Cancer is a growing problem worldwide. According to the World Cancer Research Fund International, in 2008, more than 12.7 million new cases of cancer were diagnosed worldwide. By 2030, WCRFI estimates that number will rise to 21 million new cases annually.

Here at the Purdue University Center for Cancer Research, we hope to make a big impact on cancer around the world. As one of seven basic science centers around the country, we not only make unique discoveries that help us in our understanding of how cancers form, but also take them into the clinic through our clinical partners, making a difference for patients. Over the past fiscal year, our faculty members have forged new collaborations, made new discoveries and initiated new clinical investigations, all with the goal of reducing the incidence of and death from cancer.

Last year, researchers and policymakers from seven countries convened in Rennes, France, for the second International Breast Cancer and Nutrition Symposium, which was organized by Sophie Lelièvre, associate director of our cancer discovery groups. Collaborations forged at these annual meetings have already led to groundbreaking research in six countries, focusing on how cellular mechanisms in breast cancer development link to diet, and how public policy affects access to food sources and disease prevention. In the long run, the research should have a tremendous impact on the prevention of breast cancer.

Our prostate cancer group is making great strides as well. In collaboration with the IU Simon Cancer Center at the Indiana University School of Medicine, we have submitted a biomarker grant to the U.S. Department of Defense to refine technology that will identify cancer during surgery and allow surgeons to completely resect all cancer. Other technology we are pursuing may allow clinicians in the future to more reliably assess the prognosis of low-risk tumors. Although further validation is required, our early results are positive; read more about this research on page 12.

We also have initiated a new discovery group in the prevention arena: obesity and cancer. Our goal is to better understand how obesity is linked to the increased incidence of cancer and why it appears to lead to more aggressive cancers. Already, the group has planned several seminars to discuss the mechanisms underlying this phenomenon and to create new partnerships for exploration.

Along with these great new discoveries and collaborations, I am also pleased to announce several honors that our faculty members have received. Connie Weaver, a pioneer in understanding how nutrition can help prevent cancer, has received the 2012 Herbert Newby McCoy Award, the most prestigious research honor given by Purdue University. Michael Rossmann, a world leader in determining the structure of molecules, has been appointed a fellow of the American Crystallographic Association.

Finally, a Purdue team has received a $1 million grant from the W. Keck Foundation to pursue transformative research in epigenetics: Joseph Irudayaraj, Sophie Lelièvre, and Ann Kirchmaier, all from Purdue, as well as Feng Zhou from IUPUI, were brought together through our breast cancer discovery group.

Like many of our other projects in the works, this one has the potential to make a big impact on cancer around the world. Enjoy reading about our progress in the past year, and take pride in knowing you’ve helped make our discoveries possible.

Dr. Timothy L. Ratliff
Robert Wallace Miller Director
Purdue University Center for Cancer Research
NCI-DESIGNATED CANCER CENTER

NCI-designated cancer centers are characterized by scientific excellence and the capability to integrate a diversity of research approaches to focus on the problem of cancer.

The National Cancer Institute currently has 67 designated cancer centers, seven of which conduct laboratory research only and do not provide patient care, including the Purdue University Center for Cancer Research.

QUICK FACTS

- More than 87 elite scientists collaborating with experts worldwide to make discoveries
- 16 departments on campus, driving research further than one could alone
- 14 clinical trials active based on Purdue’s basic cancer research
- 5 discovery groups with an expansive focus on various types of cancer

PURDUE UNIVERSITY CENTER FOR CANCER RESEARCH FACULTY MEMBERS BY DEPARTMENT

<table>
<thead>
<tr>
<th>Department</th>
<th>Members</th>
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<tbody>
<tr>
<td>Agricultural and Biological Engineering</td>
<td>1</td>
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<tr>
<td>Physics</td>
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<tr>
<td>Animal Sciences</td>
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<td>Basic Medical Sciences: Veterinary (Veterinary)</td>
<td>6</td>
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<tr>
<td>Medicinal Chemistry and Molecular Pharmacology</td>
<td>15</td>
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<tr>
<td>Industrial and Physical Pharmacy</td>
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<td>Health Sciences</td>
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<tr>
<td>Nutrition Science</td>
<td>5</td>
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<tr>
<td>Electrical and Computer Engineering</td>
<td>1</td>
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<tr>
<td>Comparative Pathobiology: Veterinary (Veterinary)</td>
<td>5</td>
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<tr>
<td>Clinical Sciences: Veterinary</td>
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<tr>
<td>Chemistry</td>
<td>14</td>
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<td>Biomedical Engineering</td>
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METRICS
Connie Weaver, head and distinguished professor of nutrition science, has been chosen as the 2012 Herbert Newby McCoy Award winner, the most prestigious research honor given by Purdue University. A member of the Purdue University Center for Cancer Research, Weaver was recognized for her work on calcium metabolism in adolescents and the impact of diet, gender, race and sexual maturity on calcium utilization. She is a member of the Institute of Medicine, which is the health arm of the National Academy of Sciences.

