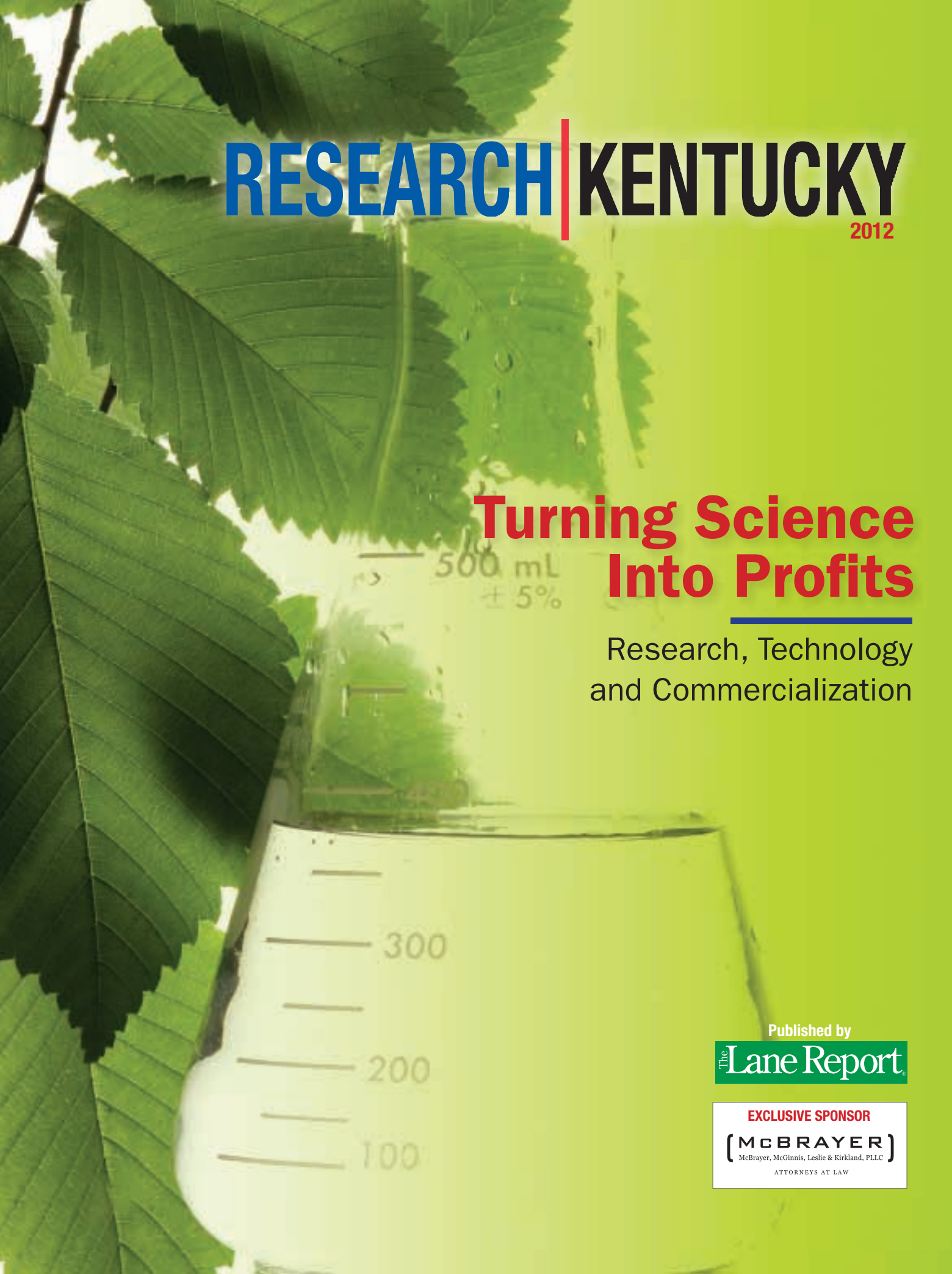


RESEARCH | KENTUCKY

2012

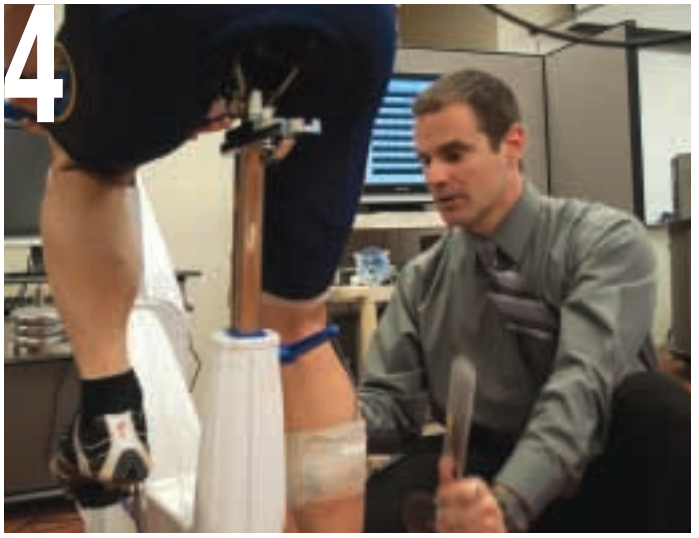
Turning Science Into Profits

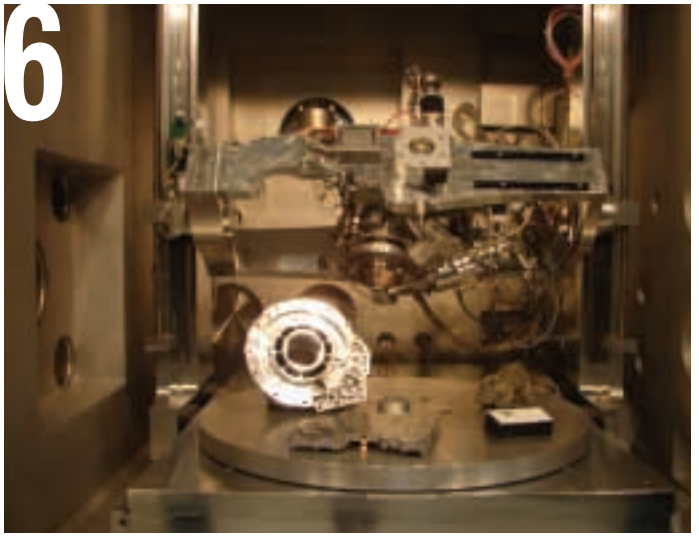
Research, Technology and Commercialization

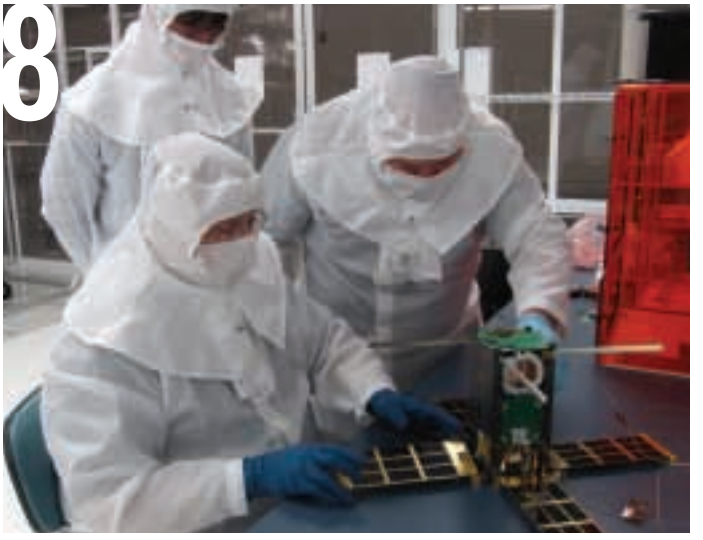
Published by
The Lane Report

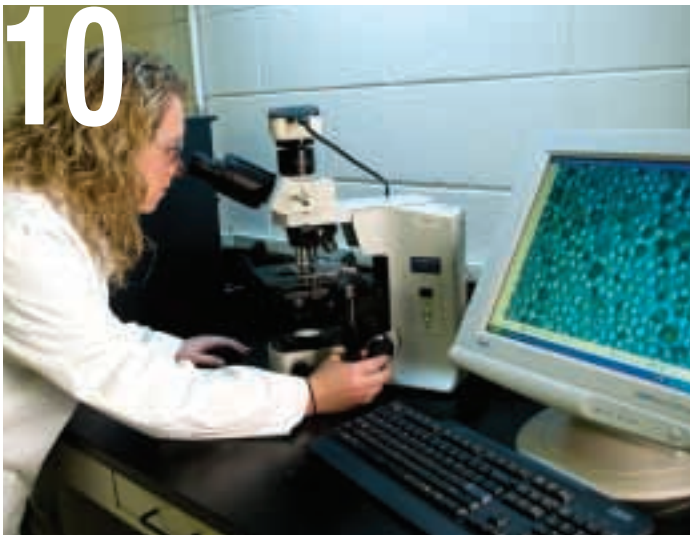
RESEARCH | KENTUCKY 2012

CONTENTS









Knowledge-Based Businesses Are Economic Growth Catalysts

This issue of Research Kentucky reports that even during a severe global recession, Kentucky's research, technology commercialization, and economic development efforts have remained viable and focused.

It is also evident that programs like Bucks for Brains (B4B) and SBIR-STTR matching grants have been very effective public investments which continue to pay dividends by creating technology jobs and attracting additional public and private research investment to Kentucky.

After evaluating its prior successful investments in technology, the General Assembly should appropriate additional public funds for use in recruiting high-tech researchers, building research labs, and creating new businesses in the technology sector.

Ed Lane
Publisher

RESEARCH | KENTUCKY

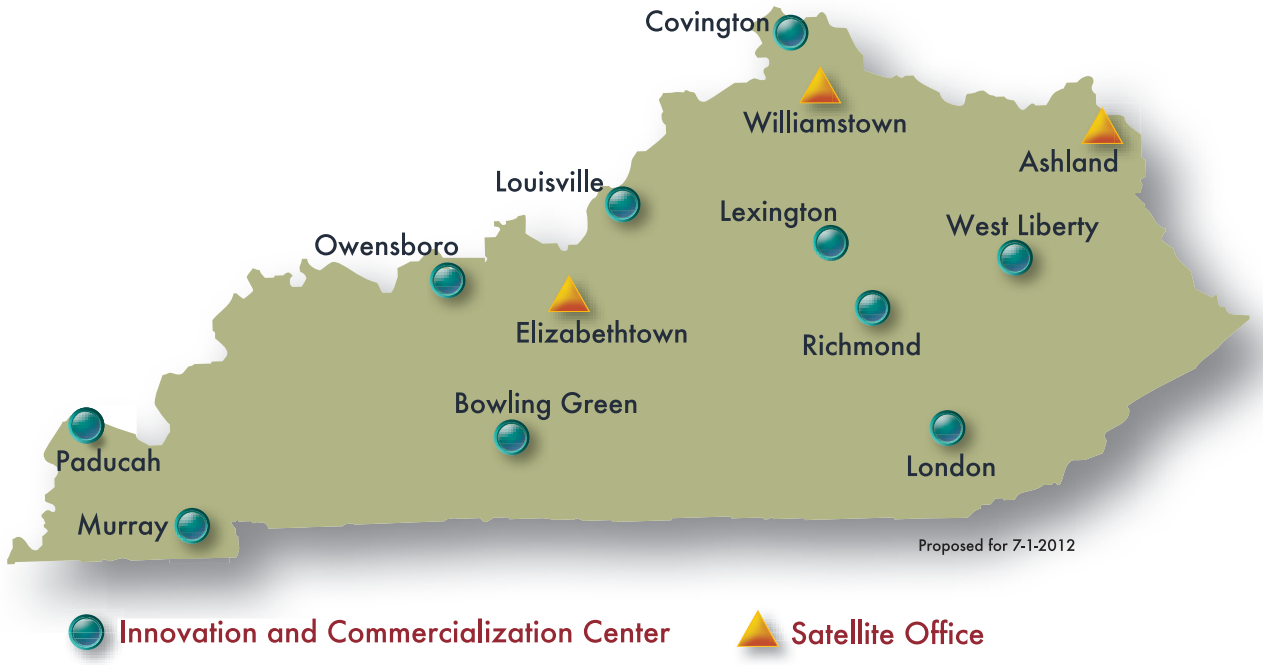
The Lane Report's Research Kentucky is a special advertising publication published by Lane Communications Group. *Research Kentucky* is published digitally at **lanereport.com**.

Publisher/Executive Editor	Ed Lane
Associate Publisher	Richard Kelly
	Donna Hodsdon
Creative Director	Dianne Alarie
Design & Production	Stone Advisory
Printing	Publisher's Press
Pre-Press	Publisher's Press
Circulation Manager	Alma Kajtazovic

The Lane Report
lanereport.com
Kentucky Business News Online

(859) 244-3500 | 201 East Main Street | Lexington, Kentucky 40507

KENTUCKY CABINET FOR ECONOMIC DEVELOPMENT



Statewide Resources to Help Entrepreneurs Start or Expand a Business in Kentucky

A wide range of public funding and business support programs help Kentucky create and grow high-tech ventures each year. From pre-seed, seed and commercialization funds, to tax incentives and other programs, Kentucky has the resources and infrastructure in place to help innovators and entrepreneurs succeed at every stage of growth.

A statewide network of **Innovation and Commercialization Centers** (see map) offers entrepreneurs advice and help in starting a company and finding funding. State funding is available to qualifying Kentucky-based companies (and those willing to move to Kentucky).

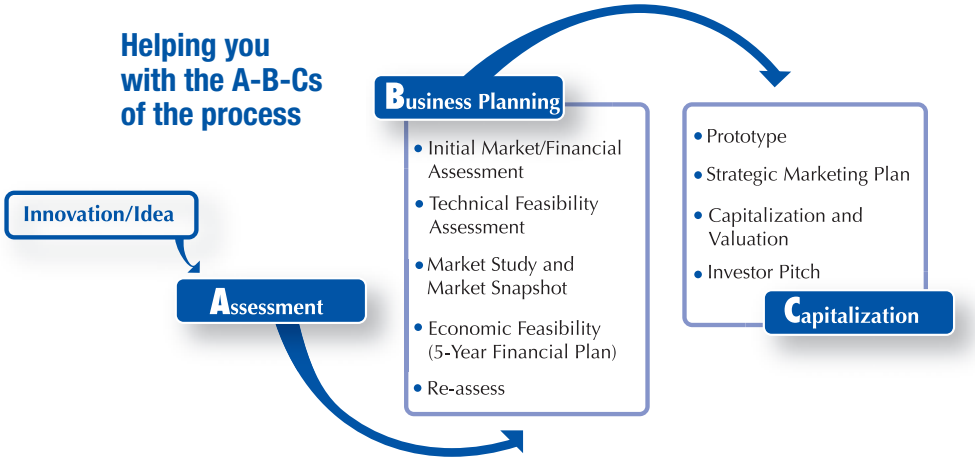
Since 2001, the **Cabinet for Economic Development**, through its Office of Commercialization and Innovation, has invested in high-tech companies, initiatives and projects that have created thousands of high-paying, high-tech jobs statewide. For details, visit **ThinkKentucky.com**.

