2009:2010
Office of the Vice President
for Research Annual Report

TRANSFORMATION»
INNOVATION *at the* NEXUS *of* HUMANS, NATURE *and* CYBERSCIENCE

PURDUE
UNIVERSITY

photos this page by Vincent Walter

(inset photos left to right) Professor Ei-ichi Negishi, Nobel Laureate in Chemistry for 2010, lectures to his sophomore organic chemistry class. Professor Jay Melosh has joined with dozens of other scientists to provide definitive evidence that the Chicxulub impact killed the dinosaurs.

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Model of neurons firing in the brain. Neurons process and transmit information via synapses, specialized connections with other cells, and then connect to each other to form networks.

Purdue News Service photo/David Umberger

Supercomputer clusters at Purdue allow researchers to concentrate on research, not on operating a high-performance computing system. The Rossmann cluster is ranked 126th, and the Coates cluster 147th, on the latest TOP500 supercomputers list.

Humans are by nature a connected species, linked to each other, the planet and its non-human inhabitants by both necessity and desire. So it's only natural that as scholars are increasingly working beyond the traditional boundaries of discipline and geography, they are focusing more on problems common to us all.

Yesterday, solving grand challenges like energy conservation and disaster mitigation seemed like distant possibilities. Today, as researchers see from a broader lens, they appear as near-probabilities. And at the nexus of this vision lies not only the human and natural sciences but also cyberscience—the electronic landscape where scientists connect far flung ideas.

Here at Purdue University, we are energized by the innovation appearing in the crossroads. Join us at the intersection and watch the transformation.

How can we target parasites responsible for drug-resistant malaria? How can we efficiently synthesize complex organic compounds? Why does the understanding of human culture help protect elephants and gorillas?

Purdue University researchers and their collaborators ask such questions about humanity daily, in laboratories, libraries and lecture halls. From the advocacy of art education funding to new theories behind nearsightedness, they found new answers last year, discovering the previously undiscoverable.

HUMANS

Targeting drug-resistant malaria

Jean Chmielewski, Purdue's A.W. Kramer Distinguished Professor of Organic Chemistry/Chemical Biology, and Christine Hrycyna, associate professor of chemistry, have worked together on projects for five years, so it made sense to take on yet another. They're now working on finding a new way to fight malaria.

Because their research shows promise for improving health in the developing world, it made sense, too, that the Bill and Melinda Gates Foundation would find their work of interest. It did, and the two were awarded a $100,000 Grand Challenges Explorations Grant in spring 2010, the first at Purdue since the grant program's 2008 launch.

Chmielewski and Hrycyna's high-risk, high-reward project was one of just 78 funded out of nearly 2,700 proposals submitted that cycle.

Bold thinking

"The winners of these grants show the bold thinking we need to tackle some of the world's greatest health challenges," says Tachi Yamada, president of the Gates Foundation's Global Health Program.

"Receiving this grant tells us that the Gates Foundation has faith in our creative idea and that our work could have a large impact on health if we are successful," says Hrycyna, who joined Purdue's faculty in 2000.

Renewing once-effective drug

Caused by plasmodium parasites that multiply in red blood cells, malaria is spread when infected mosquitoes bite humans. In the past century, the parasite has developed widespread resistance to available drugs.

Professors Jean Chmielewski and Christine Hrycyna received a Gates Foundation Grand Challenges Explorations Grant to explore an inexpensive, readily available anti-malarial drug that circumvents drug resistance.

photo by Steven Scherer

Since the disease takes the life of a child every 30 seconds and nearly half of the world's population is at risk of contracting malaria, combating it is a critical task.

The two hope to renew once-effective but now drug-resistant treatments so they will work again.

"We have designed molecules that target membrane protein transporters in malaria parasites that are responsible for drug resistance," says Chmielewski, a faculty member since 1995.

She and Hrycyna have designed a way to link pairs of molecules to traditional antimalarial drugs to block what are known as *P. falciparum* resistance transporters. The linked molecules block the digestive system so drugs build up and then can work.

The molecular pairs are linked with traceless tethers that eventually break down in the digestive vacuole, and the compound reverts to the original anti-malarial drug.

Redesign could be more potent, effective

The researchers had early success using the technique on the anti-malarial drug quinine. Experimental results suggest the redesigned molecules may even be more potent and effective against drug-resistant malaria than the original drugs.

"We attribute much of our success to the synergy of our research expertise in biochemistry and chemical biology," Hrycyna says. "We can come at this problem from two unique directions."

Plan to expand work

"We will be expanding the scope to other drug-resistant agents," Chmielewski says.

Receipt of this first Gates grant qualifies them to apply for up to $1 million in additional funding.

"We're looking forward to establishing a long-term relationship with the Gates Foundation to improve human health in developing countries," Chmielewski says. ☐

BRIEF

Linking thyroid deficiency and nearsightedness

What do some nearsighted and farsighted humans have in common with transparent zebrafish?

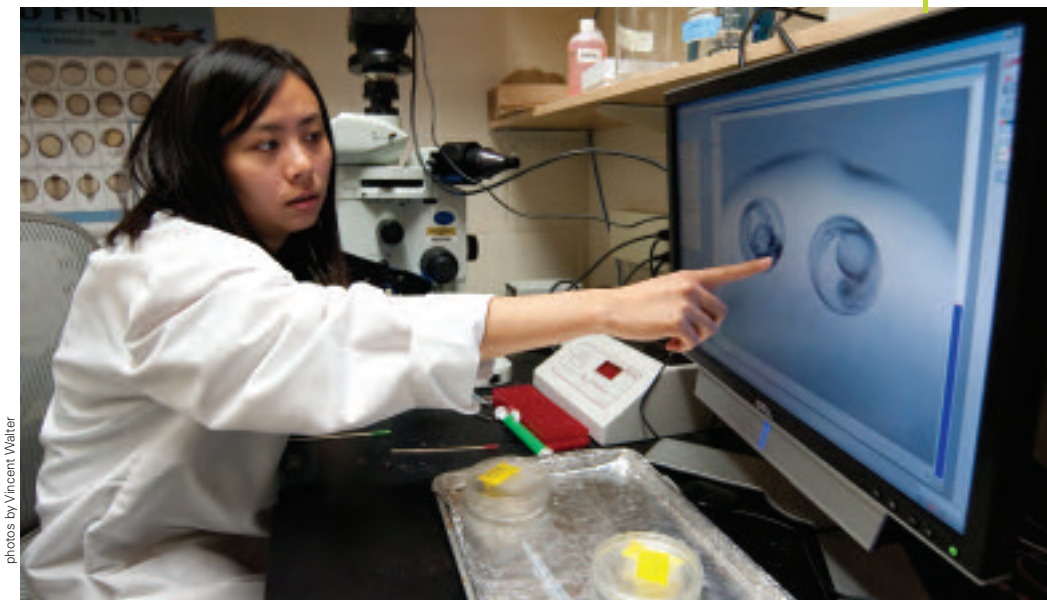
Small eyeball size—and possibly altered thyroid activity as well, according to Zeran Li. Her theory of a link between refractive errors and under-functioning thyroids has garnered Li a $2,000 grant-in-aid award from Sigma Xi, an international honor society of research scientists and engineers.

While studying zebrafish embryos that had been treated with PTU (phenylthiourea) to render them transparent for research purposes, Li, then an undergraduate, noticed that their eyes were smaller than those of untreated larvae. After further research, she discovered that PTU also inhibits thyroid activity.

Now Li is trying to establish a link between thyroid deficiency and eyeball size by seeing if an artificial thyroid hormone can correct the abnormal development.

"Some people have myopia because their eyeball is smaller than normal; the image cannot be focused properly, so it is blurred," says Li, who is working as a research assistant for Professor Yuk Fai Leung in the Department of Biological Sciences while preparing for graduate school. If they determine that diminished thyroid functioning leads to diminished eyeball size, ultimately their findings could lead to alternative medical treatments to prescription eyeglasses or surgery. ☐

Zeran Li is studying zebrafish embryos to establish a link between vision problems and hypothyroidism.



photos by Vincent Walter

Art in a test tube

If chemistry has evolved into an art form, as some would say, then palladium-catalyzed cross coupling is one of the field's modern-day masterpieces. Co-developed by Ei-ichi Negishi, the Herbert C. Brown Distinguished Professor of Organic Chemistry, the reaction has enabled chemists to create carbon-based molecules as complex as those in nature itself—and has yielded Negishi the 2010 Nobel Prize in Chemistry.

Negishi, along with co-laureates Richard Heck of the University of Delaware in Newark and Akira Suzuki of Hokkaido University in Sapporo, Japan, was recognized for the discovery of palladium as a catalyst in forming carbon bonds. In the Heck, Negishi and Suzuki reactions, carbon atoms meet on a palladium atom, with their proximity to one another kick-starting a chemical reaction. Among its many applications, the reactions have resulted in new cancer medications, antifungal treatments for crops and thinner television screens.

Negishi says he discovered catalytic reactions using a number of transition metals that allow various organic compounds to be synthesized widely, efficiently and selectively. The procedure dramatically reduces the cost of metals such as palladium in synthesis.

