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RESEARCH Kentucky

2004

Stimulating Discovery, Growing the Economy

Research Reports from Kentucky's Universities

University of Kentucky

University of Louisville

Western Kentucky University

Murray State University

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Office for the New Economy

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University of Kentucky

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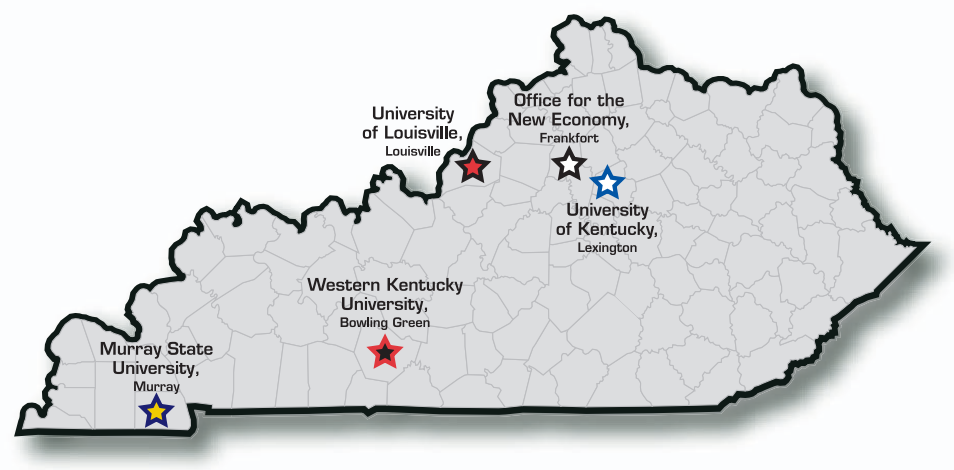

University of Louisville

U of L Research – Enriching Education And Enhancing Technology Transfer

Murray State University

More Than College Ivy

Western Kentucky University

Innovative Enterprise

PUBLISHER'S MESSAGE

Collaboration Between Business and Research Universities Is Vital to Kentucky's Economic Future

Ed G. Lane
Publisher

Globalization is one of the most significant competitive forces affecting Kentucky's economy.

In the global economy, the low cost providers of products and services will be the survivors. When it comes to basic commodities, foreign companies can manufacture products of equal quality to those made in Kentucky – at substantially less cost.

The state's future prosperity must be targeted to the commercialization of research and technologies created by Kentucky's top universities.

Research Kentucky is our effort to bring academic research and profitable entrepreneurship together in order to build the "new economy" in Kentucky. As the business community commercializes new technology, high paying jobs in growth companies will be created to replace manufacturing jobs that will gradually but ultimately be lost.

University research programs are the vital catalyst to keep Kentucky's economy growing and prospering. Creating new high tech business opportunities must be the primary emphasis of economic development efforts in Kentucky.

RESEARCH Kentucky

Publisher	Ed G. Lane
Creative Director	Steve Kries
Design & Production	Stone Advisory
Printing	Publisher's Press
Pre-Press	Publisher's Press
Associate Publisher	Richard Kelly
Circulation Manager	Cathy Boyd

The Lane Report | kybiz.com Kentucky Business Online

The Lane Report's **Research Kentucky** is a special advertising publication published twice annually by Lane Communications Group, Inc. Research Kentucky is published electronically at www.kybiz.com.

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Lexington, Kentucky 40507

Office for the New Economy

Cutting-Edge Research

Investing in research capacity will grow Kentucky's 'New Economy'

Cutting-edge research is the key to creating wealth in today's new economy.

The industries of the 21st century are built on world-class research and development that creates innovative technologies that can be applied to services, products and manufacturing processes.