Get Started

Step 1
Visit StartupKentucky.com

Step 2
Call your nearest Innovation and Commercialization Center

Kentucky's statewide network of **Innovation and Commercialization Centers** can offer the expert advice you need to get your business off the ground. These offices help Kentucky's high-tech entrepreneurs, scientists and engineers perfect their business strategies in order to build successful high-tech companies. In fiscal 2011, the program helped clients to raise over $96 million in private investments and form 147 new technology-based companies.



KENTUCKY CABINET FOR ECONOMIC DEVELOPMENT

"Without the support of the Lexington Innovation and Commercialization Center, we would have had difficulty raising the initial capital needed to get started."

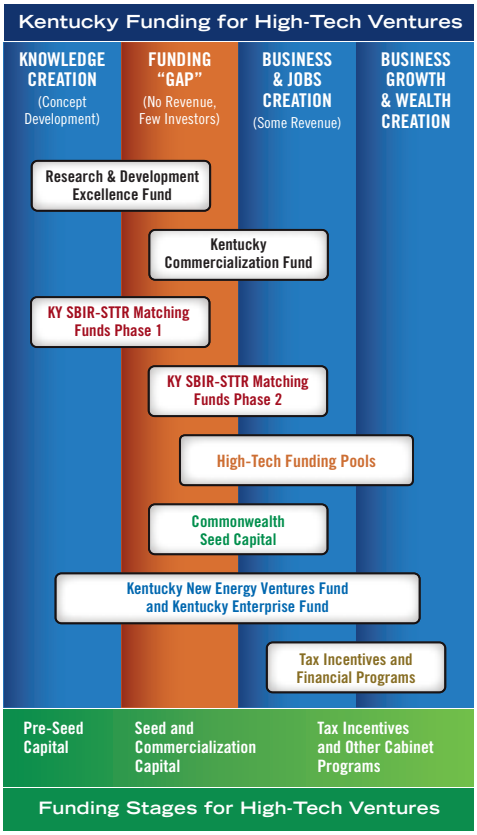
– Matt Bellis, CEO, Seikowave

At no charge, your nearest ICC can help you:

- Evaluate the market for your idea or product
- Develop a strategic plan for your business
- Produce and test a prototype
- Apply for public funding
- Find private investment
- Provide business management training and much more!

Public Funding and Business Support Programs

Kentucky offers a variety of progressive tax incentives and financial programs for companies in high-tech fields and traditional industries. You can also benefit from an array of credits and grants to help train employees, upgrade existing facilities and equipment, and make other improvements to stay competitive.



SBIR-STTR Matching Funds: Kentucky's Small Business Innovation Research and Small Business Technology Transfer Matching Funds program matches both Phase 1 and Phase 2 federal awards.

Kentucky New Energy Ventures Fund: This fund helps Kentucky companies undertake research, development and commercialization in the fields of alternative fuels and renewable energy.

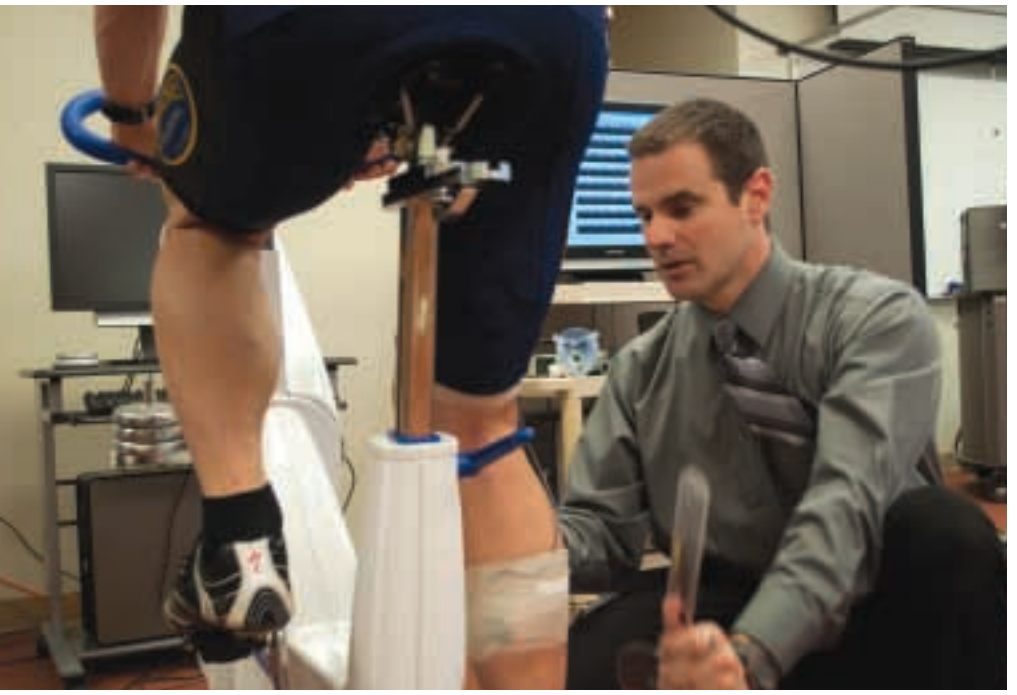
High-Tech Pool Funds: Funds are awarded to firms with technologies that are already progressing well in the commercialization process.

Commonwealth Seed Capital Fund: CSC is an independent, non-profit fund that helps create high-tech jobs by investing seed capital in promising high-tech companies. The fund also invests in venture capital funds that actively invest in Kentucky's high-tech companies.

"Our software firm moved to Kentucky from Utah to receive matching funds for our federal SBIR and STTR awards."

– Patrick Hu, CEO, Advanced Dynamics

For more information on funding and other programs, visit ThinkKentucky.com.



A steady stream of cyclists passes through Will Peveler's NKU lab for performance assessments that allow Dr. Peveler to build a database for his research.

Performance Research Is in High Gear

NKU professor is well known in cycling circles for applying science to exercise

In a high-tech laboratory on the Northern Kentucky University campus, Dr. **Will Peveler** conducts research that benefits both elite athletes and recreational riders in the sport of cycling.

Peveler recently studied the optimal position that a rider should assume on a bike relative to the seat height. His research revealed that a cyclist's knee should be bent at a 25 degree angle when it is at the bottom of its pedal stroke. Any variance in that angle results in more work, more injuries or both.

"We look for that optimum angle so that we can increase performance and for injury reduction," said Peveler, an assistant professor of exercise science at NKU since 2009.

The results of Peveler's latest research will be published in a paper entitled, "Alterations to knee angle during the pedal cycle." Two NKU undergraduate students, **Samantha Johnson** and **Brandy Shew**, will be listed as second authors on the paper because they helped with the project.

Peveler, who has a Ph.D. in human performance, exercise physiology from the University of Alabama, is well known in cycling circles for applying science to exercise.

His lab at NKU has enabled him to accelerate his research. He employs an array of stationary bikes beside machines on which road bikes are mounted. Nearby, two- and three-dimensional imaging equipment and biomonitors work to precisely measure metabolic activity and the efficiency of each test subject's performance.

"I really like NKU," he said. "I get the same support I would have had at a larger university, as nice a lab as I had at the University of Alabama. I think I've found a home."

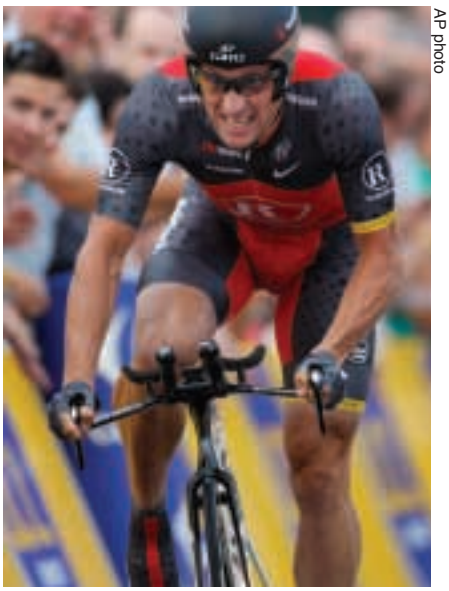
Results of his research have been published extensively in scholarly venues, including *Journal of Strength and Conditioning Research*, *Journal of Exercise Physiology*, *Journal of Sports Medicine and Physical Fitness*, and *Medicine and Science in Sports and Exercise*.

He has also shared his findings with cycling enthusiasts by contributing articles to *Men's Health*, *Women's Health* and *Cycling Plus* magazines as well as **livestrong.com**, Lance Armstrong's fitness and health website.

Peveler has even written a book on the sport, "*The Complete Book of Road Cycling and Racing*," a cover-all guide to training principles, physiological and biomechanical principles of biking, nutritional advice and injury prevention for beginning and intermediate bikers.

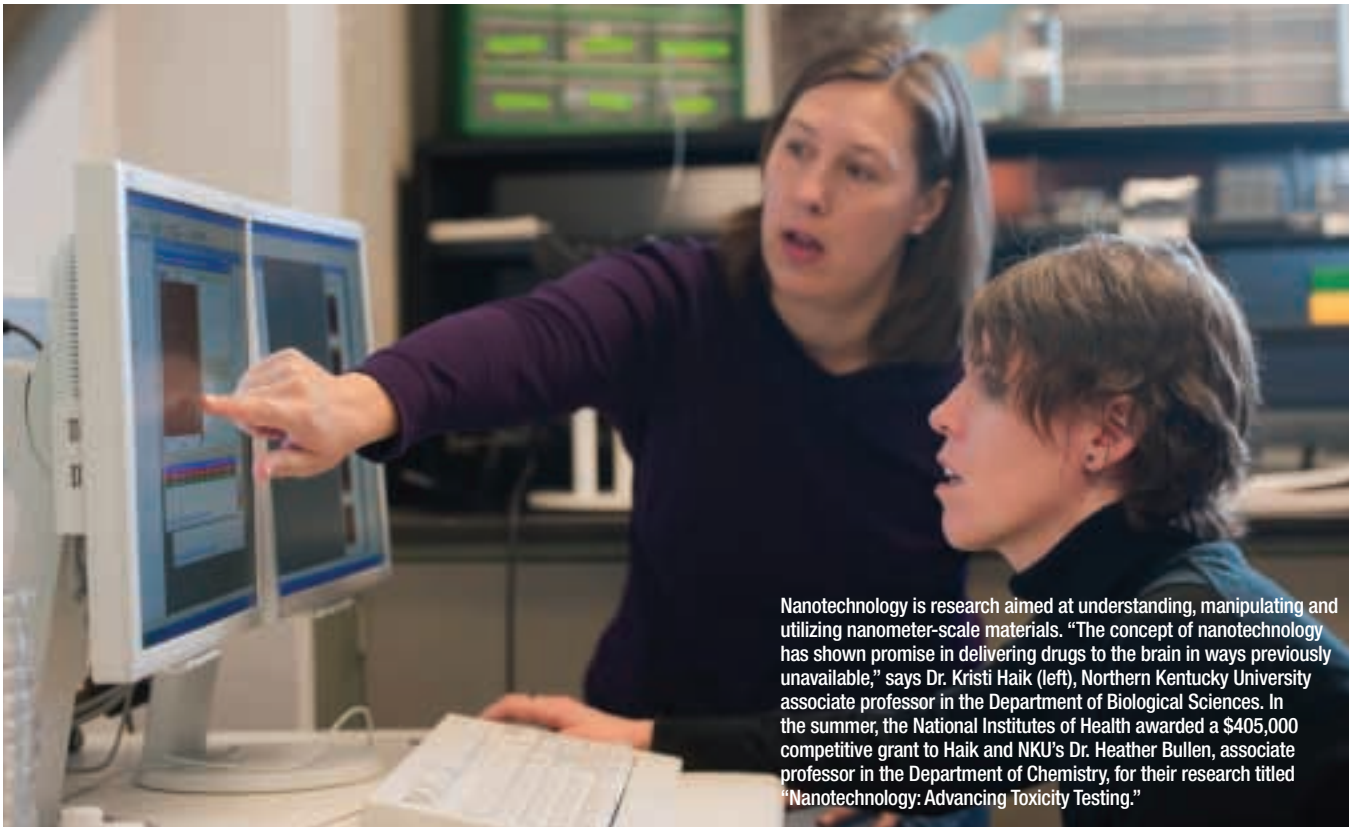
Dr. **William J. Kraemer**, editor of the *Journal of Strength and Conditioning Research*, said Peveler's multiple contributions to the journal have fit well with his publication's mission.

"Dr. Peveler's research in the sport of cycling has made many important contributions to several dimensions of the sport," Kraemer said. "(The Journal's) mission is directed toward bridging the gap between laboratory practice and practical applications for the coach and athlete. Dr. Peveler's work has helped to advance the sport science of cycling from the recreational athlete to the advanced competitor."



AP photo

Seven-time Tour de France winner Lance Armstrong is captured during the Tour's prologue last summer. Dr. Peveler blogs on cycling, health and nutrition for Armstrong's Livestrong website, livestrong.com.



Timothy D. Sofranko/NKU photo

Nanotechnology is research aimed at understanding, manipulating and utilizing nanometer-scale materials. "The concept of nanotechnology has shown promise in delivering drugs to the brain in ways previously unavailable," says Dr. Kristi Haik (left), Northern Kentucky University associate professor in the Department of Biological Sciences. In the summer, the National Institutes of Health awarded a $405,000 competitive grant to Haik and NKU's Dr. Heather Bullen, associate professor in the Department of Chemistry, for their research titled "Nanotechnology: Advancing Toxicity Testing."

NKU Prof Uses Undergrad Students to Lead the Way in Brain Research

MORE than a billion people across the world who suffer with brain diseases, disorders or injuries must receive medicine that is injected directly into the brain.