"Catalysts are not lost as they spur a chemical reaction; they are recycled and can be used over and over again," he explains. "These transition metals are very expensive, but when they can be used millions to billions of times, it dramatically reduces the cost and makes the mass manufacturing of special, complex materials practical." □

Immediately after Ei-ichi Negishi's first press conference announcing his Nobel Prize win, he returned to the classroom to teach his sophomore organic chemistry class.

photo by Vincent Walter

BRIEF

Human dimensions of wildlife research

Numerous conference presentations and publications in *Conservation Biology, African Journal of Ecology* and others are helping Melissa Remis, biological anthropologist and professor of anthropology, communicate her research findings. The message: Understanding human cultures is key to preserving gorillas, elephants and other wildlife in African parks and reserves.

Her research in the Dzanga-Sangha Dense Forest Reserve in the Central African Republic, supported by the National Geographic Society, World Wildlife Fund and others, has "made me increasingly aware of the plight and interdependence of humans and wildlife in developing countries," Remis says.

"Conservation efforts and management of protected areas are often designed with the best intentions, but sometimes supporting scientific data is missing or incorrect assumptions are made about a local culture, outsiders or trade that play a role," she says. "Conservation isn't just about protecting wildlife. You also need to consider the human dimension, such as how local hunting technologies or even migration can change how land is used."

Better integration of ecological and social domains would improve conservation, her work suggests. □

Melissa Remis

Purdue researcher Melissa Remis has found that understanding human cultures is key to preserving African wildlife.

BRIEF

Advocating for art education

Despite its name, the No Child Left Behind federal legislation leaves children behind in art, and that negatively impacts education, reports F. Robert Sabol, chair of the department of art and design and professor of visual and performing arts, who earlier spent 25 years as an elementary art teacher.

His 2009 study, supported by the National Art Education Foundation and the National Art Education Association, compiled responses from more than 3,400 educators. It found that art teachers are being asked to teach other disciplines, art education budgets have been cut by an average of 30 percent and art education has yet to achieve parity with other core subjects.

"My hopes are that the findings will influence legislators to maintain arts education in the core of learning," Sabol says. He also hopes his research will prompt protection of arts education funding when legislation is reauthorized, that art educators' workloads will be similar to other teachers, and that remediation, test prep, test taking and other activities will no longer affect time for art.

Art as a core subject is more important than ever, the study concludes. □

F. Robert Sabol

Purdue News Service photo/David Umberger

Foray named a Kluge Fellow

Exploring centuries of Dutch imperialism, Indonesia's violent decolonization and the Netherlands' refusal to confront the implications of its history is driving the current, stipend-assisted research of **Jennifer Foray,** assistant professor of history.


Jennifer Foray

Chosen by a panel assembled by the National Endowment for the Humanities and named by the Library of Congress as one of only 11 Kluge Fellows from worldwide applications, Foray is spending the 2010/2011 academic year at the library's John W. Kluge Center in Washington D.C.

"I am examining the library's rich holdings relating to my project," Foray reports, which she'll use to write *Imperial Aftershocks: The Legacies of Decolonization in the Netherlands.*

Foray came to Purdue in 2006 after earning her doctorate at Columbia University.☐

BRIEF

History moves from page to stage

History came to life last May as Purdue professors and students produced *The Fall of Man* at the University of Toronto's Chester 2010 festival and academic symposium.

"Our goal was to conduct performance-based research on medieval drama and explore questions of staging, audience reception and historical context relating to the Chester cycle of plays," says Paul Whitfield White, director of medieval and renaissance studies and professor of English.

The project began in summer 2009 with student meetings, followed by a fall 2009 medieval drama class and Maymester 2010 course, From Page to Stage: Chester 2010. Those led to the wagon-staged production directed by Gordon McCall, head of directing and associate professor of theatre, and White's symposium plenary address and essay in a forthcoming anthology.

All centered on the symposium's questions: What made the Chester Cycle powerful enough that a 1572 cleric felt it would inspire rebellion? How do theatre historians use performance in research? How do teachers use performance to explore questions with their students?

Funding sources included Indiana Humanities Council, Purdue's Office of Interdisciplinary Studies and International Programs.☐

BRIEF

Students rise to the occasion


Marcia Gentry

Like the rising tide that lifts all boats, a Purdue-developed teaching model helps all students achieve. Created by Marcia Gentry, professor of gifted, creative and talented studies, Total School Cluster Grouping uses gifted education know-how in every classroom.

The result: fewer students achieving at low levels—and more students from low-income families and underrepresented groups reaching high achievement levels.

To support earlier findings, Gentry is now in the second of a five-year experimental study funded by the U.S. Depart-

ment of Education. "This is a scale-up," she says; it involves 90 elementary schools in nine states.

"We identify the achievement levels of all kids, then cluster the highest achievers in one classroom. Additionally, we place above-average achievers among fewer achievement levels in other classrooms to help teachers more effectively meet their individual students' needs," she says.

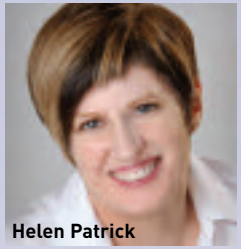
"We instruct all teachers how to teach kids as if they're gifted, and each year we re-identify student achievement levels."

Gentry expects the study to confirm earlier research. "Because we regroup students and give them a chance to grow, we improve their achievement."☐

Purdue professors and students researching 15th century pageants produced *The Fall of Man* at the University of Toronto last May *(left to right)* Case Tompkins (God), Ed Plough, Derrick Bettis, David Sweeten, Regina Bouley (Angels)

Kindergarten science project earns high marks

Educational psychology professors **Panayota Mantzicopoulos, Helen Patrick** and **Ala Samarapungavan** landed the 2010 *Journal of Research in Science Teaching* Award for their Volume 46 article, "Motivation for learning science in kindergarten: Is there a gender gap and does integrated inquiry and literacy instruction make a difference?"



Helen Patrick

Ala Samarapungavan

Panayota Mantzicopoulos

Highlighting their Scientific Literary Project, the article reports that early, meaningful participation in science motivates both girls' and boys' interests while presenting science as a discipline.

Supported by a $1.5 million, three-year U.S. Department of Education grant, project lessons integrate inquiry with literacy so kindergartners can examine "big ideas." Topics such as the nature of science, living things, and force and motion allow students to predict, observe, record and discuss. Lessons further math, reading and writing skills; parent reading guides support continued learning.☐

Political scientist named fellow

Decades of achievement earned Political Science Professor and Department Head **Bert Rockman** induction as a fellow in the National Academy of Public Administration.

He was one of 34 named in 2009 by the Congressionally authorized academy of top public management and organization scholars, who tackle complex, national administrative challenges.

"It's always nice to know your work has been taken seriously and that it's contributed to important discussion," Rockman says.

Primarily focused on the relationship between politics and experts, he says, "I'm interested in the equilibrium between bringing peoples' needs of government and enabling government to perform effectively."

Bert Rockman

Rockman is currently assessing the Obama presidency and health-care policy.

He earlier won the Richard E. Neustadt Award for best book on the U.S. Presidency and Herbert A. Simon Award for lifetime contributions to scientific study of bureaucracy.

Recent publications include *The Oxford Handbook of Political Institutions, Presidential Leadership: The Vortex of Power* and *The George W. Bush Legacy*.☐

Ji-Xin Cheng

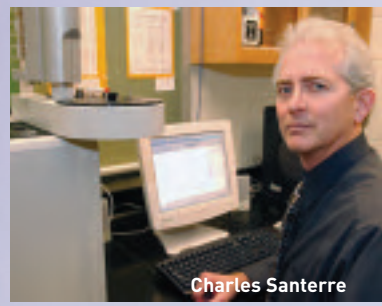
LIGHTING THE WAY

New findings from Ji-Xin Cheng, an associate professor of biomedical engineering and chemistry at Purdue University, suggest that an experimental ultrasensitive imaging technique might enable both the early detection and treatment of disease. This composite image shows luminous nanocages, which appear like stars against a black background, and a living cell, at upper left. The gold-silver nanocages exhibit a bright three-photon luminescence when excited by an ultrafast pulsed laser, with 10 times the intensity of pure gold or silver nanoparticles. The signal allows live cell imaging with negligible damage from heating. ☐

Purdue University graphic/Ji-Xin Cheng

USDA taps food toxicology expert

Being named a Fellow of the American Association for the Advancement of Science not only recognizes **Charles Santerre**'s meritorious efforts to advance science, it also takes the Purdue food toxicology professor to the U.S. Department of Agriculture in Washington D.C. for a year.



Charles Santerre

There, he's on a multidisciplinary team working to improve the National Residue Program, which surveys meat, poultry and egg products for pesticides, antibiotic residues and environmental contaminants.

"I'm working to develop strategies for rapidly responding to emergency food-borne contaminants," he says. "In recent years we have seen a number of contaminants, such as melamine, acrylamide, lead and flame retardants."

Santerre's research examines toxicity of chemical contaminants found in food. His Purdue group has also developed an iPhone application and website to help childbearing-aged women make informed seafood choices.

