2015

Conquest

Johnson Cancer Research Center

Kansas State University

95% of donated funds goes directly to K-State cancer research while 5% is used to advance the university.

$500,000 or more is awarded each year to support cancer research and education.

90 faculty researchers are fighting cancer in 17 departments of 5 colleges.

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The fight starts here!

From nanoparticles and stem cells to antioxidants and drug discovery, Kansas State University faculty are conducting the basic and translational cancer research that lead to new treatments and cures, as well as training tomorrow's scientists and medical professionals. To support the Johnson Cancer Research Center's vision to conquer cancer in our time, simply use the enclosed envelope to send your gift, or donate online at ***www.found.ksu.edu/cancer.*** With your help, we make a difference! To learn more about how you can support K-State cancer research and education, contact David Spafford at ***800-432-1578*** or ***davids@found.ksu.edu.***

On the cover: Brad Behnke.

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Welcome to our fourth issue of *Conquest,* an annual magazine about the Johnson Cancer Research Center at Kansas State University. We are pleased to again spotlight the exciting work of some of our affiliated faculty scientists.

Dr. Brad Behnke, kinesiology, studies how exercise can increase the efficacy of cancer treatments like radiation. Dr. Ric Rosenkranz, human nutrition, has a nationally recognized program to inspire changes in exercise and nutrition among girls to lower their lifetime risk of cancer. Dr. Susan Brown, biology, studies cancer-relevant genes and their functions in an insect model system.

Allow me to give Dr. Brown's research a little more context. *Conquest* often features investigations into the prevention, origin, diagnosis and treatment of cancers, but we cannot forget the importance of basic research, the study of fundamental properties of molecules, cells and organisms. Basic research has dramatically improved the understanding of cancers and their control. Dr. Brown's use of the red flour beetle to study genetics offers many advantages as it allows experimental procedures impossible in human studies yet relevant to human cancers.

Dr. Brown played a very significant role in establishing the red flour beetle as an experimental model system now used worldwide, and has since broadened her program to include DNA analysis and genome mapping of many organisms, including humans. She also is a top expert in bioinformatics. Dr. Brown is a university distinguished professor and she recently won a prestigious Higuchi-KU Endowment Award in basic research.

In this issue, you will meet K-State alumnus Josh Umbehr, M.D., who parlayed his undergraduate cancer research experience into a career as a physician, and graduate student Susan Whitaker, whose personal experience has made her extra motivated to be a part of our mission to take a leading role in conquering cancers in our time.

Finally, you'll meet K-State alumnus and strong supporter of our center, retired U.S. Air Force Reserves Maj. Gen. Harvey McCarter, and learn how thousands of other members of the K-State family rallied together last fall to support the university's fight against cancer.