Michael Rossmann, the Hanley Distinguished Professor of Biological Sciences, has been appointed a fellow of the American Crystallographic Association. A member of the Purdue University Center for Cancer Research, he was chosen for their high level of excellence in scientific research, teaching and professional duties, as well as their service, leadership and personal engagement in the ACA and the broader world of crystallography and science. He was honored in 2011 at the organization’s national meeting.

Four Purdue faculty members have received a $1 million grant from the W. Keck Foundation to pursue transformative research in epigenetics. Joseph Irudayaraj, professor of agricultural and biological engineering, Sophie Lelièvre, associate professor of basic medical science, and Ann Kirchmaier, associate professor of biochemistry, all from Purdue, as well as Feng Zhou, professor of anatomy, cell biology and neurobiology, from IUPUI, are the investigators for the grant, the first awarded to Purdue by the Keck Foundation in 20 years.

The Keck Foundation’s Medical Research Program seeks to advance the frontiers of the life sciences by supporting high-risk basic research. In this particular study, Irudayaraj and his co-investigators will seek to understand how epigenetic marks — chemical additions to the genetic sequence that lead to chronic illness — can govern gene expression at the single cell level. By studying them in a neural stem cell differentiation model and a 3D breast epithelial tissue culture system, the researchers hope to devise ways of resetting key events during neural differentiation or tumor formation in individual cells.

FACULTY AWARDS

Claudio Aguilar
College of Science, Faculty Team Award
PRF International Travel Award
Named Assistant Head, Department of Biological Sciences

Ji-Xin Cheng
2012-17 Purdue University Faculty Scholar
2011 Purdue University Cancer Center Research Excellence Award
2011 College of Engineering Early Career Research Excellence Award

Ulrike Dydak
Outstanding New Environmental Scientist Award (R01), NIH/NIEHS
Robert R. Landolt Excellence in Teaching Award, School of Health Sciences, Purdue University (2011)
The Challenge Grant Award

Graham Cooks
Centennial Prize, Royal Society of Chemistry
Cotton Medal for Excellence in Chemical Research, American Chemical Society

Donna Fekete
Faculty of 1000 as a Contributing Member of the Neuroscience Section on Sensory Systems

Robert Geahlen
2011 Jeananne D. and James B. Chaney Research and Scholarship Achievement Award
2011 Purdue Seed for Success Award
2012 Provost’s Award for Outstanding Graduate Mentor

Qing Jiang
E.L.R. Stokstad Award from the American Society for Nutrition
Purdue Entrepreneurial Leadership Academy Fellow, 2011

Ann Kirchmaier
E.L.R. Stokstad Award from the American Society for Nutrition

Sophie Lelièvre
University Faculty Scholar, 2011-2016, Purdue University
Inaugural member of Purdue University’s Global Council, 2011-on Keck Foundation Awardee, 2012-2015
Fidelity Investment Faculty Spotlight, 2012
Discovery Learning Research Center 2012 Faculty Research Fellow
Purdue Entrepreneurial Leadership Academy Fellow, 2011

Connie Weaver
Linus Pauling Research Award (2011)
Member of the Institute of Medicine

Mary J. Wirth
Sigma Xi Faculty Research Award, Purdue Chapter
2012 marked the 5th anniversary of The Challenge 5K run/walk. On April 14, more than 2,000 people gathered with Purdue football Head Coach Danny Hope to make a difference in cancer research. Through the participation of these individuals and our incredible sponsors, more than $65,000 was raised that will go directly to research to cure cancer.

We would like to extend a heartfelt thank you to all who participated by walking, running, volunteering, cheering and planning. The threat of looming spring thundershowers didn’t keep such dedicated people away.

Funds from the Challenge are earmarked for cancer research at Purdue University, particularly for innovative cancer research that otherwise has not been explored.