"My projects range from the lab bench to field investigations, human clinical trials and education interventions," Santerre says. ☐

Luo receives independent scientist award

An Independent Scientist Award from the National Institutes of Health is giving **Zhao-Qing Luo's** research a boost. The award's goal is to foster development of outstanding scientists, enabling them to expand their potential to make significant contributions.

The associate professor of biological sciences is studying the cellular and molecular mechanisms that allow microbial pathogens to survive and multiply in hostile host cells. With the knowledge gained, he hopes to be able to combat infectious diseases.

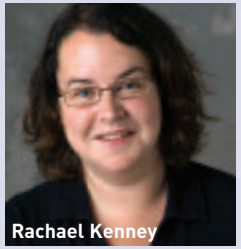
"This award allows me to fully focus on my research for five years by maximizing the time I can spend on development of research projects, grant proposal writing, and mentoring postdoctoral students, graduate students and other trainees in my laboratory," Luo says.

He's already expanded his research program and is also now collaborating with a group at Texas A&M University on a new project funded by the National Institutes of Health. ☐


Zhao-Qing Luo

Writing to learn mathematics

Mathematics and English are joining hands in a study led by **Rachael Kenney** and **Melanie Shoffner,** who are evaluating secondary mathematics pre-service teachers' experiences with the writing-to-learn-mathematics approach.


Rachael Kenney


Melanie Shoffner

They received a 2010 Faculty Research Fellowship from Purdue's Discovery Learning Research Center, which sought collaborative projects involving science, technology, engineering or mathematics (STEM) and a non-STEM subject.

"Our research agendas offer connections in the areas of teacher education, literacy and reflection," says Kenney, assistant professor of mathematics and curriculum and instruction. "Realizing the fellowship's parameters closely aligned with our interests was serendipitous."

"This research allows us to jointly extend our understanding of literacy in mathematics education and reflection in teacher preparation," says Shoffner, assistant professor of English and curriculum and instruction.

The project includes lesson plan help and team-teaching experiences for pre-service teachers. ☐

CUP OF TEA

Mario Ferruzzi, associate professor of food science and nutrition, says that an in vivo study supports earlier research showing that the addition of ascorbic acid and sugar to green tea may increase the amount of catechins the body is able to absorb. Catechins, a class of polyphenols common in tea, cocoa and grape, are antioxidants thought to fight heart disease, stroke, cancer, diabetes and other health problems. A human trial will begin soon. ☐

Purdue Agricultural Communications file photo/Tom Campbell

What can make buildings in Haiti less vulnerable to earthquakes? Where can astronauts manufacture fuel in space? How can we save ailing canines with discarded human medical devices?

Innovations in the physical world come from fields ranging from agriculture to veterinary medicine. Whether nano-steps or giant leaps, advancements such as energy-efficient heat pumps, new evidence of dinosaur extinction and findings on the health hazards of nano-bactericides propel us into new realms of understanding.

NATURE

Expert help for Haiti

From analyzing faults to surveying buildings and educating Haitian graduate students, Purdue experts are lending a hand in Haiti's recovery from the January 12, 2010, earthquake that killed 222,570 people, injured another 300,000 and displaced 1.3 million.

Among those at the forefront are Eric Calais, geophysics professor in the department of earth and atmospheric sciences, and representatives from Purdue's NEES Operations Center (NEEScomm), a National Science Foundation-funded program overseeing the George E. Brown Jr. Network for Earthquake Engineering Simulation.

Calais forecasted quake

That a magnitude 7 earthquake could strike Haiti was forecasted in 2008 by Calais, who had been studying the island's faults since 1989.

When it did, along with 59 aftershocks of magnitude 4.5 or greater, he headed to Haiti for five weeks under a National Science Foundation Rapid Response Grant. Accompanied by Andrew Freed, associate professor of earth and atmospheric science, he mapped the ruptured fault area to try to determine the likelihood of more earthquakes.

"We are very sure there will be another—tomorrow, in a year or 50 years," Calais says. "That's the problem

Purdue earthquake experts made Haiti a priority in understanding and predicting future seismic activity and assessing building damage after the catastrophic January 2010 earthquake.

Purdue News Service file photo/David Umberger

with earthquake science. We know where they will happen and can even provide a possible magnitude range, but we don't know when it will strike."

Now a U.N. staff member in Haiti

In May, Calais was appointed by the United Nations Development Program to lead a year-long effort to reduce the risks and damage from earthquakes in Haiti. On leave from Purdue, he is a science advisor under the U.N. Disaster Risk Reduction Program and is helping Haiti's government define and implement a strategy to reduce seismic risk.

Working in "not quite optimal" temporary facilities near the airport, Calais is helping the Haitian government better understand the potential for earthquakes, risks involved and how to educate people about related issues.

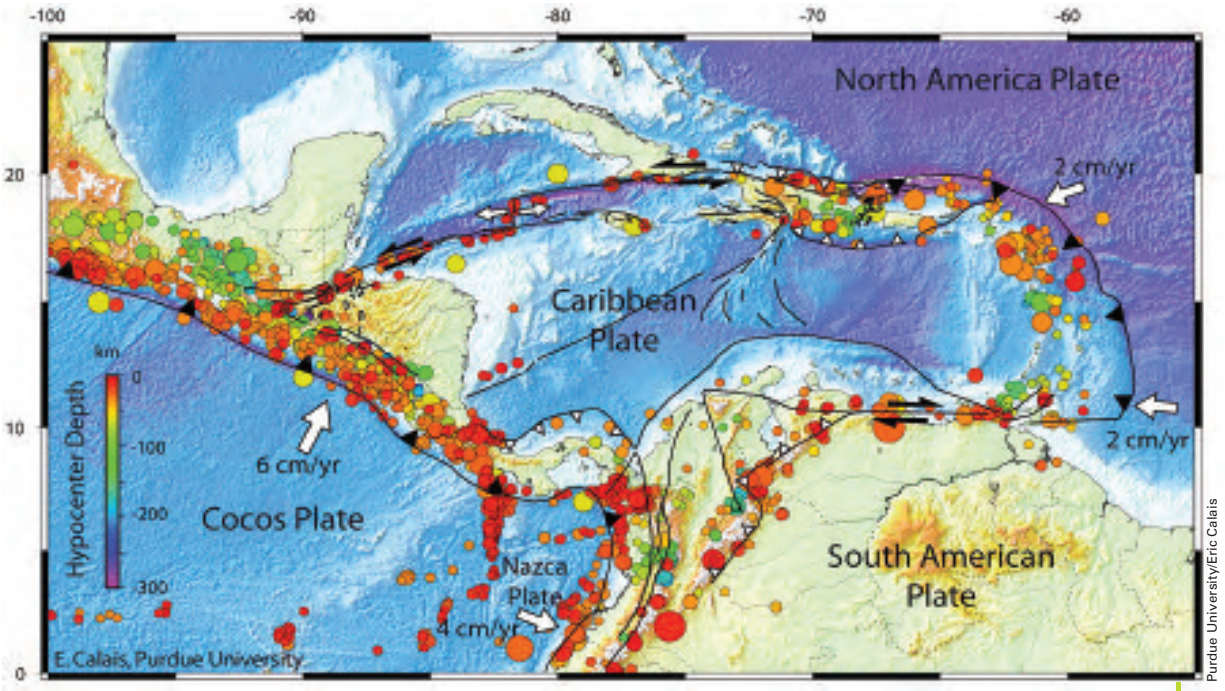
One aspect is micro-zoning, identifying seismic activity potential in specific areas before deciding how and where to rebuild. "I'm pushing hard for that to be done as soon as possible so some infrastructure reconstruction can benefit from that critical piece of information," Calais says.

A recent U.N. Development Program project has approval to rebuild six neighborhoods in Port au Prince where micro-zoning will be done. "That's progress," he says.

With 97,294 houses destroyed and another 188,383 damaged, massive rebuilding is ahead.

"The task is tremendously difficult," he says. "It's not only rebuilding infrastructure and structures, but rebuilding a government and health, education and social systems. It's building the country from scratch. My task is a small part of the whole, trying to help build earthquake safety into some aspects of reconstruction."

Much of his day is spent traveling to meetings with different national institutions, ministers and government representatives. "I've learned a lot about how to effectively communicate with decision-makers and explain problems in terms that will relate practically to the decisions they have to make."



Purdue University/Eric Calais

The seismotectonic context of Earth's Caribbean tectonic plate is shown in this map.

(below) Louis Obenson of Haiti's Civil Protection Agency installs GPS equipment in Port-au-Prince.


Purdue University/Eric Calais

NEEScomm team surveyed buildings

In June, two other Purdue faculty and four graduate students from NEEScomm joined similar groups from the University of Kansas and University of Washington in Haiti. They surveyed 170 buildings, finding that an estimated 90 percent of Haitian structures would be considered seismically vulnerable.

"The frequency of damage is higher in buildings with captive columns," says Santiago Pujol, assistant professor of civil engineering, who made the trip. Captive columns occur when attached walls are not as high as columns, leaving a portion unsupported and vulnerable. He advocates for use of larger columns and reconfiguration of partial-height walls that create captive columns. "That will save lives."