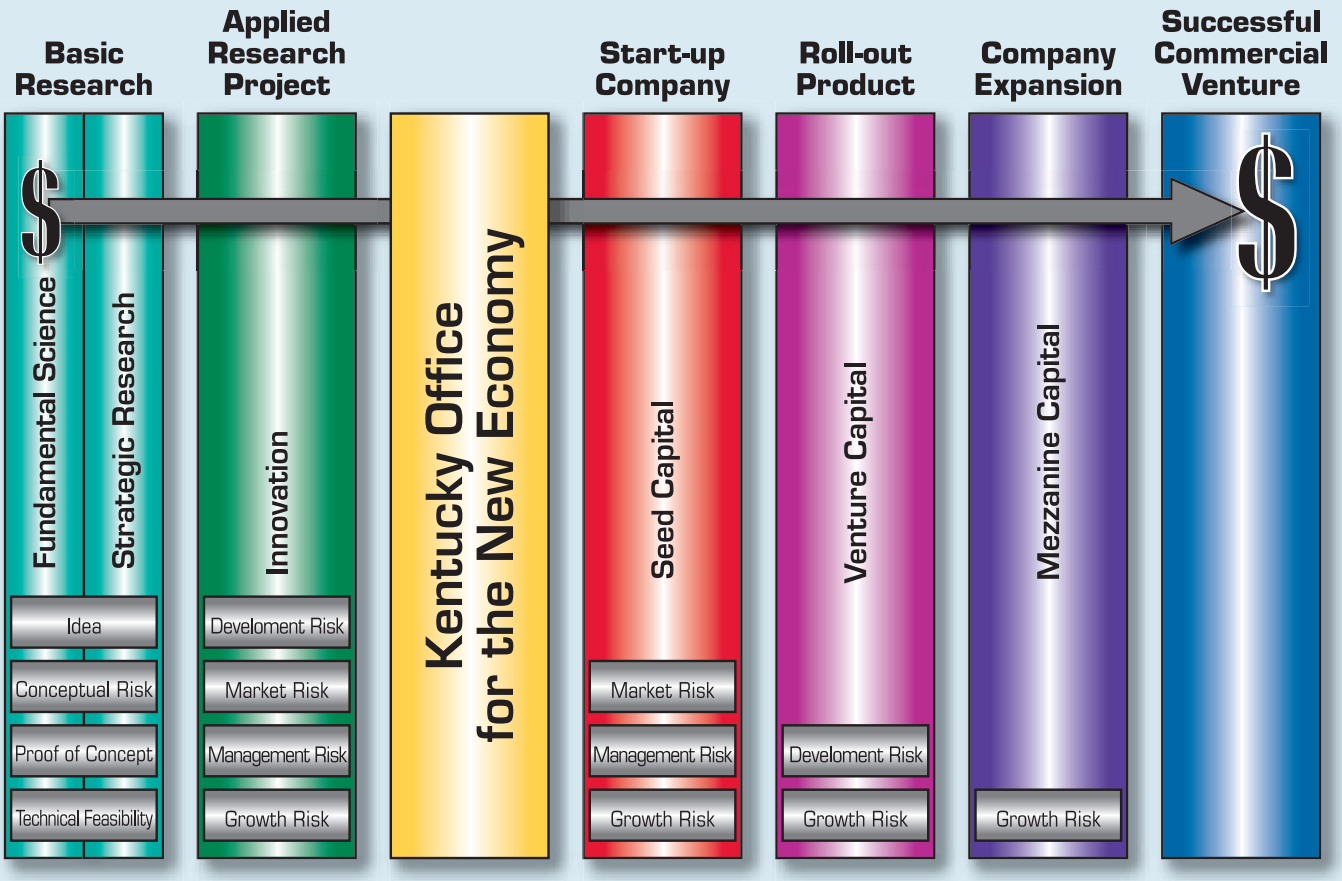
Kentucky's New Economy Research and Business Development Model:

- Relies on its universities to conduct the cutting-edge research needed to be successful in the New Economy because of limited industrial research and no federal research lab.
- Capitalizes on the "Bucks for Brains" program to recruit the top talent needed to advance targeted research areas.
- Requires our universities to be aggressive in their efforts to secure funding from external sources, such as federal agencies, foundations, private donors and corporations.
- Focuses on our strengths to build centers of excellence around which competitive high-tech business clusters can grow and create employment.
- Creates campus cultures that reward intellectual property creation, provide tech transfer opportunities and the venture capital needed to take the research from the lab to the marketplace.

"The primary challenge for the state's large universities is to secure $500 million in external research dollars by 2010."

– Dr. Bill Brundage
Commissioner,
Office for the New Economy

New Economy Business and Job Creation Model Is Built on a Research and Development Foundation



University of Kentucky/ University of Louisville

Miniscule Marvels

UK and U of L team up on nanotechnology research

Miniscule nanowires – one-thousandth the size of a human hair – are linking researchers across the state.