According to Dr. **Kristi Haik**, Northern Kentucky University associate professor in the Department of Biological Sciences, that is why nanotechnology is critical. Nanotechnology is research aimed at understanding, manipulating and utilizing nanometer-scale materials. "The concept of nanotechnology has shown promise in delivering drugs to the brain in ways previously unavailable," Haik says. "It is vital to investigate potential toxicity issues that may arise from overexposure to nanoparticles."

She says the protective properties of the blood brain barrier (BBB) make therapeutic treatment of various brain injuries and diseases very difficult. Nanoparticles are appealing for drug delivery as they can be designed to allow drugs to pass through the BBB, with the potential for specific targeting and controlled release of the drug.

Last summer, the National Institutes of Health awarded a $405,000 competitive grant to Dr. Haik and NKU associate chemistry professor Dr. **Heather Bullen** for their research titled "Nanotechnology: Advancing Toxicity Testing."

Bullen emphasized the interdisciplinary nature of the work being done at NKU. "This three-year grant award enables our research team to pursue a concept that spans biology and chemistry disciplines," she says. "Undergraduates will work with us to develop a standardized procedure to assess the potential toxicity of promising nano-drug delivery vehicles. They will also have the opportunity to present their findings at national and international scientific meetings. This is a great hands-on opportunity to prepare our future researchers."

Many of NKU's students come to the university because of the undergraduate research opportunities.

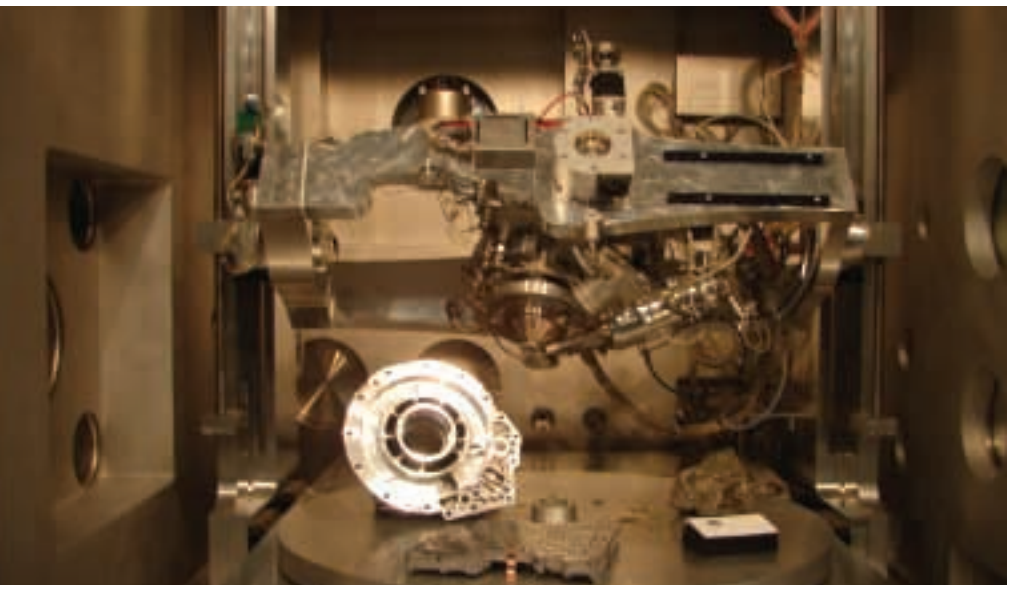
"We recently have had two research articles published in the *International Journal of Analytical Chemistry* and the *Journal of Biomaterials and Nanobiotechnology* on our previous work evaluating nanoparticles that has helped set the foundation for our current studies funded by NIH," Dr. Haik says. "All of the research that we have done and plan to do involves undergraduate student researchers who are co-authors on our papers and presentations."

Dr. Bullen says they have made significant progress in evaluating the toxicity of nanoparticles that have shown promise in treating brain tumors.

"Using our interdisciplinary approach we are creating a toxicity screening panel for these nanoparticles that could be applied to any nanoparticle of interest," she says. "Our students have already obtained some exciting results and will be attending an international conference this spring to share their findings on the effect of nanoparticle surface coating on toxicity."

At NKU, it's not only the professors who make a difference. Here, they take their students along for the ride.

WESTERN KENTUCKY UNIVERSITY



Large Chamber Scanning Microscope at Western Kentucky University's Nova Center in Bowling Green, KY.

Not the Microscope You Grew Up With

WESTERN Kentucky University officially opened the **NOVA Center** featuring the **Large Chamber Scanning Electron Microscope** (LC-SEM) on October 18, 2011.

The Large Chamber-SEM is virtually a one-of-a-kind instrument in the United States; the only other similar equipment in the United States is at Tinker Air Force Base in Oklahoma City. The LC-SEM uses electrons instead of light which will help to develop new areas of study in many areas including the medical and physical science community.

Materials and advanced manufacturing will be significantly impacted as a result of the Center's founding and will be a national focal point for nondestructive measurements. The LC-SEM can perform scientific, microscopic analysis of extremely large samples (up to 1500 mm in diameter and 650 lbs.), allowing for investigation of components without destroying them.

Because of its size "interrupted monitoring" can be performed on a variety of samples. Interrupted monitoring" allows a part to be in service for a period of time followed by an investigation in the LC-SEM, and returning the part to service after the investigation is completed. The ability to monitor a part in this way allows a more detailed understanding of fundamental physics of wear and failure of a part.

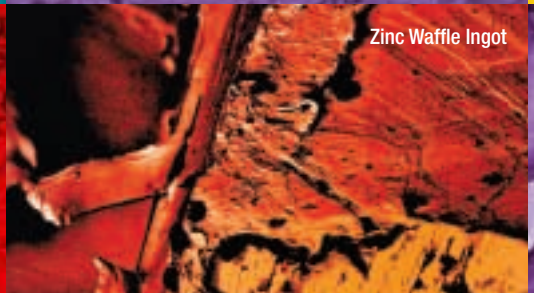
Non-destructive examination of a sample can be viewed not only at high resolution but with great accuracy. High resolution and accuracy guarantee a very detailed understanding of the failure mechanisms of a material or component. It may be used to simplify the development of new products or new processes.

Projects have also been initiated between the **Spallation Neutron Source** at **Oak Ridge National Laboratory**, **Corvette Assembly Plant**, **National Corvette Museum**, and the **University at Tennessee-Knoxville** to examine samples for which study has not been possible due to size and weight restrictions with conventional scanning electron microscopes.

The LC-SEM is a perfect research tool that meets the needs of the government, industry, and institutions of higher learning.

As the science capabilities are being developed and new regional and national partnerships are formed, the WKU NOVA Center will generate a knowledge base center and have an open collaboration with the materials science community.

Sample Analyses from Large Chamber Scanning Electron Microscope



WESTERN KENTUCKY UNIVERSITY

What is the Price Tag for Safety? Not as Much as You Might Think.

Software for security scanners provides a fast, accurate and objective analysis

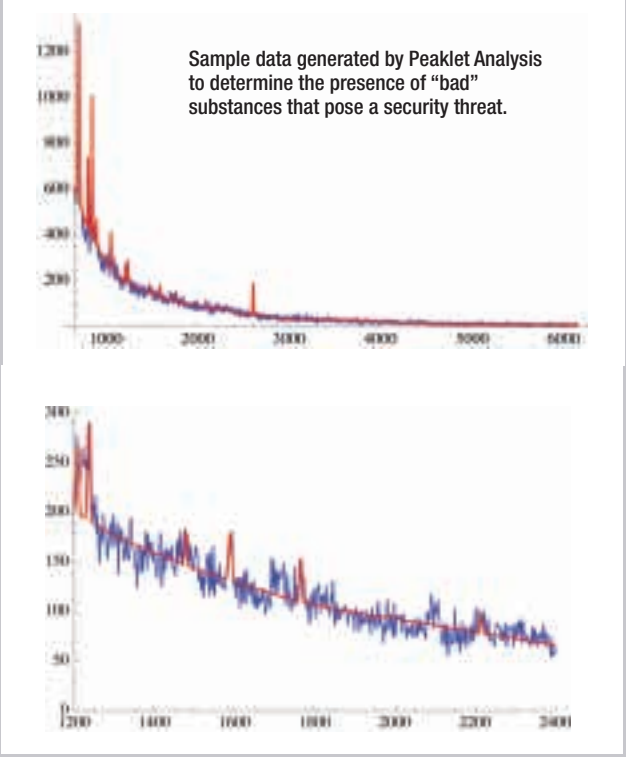
SECURITY is an ever-present and necessary part of the world in which we live. We have paid too high a price in the past when we let our guard down. However, while we want to be safe, we also want not to be inconvenienced by this need for security.

Luckily, science provides us with the means of detecting illicit compounds and items without the need for opening every bag, cargo pallet, etc. Nearly all of these techniques involve finding data values that would indicate the presence of a "bad" substance, like explosives or drugs, through a fog of data values from things that are not a threat, like clothes, shaving cream, etc. Graphically, each of these things generate "peaks", and a trained analyst has to determine if there are "bad" peaks mixed in with the "okay" peaks.

Human error is the weakest link in this security step. In a very cluttered environment, the "bad" peaks can be very difficult to see, even for the well-trained analyst. And with a constant flow of new data needing interpretation every few seconds, even the most dedicated analyst is bound to miss important information that could be crucial to the safety and well-being of the people they are trying to protect.

Dr. **Bruce Kessler**, a WKU mathematics professor, has developed a software package called **Peaklet Analysis** that can interpret these types of data sets and determine the presence of "bad" substances that could pose a threat. The software uses a relatively new mathematical tool called wavelets to see through the noisiness of data and identify the "bad" peaks. The analysis provided by the software is conducted quickly and objectively, and the computer never blinks or gets tired.

Peaklet Analysis has been developed in partnership with **HitCents, Inc.**, and can be integrated into any computer environment. For more information, go to **peakletanalysis.com**.



Sample data generated by Peaklet Analysis to determine the presence of "bad" substances that pose a security threat.

Reliable Weather and Climate Data Serves Diverse Needs

Kentucky's Environmental Monitoring Network: The Kentucky Mesonet

WEATHER and climate play a fundamental role in shaping society. Kentucky's climate is a valuable natural resource that helps to sustain the economy and contributes to quality of life. Day-to-day weather, including fluctuations in temperature and the occurrence of storms, affects business and public safety. Because weather conditions can change rapidly and vary dramatically, the availability of timely weather data is vital to decision makers.

Kentucky Mesonet automated environmental monitoring station.

The **Kentucky Mesonet** is a high-quality network of automated environmental monitoring stations. Measurements of air temperature, precipitation, relative humidity, solar radiation, and wind speed and direction are packaged every five minutes and made available in near real time (**kymesonet.org**). As part of a cyberinfrastructure based at WKU, the Kentucky Mesonet supports research initiatives in meteorology and climatology and serves diverse needs across business and government sectors. Access to accurate, reliable environmental data is vital to decision makers.

The following gives additional detail about the role the Mesonet can play in various segments of the economy.

Agriculture: Crops and livestock remain at the foundation of agriculture. Data from the Mesonet information can be used to support precision agriculture.

Education: The Kentucky Mesonet can be a bridge for students between scientific research and education. Access to current Mesonet data in the classroom can assist students in learning about the weather and climate where they live.

Emergency Management: Effective emergency management depends upon having accurate and timely data in advance, during, and after a disaster strikes. The Kentucky Mesonet can aid mitigation, response, and impact assessment efforts.

Energy: Weather drives daily variations in energy demand and consumption and affects the efficiency of energy transmission grids. Access to hourly and daily weather summaries can help energy producers, distributors, and consumers to increase efficiency.

Manufacturing: Industries are subject to water and waste regulations requiring efforts to mitigate the risk of storm water pollution. Data can be used to estimate storm water run-off and provide information to assist with environmental permit requirements.

Transportation: Inclement weather increases the risk of accidents and traffic disruptions. Data from the Kentucky Mesonet can be used to improve the safety and increase the efficiency of our transportation systems.

MOREHEAD STATE UNIVERSITY

Space Science Center at Morehead State University: An Emerging Hub for Nanosatellite Technologies

THE **Space Science Center at Morehead State University** is emerging as an important center for research in nanosatellite technologies. Talented faculty and staff from Stanford University, the University of California system, the East Coast aerospace industry, and local homegrown Kentucky scientists and engineers have gathered in the hills of Eastern Kentucky to establish a research and development center for small satellite technologies. The Center's facility is a $16 million, 45,000-s.f. building with state-of-the art laboratories that include an electromagnetic anechoic chamber (that mimics the space environment), a space systems development laboratory, a class 10,000/1,000 clean room for spacecraft assembly and integration, a spacecraft verification laboratory, and an astrophysics lab.

The centerpiece instrument is a 21-meter class antenna system (21-M) that is engaged in a rigorous research program in radio astronomy and also serves as an earth station for satellite mission support as well as a test bed for advanced satellites communications systems. The 21-M is used to provide ground operations support—controlling satellite missions for **Kentucky Space, NASA**, **Johns Hopkins Applied Physics Laboratories** and other university and commercial partners. The center also manages a digital star theater for education and public outreach that runs full 360 degrees, immersive features and planetarium shows for pre-college students and the public. Over 12,000 visitors attend shows annually.

Morehead State University Space Science Center

Hastings & Chivetta Architects, Inc./Fentress Photography

Entrance to the Space Science Center at Morehead State University—a World-class R&D Center for Emerging Nanosatellite Technologies.

Morehead State University Space Science Center 21 Meter Space Tracking Antenna used for Nanosatellite Ground Operations and Research in Radio Astronomy

The center's staff, led by Dr. **Ben Malphrus,** includes **Bob Twiggs**, the inventor of the **CubeSat** satellite standard. CubeSats are "loaf of bread" or smaller-sized nanosatellites that have become the defacto world-wide standard for small satellite technologies. CubeSats are 10 x 10 x 10 cm (or by 20 or 30 cm in length) satellites that weigh under 1 kg per unit. The recent evolution of micro/nanotechnologies and microelectronics has facilitated the development of these inexpensive ($100,000 to $1 million) highly capable small satellites that are now being flown by NASA, the U.S. Department of Defense, aerospace companies and universities around the globe.

