Our mission is discovery
OUR GOAL IS TO CURE CANCER

ANNUAL REPORT 2019–2020
One death is too many, but we are making progress, and we will make even greater progress in the coming years.”
It is with great pleasure that I announce the National Cancer Institute (NCI) has awarded the Purdue University Center for Cancer Research another five years of its designation as an NCI-designated basic science cancer center, one of only seven such centers recognized by the NCI. The Center for Cancer Research underwent a rigorous review by an outside panel of experts, which occurs every five years to make sure our center is worthy of the NCI designation. Once again, we passed with flying colors, and at the end of this new five-year cycle, the Center for Cancer Research will have held the NCI basic science designation for 47 consecutive years. What an amazing accomplishment! I am very proud of our past and present faculty for their commitment to outstanding cancer research that has made it possible for the center to obtain, and, importantly, maintain its recognition as an NCI-designated basic science cancer center.

The Center for Cancer Research currently comprises 111 faculty who are committed to cancer research. These faculty represent 21 academic departments in seven colleges across the Purdue campus. The center has great diversity in expertise, and we all work together to solve important problems in cancer. Our work includes developing new imaging technology, new drug delivery approaches, novel chemotherapy drugs, and innovative ways to activate your body’s immune system to kill cancer cells, as well as new targeted radiotherapy and discovery of new pathways that make cancer cells grow and spread. Because of our research and that of cancer researchers in other cancer centers, we anticipate tremendous progress in the current decade. Progress will be needed to further improve cancer treatment because it is anticipated that 1.9 million new cases of cancer will be diagnosed in the U.S. in 2021. To the disappointment of all, there will be approximately 608,000 deaths caused by cancer this year. While these figures show the importance of continued research, I want to emphasize that we have made great progress in treating cancer. Since the peak of cancer death rates in 1992, research has yielded new treatments that have decreased the death rate by 31%. One death is too many, but we are making progress, and we will make even greater progress in the coming years. I am proud to say that the Purdue Center for Cancer Research is among the leaders in developing new treatments.

At our last analysis, Center for Cancer Research faculty have 37 therapeutics that have been validated by animal testing. This means that the drugs were effective in treating animal cancers, the results of which form the foundation for further development. Eleven of these novel therapeutics—developed by Center for Cancer Research faculty—are now in human clinical trials.

One imaging agent for ovarian cancer was so effective in early clinical studies that it was fast-tracked by the FDA and now is in the final stages of clinical testing. A second radio therapeutic agent that specifically targets prostate cancer cells has completed clinical trial testing. This agent, developed by Dr. Phillip Low, binds specifically to a marker, prostate-specific membrane antigen (PSMA), which is highly expressed on the most advanced and deadly form of prostate cancer cells. A radiation-emitting compound is attached to the molecule that binds to PSMA, and after injection in patients, it delivers radiation treatment directly to the tumor.

Clinical studies show that treatment with this “targeted” radiotherapy provides a median survival of 15.3 months for patients with the most deadly form of prostate cancer. We are excited by the impact of this new prostate cancer treatment and proud of Dr. Low for his innovative approach to developing novel treatments for advanced prostate cancer.

How are these novel drugs generated? Well, it all begins with an idea. Our faculty are innovative and think about drug development all the time. Through thought and discussions with other faculty and trainees, an idea is formulated into mature concept. It is at this point that laboratory testing must be initiated to validate the concept through the scientific testing process. Such testing requires financial support to validate the concept and position it for greater financial support by the National Institutes of Health and other funding agencies.

You can help us nurture the ideas of our faculty. Please consider supporting our research efforts. Many of you have supported and are supporting our research. We thank you from the bottom of our hearts. Your support is making a difference as evidenced by impact of our new treatments and imaging agents.
A member of the PCCR Director’s Advancement Board, Paula Klipsch likes to point out that if the fluorescent dye that Purdue researcher Phillip Low pioneered had been available for her first surgery, she might never have had a recurrence. Low, the University’s Presidential Scholar for Drug Discovery and the Ralph C. Corley Distinguished Professor of Chemistry, invented an imaging agent—an intravenous molecular cancer “homing device”—paired with a fluorescent dye that attaches to folate receptors on cancer cells and makes them glow. This helps surgeons see diseased cells that might otherwise go unnoticed and be left behind. “I call it magic juice,” Klipsch says, smiling.