Tiny though they may be, their potential is enormous. Nanowires could be used for anything from penny-sized, lightning-fast computers or sensors that detail biological threats to fuel cells and lightweight spacesuits.

And they could mean billions of dollars to industry.

Nanowires are part of an exciting new field called "nanotechnology," which, simply stated, involves creating super-tiny materials, devices and systems. Researchers at the University of Louisville and the University of Kentucky have been collaborating closely over the past several years on how to produce and use nanomaterials.

The state is a major beneficiary of their efforts, gaining unique capabilities and intellectual property that could play a significant role in supporting existing industry, attracting new businesses and enhancing the economy.

Outside the laboratory, the two have teamed up to elevate nanotechnology from "scientific curiosity" to vital business tool through jointly sponsored workshops. The first drew more than 130 people, including scientists and representatives from Lexmark, Toyota and Ashland/Valvoline.

Partnering for the Future

U of L's Mahendra Sunkara is part of a multi-university group involved in federally funded nanotechnology research at U of L's Electro-optics Institute and Nanotechnology Center comprising Kentucky's first Nanotechnology Core Facility.

Sunkara led the team that developed a new method for producing nanowires in bulk. Now he and his colleagues are engaged in several exciting projects designed to employ them. One of the more promising is a virtually invisible, tiny skin patch equipped with a nano-scale, battery-run pump for pain-free, continuous drug delivery. A sensor controls the dosage.

"Patients with chronic pain or a disease such as Parkinson's that needs constant medication are ideal candidates for the patch," Sunkara notes. Sunkara and Richard Baldwin at U of L have discovered a new material that is proving to be unique for sensing the brain's fluids and other important biological systems.

Optical Dynamics, an international marketer of proprietary technology and optical lens products, and other area businesses also are on the nanotechnology team. Optical Dynamics, for instance, is collaborating with U of L to see whether lenses incorporating nanomaterials outperform traditional ones.

Researchers at UK and U of L work in state-of-the art cleanrooms (shown is the UK facility) to produce innovative nanotechnology devices such as this U of L creation (below, left) that may soon revolutionize industry.

Creating New Materials and Therapies

One discovery from the UK/U of L collaboration is the formation of semiconductor nanowebs – two-dimensional networks of nanowires. This work is being conducted by Uschi Graham and Burt Davis at the UK Center for Applied Energy Research. Graham says nanowebs are the foundation for novel material positioning techniques for ultra-small sensors, catalytic membranes and energy devices including next-generation solar cells. The semiconducting nature of the nanowebs presents a whole class of materials for electronic applications. Techniques to form these nanowebs are part of a joint UK/U of L patent application.

UK's Vijay Singh, Zhi Chen, Todd Hastings and Bruce Hinds are developing solar cells and flat-panel displays, fabricating nanotube transistors for smaller filters and switches, and forming nanoelectrodes. Dibakar Bhattacharyya is designing nanoparticles for environmental use.

A novel manufacturing application is being explored by Chen and Kozo Saito, who are tailoring nanosensors to improve the automobile painting process. The Toyota painting consortium is supporting this project.

Nano-based biosensor researchers include Greg Gerhardt, director of the UK Center for Sensor Technology, who is creating sensors to measure the chemical activity in the brain of people with Parkinson's.

Chemist Leonidas Bachas is testing new materials to improve sensor biocompatibility, and chemical and materials engineer Steve Rankin is synthesizing new ceramic materials with nano-sized pores.

These are just a few examples of cross-disciplinary projects under way by UK and U of L scientists immersed in the nano world.

To learn more, visit
- pyramid.spd.louisville.edu/~eri/
- www.kynanomat.org
- www.caer.uky.edu
- www.engr.uky.edu

University of Kentucky

Discovery, Synergy, Community

Welcome to a look at research at the University of Kentucky. Last year, our faculty brought in a record $223 million in outside funding from industry and federal agencies such as the National Institutes of Health, the National Science Foundation, the USDA, the departments of Education, Energy, and Defense, and NASA.

But there is more to our research enterprise than facts and stats. Research is an integral part of UK, and the funds that support research also educate our students and train the next generation of researchers. Our research leads to new medical treatments, solves manufacturing problems, improves the environment, protects our children, and touches all of us. Our research leads to new products that become the basis for high-tech startups which provide jobs for our graduates and fuel our economy.