The winner of this year’s Challenge grant was Ulrike Dydak, an assistant professor of health sciences who investigates human metabolism with Magnetic Resonance Spectroscopy (MRS). The Challenge grant is supporting Dydak’s research into new biomarkers for liver cancer that could result in more targeted treatment of this disease. Learn more about her research on page 13.

Save the date for The Challenge 2013: April 13. We hope to see you, your family and your friends there.
The 2011-2012 year saw a continuation of the strides we have made in promoting the center, building relationships, and raising money to support cancer research. Our philosophy in development is simple: Raise money to progress cancer research. Our purpose is to generate funds to be used by our researchers to advance their research. It is an expensive proposition to conduct high-end scientific research. Without the benefit of private support, many research projects would languish as the principal investigator searched for external funding through the process of grant applications. Our brilliant researchers’ time is better spent searching for discoveries rather than searching for funding.

You support cancer research, I imagine, because you hope to have an impact on curing cancer. You do have an impact. The role you play as a benefactor of the scientists at the Purdue University Center for Cancer Research is profound. Thank you!

There were a variety of activities and events which we participated in and hosted. With the increased publicity we generated and the total dollars contributed by our many, many friends, we reported our most supportive year yet. Not only does private support directly fund research, but it also helps our faculty when they are applying for other grants. Here are a few examples:

- Andy Mesecar spoke to the the Indiana Elks at the state convention in Indianapolis on progress made in cancer research.
- Tim Bobillo visited a group of donors and friends in Tucson, Arizona, updating them on cancer research at Purdue.
- Dr. Timothy Ratliff and Andy Mesecar talked with a group of alumni during the Purdue Alumni Association’s Alumni Weekend and shared information about treatment and prevention research.
- Terry and Bob Bowen hosted a gathering at their home in Bonita Springs, Florida, to thank loyal friends and encourage new ones to join in our cause.
- Ken and Kitty Decker are encouraging graduate student research by funding a scholarship that will support graduate students who hold a key role in research being conducted.
- Dr. John Seffrin, CEO of the American Cancer Society, gave a lecture at an event organized through the College of Health and Human Sciences. He highlighted the progress we’ve made against cancer in recent years in the United States. The event was sponsored in partnership with the center and the West Lafayette Sagamore Lions Club.
- Other events such as the Jordan-Rieger Fund dinner for pancreatic cancer research in Indianapolis (hosted by Jenny Pickett and Robin Walsh) and the Purdue Cancer Benefit Concert for colorectal cancer (held in coordination with the Purduettes) raised funds and awareness for the center.

These are just a few examples of the many generous donors and volunteers who make an impact on our research. Thank you for your support and interest in finding cures.

— Tim Bobillo, director of development
We often think of cancer as a single disease, but in reality, it’s a spectrum of hundreds of different diseases, all characterized by an uncontrolled division of abnormal cells in a part of the body. The complexity of cancer means that experts from many areas — from traditional areas such as chemistry or biology to the nontraditional such as biomedical engineering or even communication — can bring different perspectives to its understanding.

That’s the philosophy behind cancer discovery groups at the Purdue University Center for Cancer Research. Committed to working across disciplines and collaborating with clinicians to develop translational studies that can impact the prevention, detection or treatment of cancer, Purdue’s discovery groups are focused on specific cancers, along with emerging research areas such as obesity and cancer development.

“We can really gather a lot of collaborations from different disciplines, people with different strengths, focusing on one cancer,” says Sophie Lelièvre, a biologist with dual doctorates in veterinary medicine and pharmacology who serves as associate director of discovery groups at the cancer center. “If you study a particular cancer, you can really understand the tissue of origin and how that tissue functions.”

Our research, however, is not limited to the defined discovery groups. In the following pages, we highlight four significant findings made last year, from the use of cholesterol markers in prostate cancer diagnosis to 3-D models of breast cancer development that could lead to better prevention through nutrition. Read on and share our achievements that you helped to make possible.
More than 200,000 men in the United States are diagnosed with prostate cancer each year, and yet the majority of them have slow-growing, non-aggressive tumors. But because physicians can’t reliably assess the prognosis of low-risk tumors, many men forego active surveillance for surgery, chemotherapy and radiation — often facing a diminished quality of life as a result.

Ji Xin Cheng hopes to change that by discovering markers that link to tumor aggressiveness. Using a new imaging technique called vibrational spectral microscopy, which identifies and tracks molecules by measuring their vibration with a laser, he analyzed samples of prostate cells ranging from normal to metastatic.

