

# Advancing Research that Benefits Society

HOW DO PEOPLE MAKE ENERGY CONSUMPTION CHOICES? Can we use the body's natural replication and repair process to create the next great cancer treatment? What improvements might streamline traffic congestion? These questions and many more guide research at Portland State University (PSU) where real world problems receive careful exploration with the goal of finding useful applications.

Creating knowledge that serves public needs is central to Portland State University's mission, where today's insights become tomorrow's innovations. A strong contributor to Oregon's growth and development, its faculty conducts research at the intersection of science, technology and public policy. Using a trans-disciplinary approach, PSU researchers are creating knowledge and offering solutions that can improve the quality of life in Oregon and beyond. Their results and discoveries can be directly applied on the job, in the marketplace, and in the community.

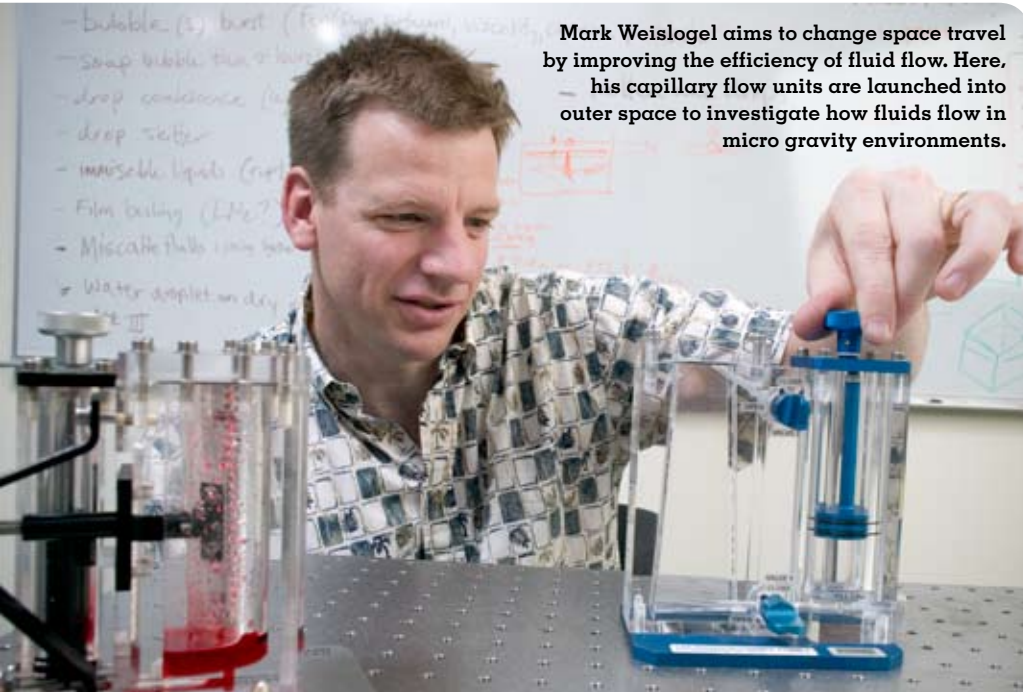


Physicist Jun Jiao is an expert in carbon nanotubes, which may one day be used to create molecular-scale transistors and semiconductors.

## ECONOMIC IMPACT

The science of the small has huge implications, potentially improving our quality of life and serving as an economic catalyst. Under internationally recognized physics professor Jun Jiao's leadership, the Center for Electron Microscopy and Nanofabrication (CEMN), was established at PSU. The premier microscopy center in the Pacific Northwest is a signature research center in Oregon and partner in the Oregon Nanoscience and Microtechnologies Institute (ONAMI). Researchers from participating institutions can access the CEMN by visiting the PSU facility, or through remote access enabling critical research to take place throughout Oregon. Jiao's principal research interests concern nanoscale materials and analytical techniques in electron microscopy to develop ultra-small sensors and new power sources.

John Carruthers, Distinguished Professor



Mark Weislogel aims to change space travel by improving the efficiency of fluid flow. Here, his capillary flow units are launched into outer space to investigate how fluids flow in micro gravity environments.

of Physics, former director of components research at Intel and an expert in semiconductors, now leads PSU's nanometrology program. It's an interdisciplinary collaboration among the sciences and engineering departments using advanced imaging technologies. Researchers are developing tools and techniques that have applications ranging from medicine, energy generation, new computer architectures, to various sensing devices.

A whole lot of shakin's goin' on inside PSU's Infrastructure Testing and Applied Research lab as engineering professor Peter Dusicka's team tests the resiliency of high-performance materials such as fiber-reinforced composites and flexible elastomers, along with concrete and steel.

During a 10-year career with NASA, Mark Weislogel sent his own zero-gravity experiments into space. Now in PSU's Maseeh College of Engineering and Computer Science, he seeks methods to improve fluids transport through experiments that are riding high aboard NASA low-g aircraft, the space shuttle and the International Space Station. Potential applications for these are improved materials for electronics cooling, passive fluids management in fuel cells, and scaffolding for tissue implants.