Haitian scholars

Purdue also is providing three years of tuition for two Haitian earth science graduate students. Their travel, living and research expenses are being funded by the Voila Foundation. □

EARTHSCOPE

Undergraduate students from throughout the central United States visited Purdue last summer to participate in a seismic study that will measure earthquakes, monitor the behavior of seismic waves, map movement of the Earth's surface and create images of the crust and mantle of the North American continent. Here, Greg Waite, principal investigator and assistant professor, and students Andrea Dixon and Marika Dalton, all from Michigan Technological University, practice using hand-held GPS units during an activity on Purdue's campus. The program was part of EarthScope funded by the National Science Foundation. ☐

photo courtesy of Perle Dorr/Incorporated Research Institutions for Seismology

BRIEF

Beans for corn

Pushing down on a heavy black lever, a farmer releases a truckload of freshly harvested corn into a 17-foot-tall grain dryer. Traditionally fueled with propane or natural gas, the costly dryers may one day be powered with a new mix of degummed soybean oil and No. 2 diesel fuel.

Continuing research begun by Professor Emeritus Harry Gibson, Klein Ileleji, an associate professor and extension engineer of agricultural and biological engineering, worked with his colleagues to test different blends of degummed soybean oil. An unrefined and cheaper product to produce than soy methyl esters, the oil is commonly known as biodiesel.

Evaluating biodiesel blends of 5 percent, 20 percent and 50 percent, the researchers found that a blend of up to 20 percent didn't significantly increase gas emissions or heat output.

Grain drying helps prevent spoilage and molding of crops, allowing farmers to harvest wet grain, store grain for longer periods of time and transport it across longer distances. But the equipment is expensive to operate, accounting for the majority of farm energy costs during the post-harvest season.

The new blend reduces sulfur emissions and could potentially save farmers money, especially if the United States government offers credits for alternative agricultural fuels. "If you monetize some of these environmental benefits, definitely you provide farmers with an incentive," Ileleji says. □

Klein Ileleji

Purdue Agricultural Communications photo/Tom Campbell

Purdue researcher Klein Ileleji found that a 20 percent blend of degummed soybean oil performed well in grain dryers and reduced sulfur emissions.

BRIEF

Cutting costs in colder climates

When subzero winds roll across the plains near Lake Superior, heat pumps need a supplemental system to keep pace with home energy needs. Those backups are expensive to operate, but a new technology on the horizon may reduce their operating costs in the future, thanks to Jim Braun, Travis Horton and Eckhard Groll.

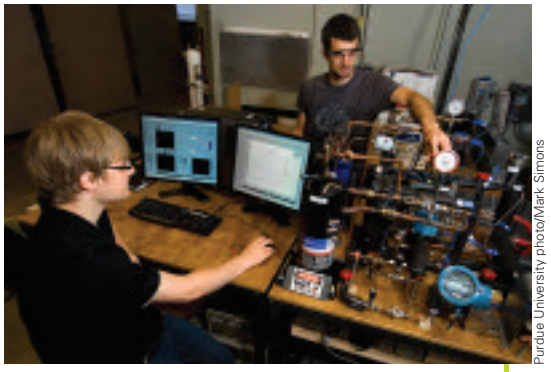
Building on previous work that began around five years ago at Purdue's Ray W. Herrick Laboratories, the researchers are developing technology that can maintain the efficiency of heat pumps even in severely cold weather.

The new technology works by modifying the conventional vapor-compression cycle behind standard air conditioning and refrigeration. In one method, oil is injected along with gas into two scrolls mated together, so that the work required to increase the pressure of the gas is reduced as it moves toward the inside of the scrolls. "Essentially it requires less work to get more benefit," says Horton, an assistant professor of civil engineering.

In the other method, the researchers inject a liquid refrigerant at several places within the scrolls, where it vaporizes to cool the gas. "It's a different idea, but you get a lot of the same benefit," says Braun, a professor of mechanical engineering.

Researchers expect to complete a prototype by the end of the three-year, $1.3 million project, funded by the U.S. Department of Energy. Depending on utility rates, the new technology ultimately could cut heating costs by up to 50 percent in places like Minnesota.

"In the coldest climates, there is a great opportunity to improve performance," Braun says. □



Purdue University photo/Mark Simons

Frederick Welck *(left)* an intern from Institut für Technische Chemie in Clausthal-Zellerfeld, Germany, and mechanical engineering doctoral student Christian Bach work with an experimental setup for testing valves as part of research to develop more efficient heat pumps.

BRIEF

Controlling heart rhythms in canines

When beloved canines are diagnosed at the Purdue Small Animal Clinic with sick sinus syndrome or a complete heart block, one life-saving intervention that Henry Green can offer is a commonly used human device—a pacemaker.

"Historically, dogs will live 4-5 years with pacemakers," says Green, an associate professor of veterinary cardiology who has helped to perfect implantation methods for the procedure. "Since the average age of these dogs is 7 at implantation, at this point in time, that's a pretty good life span."

Brand-new pacemakers are cost-prohibitive, so manufacturers donate pacemakers that have reached their sterilization shelf life. While not suitable for human use, they can be implanted in dogs once the settings are calibrated for their particular breeds.

In 2010, Green launched a study to assess how well the devices follow the dogs' heartbeats and meet their cardiac demands. While he is collecting data, he and his staff will continue to give canines a new leash on life.

"A lot of these cases are life or death situations. We're immediately impacting the life span by placing the systems in," he says. "That's what we're in the business for—to provide a good quality of life and maintain the human-animal bond."□

photos by Vincent Walter

Human pacemakers implanted in dogs extend their life spans for an average of 4-5 years, according to Professor Henry Green.

Salt receives McCoy Award for research

Using genome-scale biological approaches and information technologies in pioneering ways to study plant ionomes—mineral nutrients and trace elements—helped **David Salt** earn the 2010 Herbert McCoy Award.

"I am very pleased that my colleagues who reviewed the nominees felt my work was of sufficient quality to warrant the award," Salt says of receiving Purdue's most prestigious research award. Winners are nominated by colleagues for outstanding contributions to science and chosen by faculty representatives and Purdue's president.

A professor of horticulture and landscape architecture and an international leader in plant nutrition, Salt has contributed significantly to environmental sustainability, agriculture and human health.□

"I am very pleased that my colleagues who reviewed the nominees felt my work was of sufficient quality to warrant the award."

—Purdue Professor of Horticulture and Landscape Architecture, David Salt

David Salt

photo by Vince Walter

Jay Melosh

photo by Vince Walter

BRIEF

Craters and the end of the dinosaurs

Jay Melosh has been fascinated with dinosaurs since childhood, but his current professional interest stems from 1980, when Louis W. Alvarez, Walter Alvarez, Frank Asaro and Helen V. Michel published their asteroid impact theory of dinosaur extinction.

"It was controversial at the time, but I'd been working on impacts, and I got very interested in just how it happened and just what it was about the impact that could have caused the extinction," says Melosh, Distinguished Professor of Earth and Atmospheric Sciences and Physics.

Melosh has spent the ensuing years studying the Chicxulub impact, believed to have occurred 65 million years ago. Last spring, he teamed up with around 40 experts in paleontology, ocean-floor ecology and climatology to provide definitive evidence that Chicxulub killed the dinosaurs. Evaluating new core samples from ocean and land sites and re-analyzing relevant work, they published their results in the journal *Science.*

While a few fringe groups still dispute the theory, it's now becoming widely accepted in a number of disciplines.

"The general feeling is that the case is far stronger than we had individually apprehended in our own individual areas," says Melosh, who continues to work on understanding the mechanisms behind the disaster. "Whether there was a synergy of many different effects is still unclear, but there's so much confirming evidence from all directions that there was a big impact and that the impact caused the extinction."

Now maybe it's time to revise the Cretaceous-Paleogene history books.☐

BRIEF

Two green thumbs-up for sustainable flower pots

Sporting mottled surfaces in earthy hues like ebony, sand and terra cotta, eco-friendly flower pots help reduce gardeners' carbon footprints—but many growers won't stock them for fear these higher-priced pots won't sell. That attitude may change soon, thanks to two Purdue horticulturists.

Teaming up with researchers at Michigan State University, Texas A&M, Vineland Research and Innovation Centre and the University of Minnesota, Roberto Lopez, assistant professor of horticulture, and Jennifer Dennis, an associate professor of horticulture and agricultural economics, organized a series of silent auctions for consumers. Buyers were given $30 each that they could either pocket or use to bid on flowers in sustainable and traditional plastic pots.

In comparison to plastic pots, consumers were willing to pay an average of 58 cents more for rice-hull pots, 37 cents more for straw pots, and 23 cents more for wheat pots.

"When it comes to consumptive behavior, people will always say they'll do one thing but do another," says Dennis. "We wanted to see if people, when given money and a choice, would do it." Now they are sharing their findings with growers.

"For a grower to make that conversion to sustainability, it's a big change—water, mechanization, the higher cost of pots—but if consumers are willing to pay more, then it's obviously good for the growers," Lopez says.☐

Roberto Lopez, Jennifer Dennis

photo by Vince Walter

BRIEF

Harnessing space's natural resources

Gathering on a farm near the West Lafayette campus, a group of students and professors ignite a 9-foot rocket, watching as its zooms 1,300 feet into the sky before landing safely on the ground. Someday, the same propellant that powered the earthly experiment may help astronauts return from missions in space.