As far-reaching and potentially lifesaving as Low’s work is, it merely scratches the surface of the center’s research story, Klipsch says.

Klipsch, of Carmel, Indiana, is emphatic about the need for more people to know, understand, and support the PCCR’s cancer-fighting work. “I call the Purdue Center for Cancer Research the best-kept secret,” she says. “As a board member for the center, I am working hard to make sure that PCCR is no longer the best-kept secret. Purdue researchers are among the top. I believe Purdue is going to be known for cancer research.”

Now cancer-free for five years, Klipsch is one of the most vocal advocates for the Purdue Center for Cancer Research.
Two weeks to live. That was the prognosis given to retired health care executive Terry Boudreaux following complications from a Whipple surgery, a complex operation to remove part of his pancreas, his duodenum, and one-third of his stomach.

Doctors were unable to pinpoint the cause of his recurring high fevers and blood infections. A trip to an Indianapolis ER over Memorial Day weekend in 2017 brought devastating news. A CAT scan revealed metastatic malignancies in all of his organs. He was advised to get his affairs in order.

“I asked the doctor to give me an idea of how many,” Boudreaux says. “Like, how many tumors on my liver? She said ‘35.’ I thought, ‘I’m dead.’”

Boudreaux and his wife, Gail, president and CEO of Anthem Inc., drove home from the hospital in the middle of the night, crying. He told her she should marry again, he didn’t want her to go through life by herself. She asked if he wanted to be cremated or buried.

In the morning, Boudreaux texted his Whipple surgeon to share the distressing diagnosis. The surgeon asked Boudreaux to read the hospital reports word for word. Something didn’t add up. Turns out, they weren’t tumors, but cysts. It was a blockage in his liver and pancreas ducts that was causing the fevers.

“To go from thinking I had two weeks to live to finding out I’d been misdiagnosed was a very traumatic experience,” Boudreaux says. “My family is amazing with their support. I am blessed beyond belief.”

The Boudreaux family was embraced by the entire Purdue community when Evan, the younger of Boudreaux’s two sons, joined the men’s basketball team as a graduate transfer in 2018. In the years since, Boudreaux has undergone additional surgeries for removal of thyroid cancer and skin cancer.

“I just did not win the genetic lottery,” Boudreaux says. “It’s an unfortunate reality. But it has been a blessing for us to be connected to the center. The mission is incredible, and the work they are doing to advance cancer treatment is extraordinary.”

Terry Boudreaux’s positivity persists amid multiple cancer diagnoses.
Instrumentation developed in the Aston Laboratory of Mass Spectrometry, headed by R. Graham Cooks, the Henry Bohn Hass Distinguished Professor of Chemistry, may soon improve a surgeon’s approach to resecting cancerous tissue from the brain.

Gliomas are aggressive, fast-growing brain cancers typically treated by surgical resection combined with radiation and chemotherapy. However, it’s not always easy to identify where cancerous tissue ends and normal tissue begins.

“Surgery, by its nature, is cautious,” Cooks says. “But brain surgery is ultra-cautious. It is quite rigorous because the risks are so severe. Gliomas are highly infiltrative; it can be difficult to determine the exact borders of the tumor. And that’s one of the reasons why there are so many recurrences of glioma.”

First developed almost 20 years ago, the desorption electrospray ionization (DESI) mass spectrometry methodology allows for rapid differentiation between healthy tissue and cancerous tissue. Mass spectrometers work by converting molecules to positively and negatively charged ions that can be distinguished by mass.

The DESI method enables this ionization to occur directly on the surface of the tissue, allowing researchers to perform a reaction and analyze the results within a few minutes.

“The DESI methodology is very sensitive and very fast,” Cooks says. “Which means that measurements can be taken right away and guide the surgeon in further resection. This is critical when dealing with the brain, where a few millimeters of tissue can mean the difference between normal and impaired function.”

Intraoperative methodology may guide more aggressive brain resections.