Setting up an experiment, engineering professor Peter Dusicka tests the effects of extreme loads and durability of materials in building and bridge infrastructure.

Spanning the gulf between economists and engineers, Gerald Sheblé, Maseeh Professor of Electrical and Computer Engineering, models optimal electrical generation schedules. Though power industry engineers account for consumer and industry demand, climate, the environment, and fuel availability, most lack expertise in economics, one of the biggest factors in the power industry.

Sheblé has applied his 15 years of power industry experience to developing computer models so that utilities minimize operating costs by determining the most economical combination of energy resources. At least two dozen countries around the world have benefited from his research.



Portland State University serves as a center of opportunity for about 25,000 undergraduate and graduate students. Located in one of the nation's most livable cities, the University's innovative approach to education combines academic rigor in the classroom with field-based experiences through internships and classroom projects with community partners. PSU's motto, "Let Knowledge Serve the City," inspires the teaching and research of an accomplished faculty whose work and students span the globe.

## Sustainability a Core Competency

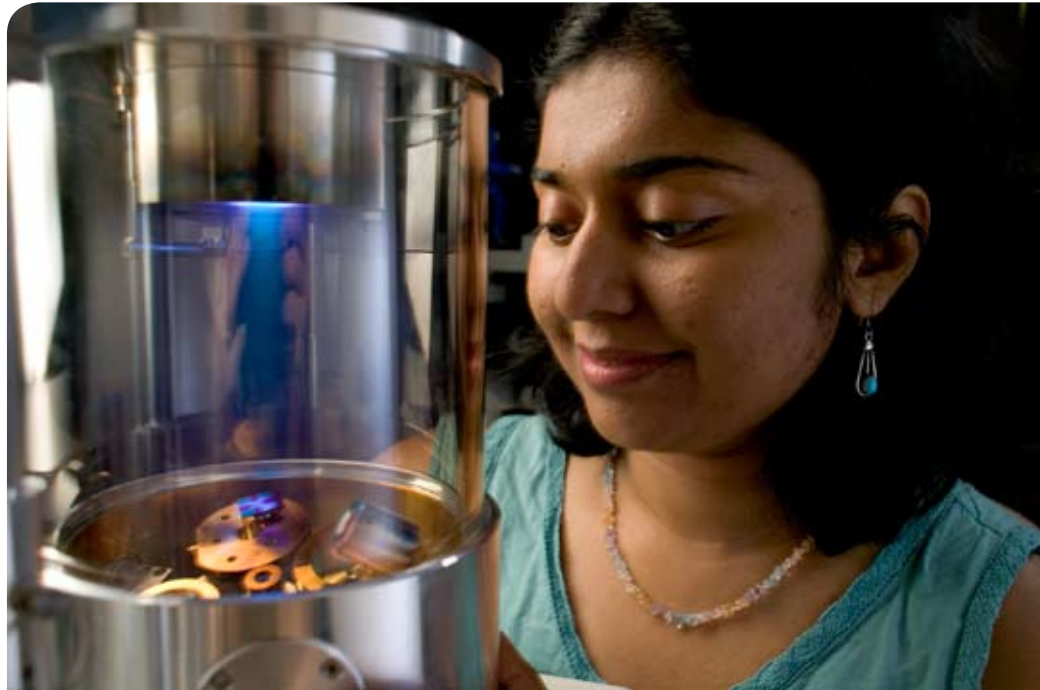
Sustainability is more than a buzzword at Portland State. Starting with the premise that all life is connected, PSU's Center for Sustainable Processes and Practices (CSP2) fosters multi-disciplinary research to understand challenges to and opportunities for sustainable solutions. In partnership with industry and community organizations, it funds research from bio-invasive species, sustainable agriculture practices, to the development of sound environmental policies. Two such examples are the center-supported assessment of green-roof performance, and the economic impact of green building in the Portland area. Other research priorities for CSP2 include supporting PSU's climate change research and advancing the development of the Oregon Bio-Economy and Sustainable Technologies Research Center (BEST).

## Research Expertise and Funding Growth

Externally funded research projects at PSU have grown dramatically in recent years, more than 13 percent in the last year alone. Spurred by grants from agencies such as the National Science Foundation, National Institutes of Health, as well as many other federal, state, and private sources, PSU is gaining prominence for its research expertise in climatology, environmental monitoring, mechanical engineering, and nanotechnology.

## From Insights to Innovations

To guide research outcomes into the marketplace, the PSU College of Liberal Arts and Sciences and School of Business Administration launched the Lab to Market initiative. The program brings research faculty and their students into the Entrepreneurship Program for feasibility studies, prototype development, and business planning. With funding from the National Science Foundation, Lab to Market works with industry partners to create successful technology companies in the region. The program has mentored twelve start-up companies in Oregon. One of these, DesignMedix, was formed to develop new pharmaceuticals to address diseases such as malaria.



Electrical and computer engineering assistant professor Shalini Prasad (above) studies very small nanomaterial, impacting such areas as medical diagnostics, the environment, and bio-defense applications. Here she is coating a microchip that will be built into a sensor.