A frozen mixture of water and nano scale aluminum powder, Aluminum-ice (ALICE) was developed by Steven Son and Timothée Pourpoint. More environmentally friendly than conventional propellants, it could potentially be manufactured from water resources on the moon or Mars.

"If you could make aluminum ice on the moon, that would be all the propellant you need to come back; you wouldn't need to carry it on the way there," says Pourpoint, a research assistant professor of aeronautics and astronautics. "Any mass is thousands of dollars, so that is a big target for NASA for reducing costs."

ALICE provides thrust through a chemical reaction; as the aluminum ignites, oxygen and hydrogen in the water molecules fuel combustion until the powder is burned.

While the formula isn't perfected, ALICE is already firing up prospective astronauts. "We've received a lot of e-mails from k-12 schoolchildren," says Son, an associate professor of mechanical engineering. "When you tell people you're going to burn aluminum with water, it's startling because usually water is a product of combustion, not a reactant. It's very much out of the box."□

This image shows the west-facing side of an impact crater on Mars, exhibiting gullies that could have been formed by flowing water, liquid carbon dioxide or dry granular flows. If Mars actually does contain water, astronauts may someday be able to manufacture fuel with water and aluminum or other nanoproducts.

Purdue University photo/Andrew Hancock

Holding a rocket launched in 2009 using the ALICE propellant are *(from left)* Mechanical engineering undergraduate student Cody Dezelan, mechanical engineering graduate student Tyler Wood, mechanical engineering professor Steven Son, aeronautics and astronautics graduate student Mark Pfeil mechanical engineering doctoral student Travis Sippel, aeronautics and astronautics research assistant professor Timothée Pourpoint, and postdoctoral researcher John Tsohas.

BRIEF

Hidden dangers of nano-bactericides

Touting its germ- and odor-fighting properties, manufacturers are imbedding nano silver in everything from baby carriages to washing machines. But new research indicates the bactericide can be toxic to fish.

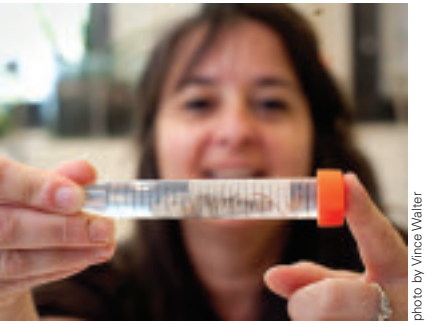


photo by Vince Walter

Exposing embryos of fathead minnows to silver nanoparticles suspended in solution, Maria Sepúlveda observed that many of the embryos died. When the nano silver was allowed to settle, the solution was less toxic but still caused developmental abnormalities.

"Silver is one of the most toxic elements," says Sepúlveda, an associate professor of forestry and natural resources. "If put in nanoform, it's almost like a mini-bomb of silver going inside the cell and causing all different kinds of problems."

Now Sepúlveda aims to conduct *in vivo* studies in zebra fish, a commonly used model for studying human disease. Ultimately, she hopes her research will inform regulators on how toxicity might be diminished by changes to the size or shape of nano particles.

"Right now, the EPA is considering that nano silver exerts the same type of toxicity at the same concentration as ionic silver," she says. "They need the data to determine if the toxicity is different, and the mechanisms are different, and this is what we need to do to decrease the risk to humans. And if you decrease the risk to humans, you're hopefully decreasing the risk to other animals as well."☐

Maria Sepúlveda

photo by Vince Walter

Maria Sepúlveda's research on the effects of nano silver on fathead minnows may lead to manufacturer recommendations on the use of the bactericide.

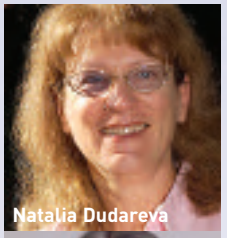
photo courtesy of NASA

Fellow appointments laud achievements

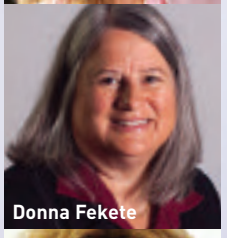
Findings that could help treat hearing loss and deafness; advancements in boosting plants' pollination, defense and nutritional values; and breakthroughs in inquiry-based physics education are among individual achievements contributing to seven faculty being named 2010 fellows by the American Association for the Advancement of Science.

Individual research also includes technology for early disease detection, land use and climate change impacts on water resources, small group chemistry learning and semiconductor excitations and their heterostructures.

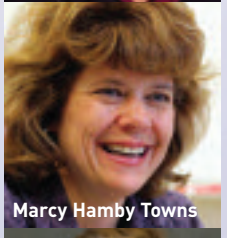
Those chosen by their peers for their meritorious efforts to advance science and technology: **Natalia Dudareva,** distinguished professor, department of horticulture and landscape architecture; **Donna Fekete,** professor of biological sciences; **Marcy Hamby Towns,** associate professor of chemistry; **Jonathan Harbor,** professor and head of the Department of Earth and Atmospheric Sciences and interim director of the Sustainability Center; **Anant Ramdas,** Lark-Horovitz Distinguished Professor of Physics; **Anita Roychoudhury,** associate professor of curriculum and instruction; and **Mary Wirth,** W. Brooks Fortune Professor of Chemistry.☐



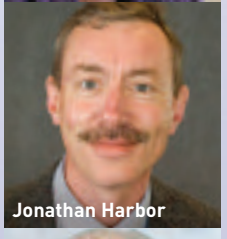
Natalia Dudareva



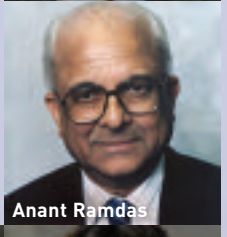
Donna Fekete



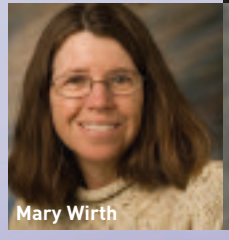
Marcy Hamby Towns



Jonathan Harbor



Anant Ramdas



Mary Wirth

Anita Roychoudhury

How can we extend classical information theory to meet modern challenges in computing and communication? Where does social networking fit into the workplace? Why is the whole of a computer cluster greater than the sum of the processors it's made of?

For Purdue faculty posing these inquiries, cyberscience provides not only a virtual space for analysis and interaction but also a new research frontier. Virtual mockups for hospital rooms, the impact of TV crime dramas on perception and the role that physics can play in determining executive compensation—all new insights into humanity, nature and the electronic world in which they intersect.

CYBERSCIENCE

Rethinking information theory

How can we extend classical information theory—which paved the way for the Internet, DVDs, and iPods—to meet new challenges posed by rapid advances in networking, biology, and quantum information processing?

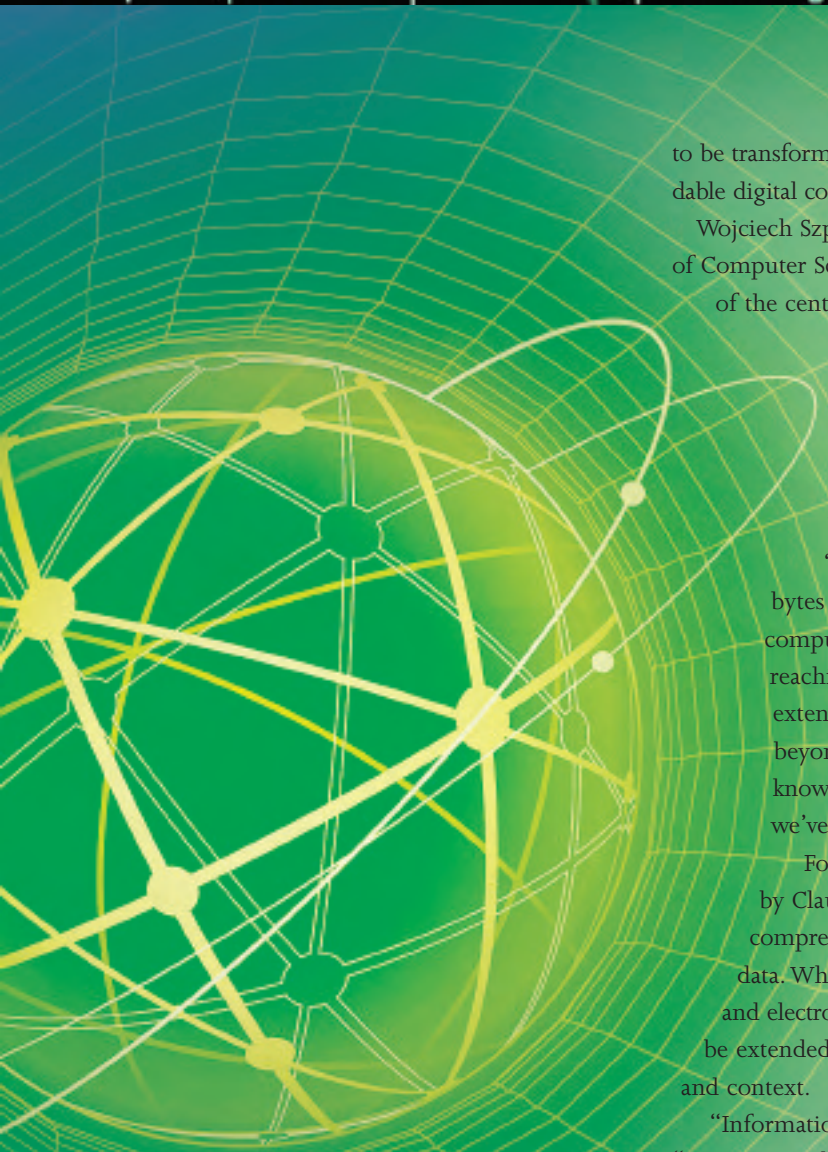
Researchers at Purdue are collaborating with institutions across the country to find the answers. Purdue University has been awarded $25 million to create the first National Science Foundation Science and Technology Center in Indiana.