Specifically, he examined the different vibrational footprints created by cholesterol metabolites within different stages of tumors. His conclusion: That not only do the tumors lead to changes in cholesterol metabolism, but that the cholesterol markers seem to be reliable indicators of tumor aggressiveness.

“This is super important,” says Cheng, who has collaborated with Tim Ratliff, the Robert Wallace Miller Director of the Purdue University Center for Cancer Research. “This opens up new opportunities to develop a market for prostate cancer diagnosis.”

The research also could lead to a new method for late-stage prostate cancer treatment. In a follow-up in vivo study, Cheng was able to suppress the growth of late-stage tumors by targeting the changed cholesterol metabolites. While follow-up studies will show the viability of this method, Cheng is enthusiastic about the possibilities: “If we can provide a new way to treat metastatic cancer, that’s another way we can make a big difference.”

“MARKER DISCOVERY

“If we can provide a new way to treat metastatic cancer, we can make a big difference.”

— JI XIN CHENG
ASSOCIATE PROFESSOR, BIOMEDICAL ENGINEERING
For people with inoperable liver cancer, a few hospitals around the country are offering new hope through internal radiation therapy and stereotactic body radiation. One of those is IU Health University Hospital in Indianapolis, which is piloting groundbreaking technology developed by Purdue’s Ulrike Dydak.

A former high-energy physicist who has spent the last 15 years working in medical physics, Dydak has created a new method for assessing treatment outcomes. Conventional imaging using CT or MRI can’t detect changes in liver tumors until months after treatment begins — often too late for people with a life expectancy of around one year. While conventional MRI images signal from hydrogen nuclei, Dydak’s method uses a novel coil wrap to detect phosphorous signal to more accurately assess the patient’s progress.

The coil, made of an array of eight loops of conductive wires, wraps around the abdomen and detects the small radiofrequency signals that the liver’s metabolites emit after having been excited by the MRI. While traditional phosphorous coils only allow clinicians to see superficially into the liver at disparate points, Dydak’s coil allows for the first time a visualization of the energy household of the entire liver.

Dydak’s team performs the MRI studies on patients during regular visits to University Hospital. “So far, we have very promising pilot data,” says Dydak, an assistant professor of health sciences who is using a Purdue Cancer Center Challenge grant to support her research. If further research bears out, it could lead not only to more personalized radiation plans but also a new method of monitoring treatment in liver cancer that uses phosphorous to seek out biomarkers.

“My goal is to impact clinical care and diagnostic possibilities for cancers,” says Dydak. “This research hopefully will allow us to implement better diagnostic techniques to improve individualized patient care.”

“My goal is to impact clinical care and diagnostic possibilities for cancers.”
— ULRIKE DYDAK
ASSISTANT PROFESSOR, HEALTH SCIENCES

INNOVATIVE DETECTION
When it comes to breast cancer detection and prevention, Sophie Lelièvre keeps in mind the 95% — the women with breast cancer who don’t carry the BRCA1 and/or BRCA2 genes. Specifically, she is interested in the role that diet and other environmental factors plays in both development and prevention of the disease.

As co-chair of the International Breast Cancer and Nutrition group, Lelièvre is involved in global research investigating links between nutrition, environment, genes and public policy. And in the lab, she is looking at how epidemiological studies linking certain nutrients with breast cancer development are borne out in cell culture models.

Last year, Lelièvre worked with biomedical engineer Ji Xin Cheng to develop a 3-D culture that mimics living mammary gland tissue. Using vibrational spectral microscopy, an imaging technique that identifies and tracks certain molecules by measuring their vibration with a laser, the team observed cellular changes linked to impacts of arachidonic acid, an Omega-6 fatty acid found in certain kinds of meat and fish, along with poultry and eggs. The technology, combined with 3-D culture, can be used to screen for agents that, by protecting breast tissue integrity, would prevent tumor development.

Ultimately, the discovery could lead to more specific dietary recommendations to reduce breast cancer risk, along with new methods for preventing tumor formation.

“Now there is no good way to assess risk for breast cancer,” Lelièvre said. “Assessments are mainly based on family history and genetic changes, and this only accounts for a very small percentage of women who get breast cancer. We need technologies to assess the risk better and then screen for protective factors that could be used on individual patients because not everybody will be responsive to the same factors.”
Back in the 1970s, when Mark Cushman first began experimenting with the synthesis of natural products for cancer treatment, he serendipitously created a class of anti-leukemia agents called indenoisoquinolines. But when National Cancer Institute researchers concluded one of them was not as effective as other leukemia treatments, the compound was filed away and nearly forgotten.

