st century, we are compelled to reach out to the world.

The issues we face here are simultaneously global and local. Hunger. Disease. Poverty. Climate change. True solutions require broad, long term and sustainable collaborations among people with distinct but complementary perspectives.

At Purdue University, we are energized by our broadening global footprint. Travel along with us as we seek to make the world a better place.

The most pressing issues facing the world today are too complex for individual institutions or even nations to solve alone. At Purdue University, we are addressing these challenges through strategic collaborations around the world. From partnerships with Columbian researchers on life sciences technology to climate-change studies with Chinese ecologists, our researchers are enhancing knowledge on a global scale.

MEETING GRAND CHALLENGES

Culture, crops and cyberspace

Imagine sitting with a netbook in a café in Capetown, compiling a presentation for local officials on the effects of drought on South Africa's sorghum crops, and simply running an analysis and pulling a map from a HUBZero® site without having to download massive amounts of data. That's the vision of Tom Hertel, who, along with his colleague, Nelson Villoria, is working with the British government on Geoshare, a cyberinfrastructure that will share data on agriculture, forestry and climate and interactions between the three.

Hertel, a distinguished professor of agriculture, was one of four researchers that received $30,000 grants in 2011 from the university's Global Policy Research Institute (GPRI) in partnership with Purdue's Center for Global Food Security.

"The researchers were selected for these project start-up funds because their work shows promise of informing policymakers of viable options for addressing international food security issues," says Arden Bement, director of GPRI. "This series of grants makes it possible for faculty experts from several disciplines to work together in addressing a significant global challenge."

Tom Hertel

Geoshare

The Geoshare project addresses critical gaps in analyzing the effects of climate change on agriculture and food supplies. Because different institutions and governments collect data from limited geographic areas, and because their measurements are often specific to their own needs,

Gebisa Ejeta *(right)*, Distinguished Professor of Agronomy and a 2009 World Food Prize laureate, leads the Center for Global Food Security, which has partnered with the Global Policy Research Institute to support researchers aspiring to improve food sources around the world.

it's currently extremely difficult to analyze the links between climate and agriculture on a global scale.

Powered by HUBZero® technology, a Purdue platform for linking scientists around the world, Geoshare will provide a robust platform for sharing and analyzing information, allowing scientists and policy advisors to more easily understand spatially explicit global and local data on such variables as irrigation, drought and poverty. That will illustrate tradeoffs between increased food production and climate change in ways that are difficult to do right now.

Mycotoxins and maize

While Hertel seeks to inform policy decisions on food supplies around the world, Klein Ileleji is striving to improve food production on his home continent. An associate professor of agricultural and biological engineering, Ileleji received a GPRI grant to address problems associated with postharvest losses and mycotoxins for maize, a major staple food crop in sub-Saharan Africa.

Drying corn immediately after harvesting helps prevent the growth of mycotoxin, which is lethal at high levels. But with limited sunshine and high humidity during the August harvest season in sub-Saharan locations, farmers can't reduce moisture content enough to protect their crops.

"When you have maize not being dried well and going moldy, it becomes a public health issue," says Ileleji, who, on a summer 2011 trip to Ghana with co-PIs Corinne Alexander and Titilayo Okoror, observed women drying corn spread on tarps in the sun where some corn had already begun to spoil. "These people are so poor that they don't necessarily throw it away."

Ileleji's solution is a grain dryer that can be attached to the back of a stove. By drying their maize at the same time they cook their meals, the farmers can protect crops from immediate spoilage, set aside grains for leaner seasons and sell their surplus. He hopes that by piggybacking on the existing cultural practice of open cooking, farmers will embrace the change.

"You don't want to bring technology that comes from a so-called expert in the west," he says. "Instead, it should be a push-through—people should be part of the solution."

photo by Vince Walter

(left) Instead of large scale production facilities and mega-supermarkets, many East Africa towns have only small stores stocked with goods processed by local villagers.

Value chains for Kenyan crops

Nearly 3,000 miles away from Ghana, in her home country of Kenya, Betty Bugusu is touring a small store stacked with canned goods processed by local villagers. There are no large-scale production facilities or supermarkets here, but Bugusu hopes to change that with the help of a GPRI grant.

As managing director of Purdue's International Food Technology Center, Bugusu aims to identify and develop a value chain that is economically, culturally and technologically feasible to enhance food security and promote economic growth in East Africa.

"In Kenya and the rest of the developing countries, the food industry is very much in the infant stages. Farmers

HUB

An open-source software platform created by Purdue University, HUBZero® provides a web-based environment through which researchers, educators and students can access tools and share information. Currently, HUBzero powers sites for 40 projects and organizations in disciplines ranging from cancer care engineering to computational nanotechnology, with a global audience of more than 600,000.

don't have anywhere to send their surplus crops, and so for the most part, the crop is lost after harvest," says Bugusu, who experienced these problems firsthand as a child.

In the past, officials have tried to minimize supply problems by increasing production, but their efforts fell short because farmers have only rudimentary, if any, ways of processing food, and there is little infrastructure for storage and distribution. Bugusu hopes to help create a value chain by collaborating with local partners as well as Purdue colleagues in market economics, engineering, technology and anthropology.

Ultimately, Bugusu says, "We hope to help farmers develop export market standards and even have food companies in the United States and Europe source their ingredients from them. But we have to do it step by step, working by region and then by continent."□

Strengthening science and society

The Global Policy Research Institute, which provided four Purdue research teams with $30,000 grants to help improve food sources around the world, was created in 2010 as part of Purdue's New Synergies strategic plan.

GPRI, which is headed by former National Science Foundation director Arden Bement, supports interdisciplinary, evidence-based research in agriculture, environment, energy systems, economics, health, security and society and leadership. "Our goal is to support high-quality scholarship aimed at resolving global problems through research with policy implications," Bement says.

In 2011, GPRI also provided a series of $30,000 and $10,000 incentive grants to researchers in other areas such as disaster recovery, diabetes management, cancer prevention and sustainability. GPRI officials intend for such seed grants to lead to larger projects funded by national organizations.

PURDUE UNIVERSITY
GLOBAL POLICY
RESEARCH INSTITUTE

BRIEF

Political scientist studies behavior in natural, manmade disasters

When natural disasters hit, neighbors provide critical resources even more beneficial than government aid, says Daniel Aldrich, associate professor of political science.

He knows first-hand. Before a Hurricane Katrina evacuation order was issued, a New Orleans neighbor warned the Aldrich family, new to town, to leave. He found similar behaviors key to surviving disasters in Japan and India. "'Who will provide food, guidance and assistance?' 'The local community' has been my answer."

Now, under a one-year U.S. Agency for International Development fellowship in Washington D.C., Aldrich is studying human behavior in manmade disasters—violent extremism.

His focus is Africa. His question: "If you want to stop the next generation of terrorists from picking up a gun or getting in a cockpit, what can we do?" Drawing on data from Israel, Ireland and Germany, he's examining how citizens interact with both friends and the government.

"We're looking at poverty, alienation and how extremists take advantage of young people. We are discussing the idea that terrorists are not born, they are made, by a combination of environment, upbringing, ideology, social networks and poverty."□

Daniel Aldrich

©istockphoto.com

photo provided by Tim Filley

Tim Filley traveled to Inner Mongolia last fall to study human impacts on terrestrial ecosystems.

BRIEF

Examining inner Mongolia's grasslands

Once a verdant landscape carpeting two-thirds of China's northern border, large portions of Inner Mongolia have degraded into desert from overgrazing and climate change. The Chinese Academy of Sciences is working to protect and restore the grassland, and a Purdue earth and atmospheric sciences professor is joining the effort.

Last fall, Tim Filley spent three months as a visiting professor with the CAS Institute for Applied Ecology in Shenyang, China, studying human impacts on terrestrial ecosystems. Trekking to Inner Mongolia to collect soil and plant samples he and his colleagues will test how the soil responds to invasive species, overgrazing by cattle and sheep, grassland fires, and excess nitrogen from fertilizers and fossil fuels.