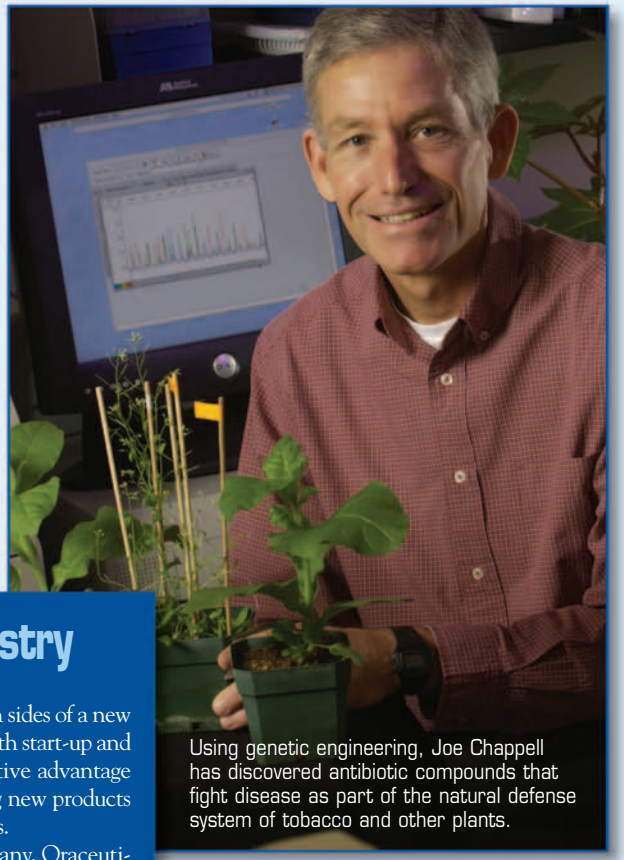
The projects and initiatives described on the next few pages present just a snapshot of the exciting and innovative research under way. For more information, including research featured in Odyssey magazine, see www.rgs.uky.edu.

"The recent $6 million award from the National Institutes of Health to Linda Dwoskin and Peter Crooks in Pharmacy and Michael Bardo in Psychology to study new treatments for nicotine addiction is just one example of a highly successful UK research program."

— **Dr. Wendy Baldwin**
Executive Vice President for Research

Making 'Natural Products' for Industry and Agriculture

How plants defend themselves against attack from microbial pathogens and other enemies is the focus of researcher Joe Chappell in UK's Department of Agronomy. In this work Chappell and colleagues have characterized a novel class of antibiotic compounds, part of the natural defense system of tobacco and other plants. Using genetic engineering and structural biology, the investigators have discovered how plants control and produce these chemical defense molecules. And, it turns out, these chemicals also have important commercial applications as "natural products" – a broad category of products derived from plants, animals and microscopic organisms. The value of natural products for commercial applications has not escaped Chappell's attention. In September 2002, he teamed with Joe Noel, a professor of structural biology at the Salk Institute in San Diego, to form Allylix Inc., which is making bioactive and other natural products for agricultural, medical and industrial applications.



Using genetic engineering, Joe Chappell has discovered antibiotic compounds that fight disease as part of the natural defense system of tobacco and other plants.

Products Alliance Links Research and Industry

UK researchers Jeffrey Ebersole, Peter Crooks and Linda Dowskin are on both sides of a new program, the Natural Products Alliance, that links university discoveries with start-up and existing biotech companies to leverage Kentucky's resources and competitive advantage in the 21st-century new economy. Natural products research – developing new products derived from animals, microrganisms and plants – is going on across the UK campus.

Ebersole, associate dean for research in the College of Dentistry, and his company, Oraceuticals Inc., is developing a plant-extract-based treatment for chronic oral infections. Yaupon Therapeutics and founding researchers, Peter Crooks and Linda Dwoskin, College of Pharmacy, are developing pharmaceuticals from medicinal plants and refining production of a novel smoking cessation agent derived from tobacco.

Funding research is just one component of the Natural Products Alliance, a partnership between academic institutions, state/local organizations and private companies administered by the UK College of Agriculture and supported by the NSF Partnerships for Innovation program, UK and the Kentucky Office of the New Economy. For more see www.ca.uky.edu/NPA.