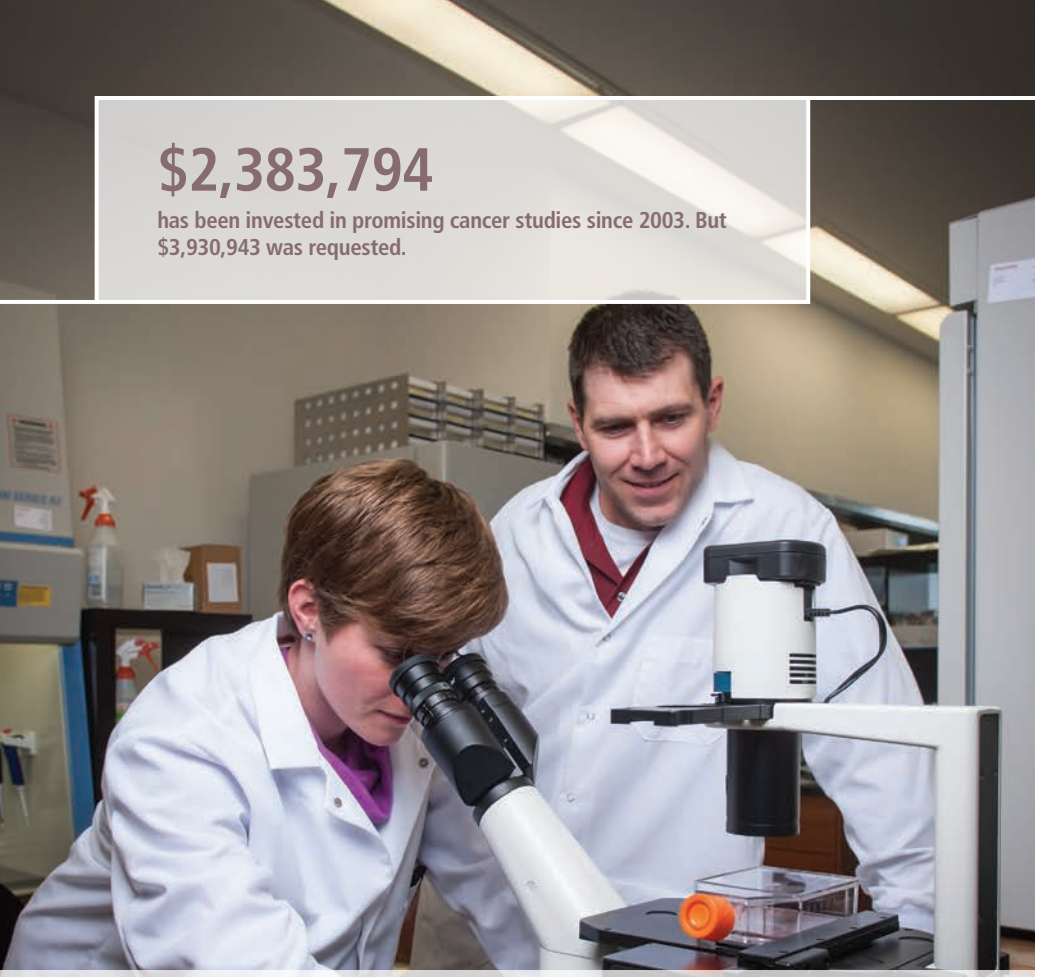
Our programs supporting K-State's promising cancer research and budding scientists are only possible because of generous donors and friends like you. Research has undoubtedly led to increased cancer survivorship, and its continued progress requires support. We thank all of you who have contributed to our efforts. There is more work to be done and now is the time for huge advances. We invite you to read further and join our fight.

Rob Denell

Director

$2,383,794

has been invested in promising cancer studies since 2003. But $3,930,943 was requested.



Research that moves

Kinesiologist's work combats cancer with exercise

By Jennifer Tidball

Kansas State University kinesiology research offers encouraging information for cancer patients: A brisk walk or a slow jog on a regular basis may be the key to improved cancer treatments.

Brad Behnke, associate professor of exercise physiology, and collaborators have shown that moderate exercise on a regular basis may enhance tumor oxygenation and improve treatments in cancer patients. Now Behnke is using a $750,000 American Cancer Society grant to study moderate exercise as a way to make radiation treatments more effective, especially for difficult-to-treat tumors.

"If we can increase the efficacy of radiation treatment, then the patient's prognosis is enhanced," Behnke said. "An intervention like exercise has almost universally positive side effects versus other treatments that can have deleterious side effects. Exercise is a type of therapy that benefits multiple systems in the body."

The National Cancer Institute at the National Institutes of Health recommends exercise for cancer patients and cancer survivors, but little research shows why. That prompted Behnke to combine his expertise in integrative physiology with cancer research. He also has received support from the Johnson Cancer Research Center.

"I became interested in finding out what happens within the tumor during and after exercise as a means to enhance treatment outcomes," Behnke said.

For the latest research, Behnke is using prostate cancer tumor models to find ways to enhance oxygen delivery to tumors. When a tumor is hypoxic, or has low oxygen, it is often very aggressive, Behnke said. Because oxygen is a "radiosensitizer," it helps destroy cancer cells. As a result, low-oxygen tumors often are resistant to traditional cancer therapies, such as radiation therapy, and interventions, such as concentrated oxygen breathing, are used to get more oxygen to the tumor before treatment.

"If we manipulate all the systems in the body — the lungs, the heart and the blood vessels — with exercise, we can take advantage of the dysfunctional vasculature in the tumor and enhance blood flow to the tumor," Behnke said. "The tumor becomes the path of least resistance for the elevated cardiac output of exercise, which results in a substantial increase in tumor oxygenation during and after exercise."

But the key is moderate exercise, said Behnke. Too little exercise may have no effect, but too much exercise may have a negative effect and may shut down blood flow to the tumor region or impair the immune system.

Moderate exercise is an activity that uses 30 to 60 percent of someone's aerobic capacity, Behnke said. The activity is nonstrenuous and is something that most people can perform, such as a brisk walk or a slow jog.

Research also has shown that moderate exercise can help cancer patients counteract some of the side effects of treatment — such as low blood count, fatigue, cachexia and lost muscle mass — which has led to many researchers labeling this as "aerobic exercise therapy" for patients with cancer, Behnke said.