The research—part of a collaboration launched in 2010 between Purdue's Center for the Environment and the CAS Institute of Applied Ecology—expands on Filley's studies of overgrazed grasslands in the Rio Grande region of Texas. "China has undergone millennia of intensive human land use," he says. "The United States does not have the same long history of aggressive agriculture and deforestation. China's long perspective on the time of human influence on ecosystems and how ecosystems respond opens up new opportunities for us."□

"China's long perspective on the time of human influence on ecosystems and how ecosystems respond opens up new opportunities for us."

—*Tim Filley, professor of earth and atmospheric sciences*

BRIEF

U.S.–China EcoPartnership

The U.S. State Department has selected Purdue University to lead one of six U.S.-China EcoPartnerships, which will focus on sustainability issues including environmental challenges posed by alternative energy and climate change in the two countries.

A formal signing ceremony took place in Washington, D.C., last spring in connection with the third annual U.S.-China Strategic and Economic Dialogue. U.S. Secretary of State Hillary Clinton was a guest speaker at the signing event.

During the five-year initiative, members of the Purdue-China EcoPartnership will collaborate on research addressing the combined effects of climate change, renewable energy and human activities on regional and global ecosystems. They'll also explore technologies aimed at restoring damaged ecosystems.

Since 2006, Purdue University, the Institute for a Secure and Sustainable Environment at the University of Tennessee (UT), and the UT-Oak Ridge National Laboratory Joint Institute for Biological Sciences have collaborated with the Chinese Academy of Sciences through the China-U.S. Joint Research Center for Ecosystem and Environmental Change, which is led by UT.□

photo by Phillip Fiorini

Han Xingguo, director of the Institute of Applied Ecology-Chinese Academy of Sciences (IAE-CAS) and Al Rebar, executive director of Discovery Park, sign an agreement for a joint laboratory between the two institutions—one of the first activities with the Purdue-China EcoPartnership.

Chapple earns top award for lignin research

While lignin plays a key role in a plant's structural strength, it can inhibit converting the renewable resource to forage, fiber and fuel.

Enter the pioneering research of **Clint Chapple,** department head and Distinguished Professor of Biochemistry, and new doors open. He's developing ways to manipulate lignin in cell walls to preserve its beneficial functions while altering its properties so that plant products are more useful and valuable.

His work has led to improved techniques for producing pulp for paper. Now, he's studying ways to alter lignin so plant cellulose can be used to produce biofuels.

Chapple received the 2011 Herbert Newby McCoy Award, Purdue's most prestigious research honor. The peer-nominated award recognizes outstanding contributions to science.

"It is humbling to be acknowledged this way and listed alongside those who earlier received this award," Chapple says. "Furthermore, those who deserve credit are the students, post-doctoral fellows and technicians who did the excellent experimental work that led to our discoveries."☐

"It is humbling to be acknowledged this way and listed alongside those who earlier received this award."

—Clint Chapple, 2011 Herbert Newby McCoy Award winner

Clint Chapple's pioneering work in mapping plant cell walls to make them better suited for forage, fiber and fuel earned him the 2011 Herbert Newby McCoy Award, Purdue's most prestigious research honor.

photo by Vince Walter

Institutes honor, seek advice from Weaver

Connie Weaver, Distinguished Professor and Head of the Department of Nutrition Science, has been elected to the Institute of Medicine, the health arm of the National Academy of Sciences, and she has received the sixth international Linus Pauling Institute Prize for Health Research.

Connie Weaver

An expert in mineral bioavailability, calcium metabolism and bone health, she also serves as deputy director of the National Institutes of Health-funded Clinical and Translational Science Institute.

"I'm very excited to help determine the agenda for the Institute of Medicine in this global way," says Weaver, who has long served the organization by reviewing reports, advising on calcium and bone-related nutrients and participating on the Military Nutrition Committee. She joins 27 other Purdue faculty who are members.

Her 2011 award from the Linus Pauling Institute at Oregon State University recognizes innovation and excellence in research in diet and health. She presented a lecture at its Diet and Optimum Health Conference.☐

BRIEF

Envisioning Colombia's future

It's a sunny, unseasonably warm day in October 2011, and dozens of Colombian guests and their Purdue hosts are meeting in Discovery Park, forging new research collaborations as part of the new Colombia-Purdue Institute for Advanced Scientific Research. Halfway across the country, Congress is coincidentally opening up economic relationships with the South American nation by ratifying the United States-Colombia free trade agreement.

The ratification was fortuitous for Purdue University, which signed an agreement with Colombia last year to pursue global engagement with its government, top universities and private companies. Through such initiatives as a Purdue transfer program for Colombian Ph.D. students, a supercomputing cluster in Colombia and research agreements with private industry (see caption at right), the institute should help position Colombia as a science and technology leader in Latin America while boosting the U.S. and Indiana economies.

Indiana currently exports more than $100 million annually to Colombia, but that could increase with the free trade agreement—especially if the state invests now in the emerging economy, says Arvind Raman, a mechanical engineering professor at Purdue and a program leader for the institute. "The quality of Colombia's science is exciting, but their visibility is not so much," he explains. "If we wait for their research to make headlines, we won't be ahead of the curve."□

photo by Vince Walter

President France A. Córdova and Federico Restrepo, CEO of Grupo Empresarial EPM (Empresas Públicas de Medellín), sign a memorandum of understanding that will facilitate collaborations in the areas of nanotechnology, water resources, environmental science and energy. Also pictured are *(front row, right)* Moisés Wasserman, rector of Universidad Nacional de Colombia; *(back row, from left)* Juan Ernesto de Bedout, group president of Latin American operations for Kimberly-Clark, a Purdue alumnus and Engineering Advisory Council chair; Leah Jamieson, the John A. Edwardson Dean of Engineering; and Arden Bement, director of Purdue's Global Policy Research Institute.

BRIEF

Purdue launching new ag programs in Afghanistan

Five Afghan universities are getting a boost in faculty development, core agricultural programs and new agribusiness/agricultural economics, food science and agricultural engineering offerings.

Purdue received a five-year, $32 million U.S. Agency for International Development grant for work that builds on efforts achieved under an earlier, $7 million grant.

"This will help Afghanistan meet the agriculture workforce needs and support development in the commercial sector," says Kevin McNamara, assistant director of International Programs in Agriculture (IPIA).

"The new academic departments will take some time to establish," he says. "The exciting news is that we have hired six of eight long-term staff, who are on the job in Afghanistan, setting up programs."

"When U.S. government agencies want a partner in development of public institutions in Afghan agriculture, they come to Purdue because we have a track record of impact in a country where success has been rare," says Jess Lowenberg-DeBoer, College of Agriculture associate dean and IPIA director.

Purdue is partnering with the University of Missouri, Kansas State, North Carolina State, Tennessee State and Washington State universities.□

A five-year, $32 million grant will help Purdue improve university agricultural programs in Afghanistan.

photo provided by Advancing Afghan Agricultural Alliance

New Science Fellows named

Seven professors with notable scientific contributions are now fellows in the American Association for the Advancement of Science, joining 38 other Purdue colleagues.

R. Graham Cooks

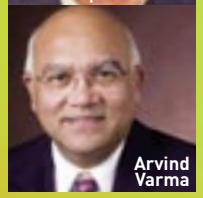
Stanton Gelvin

Paul Hasegawa

Ahmed Hassanein

Scott McLuckey

Paul Shepson


Arvind Varma

» **R. Graham Cooks,** the Henry Bohn Hass Distinguished Professor of Chemistry, is an ionization and instrumentation innovator.

» **Stanton Gelvin,** the H. Edwin Umbarger Distinguished Professor of Biological Sciences, has delivered new understandings on plant cell mediated transformation.

» **Paul Hasegawa,** the Bruno Moser Distinguished Professor of Horticulture and Landscape Architecture, focuses on plant abiotic stress and other areas.