IMPROVING PATIENT OUTCOMES

Dr. Graham Cooks
The National Cancer Institute funded a joint study between Purdue University and the Mayo Clinic to test the use of DESI during brain surgery.

“The most important information we get is prognostic information relating to the presence of a certain mutation that occurs in some, but not all, gliomas,” Cooks says. “Samples from the edge of the tumor will still show that mutation. Successive micro biopsies can be used to map out the margins of the tumor.”

Should the approach become an approved method after clinical trials, Cooks expects simplified mass spectrometers will become commonplace in the operating room.

“Aggressive resection correlates very strongly with better patient outcomes,” Cooks says. “Determining whether or not the mutation is present is critical to guiding the surgeon to make a more aggressive resection. Additionally, if DESI can measure the tumor cell percentage in a particular region of tissue, it would be possible to spot-check regions to assess the likelihood of cancerous tissue prior to the resection. And that could all happen mid-operation.”

After decades of working on DESI, Cooks remains motivated in his persistent pursuit to develop groundbreaking tools and methodology to treat cancer.

“The emotional core of science is highly charged,” he says. “There are disappointments, sure. But every now and again, you make a thrilling discovery.”
Collaboration with engineering involving cancer behaviors

Dr. Bumsoo Han’s group, which is working to develop a “time machine” to observe pancreatic cancer behavior over time, is suggesting a new drug testing approach that could help scientists better identify resistance to chemotherapy. The group has performed research on drug discovery and screening for pancreatic and prostate cancers using microfluidic tumor models. These models are carefully engineered to replicate the biological, chemical, and physical characteristics of human tumors. Their approach accelerates the discovery of novel molecular targets and innovative therapeutic strategies by reducing preclinical animal testing. Moreover, the models are also used to study the biology of cancer cells.

Computational bioinformatics

The Collaborative Core for Cancer Bioinformatics (C3B) is a joint bioinformatics core between the Purdue University Center for Cancer Research and the Indiana University Melvin and Bren Simon Comprehensive Cancer Center. Bioinformatics is a diverse interdisciplinary field, which combines statistics, biology, computer science, mathematics, and engineering to analyze and interpret complex biological datasets. Led by Nadia Atallah Lanman in this research, C3B performs bioinformatics analyses for cancer center research teams and also works tirelessly to train the next generation of scientists to be data literate. The aim of the C3B is to integrate and accelerate cancer discovery, drug discovery, and precision medicine to improve and save lives through joint bioinformatics, molecular genetics, and genomics research. The goal: Provide individualized and precise cancer-related care based on how a person’s genes react to different treatment plans.
**Compound drug resistant to AML and some cancers**

The Sintim group, in collaboration with startup company KinaRx, has been conducting safety studies on lead compounds that have the potential to threaten AML patients who have become resistant to Gilteritinib, a FLT3 inhibitor used for treatment of FLT3-harboring AML. They have also identified new chemical entities that reduce tumors that are resistant to the drugs Pralsetinib and Selpercatinib, two drugs used for RET-driven tumors. Their ultimate goal is to develop a suite of precision oncology compounds, which could be used for drug-resistant AML as well as lung and thyroid cancers.

**Targeting treatment in prostate cancer**

The Chang-Deng Hu lab is interested in understanding how prostate cancer develops, progresses, and responds to therapies at the molecular level, particularly at the transcriptional and epigenetic levels. The recent exciting findings from the lab have identified protein arginine methyltransferase 5 (PRMT5) as a key player in radiation-induced DNA damage response and the androgen receptor (AR) signaling in prostate cancer cells. These findings have been published in *Oncogene* (2017), *iScience* (2020), *Cancer Research* (2020), and *Cancer Gene Therapy* (2021). The lab is investigating how PRMT5 regulates prostate cancer cell growth and therapy response and is developing novel therapeutic agents targeting PRMT5 for prostate cancer treatment.
The next breakthrough in cancer research may be found in man's best friend. In the College of Veterinary Medicine, researchers study naturally occurring cancers in dogs to treat individual pets and learn more in order to help the next generation of dogs. And, with certain cancer types, they can learn information that will improve the outlook for people, too.