CubeSats, including those developed at Morehead, are used for a wide variety of applications ranging from tactical defense to scientific research (including astrophysics research and Earth phenomena and resource monitoring) to practical applications ranging from communications to relaying data from ground sensors. CubeSats are considered "disruptive technology" by the world-wide aerospace industry because they can provide some of the same services as conventional satellites at a fraction of the cost and with short development

MOREHEAD STATE UNIVERSITY

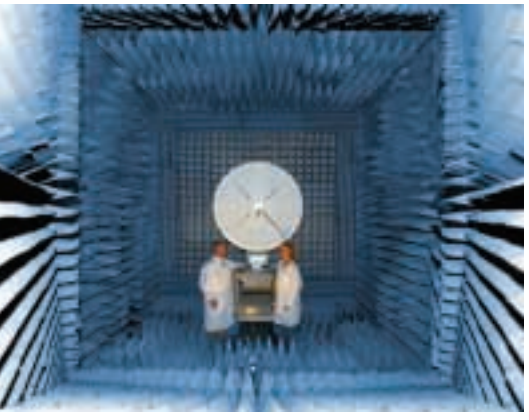
Assembly of the Cosmic X-Ray Background Nanosatellite in the Morehead State University Clean Room

times—and Morehead State University and Kentucky Space are at the forefront of this emerging technology.

The Kentucky Space program began to develop CubeSats in 2006 and successfully achieved a sub-orbital insertion of a spacecraft into space with Frontier 1 in 2010. Kentucky Space later developed KySat-1 the first orbital satellite ever built by a state—with UK and Morehead taking the lead. Although the launch vehicle failed to place KySat-1 and NASA's other payloads into orbit in March 2011, it represented Kentucky's first venture in orbiting satellites.

Since then, MSU has developed a series of nanosatellites including EduSat with the **University of Rome** that was launched from Russia on a Dnepr rocket in August 2011, TechSat-1, a tech-demo satellite for the **U.S. Space and Missile Defense Command** with commercial partners including **Radiance Technologies** and **Honeywell International**, and the Cosmic X-Ray Background Nanosatellite (CXBN). The goal of CXBN, MSU's flagship nanosat, is to significantly increase the precision of measurements of the Cosmic X-Ray Background thereby constraining models that attempt to explain the relative contribution of proposed sources lending insight into the underlying physics of the early universe.

All of the satellite systems were designed, built, tested and validated in the Morehead State Space Science Center, primarily by undergraduate students, with the exception of the X-ray detector payload which was designed by partners at the **University of California Berkeley** and built by **Black Forest Engineering** in Colorado. CXBN was selected by NASA for a flight opportunity and will be launched from **Vandenberg Air Force Base** in August 2012. CXBN is significant in that it has the potential to solve a major mystery that remains in Big Bang cosmology. Built in Morehead, largely by undergraduate students, with a launch planned from Vandenberg AFB on a major NASA space mission and operated from Morehead, CXBN represents a major milestone for the Space Science Center, Kentucky Space, and for the emerging cottage aerospace industry in Kentucky.



Space Science Center Electromagnetic Anechoic Chamber is used to test satellite systems and Earth station antennas and feeds supporting the Morehead State University Nanosatellite program

Complementing the R&D in nanosatellite technologies, the staff of the Space Science Center also focuses on fundamental research in astrophysics. Using the 21-M dish and orbiting space telescopes, they pursue research investigating the underlying physics of supernova remnants (SNRs), active galactic nuclei (AGNs) and transient phenomena like gamma ray bursts (GRBs). Led by senior research astronomer, Dr. **Tom Pannuti**, research activities have centered on studies of X-ray emission from Galactic supernova remnants like CTB 1, a supernova remnant within which the group discovered an X-ray neutron star—the remains of the progenitor star that produced the supernova explosion some 10,000 years ago. This research lends insight into the fundamental physics of stellar evolution.

In addition, to the R&D efforts, the Center offers unique degree programs, a B.S. in Space Science (an engineering technology program that trains students for careers in space technologies and applications), and a B.S. in Astrophysics. The main goal of the Space Science degree program is the production of graduates who have developed basic competencies and real-life experience in space systems engineering. The program places emphasis on astronautics, emphasizing satellite design and development—particularly in the areas of satellite systems and on ground station operations and related ground station technologies. The B.S. in Space Science is one of only five such undergraduate programs in the U.S.

ALLTECH

Could Algae Feed the World?

Alltech's Winchester facility is researching the potential of aquatic plants to yield as much protein per acre as 49 acres of corn

Alltech Algae is located in Winchester, Kentucky and is one of the largest algae production facilities in the world.

Alltech's quality laboratory ensures that all Alltech products are safe for the animal, consumer and the environment.

About Alltech, Inc.

Founded by Dr. **Pearse Lyons**, Alltech is a global animal health and nutrition company with more than 31 years' experience in developing natural products that are scientifically proven to enhance animal health and performance. Alltech has an extensive history with yeast fermentation, the basis of these products. With more than 2,650 employees in 128 countries, the company has developed a strong regional presence in Europe, North America, Latin America, the Middle-East, Africa and Asia and plans to seek new opportunities created from the fermentation of algae and its components.

Algae Are the Base of the Food Chain

An example of an Alltech Algae research fermentor in the pilot plant used for the development of new processes.

ALGAE are a diverse group of organisms that comprise the world's fastest growing plant. This growth can take place two different ways. Algae can grow autotrophically by taking in carbon dioxide from their environment, undergoing photosynthesis and then releasing oxygen. The second method of growth would be heterotrophic by taking in organic carbon, utilizing oxygen and releasing carbon dioxide.

Algae also form the base of the aquatic food chain. There are an estimated 800,000 species of algae that range from single-celled microorganisms to multi-celled organisms, such as the 200-foot long giant kelp.

Algae produce carbohydrates, oils, protein, vitamins, pigments and organic minerals. Algae can be utilized as whole-cell products or the cells can be broken down in order to differentiate the specific components. The method by which they are grown and the variety of algae will determine what is produced.

Being aquatic, algae grow much faster than land plants as they do not have to expend energy growing roots and support structures like trunks, leaves and stems. Without the need for support structures, algae can triple or quadruple their biomass every day. This rapid growth means that one acre of algae can produce the same amount of protein in a year as 21 acres of soybeans or 49 acres of corn.

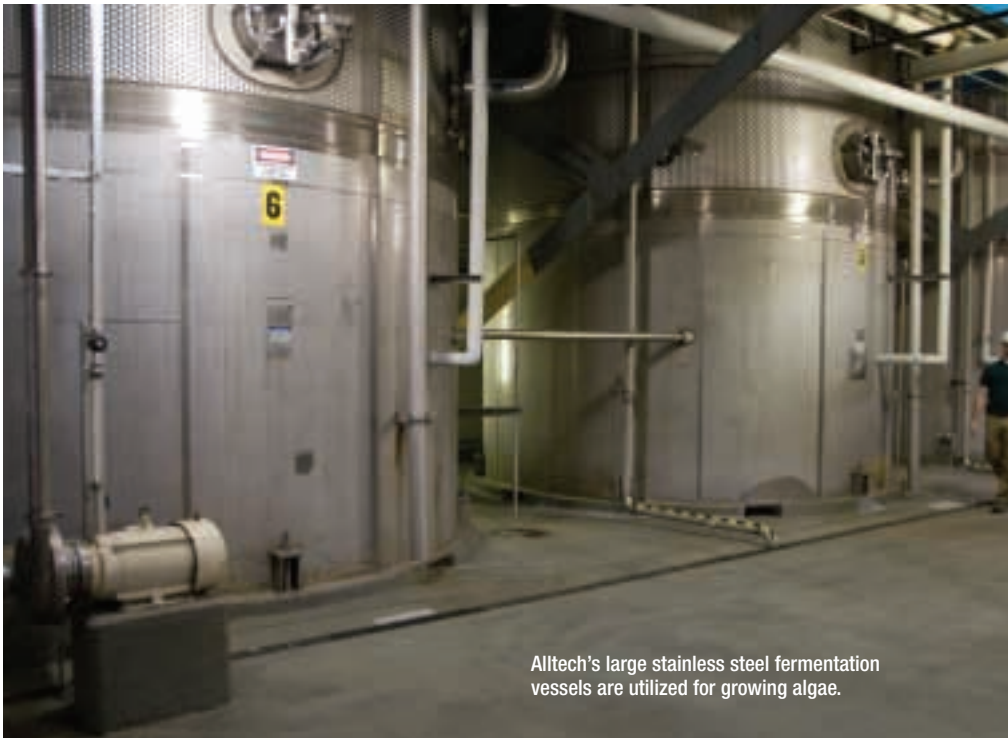
Algae's biodiversity means that they have many potential uses. Algae are used in food, animal feed, aquaculture feed, cosmetics, pharmaceuticals, and bio-fuels.

Growing Algae in Winchester, Kentucky

ALLTECH Algae in Winchester, Kentucky, is one of the largest heterotrophic algae production facilities in the world. It houses a variety of sizes and types of fermentors for growing algae.

Algae production starts with a single ounce of specific algae that rapidly matures and progresses to an eight-story tall production fermentation tank in a few days. These tanks are fully automated and can be monitored and managed from a central control room. When the algae are fully grown and have produced the final product, they undergo a two step phase to remove water. When the process is complete, a flour-like algae powder remains which can be utilized in a wide range of Alltech products.

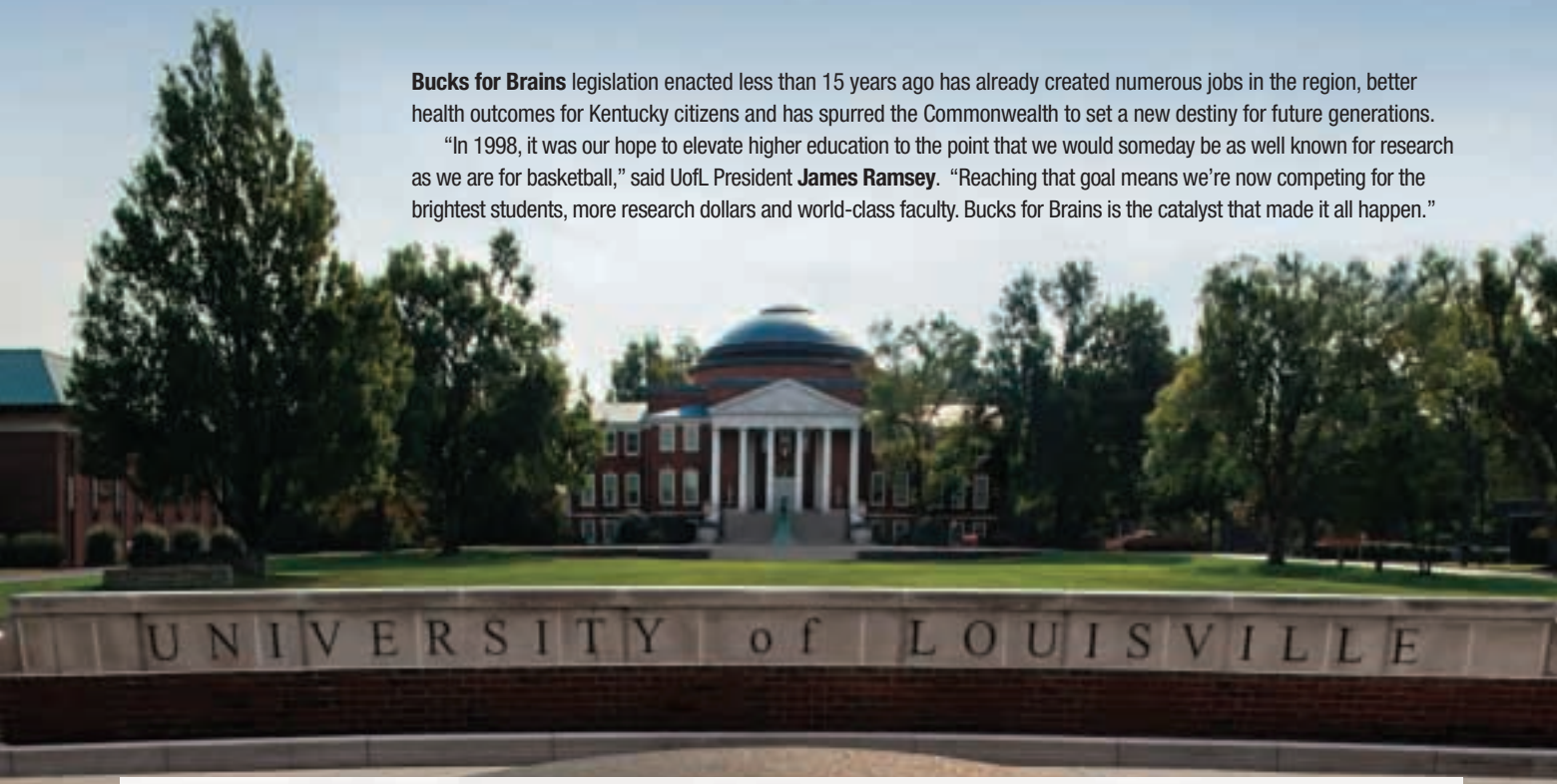
Alltech Algae is an impressive production facility but its value as a research facility may be even more important. It is equipped with a fully functional pilot plant, which is a scaled-down replica of the large production system. This system allows research and quality teams to experiment with new strains and production methods before rolling them out for commercial production.



Alltech's large stainless steel fermentation vessels are utilized for growing algae.

The potential for products from algae is as diverse as the algae strains themselves. With so much to offer, algae have the potential to be a game changer in the areas of animal feed, aquaculture, and bio-fuel.

A Beacon in Higher Education



Bucks for Brains legislation enacted less than 15 years ago has already created numerous jobs in the region, better health outcomes for Kentucky citizens and has spurred the Commonwealth to set a new destiny for future generations.

"In 1998, it was our hope to elevate higher education to the point that we would someday be as well known for research as we are for basketball," said UofL President **James Ramsey**. "Reaching that goal means we're now competing for the brightest students, more research dollars and world-class faculty. Bucks for Brains is the catalyst that made it all happen."

Kentucky's Bucks for Brains endowment match program recently won national recognition as one of six models for states and regions to follow to grow their economies and create high-paying jobs through investments in science, technology and innovation.

Charting UofL's Course with Bucks for Brains

As good stewards of the hard-earned tax dollars of their constituents, the **Kentucky General Assembly** likes to see a demonstrated return-on-investment before supporting new initiatives. That's why in 1997, when the Patton Administration took on the overhaul of higher education through its support of HB 1, we recognized our legislators would need a demonstration of absolute commitment and almost-immediate results for the program we called **Bucks for Brains (B4B)**.

Gov. **Paul Patton** knew the cost of doing nothing about the state of higher education was not acceptable and he tied his legacy to B4B's success. His team, which I was so fortunate to lead on this initiative, shared that vision. And legislators from both sides of the aisle joined in our determination to create a stronger economy through a focus on education.