"There really aren't any negative side effects of moderate-intensity exercise," Behnke said. "Exercise is often prescribed to improve the side effects of cancer and treatment, but what exercise is doing within the tumor itself is likely beneficial as well."

Behnke and collaborators have published their exercise and cancer research in the Journal of the National Cancer Institute.

At Kansas State University, Behnke is collaborating with Mary Lynn Higginbotham, assistant professor of clinical sciences; Katie Heinrich, assistant professor of kinesiology; and David Poole, professor of kinesiology. The American Cancer Society grant, "Modulation of tumor oxygenation to enhance radiotherapy," also involves University of Florida researchers in tumor microenvironment biology.

A bitter pill to swallow

A former cancer patient's quest to find a better treatment

By Stephanie Jacques

Beyond her research, Susan Whitaker, a new Kansas State University graduate student in biochemistry and molecular biophysics, never thought about cancer. It never occurred to her as the cause of her stomach pains.

She was 28 years old, a wife, mother, part-time registered nurse and a junior at the university when she was diagnosed with stage 3 colon cancer.

"They say nurses make the worst patients," Whitaker said. "I thought it might be a food intolerance or milk allergy. I had gone to the doctor and they did an ultrasound, but didn't see anything. They said if it gets worse to come back, but I just didn't go back."

Eight months later, Whitaker was rushed to the hospital and into surgery to remove a large obstruction from her colon.

"All I remember when I woke up from surgery was my husband with our daughter on his lap and he said, 'Susan, they found a tumor,'" Whitaker said. "I remember thinking, 'That's weird; 28-year-olds don't get cancer.'"

The doctors discovered the cause of Whitaker's cancer was Lynch Syndrome, a genetic disorder that increases the risk of many types of cancers, especially at younger ages. She had surgery to remove a part of her colon and started chemo treatments, which she continued into the 2013 fall semester.

"I think I missed maybe only two or three recitations because I made myself get up despite the chemo," Whitaker said. "I remember just laying against my backpack in the Chemistry/Biochemistry Building with my transfusion going."

The chemo treatments worked. She was cancer-free by October 2013 and pregnant with her second child by December. But the looming Lynch Syndrome diagnosis means she may get cancer again — and her children have a 50 percent chance of having the genetic disorder, too.

The treatment for cancer scares Whitaker more than the diagnosis of cancer.

"I was so sick from the chemo treatments," Whitaker said. "Every other week I couldn't do much because I felt horrible and I had to live with that. Now I know what it's like, so it motivates me to do a little bit more with my research."

As a graduate student, Whitaker is continuing her undergraduate research, for which she received a Johnson Cancer Research Center award to work with John Tomich, professor of biochemistry. They study Branched Amphiphilic Peptide Capsules, or BAPCs. When bombarded with radiation, the capsules absorb and contain the radiation, which may allow a targeted attack on cancer cells without harming normal cells.

"I've been working on how the BAPCs behave to figure out how we can best utilize them therapeutically," Whitaker said.