Robert Bertini, (left) a bike commuter and head of PSU's Intelligent Transportation Systems Laboratory, studies transportation both on and off campus.

### IMPROVING THE ENVIRONMENT

On a family trip to Italy when he was 14, Robert Bertini was fascinated to see that people easily got around without an automobile. The trip sparked a lifelong interest in transportation, and today he works with industries and public agencies to improve transportation systems. Head of the Intelligent Transportation Systems Laboratory, located at PSU, he collects and interprets traffic data from 500 road sensors placed throughout the metropolitan area. Information from the lab can be used for everything from timing traffic signals to building roads and planning for mass transit. Bertini also directs the Oregon Transportation Research and Education Consortium, based at PSU, which conducts multi-modal transportation research.

Saving energy and promoting sustainability makes good business sense. Quantifying the impact is David Sailor's research focus, an expert in urban climates. As part of the Mechanical and Materials Engineering Department at PSU, his study precisely calculates the energy savings of different green roof designs. A benefit to architects, it is also used in the U.S. Department of Energy's building energy design and analysis software. Gaining acceptance, green roofs may reduce urban heat, making city living more comfortable.

Watching ice melt may not seem the most riveting work, but PSU geophysicists Andrew Fountain and Christina Hulbe are among a select few in the world monitoring changes in earth's glaciers. As the most

tangible indicators of climate change, accelerated ice-sheet melting in Antarctica, Greenland, and other continental mountain glaciers could raise the global sea level. They are constructing models to predict future change and its impact on communities world-wide. These studies help scientists, policy-makers, and citizens make informed choices in response to our rapidly changing world.

Atmospheric physicist Aslam Khalil is internationally known for his work on methane production in agriculture. His research indicates that this second most harmful greenhouse gas is stable, and thus not as great a threat as some in the scientific community suggest. Now, Khalil is studying an even more noxious gas combo — the interaction of methane and nitrous oxide.

Invasive plants from around the world in our region's waterways pose ecologic and economic threats. Researching the extent of the problem as well as potential remedies is the work of PSU's Mark Sytsma, director of the Center for Lakes and Reservoirs and PSU Smithsonian Aquatic Bioinvasive Species Institute, Mitch Cruzan, a biologist, and Alan Yeakley, an environmental scientist.

### A HEALTHIER SOCIETY

Technical devices have shrunk to nanoscale while Portland State's reputation in nanotechnology expertise has grown, attracting electrical engineering researcher Shalini Prasad. She designs chemical and biomedical sensors that can detect nanoscale particles, for health care, environmental science and defense uses.

For health care, Prasad is working on portable devices to diagnose conditions such as cardiovascular disease, cancer and sepsis. Current diagnostic tests can take as long as 12 hours compared with nearly instantaneous results using her prototypes.

From the nearly 100 new biologically active natural products synthesized in PSU's chemistry department, the next treatment for cancer or other human scourges may emerge. Chemistry Chair Kevin Reynolds leads experiments that trick bacteria into producing new natural products by altering genetic pathways. These compounds are tested for their stability and toxicity, among other attributes. Discovering potential candidates for further drug research will benefit Oregon's biotech industry and introduce new therapies to medicine.


Overcoming drug resistance in diseases is one of the important areas of drug discovery

research at PSU. For malaria, a cocktail is on the menu as chemistry professor David Peyton administers one component that prevents cells from resisting the drug, and another to cure the disease. His team has developed a solution that short-circuits the malaria parasite's defenses, a response that could save more than 1 million lives a year, if effective in humans. This approach may work on many other drug-resistant diseases.

Learning how damaged human cells repair themselves may one day lead to improved cancer-fighting treatments. In biologist Justin Courcelle's PSU lab, he investigates how DNA accurately duplicates chromosomal material when some of the genetic information has been damaged by ultra violet irradiation. Using molecular and cellular techniques, Courcelle studies how the cell is able to repair and replicate the damaged DNA without errors, such that these mutagenic consequences can be avoided. The answer may yield the next cancer breakthrough.

New chemistry department arrival Robert Strongin brings fresh insights to molecular-level research, all with promising human health applications. These range from designing simple, cost-effective chemical sensors to detect cancer, diabetes, stroke and cardiovascular disease, to creating those that monitor biomarkers for birth defects and early detection of cancers, as well as material that could lead to creation of improved insulin delivery for diabetics.

### KNOWLEDGE IN ACTION

With goals to prepare a scientifically literate workforce, and to conduct research in the public interest, Portland State is a major contributor to the region's economy. Research thoroughly integrated into instruction provides PSU students with a high-quality undergraduate and graduate education. Its students contribute over 105,000 volunteer hours each year — a value of \$1.8 million annually. Awarding more graduate degrees than any other university in Oregon, Portland State prepares scientists, engineers, health-care and business professionals, educators, and many other specialists to begin careers that energize Oregon's economy. To learn more about PSU's commitment to teaching and research, visit [www.pdx.edu](http://www.pdx.edu). 



David Sailor, an urban climate expert, retrieves data on soil temperature, ground moisture content and wind speed on a PSU student housing building.