For more on UK's natural products research and new business incubator, see the Kentucky Tobacco Research & Development Center, www.uky.edu/KTRDC and the College of Agriculture's biotechnology site, www.ca.uky.edu/AGBiotechnology.

Mare Reproductive Loss Syndrome

In 2001, 30 percent of the pregnant mares in Kentucky aborted their foals, resulting in an estimated $300 million blow to the thoroughbred industry. The mysterious illness, Mare Reproductive Loss Syndrome (MRLS), was initially linked to a peak population of Eastern tent caterpillars with a predilection for cherry leaves, which carry a precursor to cyanide. The caterpillar-cyanide theory didn't hold up in early lab tests at UK, but the caterpillar's role as the causative agent in the epidemic is clear. A research team from veterinary science, chemistry, animal sciences, entomology, UK's Livestock Disease Diagnostic Center, and Venture Laboratories (a UK start-up) has conducted recent experiments that seem to indicate small hairs on the caterpillar's exoskeleton can partially penetrate the intestine, potentially resulting in abortion. While MRLS losses have declined in the past two years, down to 12 percent in 2002 and much less than 1 percent in 2003, two teams of 15 scientists at UK are continuing work to reveal the mechanism by which ingested caterpillars cause mares to abort.

For more on MRLS, visit www.uky.edu/Agriculture/VetScience/mrls.

UK continues research on Mare Reproduction Loss Syndrome that in 2001 caused 30 percent of pregnant mares in Kentucky to abort their foals.

University of Kentucky

Alzheimer's Disease Research Center Providing Care for 20 Years

"If there's anything higher than an A+, that's how my daughter and I would rank the care my wife has gotten – that we've all gotten – through the Alzheimer's center here at UK." This from Jack Buchanan from Winchester, Kentucky, talking about UK's Alzheimer's Disease Research Center (ADRC).

When it became clear to Jack's family doctor 10 years ago that Claribel, his wife, had probable Alzheimer's, the doctor suggested that Jack contact Dr. William Markesbery, director of the ADRC at UK's Sanders-Brown Center on Aging.

Markesbery suggested Mrs. Buchanan join a trial on a potential drug treatment for Alzheimer's disease being tested by Bayer. "She did really well on this trial, and in a subsequent trial with another drug," Jack says." The ADRC offers a full range of research, clinical trials and patient care for people with accelerating memory loss. The center also maintains satellite clinics in Eastern Kentucky and clinics primarily for African-American patients at Kentucky Clinic North in Lexington and Meharry Medical College in Nashville. Approximately four million Americans have Alzheimer's and it is estimated that 14 million will have the disease by the middle of the next century unless a cure or prevention is found.

Stephen Scheff, Sanders-Brown Center on Aging, works to understand how the brain and spinal cord compensate after an injury. His research has important implications for Alzheimer's disease.

Nanoparticles Target Cancer Cells

Armed with therapeutic drugs, nanoparticles injected into the body move along in the bloodstream toward their target – a cancer cell. The mighty macrophages spot a few of them and gobble them up. But these nearly invisible legions of stealthy, infinitesimal specks make it past almost all the sentries, invade the target cell, and release their potent drugs, killing it. This scenario, which holds great promise for treating various cancers and fighting viruses like HIV, is being perfected by Russ Mumper and Mike Jay in the UK College of Pharmacy through their understanding of how to work at the ultra-small level of nanotechnology. "Why nanoparticles?" Mumper says. "Well, there's one primary reason. To be effective, more and more drug therapeutics have to be delivered to specific cells, tumor cells in the brain or in the liver, for example. It's kind of like a magic bullet. It's a way to target specific diseased cells without damaging healthy cells in the same neighborhood."

Russell Mumper (left) and Mike Jay in the UK College of Pharmacy have developed new and better ways to deliver drugs. They are pioneering the use of nanotechnology to package drugs in tiny spheres and send them to specific diseased cells in the body.