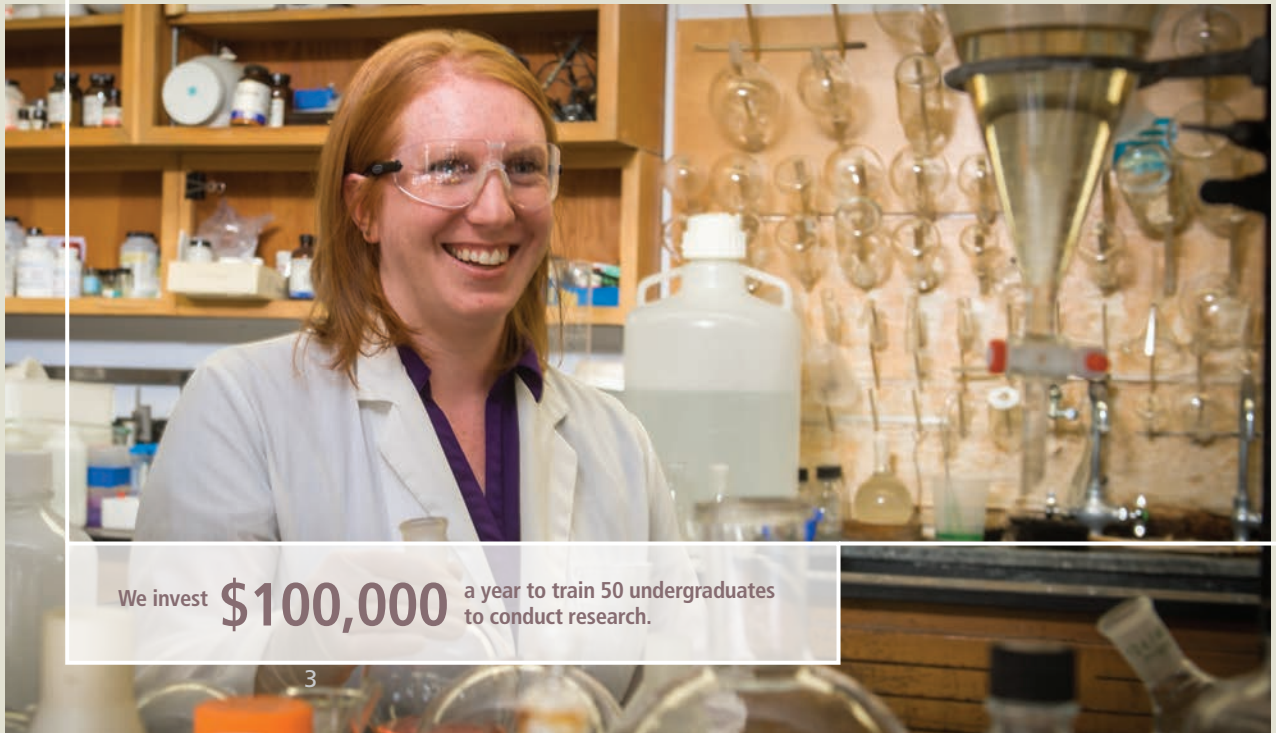
Whitaker and Tomich's research has shown that the capsules — made from two peptide variants of a sequence differing only in length — stay stable through a wide temperature range, remain intact within a cell and can encapsulate hazardous materials used to fight cancer.

"We want them to be stable for some period of time, but eventually become unstable," Whitaker said. "Under these conditions, we may be able to have them release their contents at a certain time into only the cancerous cells."

Whitaker hopes her work will someday help her and others, but implementing the capsules as a reliable therapy for cancer patients may take many years.

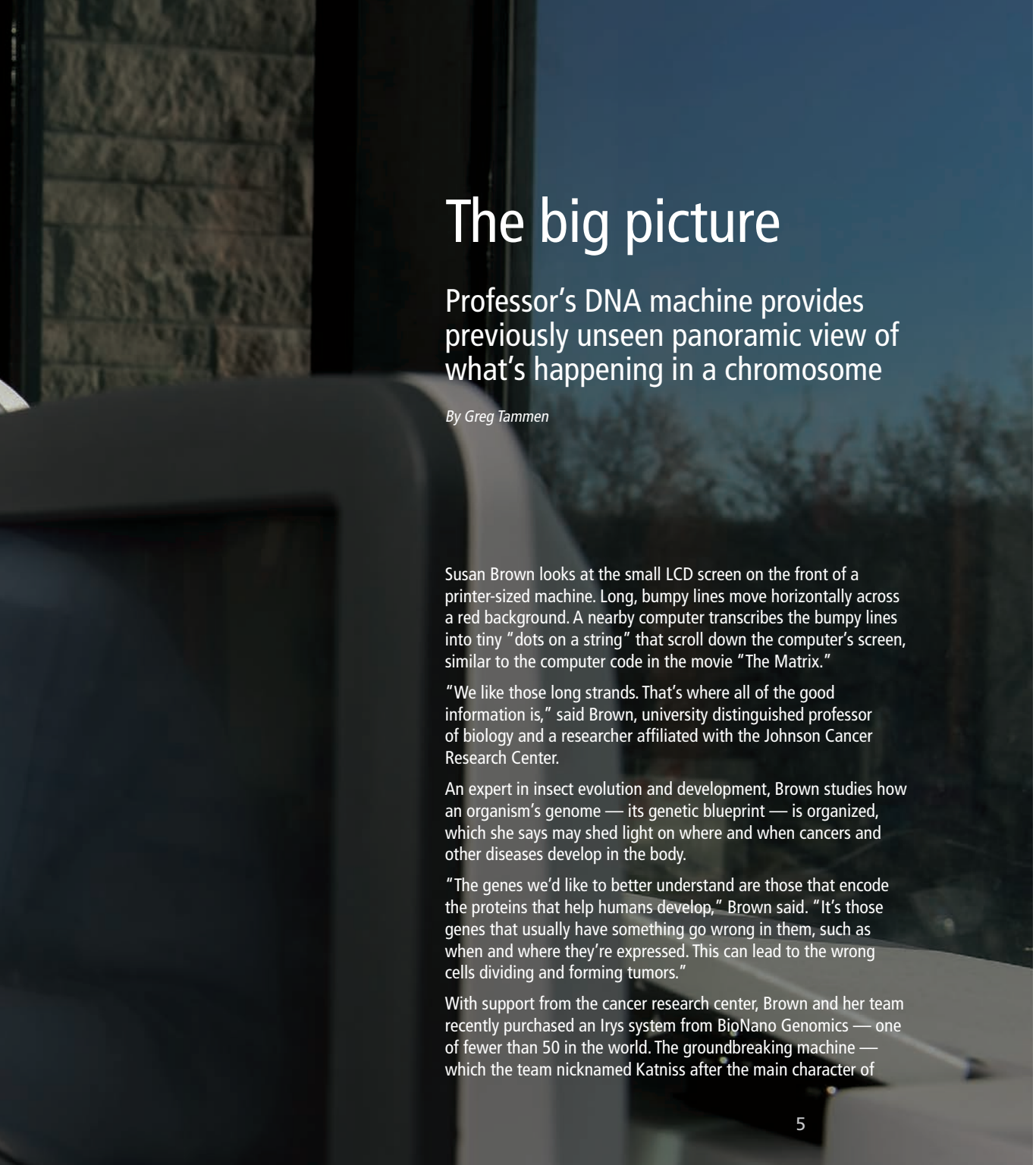
For now, Whitaker has a computed tomography, or CT, scan every six months and a colonoscopy every year to make sure the cancer hasn't returned. Though the risk of cancer returning is high, she believes she can overcome it as long as they catch it early.