The consequences and impact of B4B have been far reaching. Economic development is advanced at UofL, and across the region, through enhanced research dollars, the multiplier effect of research-related investment and the commercialization of translational research. More important, the quality of life for Kentuckians is improving because of the strides we're making in research that spans bioengineering, business and medicine.

Since B4B was enacted, Louisville has become home to world-class thinkers who are tops in their fields. The work they do at UofL, in very human terms, is creating a cleaner Kentucky, region and world; developing and launching businesses that foster creative, well-paid employees; and unlocking the keys to treating and curing cancer, heart disease and paralysis.

The **Endowment Match Program**, part of the **Research Challenge Trust Fund** included in B4B, encourages private investment in public higher education research activities to stimulate business development, generate increases in externally sponsored research, create better jobs and a higher standard of living, and facilitate Kentucky's transition to a knowledge economy. It hasn't fallen short of those goals, and has been instrumental in attracting senior faculty with significant records of externally funded research agendas.

As an investment, B4B has paid for itself many times over as well: Our endowed chairs and professorships with the federal research grants they obtain and associated development expenditures, have created hundreds of millions of dollars that can be tied back directly to B4B.

I'm proud to say that UofL has accomplished—and continues to achieve—the mandate set for it by the General Assembly: becoming a premier metropolitan research university. And I'm eager for you to read about just a few of the exceptional milestones our professors and researchers have reached in a very short time. We are setting our course for a future of promise at UofL and B4B is helping us create a better Kentucky and a better world in the process.**—James R. Ramsey, President**


James R. Ramsey, President

Van H.G. Clouse (left) co-founded UofL's business plan competition program and started the College of Business's New Venture Competition. The VLIC prize included cash, national advertising and consulting services—and ringing the opening bell at the NASDAQ OMX Stock Market on June 3.

MBA Students Create 'Cash Cows'

JENNY Corbin grew up in **4-H**, majored in equine and works in pharma, giving her a strong background in the world of agriculture. **Larry Horn**, **Terry Tate**, **Cory Long** and **Max Brudner**—her fellow students at the **College of Business's Forcht Center for Entrepreneurship**—are what Jenny terms "city boys." But **Van G.H. Clouse**, Ph.D., director of the Forcht Center and Cobb Family Professor of Entrepreneurship, thought the group had complementary skills for MBA business plan competitions.

Clouse's instinct has paid off in big way: Corbin and her colleagues formed **TNG Pharmaceuticals** and created a business plan to market and distribute **FlyVax**, a new vaccine created to reduce the $1 billion in losses incurred annually due to livestock damage by parasitic horn flies. In the process, they earned the title "**Global Champions**" at **Global Venture Labs Investment Competition** (VLIC) at the University of Texas at Austin, winning $135,000 at this "Super Bowl of business plan competitions," judged by nationally recognized venture capitalists, entrepreneurs, angel investors and business leaders.

"The horn fly is considered the most health depleting and economically damaging pest of cattle," said Corbin, TNG's president and CEO. "FlyVax starves it by disabling the blood thinner that it injects into the cow. The end game is to reduce the number of horn flies per cow, leading to increased farmer efficiency, higher production and lower pesticide use."

The team has licensed the patented vaccine that was developed by Auburn University researchers who happen to be former Kentuckians. The plan to displace ear tags (the industry standard in battling the horn fly) will take place over the next two years as the team raises $1.8 million to get through the USDA regulatory process and ultimately market and distribute a product they say is cheaper and more effective.

And they're creating believers as they move from one competition to the next, having previously won top prizes at similar competitions at University of Cincinnati, University of Nebraska and Rice University, coached by Clouse and Executive-in-Residence **Suzanne Bergmeister**. TNG's total winnings now top $800,000.

Growing Tomorrow's Entrepreneurs

UNDER the leadership of Dr. Van Clouse, students in UofL's Entrepreneurship MBA program are ranked first in the nation with an exceptional business plan that has the potential to change the global face of agriculture. At home in Kentucky, the company they are founding will be among the first to occupy space—and create future jobs—at Nucleus Innovation Park, opening in 2012.

"It's an extraordinary achievement—a once-in-a-lifetime accomplishment," says Dr. Clouse. "TNG has a patented product that appears to solve a significant problem. They have a faster path-to-market than many other life science business plans. What these students have done is remarkable, for their futures, our program, this university and the agricultural community."

Forcht Center students have a history of exceptional performance at VLIC. In 2009, two UofL teams advanced to the competition's final four (finishing third and fourth) and last year two teams reached the top 20.

UNIVERSITY OF LOUISVILLE

‘Thrivals’ in the Business World

NAT Irvin, II, Ph.D., gets incredibly animated when he talks about the opportunity to have interdisciplinary experiences and conversations that include engineering, physics, medicine, literature, art and sociology. One of the newest additions to the **UofL College of Business** faculty, Irvin is founder and president of **Future Focus 2020**, a futurist think tank dedicated to examining the impact of upcoming, permanent changes in business, social and economic cultures. As the Strickler Executive-in-Residence and Professor of Management at the College of Business, Irvin is responsible for groundbreaking demographic research that identifies a new breed of forward-thinking, multilingual, globally tuned African-Americans he calls “thrivals.”

In this new paradigm, Irvin has identified the future of African-Americans who bring a “no limits” approach to engaging in the business world, making traditional stereotypes of black consumers obsolete. Advertisers and other media use Irvin’s findings to identify new demographic groups and target them with customized messages and opportunities.

At **IdeaFestival 2011** in September, Irvin launched “Thrivals 4.0: The Future of Learning,” a day-long event at the **Kentucky Center for the Arts**, which examined how the power of human creativity, imagination and innovation has overcome the limitations of socio-economics, geography and age to make learning more exciting, accessible and effective than ever.

Nat Irvin’s research about African-Americans in business is used by advertisers and other media when targeting specific demographics.

A Blueprint for Business Ideation

DR. Nat Irvin, a thought leader and futurist in the UofL College of Business, has taken his research from the classroom to the marketplace, serving as an innovation consultant to local and national businesses. In addition, he launched Thrivals 4.0 at IdeaFestival 2011, with a showcase of the trends, technologies and personalities that are positioning an entire culture to overcome socio-economic, geographic and age barriers to learning. Among the topics covered was the rate at which computer technology is approaching that of human intelligence.

“Advances in technology and the explosion of startups, particularly in e-commerce, have huge implications for the black community. I believe that blacks have a good chance of moving from survival mode to ‘thrival’ mode.”

According to Irvin, the new transformative thinking is being spurred by digital advancements that transcend race, geography and government, and will make churches, temples and other houses of worship forums for discussing the moral and ethical implications of technology.

Exploring Multiple Pathways

RECOGNIZING that no single strategy will by itself be effective in regenerating and repairing neurons and tissues in spinal cord injury (SCI) patients, **Scott R. Whittemore**, Ph.D., vice chairman for Research in the Department of Neurological Surgery, embraces an ultimate goal: to combine individual strategies that are effective to design new interventions that will result in functionally significant improvements after SCI.

As scientific director of the **Kentucky Spinal Cord Injury Research Center**, Whittemore studies molecular changes that damage or destroy key components of the nervous system that carry signals to and from the brain—including neurons, axons and the myelin coating that protects the nervous system much like the insulation around an electrical cord, as well as the vascular infrastructure that carries oxygen to these tissues.

Whittemore's teams at the **Molecular Neurobiology Laboratory** focus on replacing lost neurons and regenerating the myelin coating around damaged or regenerating axons. "Using various gene therapies and other modalities, our lab seeks to understand the development of these key components of the vascular and nervous system at cellular, molecular and genetic levels in order to protect them from damage and/or to promote their regeneration," he explains.

"We utilize a battery of behavioral and electrophysiological analyses to both characterize the initial deficits and determine the degree to which functional recovery is observed," says Whittemore. "Adult stem cell research is a critical component of our work because it shows great promise as a gateway toward offering a future when nerves in post-injury patients can be stimulated to permit movement in the nervous system where before there was none."

The Commonwealth of Kentucky has invested approximately $19.2 million in the Kentucky Spinal Cord Research Institute to support its mission to help people with spinal cord injuries regain movement. In return, researchers have garnered $68.8 million. Additionally, private gifts to match Bucks for Brains contributions total nearly $6 million in support of attracting high-quality faculty to the University of Louisville.

Spinal Cord Research Earns National Recognition

SUSAN J. Harkema, Ph.D., professor in UofL's Department of Neurological Surgery and rehabilitation research director at the Kentucky Spinal Cord Injury Research Center, with a team of colleagues from UofL, Frazier Rehab, CalTech and UCLA were recently honored for unprecedented research that has given a paralyzed patient the ability to stand, take steps with assistance and move his legs voluntarily.

This was achieved through continual direct epidural electrical stimulation of Rob Summers' lower spinal cord, mimicking signals the brain normally transmits to initiate movement. Once that signal is given, the spinal cord is able to direct the muscle and joint movements required to stand and step with assistance on a treadmill.

Popular Mechanics' seventh annual Breakthrough Awards, held Oct. 10 at a New York City gala, are given in two categories: innovators, whose inventions will make the world smarter, safer and more efficient in the years to come; and products, which are setting benchmarks in design and engineering today.

Susan Harkema, Ph.D., and her team achieved a medical breakthrough when spinal cord injury patient Rob Summers took his first steps.

UNIVERSITY OF LOUISVILLE

Don Miller, M.D., directs the James Graham Brown Cancer Center and is a respected oncology researcher who conducts ongoing investigations.

Reimagining Cures for Cancer

THIRTY years ago, a group of dedicated citizens recognized the need to offer cancer treatment services in Louisville so Kentuckians wouldn't have to travel extensive distances to receive state-of-the-art care. So began the **James Graham Brown Cancer Center**, where Director **Donald Miller,** M.D., leads the effort to eradicate cancers of all forms. In Miller's brief tenure, horizons have expanded and the Brown Cancer Center is offering hope to millions where once they had none. That hope has been fueled by unprecedented growth. Endowments in 1998 stood at $300,000 and now exceed more than $50 million. Just as important, the annual research funding for the Brown Cancer Center has grown from $500,000 in 1999 to approximately $25 million this year.

"We're racing the clock here. The research we undertake has to be clinically sound and move from the bench to the bedside as quickly as possible. We understand the imperative of helping Kentucky get off the lists we don't want to be 'first' in," says Miller, who is also a B4B scholar and researcher. "It's terrible to be first in the incidence of lung cancer and first in cancer deaths. Our mission is to create new, more effective approaches to prevention, diagnosis and therapy, while delivering compassionate care with tremendous respect to our patients."

30 Years of Accomplishments

Over the years, the James Graham Brown Cancer Center has celebrated major cancer research discoveries, including:

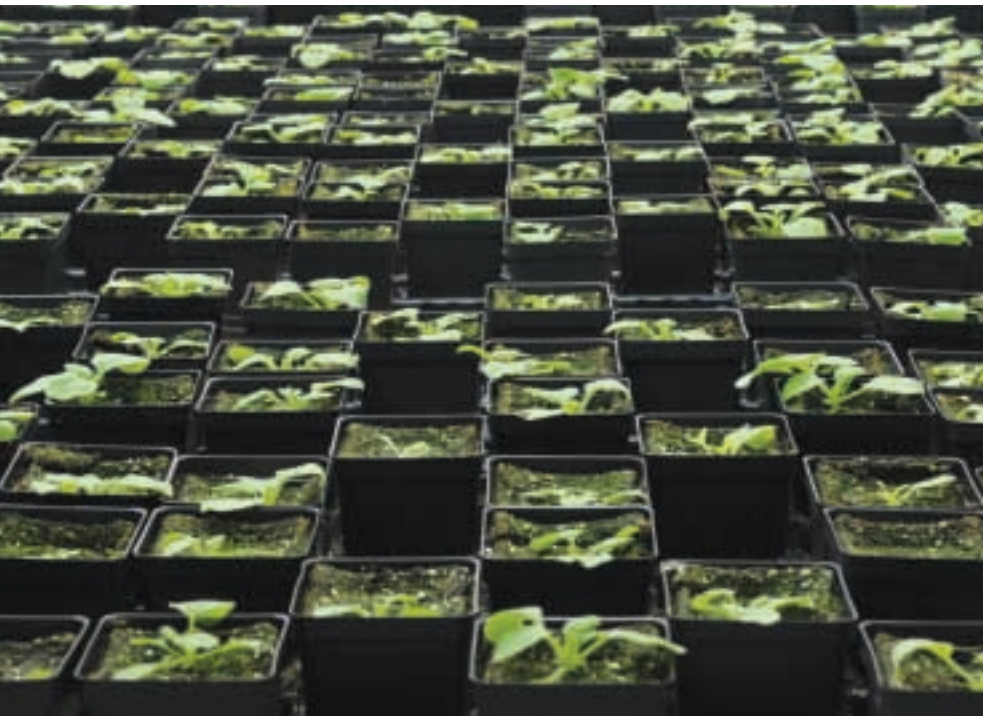
- 1st anti-cancer drugs that inhibit cancer cell metabolism (2012 clinical trials)
- 1st stem cell vaccine to prevent cancer
- World's largest nonprofit computer grid in Kentucky high schools, already used to discover more than 20 new anti-cancer drugs
- 1st clinical trial of cancer metabolism, following the fate of glucose at the atomic level
- 1st clinical testing of chemopreventive actions of colored berries
- 1st use of fruit extracts (exosomes) to deliver drugs to tumors
- 1st demonstration that depletion of regulatory T cells can induce tumor regressions in advanced cancer patients
- Discovery of a novel population of multipotent adult stem cells called Very Small Embryonic-Like (VSELs)
- Clinical trials of beta-glucans as immune-stimulants in combination with monoclonal antibodies

The Brown Cancer Center now has more than 200 investigators and physicians, backed by scores of research fellows, assistants and other clinicians with the singular focus of eliminating cancer and diminishing its burden on the people it affects.

"Clearly, we're not anywhere near where we want to be," he says. "But we are so far from where we started and we believe we have the people, the tools and are building knowledge to change the course."

NOW SHOWING: The Future of Cancer Research

AN outstanding new video explores the evolution of the James Graham Brown Cancer Center, from groundbreaking research to personal experiences of cancer survivors. Watch and learn the exciting and unconventional ways scientists are battling cancer. Explore the creation of vaccines from Kentucky's legendary tobacco crops. Marvel at harnessing raw energy to move drug research forward at light speed. Witness the transformation of our economy and lives at **chartingourcourse.org**.