» **Ahmed Hassanein,** the Paul L. Wattelet Professor and Head of Nuclear Engineering, has contributed to nuclear fission and fusion and advanced nanolithography.

» **Scott McLuckey,** the John A. Leighty Distinguished Professor of Chemistry, works in biological mass spectrometry.

» **Paul Shepson,** chemistry professor, studies chemical and photochemical processes relating to air pollution and climate change.

» **Arvind Varma,** head of and the R. Games Slayter Distinguished Professor of Chemical Engineering, has published extensively on chemical reaction engineering and advanced novel materials synthesis. ☐

BRIEF

Connecting beans with bioenergy

Riding the school bus back home, Indiana's rural teenagers breeze by a colorful agricultural patchwork, often unaware that those crops could someday help fulfill the world's energy needs. Purdue University researchers hope to open their eyes to that possibility through a $1.25 million initiative sponsored by the National Science Foundation.

The project, Research Goes to School, provides professional development to rural science teachers so they can develop lessons on topics such as alternative energy and climate change.

Poverty and teacher turnover often make it difficult for rural high school students to succeed in science, technology, engineering and mathematics. "Reduced state funding and outdated infrastructure also hinder effective STEM instruction," says Gabriela Weaver, a chemistry professor and director of Purdue's Discovery Learning Research Center.

But, says Maureen McCann, biological sciences professor and director of Purdue's Energy Center, "In the agricultural landscape of the Midwest, the relevance of bioenergy research is immediate and powerful. Many rural students in Indiana have lived on or worked on farms that grow corn and soybeans."

Ultimately, the researchers hope to spark interest in STEM careers by helping students connect the crops grown around them with pressing global needs. ☐

Purdue professors Maureen McCann and Gabriela Weaver are leading the new Purdue STEM learning initiative, Research Goes to School, thanks to a $1.25 million grant from the National Science Foundation. Pictured, *(from left)* are Weaver, McCann and mathematics education sophomore Jordan Huckaby, who is participating in the Research Goes to School program as a Noyce Scholar.

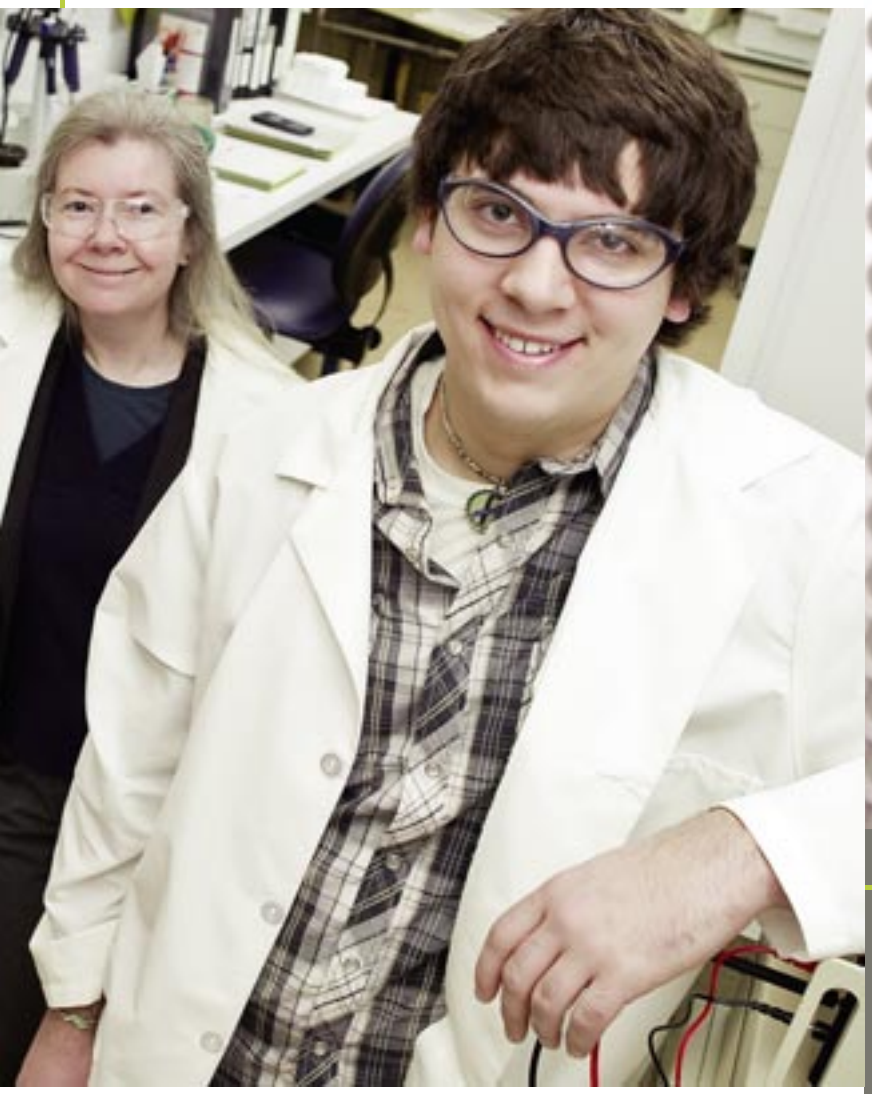
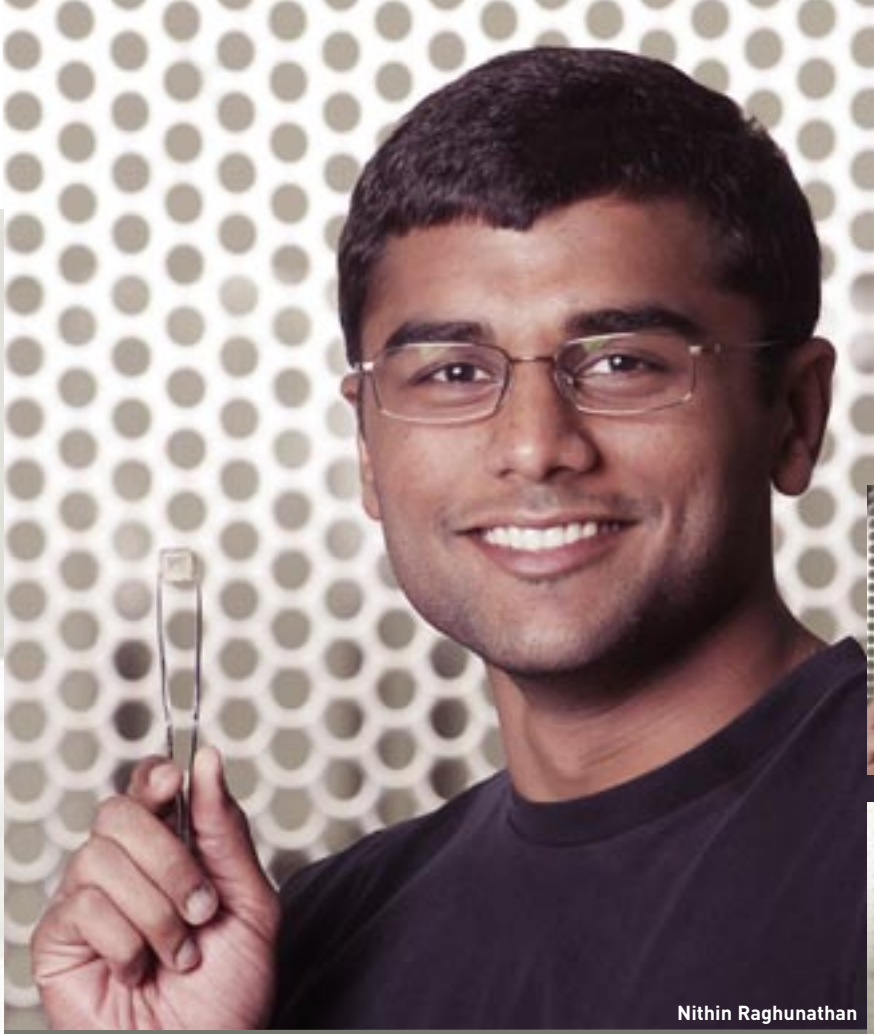


photo courtesy of Purdue News Service/Andrew Hancock



Nithin Raghunathan

Bob Sayer

Manuel Ochoa

all photos by Vince Walter

SOLUTIONS FOUND IN SMALL PLACES

In the Birck Nanotechnology Center, researchers are addressing grand challenges by investigating micro and nano sized materials that can be engineered into tiny devices with applications ranging from medicine to electronics. From physicists to molecular biologists, a diverse group of investigators are developing innovative devices that can detect pathogens and deliver therapeutics, build more efficient solar cells, monitor air quality, and continue to reduce the size of our electronic devices.