The College focuses a lot of its cancer research in dogs on three main cancer types. R. Timothy Bentley, associate professor of neurology and neurosurgery, studies brain cancer; Michael Childress, associate professor of comparative oncology, leads the work in lymphoma; and Debbie Knapp, distinguished professor of comparative oncology, works primarily with bladder cancer.

“We are tackling the disease at multiple levels,” Knapp says. “We have ongoing work to better understand how to prevent cancer, how to detect it earlier, and how to treat it more effectively.”

Personalized medicine has become a crucial factor in improving patient outcomes for dogs and people alike. Understanding how an individual will respond to a particular drug allows doctors to customize therapies while considering numerous variables.

“The molecular subtype of a cancer can affect how aggressive it will be and what treatments will be most helpful,” Knapp says. “For certain bladder cancers, the subtypes in dogs are very similar to the subtypes found in people, which means there's a high probability that therapies that work for dogs could also help people diagnosed with bladder cancer with the same molecular subtype.”

In a collaborative study between the cancer center and R. Claudio Aguilar, associate professor of biological sciences, researchers found a way to combine an anthrax toxin with a growth factor to kill bladder cancer cells and tumors.

Bladder cancer is one of the cancers most likely to recur, and Aguilar's approach involving drugs instilled directly into the bladder is showing promise. The new methodology could act more rapidly and require less time for the patient to sit with the drug in their bladder. Plus, it may be applicable to other cancers in the future, such as lung and skin cancers.

“Our understanding of cancer is advancing more quickly than it ever has,” Knapp says. “The scientific community has identified new ways to kill cancer cells through targeted therapies and immunotherapies. The promise of the new treatments coming out exceeds anything that we have experienced in decades.

“I've always recognized the potential for learning important information for pet dogs with cancer that can not only help those individual dogs and groups of dogs, but can potentially help people, too. The opportunities for that type of work have exploded in recent years. We are poised to do more now than we ever have in the past.”
Dolores L. McCall Professor of Comparative Oncology

PERFORMING AN ULTRASOUND ON A DOG

DR. DEBORAH KNAPP

Dolores L. McCall Professor of Comparative Oncology

PERFORMING AN ULTRASOUND ON A DOG
Nearly 10 million people die of cancer worldwide every year. Toni Murray feels that loss deeply. Losing two of her loved ones to cancer motivated Murray to make a difference by funding cancer research. First, her beloved aunt Ethel died of skin cancer two decades ago. “She didn’t want anyone to know that she had cancer,” Murray says. “Her options for treatment were limited, and she didn’t have much hope for remission.”

Ten years after that, Murray’s husband of almost 40 years, John, died from surgery complications only two months after his lung cancer diagnosis. His entire lung was removed, but his heart was strained by the operation. “John’s father died of lung cancer,” Murray says. “The doctors put a hole in his back, and they had to take care of it constantly. John told his physician, ‘I do not want that hole.’ Cancer treatment had come a long way since those days.”

Now, Murray wants to provide financial support to develop the next generation of cancer treatments. Following a tradition of generosity instilled by her parents, Murray established the John and Toni Murray Cancer Research Fund through an estate gift. Although neither of them are Purdue graduates, Murray feels a connection to the University due to her decades of involvement as an extension homemaker. “I give because I know that one day, there will be a discovery that will change everything,” Murray says. “It may not happen in my lifetime, but I believe it will happen. Supporting the center is the best thing I can do.”
In 1952, Chuck and Joyce Jordan began their newlywed life together at Purdue. The couple lived in campus housing in Hilltop Apartments across from Ross-Ade Stadium while Chuck was enrolled in graduate school and Joyce worked as a records assistant in the Department of Agricultural Economics. Two of their three children were born during their time at Purdue—all three would go on to graduate from the University.

Chuck retired from Eli Lilly and Company in 1992, and Joyce died the following year from pancreatic cancer. In her memory, Chuck established the Joyce Fox Jordan Cancer Research Fund.

“When Joyce was first diagnosed, the doctors estimated she had six months to a year before succumbing to this terrible disease,” Jordan says. “She volunteered for a clinical trial studying a new compound to treat pancreatic cancer, which later became an approved drug, and she lived almost two years.”