The Science of Information Center aims to define principles underlying the next generation of information theory by integrating elements of space, time, structure, semantics, and context, validating these theories on diverse applications from economic modeling to analyses of biological systems.

"The center brings together world-class scholars from top universities to collectively develop a comprehensive science related to how information is extracted, manipulated and exchanged," says Richard Buckius, Purdue's vice president for research. "The team will attack these problems by rigorous theoretical studies driven by critical real-world problems in domains as diverse as biology, social networks and computer communication networks. The outcomes promise

Wojciech Szpankowski and his colleagues at Purdue and eight partner institutions aim to define principles for the next generation of information theory.

photo by Vince Walter



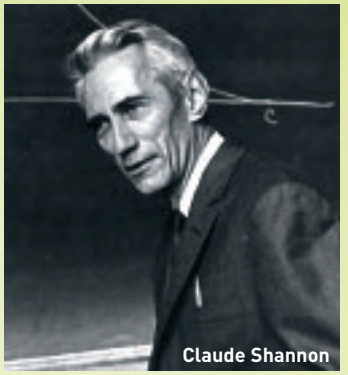
to be transformative, just as development of reliable and affordable digital communication transformed 20th century life."

Wojciech Szpankowski, Purdue's Saul Rosen Professor of Computer Science, has been appointed as project leader of the center. Along with fellow faculty members, he hopes to partner with industry representatives to develop long-term technological solutions and tools for analysis and modeling in life sciences, communications, finance and consumer behavior.

"Classical information theory, with bits and bytes as the measure of information, revolutionized computing and communication," he says. "We are reaching the limits of this foundation and need to extend it. A new theory of information that goes beyond bits and bytes will allow us to harness the knowledge available in the massive amounts of data we've collected but not yet been able to truly tap."

For example, information theory, established by Claude Shannon in 1948, finds the limits of compressing, reliably storing and communicating data. While Shannon's theory has led to efficient codes and electronic transmission of information, it needs to be extended to include space, time, structure, semantics and context.

"Information is different from data," Szpankowski says. "A person is able to look at data and pull more information from it than what is presented on its face. We naturally take context into account and can tell instantly whether the word 'bank' refers to a river, a financial institution or to count on something. We need to enable computers to evaluate information more like a person does."


Claude Shannon

Co-PI Madhu Sudan of the Massachusetts Information of Technology says he's eager to dive into such endeavors. "There is a prevailing commonplace belief that the science of computing is finished and that current-day computers can achieve all we would want to do," he says. "Yet researchers at the forefront of the technology know that we have only explored the tip of the iceberg."

In fact, says P.R. Kumar, a collaborator from the University of Illinois at Urbana-Champaign, "We envision a future consisting of wireless and wireline networks that may well be revolutionary by today's standards. Instead of transporting just data, they may transport information."

Along with advancing the science of information, Szpankowski and his colleagues will establish scholarships and fellowships and create interdisciplinary undergraduate and graduate courses. Students will be able to access a cyberinfrastructure powered by HUBzero™ software, studying tutorials, publications and simulations. They'll also interact with top faculty from partner universities and leading private sector scientists.

Of particular concern to researchers is creating a pathway for underrepresented students from Bryn Mawr College (an all-women's undergraduate institution) and Howard University (a historically black university) into STEM (science, technology, engineering and mathematics) graduate programs at partner institutions. To meet this goal, they are planning open houses, cross-institution visits, summer research experiences, seminars and mentoring programs.□

BRIEF

Consortium focuses on cybersecurity

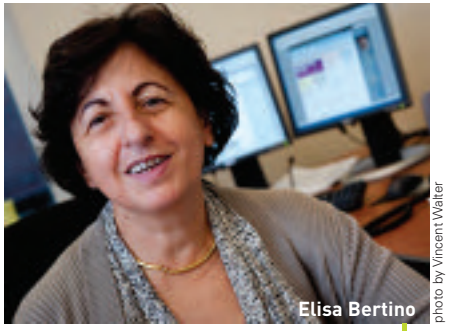
"We think this is a novel, promising approach," Elisa Bertino says of initial results of a technique that alters communication channel delays to securely transmit information via computer.

"Even if hackers try to destroy or change the delay in data packets, we are able to recall the provenance information, which identifies which computer originated or subsequently manipulated data," says the computer science professor and director of research for Purdue's Center for Education and Research in Information Assurance and Security (CERIAS).

Bertino's work in information attribution is one of four areas CERIAS is researching as a key player in the newly launched Northrop Grumman Cybersecurity Research Consortium, which also includes Carnegie Mellon University and Massachusetts Institute of Technology.

The other areas are detection and defense against attacks in cloudlike distributed systems, improving the speed and fidelity of forensics in the field on cell phones and similar devices, and decomposing Internet-scale models to accurately perform constrained experiments.

"Northrup Grumman is providing interesting feedback and applications for our technique," Bertino says. "In that respect, the consortium is working very well."□



Elisa Bertino

photo by Vincent Walter

One area of focus for Elisa Bertino, computer science professor and director of research for Purdue's Center for Education and Research in Information Assurance and Security, is origin of data streams for information attribution.

BRIEF

Virtual reality check

Donning a pair of goggles, Phillip Dunston enters a patient room, conversations from a nearby nurses' station diminishing as he closes the door behind him. Inside, the civil engineering professor walks around the space, pushing an IV cart with a handheld wireless control device to visualize its placement next to a chair.

Mockup tours are commonplace in hospital construction, but in this case it's occurring not in a medical tower but in Purdue's Envision Center. Here, in a Virtual Reality environment, Dunston hopes to reduce costly change orders and improve function by offering the sights, sounds and sense of a real hospital room.

"During the construction phase, when mockups are typically built, many of your design decisions are locked in at that point. Your ability to change has gone down dramatically," Dunston says. "With Virtual Reality, we can actually push some of these decisions back to the traditional design effort where we're underneath the curve of influence."

Dunston is now working with the Department of Building Construction Management, the School of Nursing, and the Envision Center to investigate virtual modeling of the built environment for clinical training. Placing a patient bed and an automated mannequin inside the mockup, the team hopes to understand how students perceive and function in that Mixed Reality space: "Is it close enough and similar enough to reality that it will provide answers for them?"□

In this photo illustration, Phillip Dunston appears inside his computer-generated hospital room, a virtual reality mockup aimed at reducing construction costs and enhancing nursing education.

Phillip Dunston

image by Phillip Dunston/Vincent Walter

BRIEF

Security, value and Web 2.0

Interesting insights on use of and concerns about Web 2.0 applications were found by Mihaela Vorvoreanu, assistant professor of computer graphics technology and organizational leadership and supervision, and Lorraine Kisselburgh, assistant professor of communication, when they analyzed a survey of more than 1,000 global business leaders in 17 countries.

"While most businesses see the value of Web 2.0 in supporting productivity and driving new revenue, security is the main concern preventing adoption," says Vorvoreanu.

Web 2.0 applications include social media, such as Facebook, Twitter and YouTube; microblogging; collaborative platforms; Web mail; and content-sharing tools. The debate continues on whether or how to allow employees to use the technology in the workplace.

Lorraine Kisselburgh
photo illustration shown in monitor

Professors Mihaela Vorvoreanu and Lorraine Kisselburgh communicated via Internet-based video calls during their study of Web 2.0.

"Security concerns are justified, given that 6 out of 10 organizations reported losses averaging $2 million in the previous year."

—*Purdue Assistant Professor of Communications, Lorraine Kisselburgh*

Their analysis, enhanced with expert interviews, was published in the report, "Web 2.0: A Complex Balancing Act—The First Global Study on Web 2.0 Usage, Risks and Best Practices." The work was commissioned by McAffee Inc.; the survey conducted by Vanson Bourne, an international research firm.

"Security concerns are justified, given that 6 out of 10 organizations reported losses averaging $2 million in the previous year," Kisselburgh says.

Countries widely adopting Web 2.0—topping 90 percent or more—include Brazil, Spain and India. The United States, Canada, Australia and United Kingdom reported the lowest rates. Three out of four businesses say they adopted the new technology because it might increase productivity and enhance marketing.