Eavesdropping on the Brain to Fight Parkinson's Disease

In their fight against the devastations of Parkinson's disease, Greg Gerhardt and UK anatomy and neurobiology colleague Don Gash are designing high-tech microsensors and electrodes that, implanted in the brain, allow the researchers to eavesdrop on the brain's most vital communications. "These sensors can give us new insights into how the nervous system works," says Gerhardt, who is director of UK's Center for Sensor Technology and the Morris K. Udall Parkinson's Disease Research Center of Excellence. Armed with such inside information, Gerhardt, Gash, UK hospital chief of staff Byron Young, UK Movement Disorders Clinic director John Slevin, and neurologist Charles Smith have developed a new treatment for Parkinson's. The treatment involves direct delivery of a protein that repairs damaged cells in the brain. A pump the size of a hockey puck is implanted in the abdomen, and the protein is delivered to the brain through tiny tubes. This procedure is the foundation of an ongoing Phase-I FDA-approved clinical trial in 10 patients with advanced Parkinson's disease. Results of this trial will be released in early 2004, says Gerhardt. Efficacy trials, with a much larger pool of patients, are under development.

Greg Gerhardt, director of UK's Parkinson's center of excellence, works with anatomy and neurobiology doctoral candidate Matt Joyce (left) on sensor technology. Gerhardt's work is supported by $1.5 million a year in external funding.

Program Helps Type 2 Diabetics

Diabetes is a silent killer, and in the United States obesity is its accomplice. Ninety percent of people with Type 2 diabetes are overweight. "Type 2 diabetics were typically people over 40, but now many adolescents are developing Type 2," says James Anderson, a professor of medicine and clinical nutrition at UK. "We are seeing a huge increase in diabetes in teens in Kentucky." But Anderson and L. Raymond Reynolds, an associate professor of internal medicine at UK, are working to reverse these statistics.

In a recent study, they found that 21 obese patients with Type 2 diabetes taking insulin who underwent a targeted lifestyle program gained dramatic health benefits, including improved blood sugars, lower blood pressure and reduced abdominal fat. The program was based on a 1,500 calorie/day diet and 40 minutes of moderate walking each day. "When we started, their average weight was over 200 pounds," Reynolds says. "At 12 weeks, the group averaged a loss of over 15 pounds, and by 24 weeks, 18 to 20 pounds."

Although this program focused on adults, it is also applicable to adolescents, Anderson says. Anderson and Reynolds are now incorporating these same strategies in the management of overweight and obesity in their clinical practices.

"While many factors contribute to the development of diabetes, obesity or excessive weight gain is the major factor," Anderson adds.

University of Kentucky

Seeing the Future: UK's Visualization Center

Visualize this: Two surgeons are about to operate on a woman with brain cancer. But they don't need cumbersome X-rays or CT scan printouts. Instead, they see projected on the wall in front of them a highly detailed image of the patient's brain. And with a wave of a hand, they can change the size and angle of any area they need to discuss. UK's new Visualization Center is perfecting the technology so that such a scenario may soon be commonplace. Video projectors hung from the ceiling, graphics, network cards, and PCs interact to create this immersive environment.

"Immersive visualization is all about removing the barriers to communications," says Brad Carter, director of UK's new Visualization Center. "We're working to create a seamless environment where we can interact with objects and with each other."

The center is an outgrowth of recent work spearheaded by UK's Christopher Jaynes and Brent Seales in computer science, who have created a digital world that mimics reality through innovations in networking, multimedia and computer vision. And although the center is still in its formative stage, it has already entered into partnerships with Lexel Imaging Systems Inc. at UK's Coldstream Research Campus, Arch Vision in Lexington, and the Ft. Knox battle laboratory. UK electrical engineering faculty are also involved in Visualization Center projects with Lexmark and Toyota.

"Visualization is as essential to engineers and scientists of the 21st century as was the microscope and telescope to researchers in previous centuries," according to Bruce Walcott, UK associate dean for economic development and innovations management, "the applications are limitless."

Mass-Producing Nanotubes

For 15 years, the Carbon Materials Group at the UK Center for Applied Energy Research (CAER) has been developing technologies to produce high-value carbon materials from Kentucky's fossil resources.

For the past several years, the group led by Rodney Andrews has focused on synthesis of multiwalled carbon nanotubes. Measured in nanometers – a billionth of a meter – a nanotube is a hexagonal network of carbon atoms rolled up into a seamless tube. Because nanotubes have unusual strength and high electrical/thermal conductivity, scientists and industry are eager to mass-produce them.

The process developed at CAER yields nanotubes suitable for applications ranging from reinforcing polymer composites to conductive plastics, flat-panel displays and energy storage. This process trumps other production methods, which often give low yields, and poor alignment and purity. CAER's pilot-scale reactor produces 1.25 kg/day. Andrews is seeking industry partners.