Jordan’s initial objective was to support research to develop diagnostic tests to detect pancreatic cancer at an early stage and facilitate effective treatment. However, the endowment has since expanded to support basic discovery efforts.

“With discovery research, so many outcomes are serendipity,” Jordan says. “There are no quick fixes. Experiment results may lead you down an unexpected path. As a scientist, you don’t always know what it means, but you must always remain optimistic that you will make a breakthrough that will lead to the next step.

“The ultimate goal in cancer research is to find a cure, of course. It is an elusive goal, but it is still our goal.”
An annual event organized by Zeta Tau Alpha, Big Man on Campus is a year-long philanthropic focus for the sorority that culminates in a fraternity/cooperative talent show held in the spring. Through sponsorships and corporate partnerships, ZTA raises $25,000 annually for the PCCR and has donated $1.5 million to the center since the event’s founding in 1996.

“There are many cancers that affect both animals and people, so our research helps both humans and their pets lead longer, healthier lives. Being part of the advancement board is an extraordinary opportunity to share the stories of those affected by cancer in our community.”

“Two of my grandparents were diagnosed with cancer in 2013. Taking care of them was the most rewarding, yet scary, experience of my life. I am motivated to be part of the cure. I want the student body to know about the incredible work being done at Purdue to Hammer Down cancer.”

Six student directors were appointed to the Director’s Advancement Board to help promote the work of the center across campus. Here, two students share what inspired them to serve.

Beta Theta Pi held its first-ever independent philanthropy event in 2020 to benefit the Tyler Trent Cancer Research Endowment. Twelve members of the fraternity pledged to shave their heads in memory of Trent, a charismatic student and beloved Purdue superfan. Through donations and sponsorships, the fraternity raised almost $9,000 to fund cancer research.

“Second-year doctor of veterinary medicine student

CARMEL, INDIANA

“There are many cancers that affect both animals and people, so our research helps both humans and their pets lead longer, healthier lives. Being part of the advancement board is an extraordinary opportunity to share the stories of those affected by cancer in our community.”
Indiana Elks Spring Convention

Since 1948, Indiana Elks Charities Inc. has supported Purdue's faculty with Innovative Grants funding. These grants help researchers pursue pioneering ideas that might not otherwise receive funding. Fighting cancer is the major state focus for the Indiana Elks, and more than 70 Indiana lodges raise money each year for cancer research in the state. Jerry Alberts, along with Dr. Andrew Mesecar, deputy director for PCCR, recently attended the Indiana Elks convention in French Lick, Indiana.

To learn more, visit purdue.edu/cancer-research/about/community-partners.php.

Indiana Extension Homemakers Association (IEHA)

Jerry Alberts, chief development officer for the Purdue Center for Cancer Research, spoke at the Indiana Extension Homemakers Association (IEHA) Annual Home and Family Conference to thank them for their continuous support for cancer research at Purdue. They established their own cancer research endowment in 2010 and continue to contribute to it. The IEHA was founded in 1913 to strengthen Indiana homes and families, and they continue with their mission today with just over 7,000 members throughout the state. Alberts spoke to them about how their cancer research endowment has grown since its inception and how the distributions greatly impact the research and advancements that our Purdue scientists contribute to.

A check for cancer research is presented during the convention.
It was an exciting day on April 16, 2008, for the much-anticipated inaugural Purdue Center for Cancer Research Challenge 5K Run/Walk. There was an overwhelming turnout of thousands of people packed into Ross-Ade Stadium with smiles, laughter, cheers, and bands! Cindy Ehrlich walked with her mother-in-law, as well as a friend who had lost her mom to cancer. Being part of that 5K and seeing the enthusiasm of the crowd there for a common purpose was the reason that Cindy and her husband, Rod, started supporting the Purdue Center for Cancer Research. Cindy says, “Rod and I walked in the second 5K in 2009, and it was like a party of revelers pulling together to do whatever we could to eradicate cancer! There was hope!”