Tobacco, the source of many of Kentucky's health problems, is now being grown to eradicate cervical cancer.

The Beautiful Irony

TOBACCO. If you see it growing as a crop along a highway, it's actually a beautiful plant. But until now it's been killing Kentucky. Associate Professor of Medicine **John O. Trent**, Ph.D., directs the Molecular Modeling Core Facility of the **James Graham Brown Cancer Center** where most of his research projects revolve around structure-based drug design. This involves a process of rationalization, prediction and design using molecular modeling. What he and others on the team are really doing is developing a low-cost, highly effective vaccine from the tobacco plant that will prevent HPV, the virus that causes cervical cancer, as well as other cancers.

More than 10,000 computers networked in Kentucky classrooms serve as Dr. John Trent's research lab.

Partnering with non-profit **Dataseam**, which has networked 10,000-plus computers in Kentucky classrooms, Trent harnesses one of the largest distributive computing resources of its kind in the world, speeding discovery of various structural data in molecular biology or biophysics.

"When not in use by high school students across the state, I'm able to leverage the power of the system and reduce the time to arrive at answers," says Trent. "It would take one computer 300 years to crunch some of our data; in this environment, I can move at light speed, taking only two or three days."

"Rather than costing hundreds of dollars for a vaccine, we see a day in the near future that will celebrate tobacco for its ability to cure rather than kill. It's hard to imagine that the plant that brought us the most illness may soon prevent one of the leading causes of death of women all over the world," says Dr. **Don Miller.**

'Switch and Quit'

THE Brown Cancer Center is not just waiting for cures and treatments. It is also attacking smoking head-on. **Brad Rodu**, D.D.S., is a Professor of Medicine and Endowed Chair of Tobacco Harm Reduction who recently launched a public health initiative in Owensboro to educate smokers about the option of using smokeless tobacco in their efforts to quit. More than 400 media outlets across the U.S. have carried the story about the "Switch and Quit" campaign.

Rodu's 20 years of research concludes that nicotine, although highly addictive, is not the major cause of any disease associated with smoking. And while no tobacco product is absolutely safe, the health risks of smokeless tobacco have been grossly exaggerated for more than 30 years. Additionally, the risk from smokeless tobacco use is so low that it is difficult to measure accurately. Smokers who switch to smokeless have much lower risks for all smoking-related diseases, including mouth cancer.

"Smokeless products such as snus, dissolvables and e-cigarettes are vastly safer than cigarettes in preventing lung disease, and they are highly effective in smoking cessation," says Rodu. "Kentucky smokers, and all American smokers, need to know about these alternatives as they are working to quit smoking. We are taking on this task with great responsibility and will continue to monitor our success."

Dr. Rodu's two decades of research data indicate smokers can reduce harm by switching to smokeless tobacco products.

A. Bennett Jenson, M.D. co-invented the first HPV vaccine while at another institution, but is now a Brown Cancer Center researcher. He says the university's reputation and commitment to research helped persuade him to accept his current position in Louisville in 2002. While at Georgetown University, he was only able to devote a quarter of his time to research. "I decided that I wanted to do more," said Jenson, who was recruited by Dr. Miller. "You bring in good people and the program keeps getting better."

Healing Hearts

SINCE 1984, **Laman Gray Jr.**, M.D., has been making headlines. For 33 years, he was chief of the UofL School of Medicine's Thoracic and Cardiovascular Division. The internationally recognized leader in the fields of artificial hearts and circulatory support systems, he performed the first heart transplant in Kentucky that year. In 2001, his surgical team implanted the first fully implantable replacement heart, the **AbioCor™**.

And today, Gray serves as Medical Director of the clinical translation program and an investigator at the **Cardiovascular Innovation Institute** (CII), a joint initiative between the **University of Louisville** and **Jewish Hospital** and **St. Mary's HealthCare**. In 2008, he was awarded the University of Kentucky Medallion for Intellectual Achievement, which recognizes high intellectual achievement by Kentuckians.

Cardiovascular devices and therapeutics are a $12.8 billion dollar global industry, and the Cardiovascular Innovation Institute is able to take research in these fields from the biomedical and bioengineering labs straight to the bedside, helping patients lead healthier lives.

"We believe we can accelerate translational research by unifying basic science and clinical practice; that was the founding principle of the Cardiovascular Innovation Institute. I've been able to pioneer in the areas of cardiovascular assist devices and artificial organ transplantation," he says. "At the CII, we now have a range of distinguished investigative teams doing truly significant work in other areas, too."

Laman Gray, M.D., (right) and Stuart Williams, Ph.D., are blazing trails at UofL's state-of-the-art Cardiovascular Innovation Institute.

UNIVERSITY OF LOUISVILLE

Cutting-Edge Cardiology Research: It's Happening Here

From Kentucky's first heart transplant to implanting the AbioCor™ artificial heart, UofL researchers are on the front lines in the prevention and treatment of heart disease.

STUART K. Williams, Ph.D., is an established academic and industry leader in the field of cardiovascular research and development, with a focus on medical devices and regenerative medicine.

With more than three decades of continuous funding from the **National Institutes of Health**, Department of Defense and industry, he has a successful history of developing intellectual property and translating basic scientific research into useful applications in the medical field. His research spans the fields of cardiovascular bioengineering, biomaterials, cardiovascular cellular and molecular biology, and diabetes.

He also co-founded several bioscience companies and serves as a scientific advisor for many biomedical device companies.

Williams is listed on 16 U.S. patents, with several others pending. In addition to serving as scientific director at the CII, he is the **Jewish Hospital** Distinguished Chair in Cardiovascular Innovation and a tenured professor of surgery at the University of Louisville.

"My team is getting serious attention right now for a number of reasons; one of the most interesting is the headway we're making with a unique process that uses a patient's stem cells from fat to heal his or her own heart," he says. "A generation ago no one was looking at this kind of research; because of Bucks for Brains, the CII has pulled together a critical mass of talent from all over the world and we're very close to creating hope for cardiac patients who have serious, life-threatening conditions."

$100 Million Man

THE NIH funded Dr. **Roberto Bolli**'s original grant for basic research into how adult stem cells could be used to treat heart failure at $11.7 million in 2006. Under his current project, Bolli will continue to investigate: how to improve adult stem cell therapies by introducing genes into stem cells; the signaling pathways of stem cells in the body; the effect of diabetes on stem cells; and how cytokines—a class of proteins—affect stem cells during heart failure.

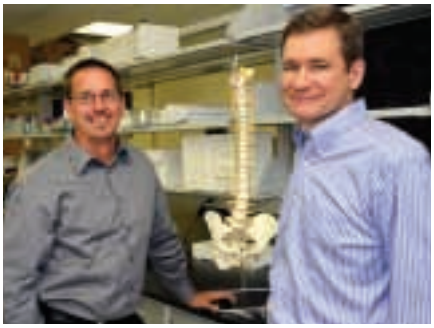
Bolli's team also has carried out clinical research into the use of a person's own stem cells in regenerating dead heart muscle after a heart attack. Sixteen patients participated in the study; all saw improvement in their heart function. In fact, the average improvement was three times greater than the researchers' projections and was reported in the prestigious medical journal, *The Lancet*.

Plans now are to develop a multi-center clinical study with hundreds of patients. "If these results hold up in future studies, I believe this could be the biggest revolution in cardiovascular medicine in my lifetime," he says.

Roberto Bolli's research in regenerating damaged heart muscle with a patient's own stem cells is showing significant promise.

UK President Eli Capilouto, UKCED Vice President Len Heller, former UK President Lee T. Todd Jr. and Coldstream Executive Director George Ward at the Tempur-Pedic International groundbreaking. The $18 million global headquarters at Coldstream Research Campus is expected to open by the end of 2012. Tempur-Pedic will add 65 jobs over the next five years for a total 300 jobs.

Dr. John Gurley, a UK Albert B. Chandler Hospital interventional cardiologist, is BVT's chief medical officer and the inventor of its flagship product.



Equinext CEO Eric Hauck (L) and Tom Hedman, CSO of parent company Orthopeutics. Also a UK research faculty member, Hedman developed the technology to treat equine injuries.

UK chemistry professors, Sanders-Brown Center on Aging researchers, and CoPlex Therapeutics co-founders Bert Lynn (L) and Mark Lovell and CEO John Beran are also partners in Scout Diagnostics.

Seikowave CEO Matt Bellis (L) and Daniel Lau, chief technology officer and UK associate professor of electrical engineering, in their ASTeCC campus incubator lab.

Commercializing UK Innovations

THE University of Kentucky Office for Commercialization & Economic Development helps accelerate the Kentucky economy by commercializing UK research and assisting entrepreneurs at UK, in the Lexington-Bluegrass Region, and at small businesses throughout the Commonwealth to create jobs and be successful.

UKCED is comprised of the ASTeCC campus incubator, Coldstream Research Campus, Intellectual Property Development, Kentucky Small Business Development Center, Kentucky Technology Inc., Lexington Innovation & Commercialization Center, Marketing & Communications, Technology Transfer, and the Von Allmen Center for Entrepreneurship.

The following are UKCED technology-based client success stories from 2011.

UK medical technology incubator **Therix Medical** launched its first spinout company, **Bluegrass Vascular Technologies**. BVT will develop life-saving devices and methods that address shortcomings in vascular access procedures. UK interventional cardiologist **Dr. John Gurley** expects their first-in-man study to be completed by the end of 2011.

UK spinoff company **Equinext** began testing its device to treat equine tendon and ligament injuries with strategic partner **Hagyard Equine Medical Institute**. Equinext closed an $850,000 Series A investment round with funds raised entirely from local investors, including UK, through **Kentucky Technology Inc.**, the Bluegrass Angels, two state funds, and the local equine industry. **Equinext** is a spinoff of **Orthopeutics-Intralink Spine** recruited to Lexington in 2010. Both companies are located at **Coldstream Research Campus**.

Seikowave began production on optic units to capture 3D images for dental applications in its **ASTeCC** lab. The UK spinoff company uses engineering professor **Daniel Lau**'s real-time 3D measurement research. CEO **Matt Bellis** said other customers will use the UK technology in automotive and body scanning applications. Bellis is also raising the first tranche of Series B financing, which includes lead investor Mitsubishi, the Bluegrass Angels, BGA Fund II, and Commonwealth Seed Capital.

CoPlex Therapeutics signed a global license agreement with commercial-stage specialty drug company Hawthorn Pharmaceuticals to develop *hawAD14*, a preclinical oral small molecule candidate for the treatment of Alzheimer's and other neurodegenerative diseases. CoPlex founding scientists, UK chemistry professors and Sanders-Brown Center on Aging researchers **Mark Lovell** and **Bert Lynn** discovered the compound. **John Beran** is CEO of CoPlex and a related UK spinoff company, **Scout Diagnostics,** with professors Lovell and Lynn.

For more information on UKCED including news, success stories, programs and services, see **EconDev.uky.edu** and subscribe to **UKEconDevNews** at **EconDev@uky.edu**.

Marie Wehenkel, PhD, pipetting samples in one of the college's research laboratories.

UK's College of Pharmacy Is Nationally Ranked in the Top 5

THANKS to its new 286,000-s.f. facility alongside South Limestone, the nation's fifth-ranked **UK College of Pharmacy** continues to move the research dial. The college's world-class faculty conduct research in four primary areas: drug discovery, drug development, therapeutics, and pharmaceutical policy.

Pharmacy research faculty rank 4th out of 354 institutions in scholarly activity. And they aren't just focused on conducting research; they are committed to changing Kentucky's economy. Since 1989, UK College of Pharmacy faculty have created 25 start-up companies.

Two new floors of research space opened in College of Pharmacy in November 2011.

The college opened the final two floors in November 2011 and is filling them with some of the leading pharmaceutical researchers in the world.

Retaining Our Best and Brightest

Dr. Linda Dwoskin

- **Dr. Linda Dwoskin**, the college's associate dean for research, who is known throughout the world for developing therapies for smoking cessation and weaning people off of drugs of abuse.

Dr. Kim Nixon

- Dr. **Kim Nixon**, who is among 85 researchers receiving the Presidential Early Career Awards for Scientists and Engineers (PECASE), the highest honor bestowed by the U.S. government on science and engineering professionals in the early stages of their independent research career.

Recruiting Research All-Stars

- Dr. **Peixuan Guo**, one of the top three nanobiotechnology experts in the world, will join the college in January. For the past four years, Guo has also been the director of a National Institutes of Health Nanomedicine Development Center, one of only eight such centers in the country. That center is moving to UK.

Dr. Peixuan Guo

- Dr. **Jon Thorson**, who started in the college Oct. 31, 2011, was recruited to the UK College of Pharmacy to lead its new Center for Pharmaceutical Research and Innovation (CPRI). His lab is focused on developing antibiotics and anticancer drugs from natural products. Dr. Thorson's vision for CPRI is to fill the "commercialization gap" by elevating basic drug discovery and development ideas to a proof of principle stage that will better prepare UK to partner with those in the pharmaceutical industry.