"I couldn't have done it without my husband," Whitaker said. "When I was in the hospital my husband said, 'We're going to beat this. We don't have a choice,' and we have so far."



We invest **$100,000** a year to train 50 undergraduates to conduct research.

$86,740 supported laboratory equipment purchases in 2014. But hundreds of thousands of dollars are needed.



The big picture

Professor's DNA machine provides previously unseen panoramic view of what's happening in a chromosome

By Greg Tammen

Susan Brown looks at the small LCD screen on the front of a printer-sized machine. Long, bumpy lines move horizontally across a red background. A nearby computer transcribes the bumpy lines into tiny "dots on a string" that scroll down the computer's screen, similar to the computer code in the movie "The Matrix."

"We like those long strands. That's where all of the good information is," said Brown, university distinguished professor of biology and a researcher affiliated with the Johnson Cancer Research Center.

An expert in insect evolution and development, Brown studies how an organism's genome — its genetic blueprint — is organized, which she says may shed light on where and when cancers and other diseases develop in the body.

"The genes we'd like to better understand are those that encode the proteins that help humans develop," Brown said. "It's those genes that usually have something go wrong in them, such as when and where they're expressed. This can lead to the wrong cells dividing and forming tumors."

With support from the cancer research center, Brown and her team recently purchased an Irys system from BioNano Genomics — one of fewer than 50 in the world. The groundbreaking machine — which the team nicknamed Katniss after the main character of "The Hunger Games" because it's "temperamental but fierce" — helps researchers see a bigger picture of the genetic information and its arrangement in a genome. The machine quickly analyzes DNA from a blood or cell sample and then creates a panoramic image of the donor's genetic landscape for analysis, which was previously impossible.

"We now can see longer pieces of the DNA in a chromosome at one time," Brown said. "It's like zooming out on a subject and getting a bigger picture of the whole scene. And that's exactly what this machine does: It enables us to take pictures of very long pieces of DNA."

In the course of one day, the machine can produce enough pictures of long single DNA molecules in 26,000 parallel nanochannels on a silicon chip to map an individual's genome. Researchers can then compare this map against the healthy reference human genome in the National Center for Biotechnology Information's database to spot differences and problematic regions that may be relevant to tumor formation. Brown says this is already beneficial for leukemia and other blood disorders, and will soon be applied to solid tumors.

To get a feel for the technology, Brown's lab has run and analyzed blood or cell samples from a chimpanzee, monk seal, mouse lemur, hooded crows and various insects. The team will soon begin testing human tumor samples, which will include taking images of cancer genomes and comparing them to the genome of normal white blood cells from the same person.

"This will enable us to highlight genomic difference specific to the disease and rule out normal variation between individuals," Brown said.