Only eight years later, Rod was diagnosed with non-Hodgkin’s lymphoma, which started a 10-month journey of medicine, chemotherapy, ups and downs, and seeing firsthand what cancer research has been able to accomplish. After fighting a long, hard battle, their prayers were not answered as they had hoped. But it was with hope that Cindy walked with a friend in 2020’s virtual 5K to further the cause of cancer research, doing what they could with their hearts and their resources to stamp out cancer. Next spring, take the challenge!

LuAnn Blough got involved with the Purdue Center for Cancer Research Challenge 5K in 2014. A non-smoker who had tongue cancer 25 years ago, she had always been supportive of cancer research. Knowing that LuAnn was a cancer survivor, friend and not overhead. Andrea and LuAnn formed Team Kickin’ It with the goal of kicking cancer to the curb! David gets his competitiveness from LuAnn, which led to Team Kickin’ It finishing first in fundraising the four years they were in West Lafayette for David’s football seasons at Purdue. Even in fall 2020, they participated in Dallas for the virtual Challenge 5K and finished as the top team!

There are many favorite memories to be recalled, such as being on the field with David and Coach Hazell at halftime of the Hammer Down Cancer game supporting the other cancer survivors. It was very meaningful to share her story while walking with a reporter. LuAnn says, “I always liked the energy at the beginning of the race and seeing family and friends of survivors giving up their time to support the Purdue Center for Cancer Research. I have been involved seven years, and Lord willing, I am planning to go back up next April and walk again! Team Kickin’ It will be back!”

Andrea Bridge invited her to participate. LuAnn liked the fact that the money raised by the Challenge all went to research and not overhead. Andrea and LuAnn formed Team Kickin’ It with the goal of kicking cancer to the curb! David gets his competitiveness from LuAnn, which led to Team Kickin’ It finishing first in fundraising the four years they were in West Lafayette for David’s football seasons at Purdue. Even in fall 2020, they participated in Dallas for the virtual Challenge 5K and finished as the top team!

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HOPE—DO WHAT YOU CAN DO!

LuAnn Blough with her son, David Blough

Rod and Cindy Ehrlich and Marcy Ziek
Marvin “Leroy” Keyes—a dear friend of the PCCR and a true Boilermaker icon—passed away on April 15, 2021, at age 74. Leroy left an indelible mark on so many. PCCR was honored to have his support of the annual Challenge 5K event. His thoughtful words at the end of each event and presentation of the Leroy Keyes award were always memorable.

THANKS AND HONOR TO A LEGEND

MARVIN “LEROY” KEYES

Join us in our Hammer Down Cancer sponsorships this fall and spring with Purdue Athletics to see the impact our center is making and to learn how you can get involved to make a difference. When you donate to PCCR, 100% of your gift supports the Purdue Center for Cancer Research.
In terms of gifts received, funds raised, and awards distributed, fiscal year 2019–20 was another outstanding one for the Purdue Center for Cancer Research. Contributions to the $10 million matching-funds gift, presented by the Walther Cancer Foundation in the 2018–19 fiscal year, rose from $5.3 million to $6.3 million, and more than $240,000 in awards across the four core research areas was distributed.
Covid . . . pandemic . . . quarantine . . .
This trio managed to put a stop to many things but not the Purdue Center for Cancer Research Director’s Advancement Board (DAB). Although we were not able to meet in person for our semi-annual meeting in the spring, we did so virtually with nearly 100% attendance, including our student board. Zoom, emails, texts, and phone calls became our way of life. As thankful as we are for the technology, we are looking forward to this fall when we will all meet in person.

The DAB is stronger than ever and ready to bring awareness of the Purdue Center for Cancer Research both on campus and beyond. Recognition is high on our agenda, and to that end, we have formed three committees: executive, marketing, and events and fundraising. Each committee reported to the board in the spring. New board members were introduced and ideas shared. Our student board members were active participants. They have added a great deal of energy to the DAB, for which we are grateful.

The entire DAB thanks you for your continuing generosity. Without you, we could not support the top researchers in the field of cancer research. You are making a difference. Together, we will Hammer Down Cancer.

A message from PCCR Director’s Advancement Board Chair

MARTI SCHMIDT