One nanometer (nm) is one billionth of a meter, or if a marble measured one nanometer in size the earth would measure one meter by comparison.

Improving quality of life requires not only making breakthrough discoveries but also delivering the innovations to people who need them. At Purdue University, we are advancing the frontiers of knowledge in order to enhance well-being. From making micro devices that could boost the power of radiation therapy to crafting handheld scientific scanners for consumers, our researchers are creating practical solutions.

DISCOVERY WITH DELIVERY

Time-saving science

The crew of the fictitious starship Enterprise carried tricorders on planetary expeditions to scan and detect abnormal phenomena. Now, some real-life handheld devices are being tested for simple treks to the supermarket.

R. Graham Cooks, the Henry Bohn Hass Distinguished Professor of Chemistry, and Zheng Ouyang, an assistant professor of biomedical engineering, led the team last spring that used their miniature mass spectrometer to test for a fungicide on oranges and a scald inhibitor on apples.

In the technology's first venture out of the lab, it successfully identified specific chemical residues on apples and oranges in a matter of minutes right in the produce section without having to peel or otherwise prepare a sample of the fruit.

"We're trying to take powerful, sophisticated instruments out of the lab and into the real environment where they could help monitor fresh produce all along the supply chain from production and supply to the consumers," says Cooks, who is co-founder of Purdue's Center for Analytical Instrumentation Development.

Cooks fundamental research in ion chemistry has significantly contributed in making mass spectrometry one of the pre-eminent methods of chemical analysis; however, most available mass spectrometers require that a sample be specially prepared and placed in a vacuum chamber for analysis. Cooks and his team have developed a technique called ambient ionization, which allows critical steps to be performed in the air or directly on surfaces outside of a mass spectrometer. Molecules from the sample's surface are then vacuumed into the equipment for analysis.

Conventional mass spectrometers also are cumbersome instruments that weigh more than 300 pounds. Purdue's

Graham Cooks envisions a day when everyone will carry his or her own handheld scanner.

photo by Andrew Hancock

miniature mass spectrometer, called the mini 10.5, is a handheld device roughly the size of shoebox that weighs 22 pounds.

In the wake of foodborne-illness outbreaks among lettuce, cantaloupe, eggs and the like in recent years, the need for real-time testing is becoming more critical. One day, mini mass spectrometers may give everyone from grocery store managers to grandparents some added peace of mind. "I would like everybody to have a little miniature mass spectrometer for themselves," Cooks says.

Timely testing

Four floors above Cooks in the Wetherill Hall of Chemistry, Daniel Raftery is working on his own peace-of-mind project, this one for cancer survivors. Last fall, the peer-reviewed journal *Cancer Research* published the findings of Raftery and his colleagues, showing that their VeraMarker™-BCR blood test correctly identified 86 percent of breast cancer recurrences, and detected the recurrence of breast cancer in 55 percent of the patient survivors an average of 13 months before their diagnosis using currently available tests.

"Knowing there's a test that can detect the recurrence of cancer at a far earlier time point when the cancer may be more treatable should provide tremendous hope to breast cancer survivors and also relieve the tremendous worry they feel with each visit to their doctor," says Raftery, a professor of analytical and physical chemistry and co-founder of Matrix-Bio, which has licensed the test. "Its accuracy and early stage detection should offer a much better window for treatment."

Most breast cancers that recur do so within three to five years after initial treatment. While survivors are closely monitored during this time, current biomarker tests may yield false positives or may not detect evidence of cancer until it has spread and is more difficult to treat.

VeraMarker™-BCR blood test, which combines the measurements of multiple small molecules or metabolites that are sensitive to the development of recurrent breast cancer, holds promise for an earlier, more accurate diagnosis. It's also easy to use: Blood is drawn from the patient and sent to a lab for analysis. If the test yields positive results, the oncologist can order additional tests such as a bone scan, MRI, CAT scan, chest X-ray or liver blood tests to identify and locate the tumor.

Raftery hopes his test, which is undergoing clinical validation trials and may become commercially available in late 2011, will lead to more treatment options for patients. "Existing cancer recurrence tests are inadequate to meet the needs of a large and growing population of breast cancer survivors," he says. "I'd really like people to know more about the status of their disease, whether they're cancer free or at the earliest time point that there's something that needs to be treated."□

Dan Raftery *(left)* expects that his breast cancer biomarker test will lead to more treatment options for patients. Here he stands with three colleagues from his laboratory: research scientist Naraimhamurthy Shanaiah, research assistant Vincent Asiago and research scientist Nagana Gowda.

photo provided by Purdue Research Foundation

REAL-LIFE TRICORDER

Purdue University graduate student Santosh Soparawalla *(left)* and postdoctoral researcher Fatkhulla Tadjimukhamedov demonstrate a miniature mass spectrometer that can detect chemicals and bacteria on store produce.

Purdue News Service photo/Mark Simons

BRIEF

Helping launch entrepreneurship in Russia

A partnership that launched in 2010, Enhancing University Research and Entrepreneurial Capacity (EURECA), is guiding Russian universities as they develop entrepreneurship curriculum and commercialize academic research.

Several Purdue University faculty and staff have visited Russia's Lobachevsky State University of Nizhny Novgorod, and a Russian delegation came to Purdue and Purdue Research Park.

"Our project is geared to helping them develop a student-oriented entrepreneurial program," says Alan Rebar, Purdue's senior associate vice president for research and executive director of Discovery Park. "That involves setting up an entrepreneurship center and developing courses, which will be modeled after ours."

Curricula is now under development, which Purdue will review.

Other participants include University of California-Los Angeles, University of Maryland, University of Washington and a consortium led and financed by the U.S. Russia Foundation for Economic Advancement and the Rule of Law.

The program is administered by nongovernment organizations: Russia's New Eurasia Foundation, American Councils for International Education and National Council for East European and Eurasian Research.

"It's going well," Rebar says. "Our long-term goal is to develop true research collaborations with leading Russian research universities."□

(top) Purdue University faculty and staff are guiding Russian universities in developing entrepreneurial education programs.

BRIEF

Tiny medicine, big payoff

Radiation therapy works by damaging DNA inside a cancer cell, disrupting its ability to grow and reproduce. But because portions of tumors can become deficient in oxygen once they've outgrown their blood supply, they're more resistant to radiation damage than non-hypoxic cells.

Babak Ziaie hopes to change that with devices as small as a grain of rice. Collaborating with the Indiana University School of Medicine, he has created a micro-oxygen generator. When encapsulated and injected into a tumor with a needle, his IMOG generates oxygen with the help of ultrasound, preparing the tumor before radiation therapy begins so that cells will generate necessary free radicals for destruction.

"With most of these devices, the main goal for radiation oncology is to try to reduce the load that the patient is receiving. The less radiation, the fewer side effects and the less damage to healthy tissue," says Ziaie, a professor of electrical and computer engineering. "These devices will help physicians give the maximum dose to the patient but leave surrounding tissue unharmed."□

photo by Vince Walter, *(right)* photo provided by Birck Nanotechnology Center, Purdue University

Babak Ziaie *(left)* and his colleagues have created and tested a miniature device, below, which can be implanted in tumors to generate oxygen, boosting the killing power of radiation and chemotherapy. The Alfred Mann Institute for Biomedical Development at Purdue University is working with Ziaie to help move the technology into the market.