Brown's team includes Michelle Coleman, research assistant who runs the machine; Jennifer Shelton, K-INBRE outreach coordinator who has developed algorithms that analyze the genomic data; Nanyan Lu, research assistant who processes the data; and Nic Herndon, computer and bioinformatics specialist who helps analyze the resulting large data sets on Beocat, the university's supercomputer cluster.

In addition to human health aspects, the genome maps made using the Irys machine provide essential genomic resources for improving the recently sequenced genomes of crop plants, pest and beneficial insects, and food animals.

Fighting for a Cure campaign rallies Wildcat community to celebrate, support university's cancer research

By Sheila Ellis-Glasper

Thousands of K-Staters combined their passion and support for Kansas State University and cancer research with the Johnson Cancer Research Center's Fighting for a Cure campaign.

The fall campaign raised $15,000 by selling purple T-shirts that featured a pink Powercat, pink ribbons and the phrase, "Fighting Ever Fighting for a Cure," inspired by the university's fight song, "Wildcat Victory."

"There was an outpouring of support for this campaign," said Marcia Locke, communications and outreach coordinator for the Johnson Cancer Research Center. "We united together as a K-State family to promote a worthy cause."

The campaign, which celebrated the university's world-class cancer research and Breast Cancer Awareness Month, culminated in the inaugural Fighting for a Cure Shirt Day on Saturday, Oct. 4, 2014. Hundreds of supporters donned "Fighting" T-shirts at the Wildcats' home football game.

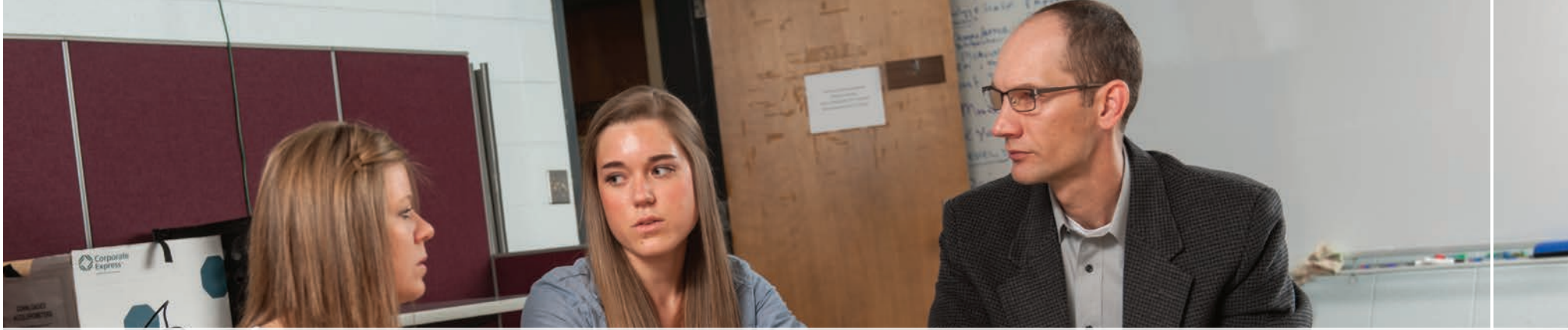
Well-known K-Staters, including Coach Bill Snyder and his wife, Sharon Snyder; university President Kirk Schulz and first lady Noel Schulz; and former K-State football standout and NFL player Kevin Lockett, proudly displayed their pride in the university's cancer research with their shirts.

The three-week social media campaign was a hit, featuring the call-to-action hashtag #HelpKStateFightCancer. Dozens of photos showing campaign supporters wearing their shirts were posted to Facebook and Twitter using the campaign hashtag.

Local businesses, radio stations and other media outlets rallied around the cause, promoting the campaign to make it a success. Almost 2,000 shirts were sold by Varney's and the cancer research center, with N Zone's help with online sales and distribution.

T-shirts are still available for purchase, and the second Fighting for a Cure Shirt Day is planned for Oct. 17, 2015. For information visit: cancer.k-state.edu/newsevents/FightingForACureShirt.html.

Every gift helps, and last year, **95% of funds donated came from gifts of less than $1,000.**



Creating a healthy lifestyle for girls in a SNAP

By Stephanie Jacques

Research support has been leveraged by our faculty to 25 times as much in national funding.

Starting children on a path to a healthier lifestyle is a snap for Ric Rosenkranz, Kansas State University associate professor of human nutrition.

Rosenkranz created the Scouting Nutrition Activity Program, or SNAP, a health promotion program that targets Girl Scout troops and was recently adopted by the National Cancer Institute as a Research-Tested Intervention Program.