Then 18 years later, Cushman received an unexpected call from an NCI researcher, who’d been running Cushman’s agent through a computer program that analyzed its effects against different kinds of cancer cells. “He was very excited and said that indenoisoquinoline had the same cytotoxicity profile as some clinically useful topoisomerase I inhibitors,” says Cushman, a Distinguished Professor of Medicinal Chemistry. “He wanted us to send more of the compound to test.”

Over the last 10 years, Cushman and his team have been perfecting the anticancer activity of the lead indenoisoquinoline. After synthesizing 500 pounds, he provided two optimized compounds to NCI, where they’re being tested against colorectal and other cancers.

Already, results are promising; in one patient with metastasized colon cancer whose lung nodules had not responded to other treatments, physicians discovered a decrease in the size of nodules after just five days of Cushman’s agents.

“This is the first evidence of efficacy that we have seen. Other drugs were not working, but our drugs are, to that is good news,” Cushman says. “I’m thrilled to be involved in this type of research because it allows us to create organic compounds that don’t exist in the known universe – and won’t exist unless we put them there.”

“I’m thrilled that this research allows us to create organic compounds that don’t exist in the known universe.”

— MARK CUSHMAN
DISTINGUISHED PROFESSOR OF MEDICINAL CHEMISTRY

ADVANCING TREATMENT
LEADERSHIP

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Kimberly Crist, Administrator, Milestone-based Funding Program/Development Assistant
Lanie Foster, Business Office Clerk
Julie Hendon, Manager of Donor Relations and Development Operations
Michelle Liratni, Secretary
Catherine Reedy, Business Office Manager

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Program Co-Leader: Scott Briggs (Biochemistry)

Chemical and Structural Biology
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Program Co-Leader: David Thompson (Chemistry)

Drug Delivery and Molecular Sensing
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Program Co-Leader: Joseph Iruayaraj (Biological Engineering)

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Mark Walter, Chair, Professor, Department of Microbiology, University of Alabama Birmingham
Peter Wipf, Director of the Combinatorial Chemistry Center and the Center for Chemical Methodologies and Library Development, University of Pittsburgh, Department of Chemistry, Chevron Science Center
also currently the associate vice president for research at Purdue. She spearheads a large multi-institutional project focusing on identifying molecular signatures in the blood that indicate the early presence of colon cancer and are predictive for the most effective treatment. Her lab focuses on signal transduction in the immune system. Marietta loves to travel, especially when the destination is visiting her two children.

Doug Cuttell, Managing Director, Purdue University Center for Cancer Research

Doug Cuttell facilitates research, oversees center operations, administers the core grant and launches new initiatives for the center. Recently he launched the PCCR’s newest initiative, Affecting Cancer Together™, focusing on the underserved community in Marion County, Indiana. This unique program aims to recruit barbers to serve as lay health educators and patient navigators for men to understand their risks for prostate cancer. In his spare time, he loves spending time with his family and watching his children grow and learn about the world.

Sophie Lelièvre, Associate Director, Discovery Groups

Sophie Lelièvre joined the Department of Basic Medical Sciences in the Purdue University School of Veterinary Medicine in 2000. Her research focuses on early detection and prevention of breast cancer, including public health issues. Most recently, she launched an international program and symposium on breast cancer prevention, epigenomics and nutrition, which was held in her home country of France last fall. Lelièvre also serves as associate director of the cancer center’s discovery groups.
MESSAGE TO DONORS

The Purdue University Center for Cancer Research is continually exploring new methods of treating cancer, techniques to detect cancer and preventive measures that we can share with our partners in the medical industry. By working together with cancer specialists on what patients need, we are able to expand our expertise, provide headway in clinical trials and get valuable information to the public more efficiently.

New ideas cost money, which is why your contributions to the Purdue University Center for Cancer Research are valued and appreciated. It’s because of your generosity that we are one of the leading NCI basic cancer centers in the United States. Thank you for believing in us and for being a valued partner.

Please visit www.cancerresearch.purdue.edu to learn more about the discoveries and innovative research happening here. Or give us a call: 765-494-1109. We look forward to a continued partnership with you. Our mission is discovery. Our goal is to cure cancer.

To make a gift, please call 765-494-1109 or visit www.cancerresearch.purdue.edu/donate.