Shaping the Future of Software

(From left) Trevor Barnett, Sarah Howard, Jane Hayes, Karthik Ramkumar, and Ramkumar Singh talk about life-cycle models for software development in CS616, one of three graduate-level software engineering courses Hayes has created since coming to UK in 2001.

After 17 successful years in industry, Jane Hayes has made UK her new professional home. And she has a clear goal for the software engineering program she's creating: design software to further UK research and empower students to tackle real-world problems. Hayes is addressing these problems through ongoing research on the process through which software is designed, assessed and redesigned. And programs used by NASA and other industrial partners, as well as software written by her own students, are the subjects of her work. Past projects include software for a PDA that incorporates the USDA nutritional database to help people with phenylketonuria, a rare metabolic disease, keep track of what they eat; software that uses positive feedback for children with speech problems so kids will be enticed to do speech therapy at home; and software that uses color recognition to automatically distinguish between bone, marrow and soft tissue for surgeons interested in bone growth factors and regeneration.

Reducing Waste in Machining Aluminum Wheels

Central Manufacturing Company (CMC), located in Paris, Kentucky, had a problem, so they came to UK's Center for Manufacturing for help. CMC produces cast aluminum wheels for automobiles. In order to produce the appealing and maintenance-free shiny surfaces on the wheels, CMC machinists typically used a contour turning process that produces "hard chips." These long metal ribbons or spiral coils cause hairline scratches on the surface of the wheels. With CMC funding, I. S. Jawahir in the Department of Mechanical Engineering and graduate research assistants Shi Chen and David Troutman developed a model for predicting the cutting force and chip flow direction in contour turning. They found that the most desirable solution for the chip flow problem was to design a chip-groove feature on the tool face. Such prototype tool inserts were produced for CMC, which has reported significant improvements in chip flow patterns.

I. S. Jawahir, the James F. Hardymon Chair in Manufacturing Systems, and Graduate Research Assistant Shi Chen solved an aluminum wheel production problem for Central Manufacturing Company in Paris, Kentucky.

Countering Bioterror

As the threat of bioterrorism became alarmingly real after 9/11 and as the anthrax outbreak a month later illustrated, public education is one of the key steps to reduce the panic associated with infectious diseases. One important part of that education is gaining basic knowledge about "Category A" biological agents.

Susan Straley and Robert Perry, professors of microbiology, immunology, and molecular genetics, are leading the pneumonic plague program for the Southeast Region Emerging Infections and Biodefense Consortium. Research to fight infectious microbes is also under way in other UK labs. Richard Greenberg, a professor of infectious diseases, is leading the first clinical trial of a new smallpox vaccine developed by Dynport Vaccine Company, the vaccine contractor for the military. His Vaccine Trial Evaluation Group is also leading a clinical trial for an anthrax vaccine and doing Phase II testing of another smallpox vaccine. Other UK researchers are developing biodefense strategies for the food supply and training first responders.

Shown here with Research Analyst Tanya Myers, professor Susan Straley is one of two UK researchers in the Department of Microbiology, Immunology, and Molecular Genetics responsible for the pneumonic plague program for the Southeast Region Emerging Infections and Biodefense Consortium. Straley and Robert Perry are heading up projects to identify components of the plague bacterium that can be targeted by new vaccines and therapeutics.

Scientists Create Clean Energy

Clean Fuels Research

Research on fossil fuels by the Clean Fuels Group at the Center for Applied Energy Research focuses on:

- the catalytic conversion of coal-derived synthesis gas to make environmentally friendly, sulfur-free fuels
- converting fossil fuels into hydrogen (a reforming process) and utilizing renewable energy systems, which use sunlight to produce hydrogen from water
- using hydrogen to run fuel cells and developing novel sensors
- working on nanotechnology-enhanced improvements to catalysis, which will help the efficiency of the extraction and consumption of fossil fuels or solar energy
- providing materials and testing for advanced energy storage and conversion devices, and researching issues facing developers and manufacturers of nano-scale materials

Premium Fuel from Coal Waste & Sawdust

UK scientists have joined with two of Kentucky's biggest industries to create a premium fuel from coal and timber waste. B.K. Parekh and Darrell Taulbee from the Center for Applied Energy Research, along with researchers in UK's mining engineering department, are using advanced separation technologies to obtain coal from refuse ponds. The coal will then be dewatered to moisture levels lower than current technologies can manage, and this is where sawdust comes in.