Vorvoreanu and Kisselburgh are both affiliated with Purdue's Center for Education and Research in Information Assurance and Security. ☐

BRIEF

Seeing is believing

Television dramas centering on crime and the judicial system do more than deliver an evening's entertainment. They influence regular viewers' perception of reality and can even prompt fans to feel fearful in their daily lives.

Those are among the research findings of Glenn Sparks, professor of communication, and doctoral student Susan Hueising Sarapin. Their survey of 103 jury-eligible adults unearthed some dramatic misconceptions.

Those regularly watching crime shows "are more likely to overestimate the frequency of serious crimes, misperceive important facts about crime and misjudge the number of workers in the judicial system," Sparks says.

Regular viewers, for example, suggested that 16 percent of our country's workforce are lawyers and 18 percent, police officers. The truth: less than 1 percent of all workers are in those professions. Those viewers also estimated annual murders at two-and-a-half times the real number.

With crime central to their entertainment lives, many believe the real world is a parallel, and that prompts anxiety. "This kind of television viewing can lead to 'mean world syndrome,' where people start to think about the world as a scary place," says Sparks. He studies mass media effects and believes that it is important to understand how popular crime shows might influence people.

"Some people develop a fear of victimization, and this belief can affect their feelings of comfort and security," he says.

Their research was presented at the International Crime, Media and Popular Culture Students Conference: A Cross Disciplinary Exploration at Indiana State University. ☐

Glenn Sparks

ADVANCING COMPUTER CHIPS

Nuclear engineer Ahmed Hassanein works at his Purdue lab, where researchers are adapting the same methods used in fusion-energyresearch to develop a new type of "nanolithography" for creating future computer chips. Supercomputers at the U.S. Department of Energy's Argonne National Laboratory are needed to run simulations critical for the research. The technology revolves around extremely thin plasma beams for making tiny features in future computer chips and continuing Moore's law, an unofficial rule stating that the number of transistors on integrated circuits, or chips, doubles about every 18 months.☐

phtoto by Vincent Walter

Roy Earns Humboldt Award for lifetime achievements

Hoping to again have an opportunity to work with **Kaushik Roy,** Purdue's Roscoe H. George Professor of Electrical and Computer Engineering, a colleague of his at the University of Bremen nominated him for the Humboldt Research Award from the Alexander von Humboldt Foundation in Germany.

Roy, a pioneer in the field of low-power design, was chosen for the award, which recognizes a lifetime of achievements in research that shaped fundamental new discoveries, findings and theories. Along with the international recognition, Roy received a research stipend and the opportunity to work with the department of computer architecture at the University of Bremen for up to a year, to further international scientific cooperation.

"Certainly, I feel honored," Roy says. "After several years, we—Professor Rolf Drechsler of Bremen and I—are again collaborating, but on complementary topics. Low-power design is one. They'll look at the computer design side and I'll work on the circuit/device side."

Roy spent summer 2010 at Bremen, and will return in 2011. Meanwhile, a Bremen University postdoctoral student is spending time with Roy at Purdue. "We plan to work on joint things," Roy says.☐

Kaushik Roy

The award recognizes a lifetime of achievement in research that shaped fundamental new discoveries, findings and theories.

Venkat Venkatasubramanian, a Purdue professor of chemical engineering, displays some of the mathematics behind his new theory, "statistical teleodynamics."

BRIEF

A physics formula for executive pay

When it comes to compensating top executives, how do you determine annual salaries, stock options and bonuses? Surprisingly, Venkat Venkatasubramanian says the answer comes not from traditional economics but from statistical physics and information theory.

A professor of chemical engineering, he has devised a theory of statistical teleodynamics generalizing the law of entropy.

"Entropy has been generally interpreted as disorder or randomness in thermodynamics or as a measure of uncertainty in communication theory, but it's really a measure of fairness," he explains. The same goes for economics; while conventional economic wisdom says that free markets are about efficiency, Venkatasubramanian says that when you examine their behavior, they only function optimally, under ideal conditions, if all participants believe they are getting a fair treatment.

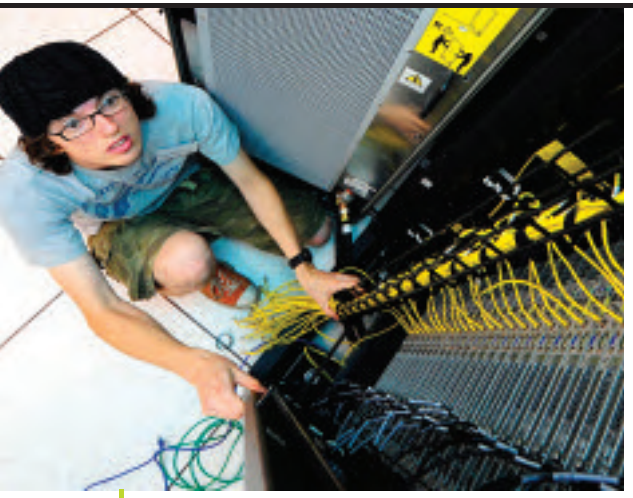
According to Venkatasubramanian's theory, a CEO should be paid, ideally, no more than eight times what the company's lowest-paid employees earn. "You can expect the non-ideal real world to be 2-3 times more than the ideal limit, so that the CEO pay ratio may be 25 times more, but anything over 25 affects the morale of employees, as management expert Peter Drucker observed," he says.

In the United States, 2008 salaries of the top 35 CEOs were about 129 times the ideal. Since much of that pay was based on short-term incentives, the discrepancy explains in part the economic crisis of the last few years. "If the senior management can exercise their options in a year or two, they tend to play games," he says. "Many took huge risks because their payoffs could be huge in the short term."□

PERFORMANCE ART

The live art pictured here was part of a series of computational visuals, motion and music performances created by Petronio Bendito in collaboration with Carol Cunningham-Sigman, Rebecca Bryant and Holly Jaycox from the Dance Department for the 41st Annual Conference of the International Visual Literacy Association (IVLA) in 2009 in Chicago, Illinois. This ongoing project explores the intersection of dance performance and methods associated with custom software and digital color projection. An assistant professor of visual and performing arts at Purdue, Bendito works in a variety of media including software art and computational color design with a focus on interdisciplinary art and design practices.□

photo: Professor David Sigman; dancer: Rebecca Bryant



The Rossmann, Coates and Steele supercomputers are all part of Purdue's 2010 Campus Technology Innovators Award-winning Community Cluster Program. Coates, pictured here, was built in July 2009 from more than 10,000 computer cores.

BRIEF

The synergy of supercomputers

Norbert Neumeister doesn't hesitate when asked about the advantages of the Community Cluster Program operated by ITaP.

"It's the price and it's the convenience of having the cluster operated for you," says the physics professor, whose lab focuses on data from the Large Hadron Collider, the international particle accelerator that may expand knowledge of basic physics and the universe.

ITaP provides space, infrastructure such as racks and networking, and power and cooling for the cooperative supercomputers. Purdue's central information technology organization also handles storage, maintenance including software updates, end-user support and security. The idea: let researchers concentrate on research, not on operating a high-performance computing system.

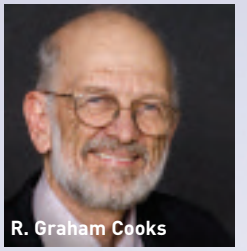
"You don't need a machine room," Neumeister says. "You don't have to hire somebody to run your equipment."

The clusters' faculty owners also save money. Because of group purchase agreements, Purdue saved more than $1 million on computer clusters built in 2008, 2009 and 2010, allowing faculty members to buy more computing power than they could have otherwise.

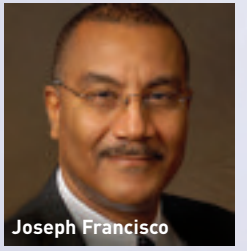
Researchers also have access to nodes they buy and potentially to many more; when parts of a community cluster are idle, they're shared with other users, allowing Purdue's clusters to keep busy 95 percent of the time. That maximizes return on the investment. "It gives you access to more computing power than you would be able to get on your own," says Scott Jackson, agronomy professor. □

Three elected to American Academy of Arts & Sciences

Three professors joined other education, arts, business and public affairs leaders with their 2010 election to the American Academy of Arts & Sciences. One of the nation's most prestigious honorary societies, it was founded in 1780 and also operates an independent research center. Elected:



R. Graham Cooks



Joseph Francisco

Freydoon Shahidi

» **R. Graham Cooks,** the Henry Bohn Hass Distinguished Professor of Chemistry and head of the Center for Analytical Instrumentation Development

» **Joseph Francisco,** the William E. Moore Distinguished Professor of Earth and Atmospheric Sciences and Chemistry

» **Freydoon Shahidi,** Distinguished Professor of Mathematics.

A pioneer in ambient ionization and tandem mass spectrometry, Cooks developed a desorption electrospray ionization technique, eliminating chemical manipulation of samples analyzed in vacuum chambers—with applications in food safety, airport security and cancer cell identification.

Francisco's research revolutionized the understanding of chemical processes in the atmosphere and recently solved a 40-year search for a molecule essential in breaking down pollutants. He's also mapped chlorofluorocarbons to understand how they break down.