Dr. Jay Thorson

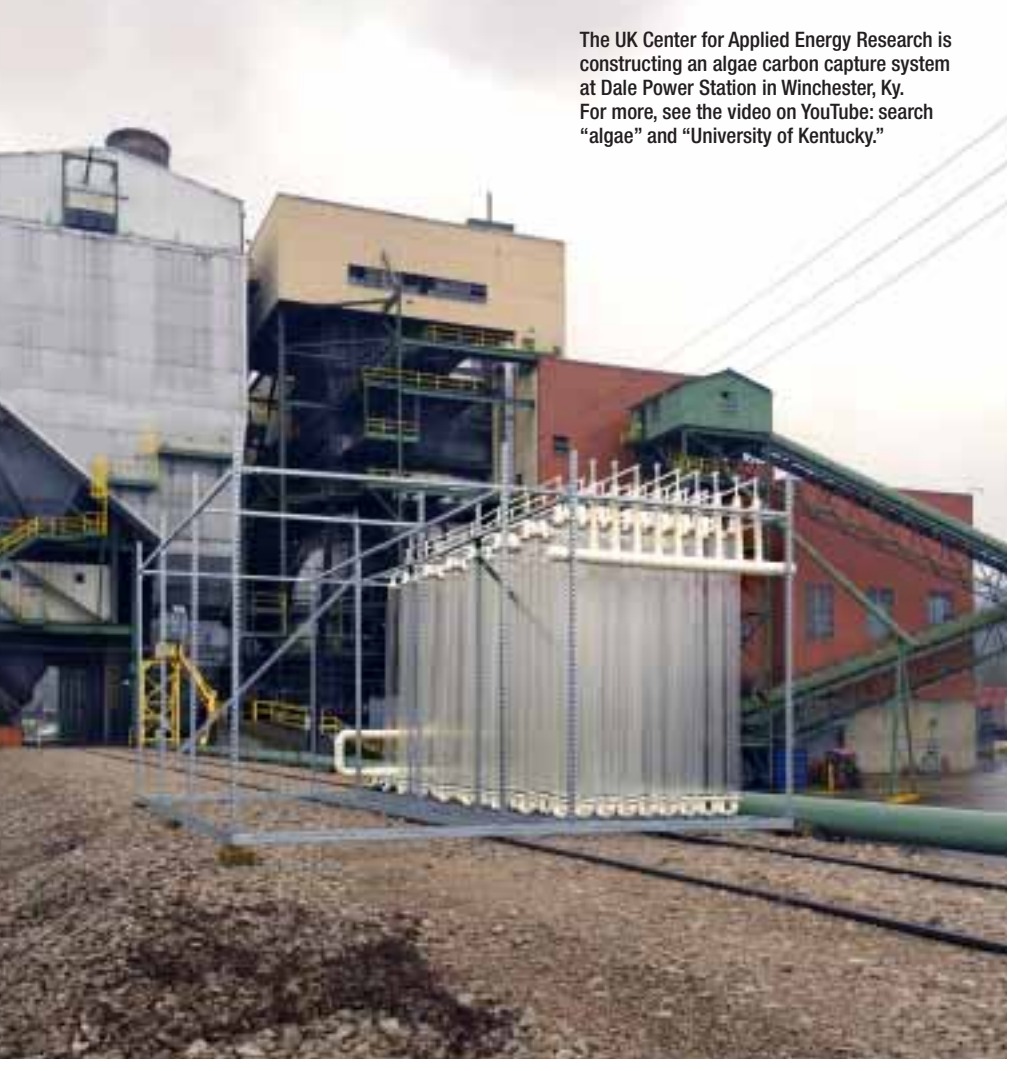
UK College of Pharmacy building

UNIVERSITY OF KENTUCKY

Research for Kentucky's Energy and Healthcare Future

WE'D like to share three projects under way at the University of Kentucky that are part of the university's $360-million-a-year research enterprise. The first two showcase the impact of university-state-industry partnerships on Kentucky's energy future through the work of the Center for Applied Energy Research (CAER), one of UK's multidisciplinary research centers. The final project highlights the largest award ever received by UK – $20 million from NIH – which will meld UK's research strengths in cancer, heart disease and diabetes with expertise in pharmaceutical sciences and biomedical engineering to enhance the lives of Kentuckians. Learn more at www.research.uky.edu.

—**Dr. James W. Tracy**, UK Vice President for Research



The UK Center for Applied Energy Research is constructing an algae carbon capture system at Dale Power Station in Winchester, Ky. For more, see the video on YouTube: search "algae" and "University of Kentucky."

Algae to Capture Carbon at Power Plant

A research breakthrough—utilizing the photosynthetic prowess of algae—could lead to significant improvements in carbon capture technology. In October 2011, state officials joined UK scientists to announce funding to scale up this research, which uses algae to capture carbon dioxide from coal-burning power plants and convert it to biomass.

The technology is so promising that the Kentucky Energy and Environment Cabinet is committing nearly $1.3 million over two years for the **UK Center for Applied Energy Research** (CAER) to demonstrate the process at **East Kentucky Power Cooperative**'s Dale Power Station in Winchester, Ky. EKPC is contributing in-kind costs to the project estimated at $75,000, and UK is providing a $543,663 cost share.

For the past three years, researchers from CAER and the **UK Department of Biosystems and Agricultural Engineering** have studied the potential of using waste CO2 and heat from a coal-fired power plant to cultivate algae. The double reward of the research is that valuable products—like biodiesel, animal feed, fertilizer, and chemicals—can be gained at the end of the process.

This technology uses a series of vertical tubes, called photobioreactors, which are 8 feet tall by 5 inches in

UNIVERSITY OF KENTUCKY

Coal/Biomass-to-Liquid Unit Groundbreaking: (from left) Building Project Manager David Jacques, Kentucky Energy Secretary Len Peters, CAER Director Rodney Andrews, CAER Associate Director for Clean Fuels Burt Davis, U.S. Representative Hal Rogers, U.S. Representative Geoff Davis, Kentucky Floor Majority Leader Rocky Adkins, and UK President Eli Capilouto.

diameter. The entire bank of tubes will equal the length of a football field.

"East Kentucky Power Cooperative is proud to partner with UK and the state to explore viable options for reducing carbon dioxide emissions from power plants while keeping electricity costs affordable," said **Tony Campbell**, CEO of EKPC. "This research is vital to EKPC and to Kentucky's economy."

"This project furthers the goal of one of the key strategies in Gov. **Steve Beshear**'s energy plan: to initiate aggressive carbon capture and sequestration projects for coal-generated electricity in Kentucky," said Energy and Environment Cabinet Secretary **Len Peters**. "We recognized that the use of algae to capture carbon dioxide from power plant emissions deserved further research because of the co-benefit that results from the production of biofuel. This project is an example of how our partnership with CAER can advance clean energy in the Commonwealth."

Future Fuels from Coal and Biomass

In November 2011, Congressmen **Geoff Davis** and **Hal Rogers** participated in the groundbreaking of a UK coal/biomass-to-liquids unit. The $5.7 million facility at CAER could produce liquid transportation fuels from Kentucky's coal and biomass resources.

"Energy independence is an absolute must if this nation hopes to remain globally competitive," said UK President **Eli Capilouto**. "One of our chief missions at UK is attacking the challenges that confront our commonwealth and our nation. No challenge looms larger than energy security. At UK, we are working with our partners in Washington and in Frankfort to find solutions."

"Coal-to-liquid technology has the potential to provide our nation with a reliable source of safe and affordable fuel and to help reduce our dependence on foreign energy," said Davis.

"Our future is under our feet. By encouraging and expanding the development of coal use technology, we can attain greater energy independence, reinvigorate our economy, and create new jobs, right here at home," said Rogers.

Funding for the process-development unit includes support from the U.S. Department of Energy ($4.55 million), the Kentucky Energy and Environment Cabinet ($708,000), and a UK cost share ($453,000). The unit will focus on state-of-the art technologies to improve efficiency and reduce the amount of carbon dioxide created when converting coal and biomass to liquid fuels. The gasification unit will be capable of producing one barrel of fuel per day.

"A key benefit of this unit is that it can be used as a test-bed for new concepts at an affordable level," said **Rodney Andrews**, director of CAER and the project's principal investigator. "Our goal is to develop facilities and personnel to sustain a synthetic fuels industry in Kentucky."

Moving Research Discoveries to Health Care Solutions

The National Institutes of Health (NIH) awarded $20 million to UK to speed up the process of moving research discoveries to health care solutions.

The five-year award, through the NIH's institutional Clinical and Translational Science Awards (CTSA) program, is the largest research funding award ever received by UK and will be used to support research at **UK's Center for Clinical and Translational Science** (CCTS), making it part of a select national biomedical research consortium. UK's center is the only designated CTSA in Kentucky.

Translational research refers to turning laboratory findings into preventions, treatments and cures for patients through collaborations with interdisciplinary research teams.

The CCTS is led by **Philip Kern**, associate provost for clinical and translational science, who will serve as principal investigator of the program. "At UK we are integrating our research strengths in cancer, heart disease and diabetes with our strengths in pharmaceutical sciences and biomedical engineering to develop novel drugs and medical devices," said Kern.

Chike Anyaegbunam (right), associate professor in the UK College of Communications and Information Studies, works alongside UK entomologist Stephen Dobson in American Samoa.

Participatory Communication Facilitates Mosquito Abatement in American Samoa

CHIKE Anyaegbunam, associate professor in the **UK College of Communications and Information Studies**, is part of a research project in American Samoa aimed at reducing the incidence of a mosquito-borne infection called lymphatic filariasis.

Anyaegbunam is working alongside UK entomologist **Stephen Dobson**. Dobson and his team have created a procedure to infect mosquitoes with bacteria that hinder their reproductive capabilities. By infecting male mosquitoes, the team hopes to reduce the number of mosquitoes that serve as vectors for mosquito-borne diseases.

Anyaegbunam, who specializes in community engagement and participatory communication, will accompany Dobson to the American Samoa islands. His role will be to communicate with the community stakeholders to both obtain consent for the project and clarify the project's methods and goals.

'1-2-3 Pap' Video Aims to Reduce Cervical Cancer

ELISIA Cohen's research seeks to identify communication strategies to improve health and reduce the burden of cancer in Kentucky. Her most recent research, funded by the Centers for Disease Control and Prevention, is a collaboration with Drs. **Richard Crosby**, **Robin Vanderpool** and **Baretta Casey** from the **UK College of Public Health** that seeks to reduce the burden of cervical cancer in Kentucky.

One of the problems Cohen and Rural Cancer Prevention Center researchers discovered is that Kentuckians are less likely to receive HPV vaccination, less likely to adhere to the HPV vaccination schedule, and less likely to receive timely pap tests compared to other U.S. populations.

To reduce "communication gaps" in individual knowledge, attitudes and vaccination practices, Cohen created a novel, video-based "1-2-3 Pap" intervention to improve adherence to the three-shot HPV vaccination and Pap test schedule. The intervention has been deployed in Eastern Kentucky counties burdened by cervical cancer mortality. Given the early indicators of success for the intervention, a "1-2-3 Pap" Kentucky and West Virginia effort will be implemented in statewide dissemination pilot projects in the next year.

Using Technology to Improve Communication in Hopsice Care

Elaine Wittenberg-Lyles, associate professor at the **Markey Cancer Center** and the Department of Communication, is an active member of the Telehospice Project, a long-standing interdisciplinary team of researchers committed to intervention research using telehealth technology.

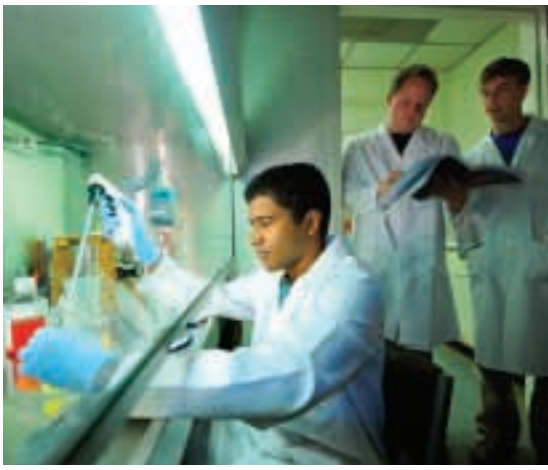
Her research aims to design and test interventions for hospice caregivers that can be delivered through telehealth technologies in an effort to overcome the geographic burden and isolation created through caring for a dying love one. She currently serves as co-investigator on two randomized controlled trials funded by the **NIH National Institute of Nursing Research**.

Both projects are based on a conceptual framework that positions informal caregivers (family and friends) as central to hospice care. The research emphasizes improving caregiver quality of life and improving skills. Wittenberg-Lyle's primary focus is on the caregiver's role and communication with the interdisciplinary team.

Safeguarding the Nation's Food Supply

SEVERAL faculty and graduate students in Communication led the Risk Communication area of the **National Center for Food Protection and Defense** (NCFPD), a Center of Excellence sponsored by the **Department of Homeland Security**. NCFPD addresses the vulnerability of the nation's food system to attack through intentional contamination with biological or chemical agents. The team at UK works with subject matter experts throughout the food industry to develop crisis messages designed to be shared rapidly and to provide consumers with the instructions they need to avoid harm in the case of an attack. The group does extensive media tracking and message testing experiments to develop and constantly update a set of communication best practices for risk and crisis communication. They share their findings with spokespersons from many government agencies and throughout the food industry.

Left and below: Students from the Center for Biomedical Engineering research biodegradable drug delivery systems aimed at bone regeneration.



UK Engineering is Top-Ranked

THE **UK College of Engineering** is the state's top-ranked engineering program, an accomplishment that would not be possible without its commitment to progressive research into real-world problems requiring engineering solutions. Consider:

• There are currently over 350 active research projects conducted by faculty and students in the College of Engineering.

• Sponsored project awards underway totaled over $90 million over a four-year period.

The college participates in a wide variety of research projects that include aerospace, biotechnology, nanotechnology, energy, security and sustainability. Examples include:

• **The Space Systems Lab** fabricates and tests space hardware, including KySat-1, an orbital satellite built on the CubeSat specification. CubeSats have enabled UK to send and receive payload and conduct experiment aboard the International Space Station.

• A UK faculty member is at work on a smart skin patch that helps users quit smoking. The device utilizes integrated electronics to eliminate cravings and reduce withdrawal symptoms. Its carbon nanotube membrane is programmable and has many potential applications.

• Supported by a NSF CAREER award, UK researchers are investigating ways to use nanostructured coatings to improve the performance of solar cells.

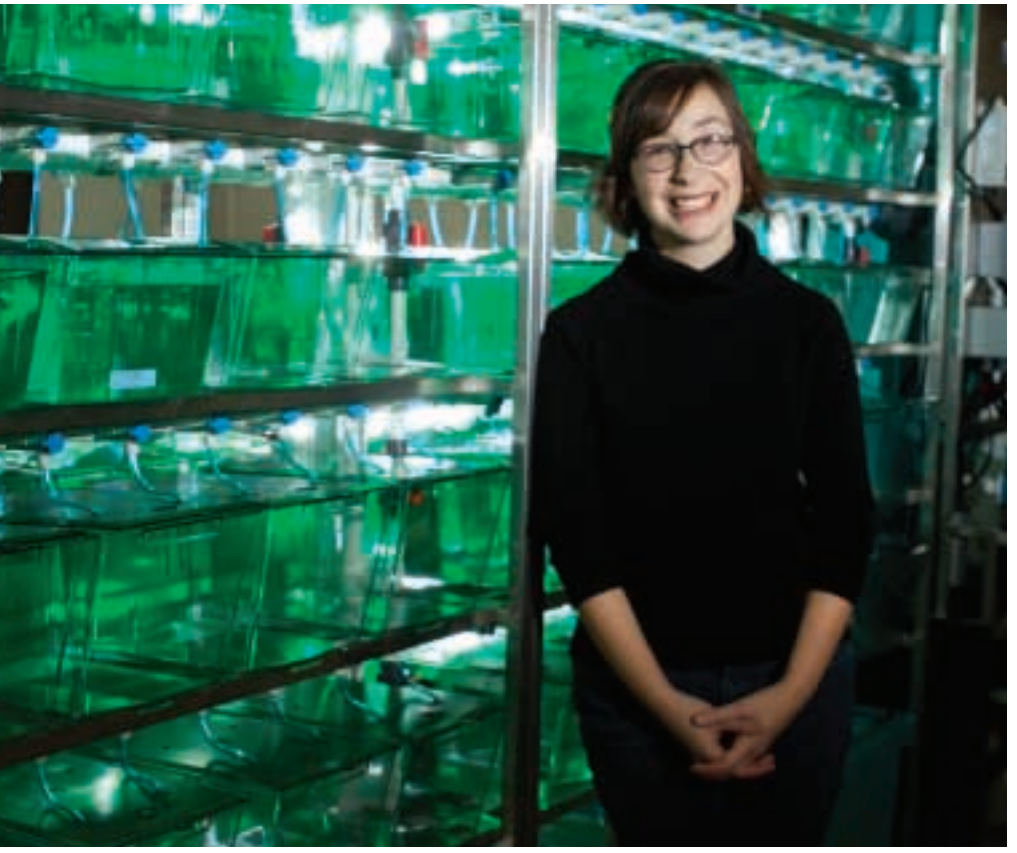
• Funded by a grant from the **U.S. Department of Energy**, the **Power and Energy Institute of Kentucky** (PEIK) aims to research ways to improve the reliability of existing power infrastructure, as well as research novel solar, wind and micro-hydroelectric power generation methods and their application in Kentucky.