Top honors from the White House

Rakesh Agrawal, a distinguished professor of chemical engineering, received the National Medal of Technology and Innovation in 2011. The award is the highest honor for technological achievement bestowed by the president of the United States.

Agrawal, the Winthrop E. Stone Distinguished Professor in the School of Chemical Engineering, has significantly impacted electronic device manufacturing, liquefied gas production and the supply of industrial gases for diverse industries.

Agrawal was one of five honored during a White House ceremony. "Each of these extraordinary scientists, engineers, and inventors is guided by a passion for innovation, a fearlessness even as they explore the very frontiers of human knowledge, and a desire to make the world a better place," President Barack Obama said. "Their ingenuity inspires us all to reach higher and try harder, no matter how difficult the challenges we face."□

Rakesh Agrawal

photo by Pablo Martinez Monsivais, with permission from AP

BRIEF ‖

World-class innovator

From being honored in the children's Physics Olympics to being named one of the world's Top 35 Innovators under the age of 35 by *Technology Review* magazine in 2011, Alexandra Boltasseva has long earned recognition for her studies and work.

As a youth, she says, "I was very keen on getting into the best university for physics and math, and I did—the Moscow Institute of Physics and Technology."

Now a Purdue assistant professor of electrical and computer engineering, she is researching ways to steer light through new classes of nanostructured composites based on metals, semiconductors and dielectrics. She also maintains ties to researchers at the Technical University of Denmark.

"There are so many ideas in our field that could revolutionize the world, and so many applications yet to come," she says.

"We are entering a new age of materials and devices not possible before. Not only much faster computers and optical networks, but also a revolution in imaging devices—microscopes, energy conversion, bio- and medical sensors and other applications—and even phenomena that remain as yet undiscovered."□

photo by Anna Knott. Copyrighted © 2011 *Technology Review*. All Rights Reserved. 82212cw.

Named one of 35 of the world's top innovators under the age of 35 by *Technology Review* magazine, Alexandra Boltasseva is researching new classes of nanostructured composites to steer light.

BRIEF

Collaborating for community health

For Sonak Pastakia, it doesn't matter so much where in the world he is; what matters more is being somewhere that he can truly impact patient care.

For the last four years, that place has been Eldoret, Kenya, a city of nearly 200,000 where lives are too often cut short because of chronic disease. As an assistant professor of pharmacy practice and team leader of the Purdue Pharmacy in Kenya program, Pastakia works side by side with his Kenyan and North American collaborators to create comprehensive health care programs in much needed areas such as diabetes, anti-coagulation and community owned pharmacies.

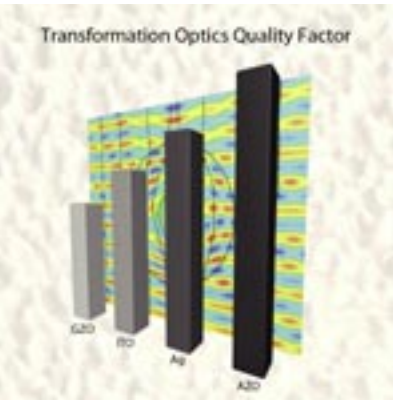
"Solutions that only consider the western approach are almost destined for failure," says Pastakia, who received a grant last winter from Purdue's Global Policy Research Institute to develop training programs that teach people with diabetes to be their own community health providers. "Our approach of creating training programs relieves a lot of dependency on foreign donors or collaborators. Merging our experiences with theirs is where the true solution lies."☐

"Our approach of creating training programs relieves a lot of dependency on foreign donors or collaborators."

—*Sonak Pastakia, assistant professor of pharmacy practice*

photos provided by Sonak Pastakia

Sonak Pastakia works side by side with his African and American collaborators to create holistic health care programs in Kenya.



(below) photo provided by Birck Nanotechnology Center, Purdue University.

Obama taps World Food Prize Winner Ejeta

President Barack Obama chose **Gebisa Ejeta** for a three-year appointment to the Board for International Food and Agricultural Development. A Distinguished Professor of Agronomy and executive director of the new Purdue Center for Global Food Security, Ejeta received the 2009 World Food Prize for developing a drought- and disease-resistant sorghum.

In his new board post, Ejeta will advise the U.S. Agency for International Development (USAID) on agricultural development priorities and the country's role in worldwide issues related to Title XII, Famine Prevention and Freedom from Hunger.

"I have now gone full circle," Ejeta said, noting that a USAID predecessor built the high school

Gebisa Ejeta

and college he attended in Ethiopia. "I now have a chance to offer a new vision or policy directive that may give a similar chance for an education or life-saving act for another child. What a privilege and responsibility."

Ejeta also serves as a science envoy for the U.S. State Department.☐

BRIEF

Team creates supply chain medicine model for Sierra Leone

For Sierra Leone—a country with the highest maternal death rate in the world and a life expectancy of just 39 years for women and 42 for men—improving quality of life is a monumental task. But Ananth Iyer can summarize his team's mission in a single sentence.

"The one number which we want to change is the in-stock level of medicines," says Iyer, the Susan Bulkeley Butler Chair in Operations Management, director of Purdue's Global Supply Chain Management Initiative and director of Dauch Center for the Management of Manufacturing Enterprises. "If medicines are available in stock and people get treated on time, outcomes are very different."

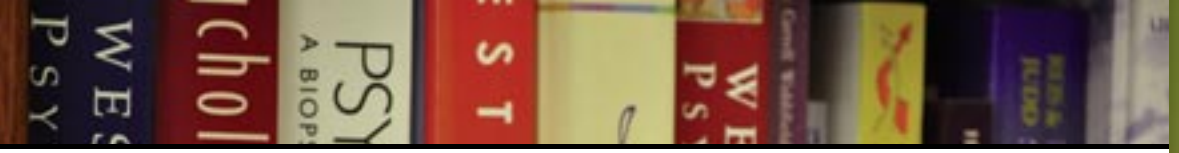
Last spring, Sierra Leone enacted the Free Care Health Initiative for children under the age of 5 and pregnant and lactating females. To help ensure that eligible women and children receive appropriate and timely services, a team of faculty and students from Purdue and the MIT Zaragoza Logistics Center in Spain is studying ways to improve medicine distribution and availability.

Now that the team has created a prototype for a supply-chain medicine distribution system, Iyer and his colleagues are sharing their ideas with Sierra Leone government officials, United Nations representatives and nongovernment organizations. UItimately, Iyer hopes that the business model can make life-changing differences in the country of 5.8 million.

"Certainly, solving a problem for a company to increase profits is a very important thing. But so is global health," he says. "The ability to help people keeps us who we are as human beings. Everybody derives joy in getting more successful health outcomes in Africa and around the world."□

Ananth Iyer

Ananth Iyer and his team used supply chain processes to create a prototype for delivering medical supplies in Sierra Leone.



BRIEF

Personality and longevity

Can we really worry ourselves to death?

It's not quite as simple as that, but Prof. Daniel Mroczek says that a correlation *does* exist between high levels of neuroticism—the tendency to experience excessive worry, anxiety and other negative emotions—and shortened life span. Now, he wants to see exactly how those negative emotions turn against us.

Mroczek, a professor of human development and family studies who received a $2.1 million grant from the National Institutes of Health to further his research, surmises that people ranking high on neuroses scales likely have poorly regulated hypothalamus-pituitary-adrenal axes along with elevated cortisol and inflammatory marker levels—all of which are associated with disease.

Now, he's studying older adults to see how these measurements correlate with wellbeing and personality. Ultimately, he hopes that health professionals can use personality testing to target people most likely to benefit from therapies such as meditation, exercise or psychotropics.