Shahidi is a preeminent Langlands program researcher, relating algebraic geometry, harmonic analysis and number theory to discover properties and interrelations of prime numbers. His work has practical applications in cryptography. Techniques he pioneered, now known as the Langlands-Shahidi method, are central to the program's recent progress.

They join four others from Purdue: President France Córdova; Arden Bement, director of Purdue's Global Policy Research Institute; and professors Albert Overhauser and Michael Rossmann. □

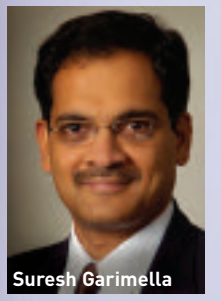
BIG NUMBERS

Purdue mechanical engineering professor Steven Wereley analyzes a video clip of the oil well leak in the Gulf of Mexico. After estimating the rate of the spill using a formula for particle image velocimetry, Wereley testified before Congress and then became part of National Incident Command's Flow Rate Technical Group. After the leak was capped and more precise measurements could be taken, the group announced that initially 62,000 barrels of oil had been spilling daily, tapering to 53,000 by the time the valves were turned off. ☐

Purdue University photo/Mark Simons

Two receive Jefferson Science Fellowships

Two mechanical engineering professors are spending a year at the U.S. Department of State as Jefferson Science Fellows, building on science, technology and engineering contributions to inform and formulate domestic and foreign policy.


Suresh Garimella


Jay Gore

Suresh Garimella, the R. Eugene and Susie Goodson Distinguished Professor of Mechanical Engineering, and **Jay Gore,** the Vincent P. Reilly Professor of Combustion Engineering, were among 12 tenured faculty chosen nationally for their scientific achievements, communication skills and interest in science policy issues.

Garimella will draw on his energy and information technologies background; Gore, on his work as former associate dean of engineering for research and entrepreneurship and as founding director of the Energy Center in Discovery Park. ☐

Purdue's committed sponsors share in a vision of transformation among the human, life and cybersciences. Their support enables scholarly innovations, which ultimately become commercial successes.

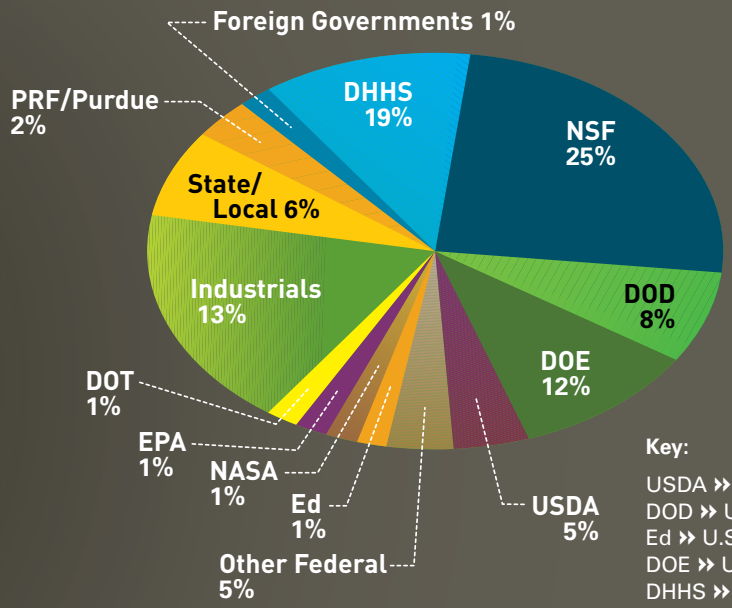
DISCOVERY WITH DELIVERY

A record $438 million in sponsored research funding was made payable to Purdue University during the 2009-10 fiscal year, an increase of 28 percent.

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

Supporters of Purdue research activities can be found in industry and government.

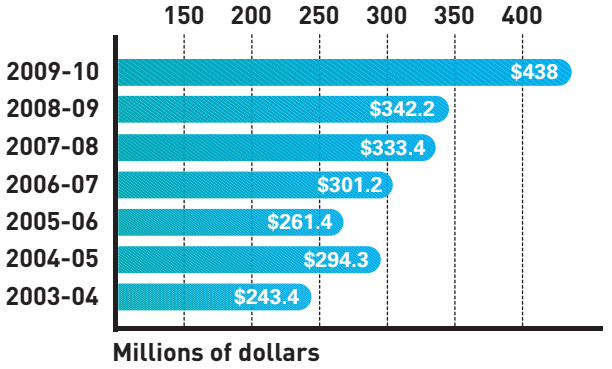


Key:

USDA ›› U.S. Department of Agriculture
DOD ›› U.S. Department of Defense
Ed ›› U.S. Department of Education
DOE ›› U.S. Department of Energy
DHHS ›› U.S. Department of Health and Human Services
DOT ›› U.S. Department of Transportation
EPA ›› U.S. Environmental Protection Agency
NASA ›› National Aeronautics and Space Administration
NSF ›› National Science Foundation

Ever-increasing sponsorship

Purdue University research requests continue to land significant funding.



From the **PRESIDENT** »

Last year, our faculty members' interdisciplinary collaborations yielded pioneering advances in grand-challenge areas such as disaster mitigation and cyber security. The complementary perspectives of different disciplines allowed these cross-functional partnerships to address problems too immense for single disciplines to solve alone. Tomorrow, as our faculty members continue to pursue discoveries across traditional boundaries, we expect to see more transformative technologies that serve humanity and improve the quality of life around the world.
—France A. Córdova, *President*

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

During the 2010 fiscal year, Purdue experienced the largest ever increase in research funding in Purdue history, thanks to the tremendous efforts of our faculty and staff. Our researchers are immensely talented not only in the human, life and cybersciences but also in the commercialization of their findings. Their dedication to the discovery-with-delivery process pushes innovations into the marketplace, enhancing lives and strengthening economies.
—Richard Buckius, *Vice President for Research*

From the **PROVOST** »

One of the central goals of our strategic plan is to cultivate successful global citizens and leaders. Working alongside our world-class researchers in state-of-the-art facilities, our students are deepening skills and clarifying values, preparing themselves to solve complex problems in a dynamic global society.
—Timothy Sands, *Provost*

Panitch named Purdue's first entrepreneur-in-residence

Both business- and science-savvy, Alyssa Panitch is now guiding others as they parlay research breakthroughs—their own or technologies they license from Purdue or others—into commercial successes.

Named in 2010 as Purdue's first faculty entrepreneur-in-residence, the associate professor of biomedical engineering offers assistance through Discovery Park's Burton D. Morgan Center for Entrepreneurship.

photo by Vincent Walter

Alyssa Panitch

Her resources for Purdue faculty, staff and students interested in launching a company include her own experience with three high-tech startups and a network of faculty experts she is assembling to help advance the University's commercialization efforts.

"My hope is that, collectively, entrepreneurial faculty, staff and students can do bigger and better things," says Panitch,

whose research focuses on designing biological and synthetic materials for drug delivery and tissue engineering and developing peptide-based pharmaceuticals for restoring normal healing of vascular, neural and fibrotic diseases.

"There is a lot to be gained by meeting with a group of people with like interests to discuss successes, issues and future plans," she says.

Panitch has been involved in launching three companies. One startup was later sold to another company, while a second company has one drug in preclinical trials and two more in development. The third startup, which spun out of the Alfred Mann Institute at Purdue, is based on platform technology and devices for three different medical indications, with the lead device now in preclinical development.

She was a member of Purdue's inaugural Entrepreneurial Leadership Academy, part of the Kauffman Campuses Initiative.☐

Philip Low

Purdue University photo/Andrew Hancock

Low's forte: Commercializing research

With drugs in clinical trials for kidney, ovarian, lung and endometrial cancers; a medical device under way to improve tumor cell detection; and other breakthroughs streaming from Purdue laboratories, Philip Low and his research team know how to put science to work.

So far, his tally for receptor-targeted therapeutic and imaging agents tops 35 U.S. patents and patents pending.

At Purdue since 1976, Low is the Ralph C. Corley Distinguished Professor of Biochemistry, a member of the Purdue University Center for Cancer Research, and founder and science advisor of several companies.

Startup companies that have emerged from Low's discoveries include Endocyte Inc., a biopharmaceutical company with a strong track record in designing tumor-targeted small molecule drug conjugates, and PathoChip Inc., a device company developing rapid, accurate tests for identification and quantitation of pathogens. A third company is IVDiagnostics LLC, which is developing a device to detect cancer cells in blood.

Earlier, Low's team announced a new prostate cancer homing molecule could potentially improve detection and delivery of targeted therapies for prostate cancer, a first for the disease, and a choice that would be both more effective and less harmful than current treatment options.☐

Philip Low and his research team know how to put science to work. So far, his tally for receptor-targeted therapeutic and imaging agents tops 35 U.S. patents and patents pending.

For all of human history, innovation has come from ingenuity—looking at familiar ideas in new ways. Today, as scientists tackle grand challenges such as energy conservation and disease, their perspectives are increasingly collective.

In the human, natural and cybersciences, scholars are reaching across borders, forming new connections in order to examine problems from multiple points of view. Doubting and discovering, probing and proving, great minds are meeting at the crossroads, transforming through common aspirations.

2009:2010 Office of the Vice President for Research Annual Report

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