The institute selected the program because it has potential to aid in cancer prevention and can be easily adapted into many different communities.

"There are direct links between cancer and a sedentary lifestyle and obesity," Rosenkranz said. "The National Cancer Institute suggests 30-40 percent of cancers are preventable by establishing a more healthy lifestyle, particularly by implementing good nutrition and an increase in physical activity."

The program provides troop leaders with educational materials and learning opportunities that promote physical activity and healthy eating, which Rosenkranz hopes will lead to a healthy life path for young girls.

According to Rosenkranz, girls tend to be less physically active than boys, which is why he is targeting Girl Scouts.

"Girls in elementary school are a little bit less active than boys, but in middle school and high school physical activity decreases greatly," Rosenkranz said. "We want to make sure that girls have every chance possible to maintain a physically active and healthy lifestyle."

The 2-year-old program has already seen success. Rosenkranz worked with four troops in Manhattan, Kansas. He asked girls and parents to wear accelerometers, which logged a daily increase of about 1,000 to 1,500 steps among the participants.

"That's close to a mile extra of physical activity per day," Rosenkranz said. "I think we added to the program's success by communicating with parents so they could better see the purpose of it. I think this increased their support."

In addition to the girls' increase in activity, the program showed a reduction in body mass index for 7 out of 8 participants who were in overweight or obese ranges.

"The cool thing about it was that it wasn't a weight loss program; this was just a healthy lifestyle program — increase physical activity and eat healthier," he said.

Rosenkranz didn't originally create the program as an opportunity to prevent cancers, but now sees endless opportunities to help children establish a brighter future.

"I really believe that an ounce of prevention is worth a pound of cure," Rosenkranz said. "If we are going to prevent chronic diseases such as cancer, it makes sense to work with kids and get them on a healthy track."

Rosenkranz received seed grant funding from Kansas State University's Johnson Cancer Research Center and an equipment grant from the Kansas Health Foundation to help him grow the program and seek more national funding. He continues to refine the program, which is available on the National Cancer Institute's website, rtips.cancer.gov/rtips/programDetails.do?programId=2570231.

More than medicine

Graduate opens "direct primary care" practice in Kansas

By Lindsey Elliott

Josh Umbehr is changing the face of primary care medicine by removing the middleman and focusing on the patient. His innovative "direct primary care" model of medicine is growing in popularity, and his path to developing it began at Kansas State University.

Umbehr majored in human nutrition and was chosen by the Johnson Cancer Research Center in 2001 to take part in its undergraduate Cancer Research Award program, which offers faculty-mentored research experiences.

He worked with Richard Baybutt, former associate professor of human nutrition, studying how vitamin A or E altered the lung's response to cigarette smoke constituents. His research found that vitamins A and E restored surfactant synthesis and cell adherence, suggesting these antioxidants decreased the toxicity of the cigarette smoke toward type II pneumocytes, which help maintain lung function.

"My experience in research helped me get into medical school because I was able to speak intelligently about the process of scientific research and show a deeper intellectual capacity," Umbehr said.

"Undergraduate research gives you a lot of insight into the research world and how basic science transitions into a bedside prescription," Umbehr said. "It educated me on how scientists research complex medical issues, and I am now able to translate that to my patients. They appreciate having someone with research experience, especially cancer research."

While at Kansas State University, Umbehr was active in many programs and activities, including Student Health Advisory Committee, Sexual Health Awareness Peer Educators, Sensible Nutrition and body image Choices and Big Cats. These experiences, combined with his research, helped him advance in his career and become an accomplished doctor.