"Identification of those who are predispositionally at higher risk for certain risk factors is a hallmark of the new area of individualized medicine," he says. ☐

Daniel Mroczek

photo by Rohini Swaminathan

Garimella named Senior Fellow, Energy and Climate Partnership

Clean energy, energy security, greenhouse gas emissions and other environmental matters are capturing **Suresh Garimella's** focus as he takes on his newest role: a senior fellowship with the U.S. State Department's Energy and Climate Partnership of the Americas.

Suresh Garimella

Garimella's activities in the partnership, created by President Barack Obama at the April 2009 Summit of the Americas, will include visits to Western Hemisphere countries, consultations with governments, outreach and speaking engagements.

"I'm excited to be invited to help our partner countries address their energy and environmental challenges," he says.

Garimella, who serves as Purdue's associate vice president for engagement and is the R. Eugene and Susie E. Goodson Distinguished Professor of Mechanical Engineering, earlier received a Jefferson Science Fellowship, also through the U.S. State Department. That gave him an opportunity to help guide U.S. foreign policy.

In 2010, he received the Heat Transfer Memorial Award from the American Society of Mechanical Engineers. ☐

HIV researcher receives MERIT Award

After developing the Darunavir molecule now approved in 80 countries as a frontline therapy for HIV and AIDS, **Arun Ghosh** is on to his next quest: designing even more powerful molecules to improve treatments and reduce side effects.

The Ian P. Rothwell Distinguished Professor of Chemistry and Medicinal Chemistry in the colleges of Science and Pharmacy, Ghosh has received a Method to Extend Research in Time (MERIT) award from the National Institute of General Medical Sciences.

Arun Ghosh

Awards go to highly productive scientists likely to deliver innovative, impactful research. They include five years' initial funding and up to another five, with staff and council review.

More research is critical, since HIV can be treatment-resistant. Ghosh has already expanded Darunavir's structural features, creating a molecule 10 times more effective against drug-resistant HIV.

"We've only scratched the surface," he says. The backbone-binding concept used in Darunavir could be applied to other diseases, including yellow fever, Dengue virus and avian flu. ☐

Preparing individuals for success in a dynamic, global society requires a rich academic culture that promotes inclusion as well as diversity. Students of all ages are developing worldly viewpoints through innovative research projects at Purdue University. From math software that individualizes instruction for struggling fourth graders to engineering projects that challenge undergraduates to work with a developing nation's existing resources, today's students are becoming tomorrow's global citizens.

LAUNCHING NEW LEADERS

Digging Around

"I decided to be a little bit of an overachiever about it." That's how Emilia Czyszczon sums up her decision to head deep into a privately owned Bedford, Ind., cave for a soil sample that produced her unique bacteriophage—a virus that infects bacteria.

As part of a two-semester biotechnology lab course funded by the Howard Hughes Medical Institute's Science Education Alliance, the biomedical engineering major embarked on a spelunking adventure 120 miles from the West Lafayette campus.

"We took a boat on the underground river in the cave, and I took a small soil sample from the wall. It was glacial mud that's been around since the ice age," says Czyszczon, whose finding in Blue Springs Cavern is being named Czyszczon1. In addition to being tens of thousands of years old, the sample she collected contained a virus that kills a form of bacteria similar to tuberculosis and leprosy.

"Tuberculosis is prone to being antibiotic-resistant. It would be cool to see if my bacteriophage could be a stepping stone to finding a treatment for tuberculosis," she says.

Adding to GenBank

Czyszczon is one of several students contributing to GenBank, the National Institutes of Health's genetic sequence database, as part of Science Lab: CNIT 227. If the soil they've sampled has no bacteriophage,

Sophomore Emilia Czyszczon stands at Blue Spring Caverns in Bedford, Indiana, where she discovered a previously unidentified virus that will bear her name: Czyszczon1.

photo courtesy of *Chicago Tribune*

they head out for another sample. If it does, they isolate, purify and characterize it, growing the phage in a petri dish and examining it through an electron microscope, finally extracting DNA. Their work has value because bacteriophages can be key to controlling food-borne bacteria or attacking antibiotic-resistant bacteria.

"The Science Education Alliance course gives students a chance to do authentic, hands-on science within the context of a science class," says Kari Clase, industrial technology associate professor, who teaches the course with Jenna Rickus, associate professor of agricultural and biological engineering.

"Students seem to understand a bit better what research is after this class," Clase says. Besides research skills, they learn to communicate with professionals."

"They have to make their own decisions, determine everything that has to be done," Rickus says. "Bringing research like this into the classroom makes students use critical-thinking skills."

Hands-on learning

The hands-on opportunity and chance to work independently are what Sean Kearney most liked about the class.

"The first few weeks, I was having trouble isolating a phage. In a lab course, you usually don't have to experience failures or face the consequences of failure," says Kearney, a biological engineering and applied mathematics major. "It was a continuous process, so I had to work through my failures. The experience taught me to work methodically through problems."

His successful soil find was in a flower bed on campus. "We tried four or five other places before this one," he says. "In this class, you have to think independently, but work collaboratively," says Kearney. "You get a unique research experience that potentially has impact."

Course funding allows for one phage to be sequenced and annotated from each class, and Kearnery's phage was selected during his semester. Lightheartedly named "MrGordo" after a stuffed pig in the Buffy the Vampire Slayer television show, the phage is now available for scientists around the world to study and use.

For Czyszczon, whose bacteriophage also has been banked, the experience has her considering medical research rather than clinical practice.

"I was able to work on a real research project," she says of the class. "Even though our professors were there, we had to make our own timeline and figure out what to do each day. Being thrown into it was better, because we got to learn from our mistakes as we went on with the timeline we needed to meet."□

Tom Campbell, Purdue Agricultural Communication

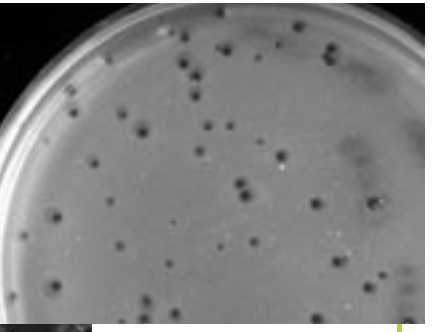


photo by Tom Campbell, Purdue Agricultural

Jenna Rickus *(left)*, associate professor of agricultural and biological engineering, keeps a watchful eye on Leah Liston, who is sequencing a genome. *(above)* Sean Kearney discovered a bacteriophage in a Purdue flowerbed.

ART AND SCIENCE COMBINES TO CREATE DIGITAL PERFORMANCE

A Purdue interdisciplinary research team composed of visual and performing artists and computer scientists collaborated on a project that uses interactive technologies to integrate the audience into the performance. The creation, Ad Infinitum^3, was invited to perform at the Prague Quadrennial 2011 Scenofest in the Czech Republic. The audience was integrated into the performance as both characters and variable forces through the use of avatars created on any wi-fi equipped cell phone. Performers engaged the audience both visually and audibly using audience controlled projections and sound.

photo by David Sigman

BRIEF

Fostering climate change understanding

Record-breaking floods, melting ice caps and a surge in heat-related deaths. It's all covered on the nightly news, but flip through today's high school science textbooks, and there are scant instructional materials designed to foster students' conceptual understanding about climate and climate change.

Anita Roychoudhury and her colleagues hope to change that with a $1.5 million grant from the National Science Foundation. Collaborating with science teachers from four school districts, the researchers are developing, modifying and implementing lessons for 500 7th and 8th graders.

Understanding climate change, says Roychoudhury, requires comprehension of both climate science and underlying physics concepts, but those two subjects are rarely merged in K-12 school level science. And common lessons such as local weather collection don't teach climate change concepts because measurements are localized and time-limited.

Around 1,200 middle school students from four school districts have participated so far. Data from the first round of implementation show a significant improvement in student understanding of several key concepts such as greenhouse effect, the difference between weather and climate, and global warming.