• UK researchers have applied blast mitigation concepts to windows that, in the event of an explosion, will bend inward, but not break. Such windows have the potential to minimize the damage and expense of a terrorist attack in an urban area.

• A group of researchers from UK's Institute for Sustainable Manufacturing are working on the Air Force sponsored Risk Assessment for Next Generation Supply Chain Readiness (RANGER) project and have been successful in developing a new tool to model and analyze individual risks to supply chains and their interrelationships.

At the UK College of Engineering, we strive to live by the principle of "Innovation with impact, research with results." Our mandate is to engage in research that improves our quality of life, drives economic development and enriches the educational experience of our students.

Dr. James Lumpp and UK College of Engineering students communicate with astronauts on the International Space Station from the CubeLab Ground Ops Desk.



Ann Morris, assistant professor in the UK Department of Biology, is conducting research with zebrafish to help unlock a cure for blindness and other visual impairments in humans.

College of Arts and Sciences Supports Diverse Research Initiatives at UK

THE **UK College of Arts & Sciences**, with its wide spectrum of disciplines, is home to not only a wide variety of research but also a number of services that support research in A&S and other areas of the university.

Stats Lab to be New Face of Statistical Analysis on Campus

In July 2011, UK opened its first Applied Statistics Lab (ASL), with the help of the Office of the Vice President for Research, several UK college deans, and infrastructure grants such as the university's recent Clinical and Translational Science Award (CTSA), UK statisticians in the College of Arts & Sciences' Department of Statistics, and the College of Public Health›s Department of Biostatistics.

The main objectives of this venture are to provide improved statistical services to groups preparing grant proposals, direct faculty involvement from the Departments of Statistics and Biostatistics for study design and data analysis throughout UK, foster collaborative research between scholars who develop quantitative methodology and those who use such methodology in their work, and to become a resource which may be referenced in institutional support for larger grants, in addition to direct statistical support typically included in such grants.

Zebrafish Research Could Lead to Blindness Treatment

Ann Morris, assistant professor in the UK Department of Biology, specializes in cellular differentiation and gene expression in the vertebrate retina, the photosensitive lining at the back of the eye. Morris' research on zebrafish is leading her to identify genes that are involved in retinal regeneration, an important step towards the long-term goal of curing blindness and visual impairment in humans.

Although externally the aquatic zebrafish appears drastically different from humans, the zebrafish retina is equipped with the same light-capturing neurons called photoreceptors. "Rod" photoreceptors control night vision, whereas daytime and color vision care determined by "cone" photoreceptors.

Ocular diseases, such as retinitis pigmentosa (RP) and macular degeneration, develop when genetic mutations cause degeneration of photoreceptors. According to Morris, RP is one of the most common causes of inherited retinal disease for which there is currently no cure. By developing genetic models of zebrafish with photoreceptor degeneration, Morris hopes to identify novel genes that serve as regulators of photoreceptor development and regeneration.

Battery Center to Get Energy Boost from Two New Chemistry Professors

Susan Odom

Doo Kim Young

Energy will be a central focus for new assistant professors **Susan Odom** and **Doo Young Kim**, as both have experience in energy and materials research and both will find a second home at UK's Center for Applied Energy Research (CAER), a multidisciplinary center whose energy research provides a focal point for coal and energy research in Kentucky.

Both were specifically interested in UK›s Department of Chemistry because of its close relationship with the CAER and **The Kentucky-Argonne Battery Manufacturing Research and Development Center**.

The Battery Center, scheduled to open in spring 2012, will focus on the lithium-ion battery market, developing manufacturing processes and equipment; evaluating advanced battery materials; and improving its technical readiness for military and commercial applications.

HBEER design concept developed by the College of Design became a reality in partnership with Stardust Cruisers.

College of Design and Houseboat Industry Collaborate on Energy Efficient Residences

THE **UK College of Design** continues to be on the forefront of design study and research by challenging its faculty and students to develop solutions for real world problems. As part of the college's Design + Energy Initiatives projects, students and faculty are focusing on how design affects and can respond to issues associated with energy initiatives both locally and beyond. One of these ground-breaking initiatives is already garnering the college national attention and funding to design and build energy efficient, low-income residences.

Partnering with the **Center for Applied Energy Research at UK**, and sponsored, in part, by the **Kentucky Highlands Investment Corporation** and the **Kentucky Housing Corporation**, UK College of Design initiated the multi-year project **Houseboat to Energy Efficient Residences** (HBEER) in the fall of 2009.

The initiative directly responds to the impact the economic downturn has had on the houseboat manufacturing industry in the Commonwealth.

The overall concept of HBEER was to design energy efficient, low-income housing units that can be manufactured in the Lake Cumberland area of the state and help local factories there retrain workers from the houseboat industry. In addition, HBEER utilizes Kentucky products where possible in the design. More than 50 students and faculty at the UK College of Design developed the initial models for the homes.

Now, in partnership with **Stardust Cruisers**, these housing units are becoming a reality. The first of two 1000-s.f. manufactured housing units created from redesigned and refitted former houseboats was set in Monticello in August of 2011. The second prototype was set in December in Whitley County in the community of Goldbug. The two future homes were made possible with funding from a federal grant of $250,000.

"The HBEER project is unique in that it has allowed us to share leading edge techniques in design, energy performance and construction with a region of our state that is well positioned to implement them in a way that will have a very positive and immediate impact on southeastern Kentucky," said **Josh Ayoroa**, HBEER Project Manager and UK graduate who started with the project during his architecture graduate studies.

The belief that HBEER's innovative concept could be implemented in a number of communities has attracted support for the project at local, regional and national levels, including a $1 million grant from the **Appalachian Regional Commission** to continue research and development of the project.

"The HBEER project must ultimately be judged by the quality of our students and the kind of impact they can and will have in all our communities," said Dean **Michael Speaks**, of UK College of Design. "Judging from the example of those students who worked so hard and so energetically on the project, I think we all have a great deal to be proud of and a lot to look forward to."

UK College of Design's HBEER models of future homes

UK College of Design
117 Pence Hall
Lexington, KY 40506-0041
Michael Speaks, Dean
(859) 257-7619
www.uky.edu/Design

UK Theatre has teamed up with the university's Louie B. Nunn Center for Oral History and Veterans Resource Center to capture real life stories of UK's student veterans in the play "civilian."

UK College of Fine Arts Research in the Spotlight Locally, Nationally and Abroad

THE **College of Fine Arts** is the vibrant arts and culture hub of the University of Kentucky. It is an incubator for creativity and discovery, providing quality educational opportunities for students and engaging arts experiences for the community. Its faculty continues to stay at the top of their fields as artists, educators and scholars; academic and artistic research enriches programs in the classroom and beyond. Here are a few examples of the significant work being done at the UK College of Fine Arts.

Collaboration and Storytelling

In partnership with UK's **Louie B. Nunn Center for Oral History** and the **Veterans Resource Center**, UK Department of Theatre brought to local, and later the national stage, the real life stories of the university's student veterans. Capitalizing on "From Combat to Kentucky," an oral history project chronicling stories of student veterans of the wars in Iraq and Afghanistan collected by the two centers, **Herman Daniel Farrell III**, assistant professor at UK Theatre, devised a script drawn from the oral histories with his "Staging History" course. After opening on the UK campus in 2010, "civilian" was picked to premiere in New York City as part of the 2011 New York International Fringe Festival, one of the largest multi-arts events in North America.

Leading the way in Music Therapy

UK is the first higher education institution in the state to offer a graduate degree in music therapy, launching in spring 2012. Students pursuing the degree will study music therapy theory and garner advanced clinical skills, research skills, musical skills and clinical administrative skills. The UK graduate program was made possible with support from **UK HealthCare** and the **Lucille Caudill Little Performing Arts in HealthCare Program**.

"I think we have a unique opportunity to contribute to the field via research, which will enhance both the academic and clinical portions of the program," said **Lori Gooding**, assistant professor of music and director of UK's music therapy program. "We also have the opportunity to develop specialized training in areas that currently do not exist in our field."

Gooding has already been hard at work in the classroom and hospital. Current research projects at UK will determine what relationship can be found between musical participation and cognitive reserve and will evaluate the effectiveness of low-cost, theory-based, one-time lectures about hearing, noise induced hearing loss, and hearing protection on college age students' use of hearing protection in noisy environments. The research projects are being funded by the National Institute on Aging and the UK College of Health Sciences respectively.

Cultural identity

Ebony G. Patterson, assistant professor of painting at the UK Department of Art, became the first visual artist to receive the Rex Nettleford Fellowship in Cultural Studies. Patterson has received funding and a travel grant to execute a large-scale interactive multi-media installation with embellished objects in a setting that mimics a neighborhood photo studio in Jamaica. The artwork furthers her research in gender and masculinity in Jamaican dancehall culture and will be comprised of 10 outfits that participants can wear to be part of the piece by acting as idealized masculinities, functioning like props in a photo studio. Non-participating audience members will be able to observe this process as well as see the embellished objects and documented images of the artwork or a live projected video feed that will appear in several locations throughout the Caribbean.

Lori Gooding worked with spina bifida patient Joshua Divens earlier this year during a music therapy session at Kentucky Children's Hospital.

UK College of Fine Arts
202 Fine Arts Building
Lexington, KY 40506-0022
Michael Tick, Dean
(859) 257-1707
www.uky.edu/FineArts

College of Agriculture Research Impacts All Kentuckians

From setting a national example in veterinary diagnostics to cutting-edge bioenergy research and finding innovative ways to help homegrown food business, the UK College of Agriculture is impacting all Kentuckians.

With expanded facilities and advanced technology, Craig Carter and the VDL staff are working hard to be a national leader among veterinary diagnostic labs.

Steve Patton photo

VDL is a National Leader

Practicing veterinarians don't always have the same resources a human doctor has; they just can't usually afford it. **UK Veterinary Diagnostic Lab** (VDL) director **Craig Carter** said that was a reason university and state-based diagnostic labs were created in the 1950s and the same reason the UK lab is leading the way today.

The UK lab provides diagnostics for all food animal species and companion animals. Under Carter's leadership, the lab has developed Kentucky's first fully integrated animal health information and surveillance system.

"The system fuses a lot of animal health data streams and other communications we have from vets and producers," Carter said. "It gives us a unique vantage point to assimilate data and push it back to our vets and farmers. We are really the only state doing anything like this right now and we feel it could become a model for the nation."

The lab generates alerts to the state veterinarian and other stakeholders, which help mount a rapid response to emerging diseases and provide early detection of possible agriterrorism threats. To further support veterinarians in the field, the VDL is developing an application for smart phones and tablets.

With the expanded lab facilities, Carter said the VDL is in a great position to enhance its services for Kentucky's animal agriculture industries.

Solutions for Local Food Entrepreneurs

The UK College of Agriculture's Food Systems Innovation Center uses a multidisciplinary approach to provide applied research solutions to Kentucky's food industry.

The center's works to develop strong food businesses by facilitating the profitable production, processing and marketing of local, healthful foods by integrating research, education and extension programs. By working closely with other Kentucky agencies, the center assists the efforts of manufacturing firms and farms transitioning from tobacco dependence to value-added food production.

"We have a lot of unique opportunities," said **Gregg Rentfrow**, assistant extension professor in the UK Department of Animal and Food Sciences. "We have a lot of major restaurant chains and food companies based in Kentucky."

Recently, the center renovated the sensory laboratory to include red lighting for some studies. Red lighting masks the type of product and how it's prepared so panelists can be more objective.

A New Kind of 'Pit Stop'

Fruit pits, nut and coconut shells could be more than kitchen waste. **UK College of Agriculture** researchers believe they could also have potential in biofuels production and give the term "pit stop" a fresh meaning.

Recent research compared the content of lignin, a major component of cell walls, in these fruit and nut byproducts to that of the more traditional biofuels crops like switchgrass, cottonwood and tobacco. **Seth DeBolt**, assistant professor in the college's horticulture department, said he and his colleagues sought to identify plants that already have production value—food crops, plantation crops, horticultural crops or proposed bioenergy crops.

"We've been working to identify plant feedstocks that have high lignin content and have found that the stones of certain soft fruits like peaches and olives, as well as inedible parts of coconuts and walnuts, have quite a bit of potential," DeBolt said.

These lignin-rich byproducts can go through the thermochemical deconstruction process and become hydrocarbon biofuels to replace gasoline and diesel and jet fuels.

"They can also function as 'drop-in' fuels and are from a waste stream that complements, rather than competes with, food," DeBolt explained.

Research revealed peach stones are the cleanest to process into bio-oil, which gives a whole new meaning to the term "pit stop."

201 East Main Street, Suite 1000
Lexington, Kentucky 40507
(859) 231-8780 | www.mmlk.com

Business Law ☐
Government Access ■
Healthcare Regulation ☐
Real Estate ☐
Litigation ☐

THIS IS AN ADVERTISEMENT

HOW THE LAW PAVES THE WAY FOR ECONOMIC DEVELOPMENT.

McBRAYER
McBrayer, McGinnis, Leslie & Kirkland, PLLC
ATTORNEYS AT LAW