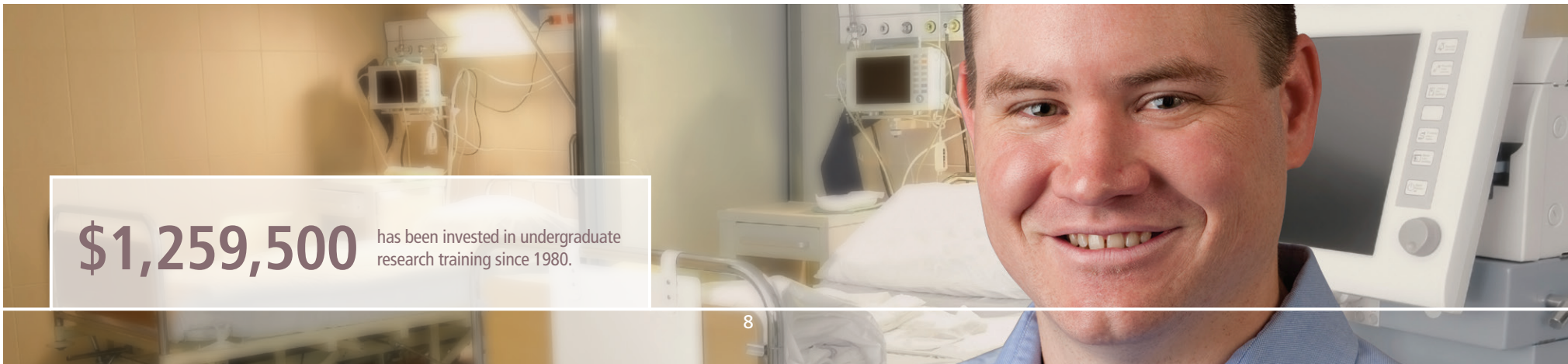
Umbehr graduated in 2003 and went on to medical school at the University of Kansas and a residency in Wichita. He opened his family practice, AtlasMD, in Wichita in 2010. It is regarded as a revolutionary practice for its "direct primary care" model.

His practice does not use health insurance; rather he charges a flat monthly fee in exchange for unlimited access to his office. The fee includes procedures performed in the offices and prescription medicines provided at his practice.

Less burdened by government and insurance regulations, Umbehr can be more focused on his patients and their needs. This allows him to spend more time giving them detailed health information, incorporating what he learned at Kansas State University.

"My experience in human nutrition has been very valuable because nutrition is not a topic covered much in medical school, but it is a large component of family medicine," Umbehr said. "I'm able to give more detailed nutrition information and suggestions because I have that background in human nutrition."

Umbehr and his partners have now launched more than a dozen similar practices and helped 67 doctors across the country. He also is involved with the Wichita Down Syndrome Society and is a board member of Rainbows United, a developmental training center for children with special needs. He was the recipient of the College of Human Ecology's 2012 Young Professional Award.



Why he gives

Family's struggles with cancer inspire McCarter to do more

By Beth Bohn

Harvey McCarter knows success.

After graduating from Kansas State University in 1956 with a bachelor's degree in electrical engineering, he rose to the rank of major general in the U.S. Air Force Reserves and served at the Pentagon. As a professional engineer, he worked on projects for national defense — including the B-52 and the Titan II missile system — as well as the U.S. space shuttle program. He's been a commercial airline pilot and flight instructor, and he made his mark in the business world as an executive of several flight training companies.

Now retired, McCarter, who lives in Fairview, Texas, is not slowing down. He hopes his next success is helping his alma mater find a cure for cancer. He's doing this through gifts that fund research at the university's Johnson Cancer Research Center.

Giving back to his university and supporting efforts to fight cancer are important to McCarter.

"Marilyn, my current wife, lost her husband to cancer, and I lost my second wife to cancer," McCarter said. "Giving to the cancer research center is an opportunity to help my alma mater. I have a sincere hope we can cure this disease."

It was research by Deryl Troyer, professor of anatomy and physiology, and Stefan Bossmann, professor of chemistry, that sparked McCarter's first large gift to the center in 2007. He was hooked when he met with Troyer and saw a presentation about using nanoparticles to overheat or bore holes through cancerous tissue to kill it. Since then, the researchers have also, among other projects, developed a simple blood test that can, in less than one hour, accurately detect the beginning stages of several cancers.

McCarter enjoys selecting projects to support at the center, which he has done for nearly 10 years. He knows his gifts are making a difference in the battle against cancer.

"All of the projects I have supported have been critical and helpful, and some have even resulted in patents," he said. "I would highly encourage everyone to support the cancer research center because of the personal satisfaction you get out of the goal of trying to stop cancer and the serious results your support helps produce."

Not only has McCarter given back to K-State through gifts to the cancer research center, he also established an endowed fund to support an annual engineering scholarship at the university. In addition, he supports the K-State Alumni Association and K-State Athletics' Mike Ahearn Scholarship Fund. He is a member of the Kansas State University Foundation President's Club, which honors exceptional supporters of the university.

"I see my contributions as a way to support the university's goal of becoming a Top 50 public research university by 2025," said McCarter. "I owe so much to Kansas State University. I got my Air Force commission, entry into flight school and my engineering degree through K-State. Everything has worked out kind of nicely for me and I like to give back."

Programs to advance K-State cancer research and education are made possible by private donations.

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