"This research will help students learn science in a coherent way," says Roychoudhury, an associate professor of science education. "It will also help teachers and science educators develop a better understanding of the ways students learn."□

Anita Roychoudhury

Team members who developed an all-natural denture cream adhesive they call Dentural took the top prize in the Student Soybean Innovation Contest. They are *(from left)* Manaz Taleyarkhan of Lafayette; Ankit Gupta of Carmel; David Barron of Saline, Michigan; and Alvin Ang of Malaysia.

photo by Purdue Agricultural Communication/Tom Campbell

BRIEF

Student racks up entrepreneurial wins

With three first-place finishes in 2011 student entrepreneurial competitions—on top of earlier awards—Ankit Gupta is standing tall.

The 2011 accounting and management graduate is quick to share credit. "Having a team is absolutely necessary to accomplish something great," he says. "I've learned about my own strengths and weaknesses, and with a team, we use everyone's strengths."

That proved true when he joined fellow Purdue students Alvin Ang, David Baron and Manaz Taleyarkhan to create a soy-based denture adhesive and form Dentural. They landed the $20,000 first place in soy in the Student Soybean and Corn Innovation Contest.

The same group, operating as RollOut Green with an easy garden-planting system, won first place in the university division at the PolyU Innovation and Entrepreneurship Global Student Challenge 2011 at Hong Kong Polytechnic University.

Gupta also landed $1,000 and the top undergraduate award in Purdue's Elevator Pitch Competition. Earlier awards included a second place in another elevator pitch contest and a global student entrepreneurial award.

Of his successes, Gupta says, "The outcomes are beyond what I ever thought was possible."□

Alucozai youngest-ever Sigma Xi

It takes research potential and achievements to gain entry into Sigma Xi, the international science and engineering society. How did Purdue College of Health and Human Sciences **Milad Alucozai** earn an invitation as a freshman, making him the youngest-ever Purdue chapter member?

Milad Alucozai

He started in high school, winning research awards and working in Purdue labs. As a freshman, he took a first in the Purdue Research Symposium. Today, he's researching neurodegenerative diseases in the Purdue Center for Paralysis Research.

"What got me in relates to my ability to juggle a rigorous course load, extracurricular activities, and still have time to perform serious, meaningful research," he says.

He's been on a medical volunteer trip to Nepal, and he co-founded and directs Project HEART, a health, agricultural and educational project planned for Ethiopia.

"I've gained leadership skills by throwing myself into tough situations and pushing myself to my limits."☐

BRIEF ‖

NSF fellow studies shrinking cities' impact on infrastructure

Shrinking cities face mounting challenges in maintaining critical infrastructure. When one infrastructure is decommissioned or fails, what happens to the others?

That's the research focus of Kasey Faust, who received a National Science Foundation Graduate Research Doctoral Fellowship.

"I'm interested in infrastructure interdependence—between systems, such as transportation, electric, wastewater and water—and how different infrastructures depend on each other," says the civil engineering graduate student.

After assessing prior research in shrinking cities and critical infrastructure to identify gaps, she's selecting cities to study and choosing metrics. "I'll be analyzing a lot of nodes, linkages and system dynamics," she says.

Criteria for the three-year fellowship included her accomplishments and her project's potential to contribute to strengthening the vitality of the science and engineering enterprise.

©istockphoto.com

As a volunteer for a homeless shelter and Innovation to Reality, an after-school program bringing engineering concepts to middle schools, Faust contributes to her community while getting a big-picture view.

"I am passionate about engineering and people," she says. "Critical infrastructure is essential to provide service and maintain health and economic security."☐

Kasey Faust

BRIEF ‖

Power to the people

Nestled in the mountains and dotted with rain forests and waterfalls, Bangang, Cameroon, boasts a natural beauty that belies its modern-day inconveniences—villagers have no access to basic resources and must travel long distances for water. Now a group of researchers and students is installing a turbine that will provide electricity for vital services, homes and schools.

The hydropower system, funded with $74,074 by the U.S. Environmental Protection Agency's People, Prosperity and the Planet (P3) program, will power a mini grid with enough electricity for around 1,000 homes. It also will provide power for drinking water systems, homes and health-care facilities.

Bangang officials have attempted to install hydropower systems, but previous efforts have lacked engineering expertise, says Klein E. Ileleji, an associate professor of agricultural and biological engineering.

"It is not just a turbine design—any engineering project is just not involved in the mechanics," Ileleji says. "But it's how to holistically bring the technology to the community with the project making the P3 criteria—the people, as in the community, prosperity and the environment."☐

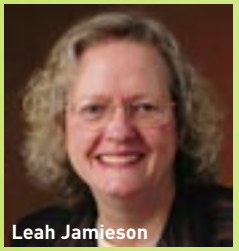
This picturesque waterfall in Bangang, Cameroon, will be the source of a new hydropower system that a Purdue student team is creating. *(inset)* The group was one of five winning teams among 55 universities competing for grants from the U.S. Environmental Protection Agency's P3 Program.

photo courtesy of Purdue Global Engineering Program
(inset) photo courtesy of U.S. Environmental Protection Agency

New American Academy of Arts and Sciences Members

Three Purdue faculty joined seven others elected to the American Academy of Arts and Sciences, founded in 1780 to study complex, emerging problems.

Leah Jamieson, the John A. Edwardson Dean of Engineering and Ransburg Distinguished Professor of Electrical and Computer Engineering, cofounded and led Engineering Projects in Community Service (EPICS). Jamieson was also named a fellow of the American Society for Engineering Education.


Leah Jamieson

H. Jay Melosh, Distinguished Professor of Earth and Atmospheric Science and Physics, an expert in impact cratering, planetary tectonics and earthquake and landslide physics, served on a NASA science team for a lunar gravity mission. He's now working on three space missions, imaging comets and examining compositions and behaviors.

H. Jay Melosh

Ei-ichi Negishi

Ei-ichi Negishi, the Herbert C. Brown Distinguished Professor of Chemistry, earned the 2010 Chemistry Nobel Prize with Richard Heck and Akira Suzuki. Negishi is known for discoveries and developments linking carbon atoms for easy synthesis of complex organic compounds used in pharmaceuticals, electronics and many other areas.☐

BRIEF

Cyber-tutors for multiplication

Clicking steadily with her mouse, a fourth grader in Lafayette, Ind., builds one, two, three towers of cubes in the computerized Cubes and Towers Playground. The youngster is part of a project funded with a $2.9 million grant from the National Science Foundation designed to help struggling students gain multiplicative reasoning skills.

Principal investigator Yan Ping Xin's premise is that conceptual understanding needs to go above and beyond concrete level of operations and that children with learning difficulties must transition, at their own pace, from concrete operations —such as counting cubes in towers or apples in baskets—to abstract reasoning through algorithm and/or mathematical models. But in a classroom of 30 children, it would be difficult for the teacher to tailor lessons to individual children.

That's where the cyber-tutor can help. As students complete simple mathematical tasks, the software engages the students in tasks that are designed to promote their conceptual understanding to the next level on the basis of their current performance. Once students advance to abstract models, they can solve problems involving larger numbers that would be impossible to count physically.

"This bridges arithmetic learning with algebraic learning," says Xin, an associate professor of special education.□

Principal Investigator Yan Ping Xin *(far right)* works with Lafayette School Corporation students on the PGBM-COMPS Intelligent Tutor software.

photo courtesy of Yan Ping Xin

BRIEF

Sustainable comfort

A living philodendron wall that filters the air, photovoltaic panels that actually send energy back to the grid, and a smart phone-enabled system that controls temperature, lighting and electricity consumption—these are some of the features that yielded Purdue's INhome second place in the Solar Decathlon 2011.

Sponsored by the U.S. Department of Energy in Washington, D.C., the event featured 19 solar-powered homes built by collegiate teams.

Work on INhome began in fall 2009 and involved more than 200 students from six colleges and schools: Technology, Engineering, Liberal Arts, Agriculture, Krannert, and Health and Human Sciences. While some teams focused on constructing homes that could be easily transported to the Mall for the competition, Kevin Rodgers, project manager and a graduate research assistant in the College of Technology, says that Purdue's team focused on aesthetics as well.

photo by Stefano Paltera/U.S. Department of Energy Solar Decathlon
(right) photo by Jim Tetro/U.S. Department of Energy Solar Decathlon

photos by Stefano Paltera/U.S. Department of Energy Solar Decathlon

(left) Ph.D. student Eric Holt slides the leader flag into place after his team takes first place in the Solar Decathlon following the results of the Affordability Contest. Team members *(right to left)* are Lee Causey, Seth Holloway, Jordan Wallpe, Sam Landry, and Hayden McMurtie. *(top)* Purdue team members react to their second place finish. *(above)* Purdue students cheer with U.S. Energy Secretary Steven Chu outside their entry in the U.S. Department of Energy Solar Decathlon 2011. *(below left)* Exterior architectural photograph of Purdue University's entry in the U.S. Department of Energy Solar Decathlon 2011.

"We designed a more traditional, Midwestern-style home. It's definitely appealing."

Adds McKenna Regan, a Krannert School of Management student who handled marketing and communications for the project, "It shows that you don't have to give up comfort to live sustainably." ☐

Purdue's committed sponsors partner with us in reaching out to the world.
Their support enables scholarly innovations, which ultimately become sustainable solutions.

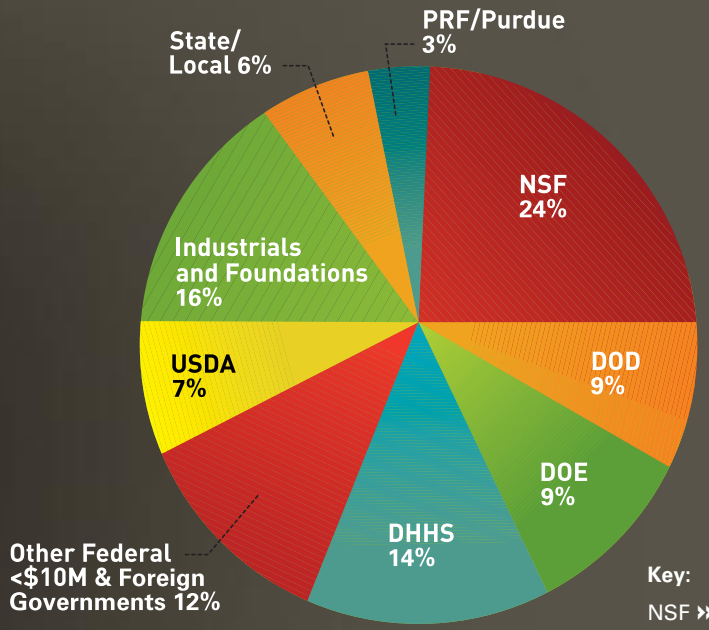
METRICS

During the 2010-11 fiscal year, $420 million in sponsored programs funding was made payable to Purdue University.

Funding sources included private industries, the National Science Foundation, several federal government departments, some state and local grants, and support from foreign governments.

Multiple sources

Awards for Purdue research activities can be found in industry and government.

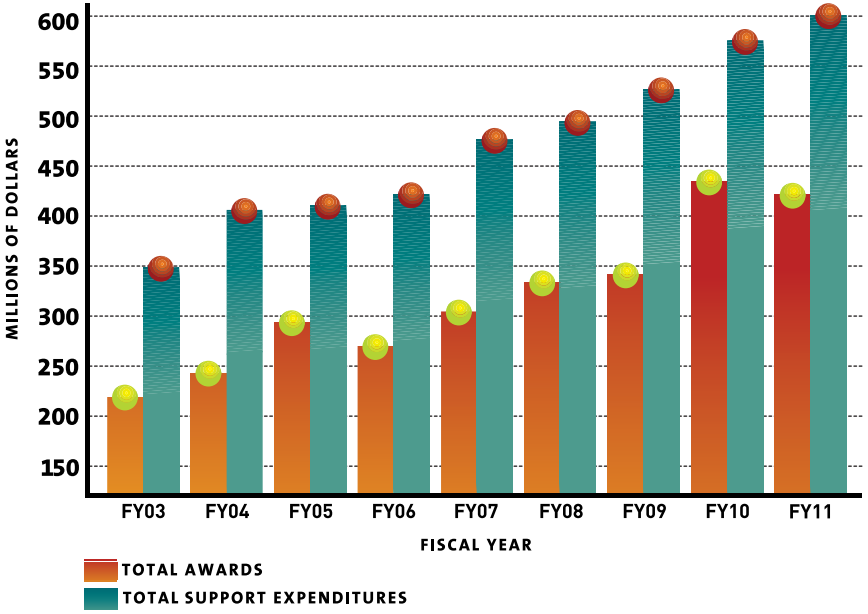


Key:

NSF ›› National Science Foundation
DOD ›› U.S. Department of Defense
DOE ›› U.S. Department of Energy
DHHS ›› U.S. Department of Health and Human Services
USDA ›› U.S. Department of Agriculture

Ever-increasing sponsorship

Purdue University sponsored programs continue to land significant funding.



From the **PRESIDENT** »

Meeting grand challenges As a land grant university of the 21st century, Purdue University is collaborating internationally to address the grand challenges of our time. Our faculty, staff and students bring a rich perspective to local and global issues, allowing us to design initiatives that improve human well-being and extend the benefits of knowledge, science and technology to far corners of the world.
—France A. Córdova, *President*

From the **VICE PRESIDENT** *for* **RESEARCH** »

Promoting discovery with delivery Purdue University has long been recognized around the world for our excellence in discovery. Today, our researchers are increasingly mindful of how their innovations can fulfill broader societal goals. By conducting field-defining research with breakthrough outcomes, we are changing lives and impacting the future.
—Richard Buckius, *Vice President for Research*

From the **PROVOST** »

Launching tomorrow's leaders Our faculty, staff and students are champions of transformation. By infusing international perspectives into our scholarly activities, we are enhancing learning experiences to meet a changing set of global imperatives. These enriched experiences allow us to foster scholars whose influence and impact will be felt on a worldwide scale.
—Timothy Sands, *Provost*

photo by Stefano Paltera/U.S. Department of Energy

U.S. Department of Energy Solar Decathlon 2011 collegiate teams, representing five countries and four continents, gather for an all-team photo. Purdue team members are in green in the back.

Graphic representation of Purdue's global reach. Markers indicate number of collaborative sponsored program agreements and global linkages with international partners outside the contiguous United States.

Source: Sponsored Program Services, Purdue University International Programs, Data Digest

Crossing borders is transformative, challenging us to view the same problems from different perspectives. And partnering with people from disparate cultures is revolutionary; collectively, we create innovations that are greater than the sum of our individual ideas.

As our world becomes increasingly interdependent, Purdue's transnational partnerships are helping us to cultivate new leaders, make groundbreaking discoveries and address society's greatest challenges. Reaching out, welcoming in, we are broadening Purdue's global footprint, ultimately contributing to the common good.

2010:2011 Office of the Vice President for Research Annual Report

EDITOR » *Pamela Burroff-Murr; director, research communications; Office of the Vice President for Research*
WRITERS » *Kathy Mayer, Angie Roberts, with contributions from Purdue News Service*
DESIGNER » *Cathy Swick, Cathy Swick Design*

Send correspondence to »
Office of the Vice President for Research
Purdue University
Hovde Hall of Administration
610 Purdue Mall
West Lafayette, IN 47907-2040

This report is available online »
www.purdue.edu/research/vpr/publications/

Office of the Vice President for Research
Purdue University
Hovde Hall of Administration
610 Purdue Mall
West Lafayette, IN 47907-2040
(765) 494-6209
(765) 496-2589, Fax

» WWW.PURDUE.EDU/RESEARCH/VPR

The report is available online at: www.purdue.edu/research/vpr/publications/

PURDUE
UNIVERSITY

EA/EOU
CSD.12.11.HAY