Studies have shown that the addition of sawdust improves filtration properties of the coal, yielding a product with less moisture. If successful, the process will produce a fuel with an energy value of over 9,000 Btu/lb. The state could realize a significant annual energy recovery of sawdust and fine-coal currently being disposed of. Two coal and lumber companies are assisting UK scientists by supplying materials and acting as technical advisors to the project.

Running on Hydrogen: Car of the Future?

UK researchers are joining scientists nationwide in an effort to develop an automobile that will run on hydrogen, an energy source that could revolutionize transportation. UK's Consortium for Fossil Fuel Science is in the fourth year of a DOE-sponsored program to produce ultra-clean transportation fuels. "Hydrogen gas replaces petroleum," says Gerald Huffman, consortium director. "One advantage of this, especially in Kentucky, is that we can get the hydrogen from fossil fuels." In the approach developed at UK, hydrogen is catalytically extracted from gasoline, diesel, or other liquid fuels. The gaseous hydrogen is then directed to a fuel-cell stack that generates electricity from it to power the motor. As the car runs, it produces only water, which is exhausted into the air. Huffman says that a major development in this work at UK is that consortium researchers have figured out how to produce hydrogen in a single step. "Before, it's been a complicated process involving three or four separate steps," he says. The federal government hopes that by 2015 hydrogen-powered cars will be on the market.

Western Kentucky Quake Zone

No one can predict when the New Madrid Seismic Zone in Western Kentucky will come alive again. But homeowners, business, emergency-response planners, engineers, and government officials need scientifically sound assessments of earthquake hazards and risks. These assessments are used to establish design specifications for earthquake-resistant buildings and bridges, and rates for insurance premiums. For the past 23 years, a wealth of data has been gathered by the Kentucky Seismic and Strong-Motion Network, operated by UK's Department of Geological Sciences and the Kentucky Geological Survey. The network has 21 stations that monitor any earthquake occurring in or around Kentucky with a magnitude greater than 2.0, as well as earthquakes in the central United States. The UK network is the largest in the United States outside of California.

For more, visit www.uky.edu/KGS/geologichazards/kssmn.htm.

University of Kentucky

Markey Cancer Center: People Helping People

Cancer is the second leading cause of death in the United States. Kentucky has the highest incidence of lung cancer in the nation: more than 3,000 Kentuckians die from lung cancer each year. For the past 15 years, the University of Kentucky's Markey Cancer Center has been a leader in cancer prevention and control, basic research and clinical investigations. Our cancer research program brings $18 million annually into the state from federal and other outside sources, funding nearly 90 grants and contracts in cancer-related areas led by 60 researchers across campus. The goal of all of our research programs – only a very few of which are described below – is to reduce or eliminate the impact of cancer on patients and their families. Patient care is provided by integrated multi-specialty faculty teams, all with links to clinical and laboratory research programs.

— **Dr. Alfred M. Cohen**
Director, Lucille P. Markey Cancer Center
Markey Foundation Chair
Professor of Surgery

Natasha Kyprianou, professor of urology, molecular biochemistry and pathology, hopes her research will lead to novel treatments for patients with advanced prostate cancer. Kyprianou works with Anastasios Tahmatzopoulos, visiting scholar from Greece, and Research Associate James Partin.

Lung Cancer Recurrence Vaccine

Eighty percent of people diagnosed with non-small-cell lung cancer, the most common form of lung cancer, will die from the disease. For the vast majority of these lung-cancer patients, chemotherapy and radiation are the only treatment options, and the cancer is rarely cured.

Even when patients undergo surgical resection, recurrence rates approach 50 percent. UK's John Yannelli and Edward Hirschowitz in the Department of Internal Medicine are working on an experimental vaccine that offers hope for non-small-cell lung-cancer patients. The two-year clinical trial will involve 30 patients who have already undergone surgery, radiation or chemotherapy.

Some of the patient's own white blood cells, called dendritic cells, are mixed with cancer proteins to make the vaccine. The vaccine directs the immune system to kill cancer cells. The researchers believe that the immune cells will circulate throughout the body and attack tumor cells while leaving normal cells intact.

Cancer-Killing Genes

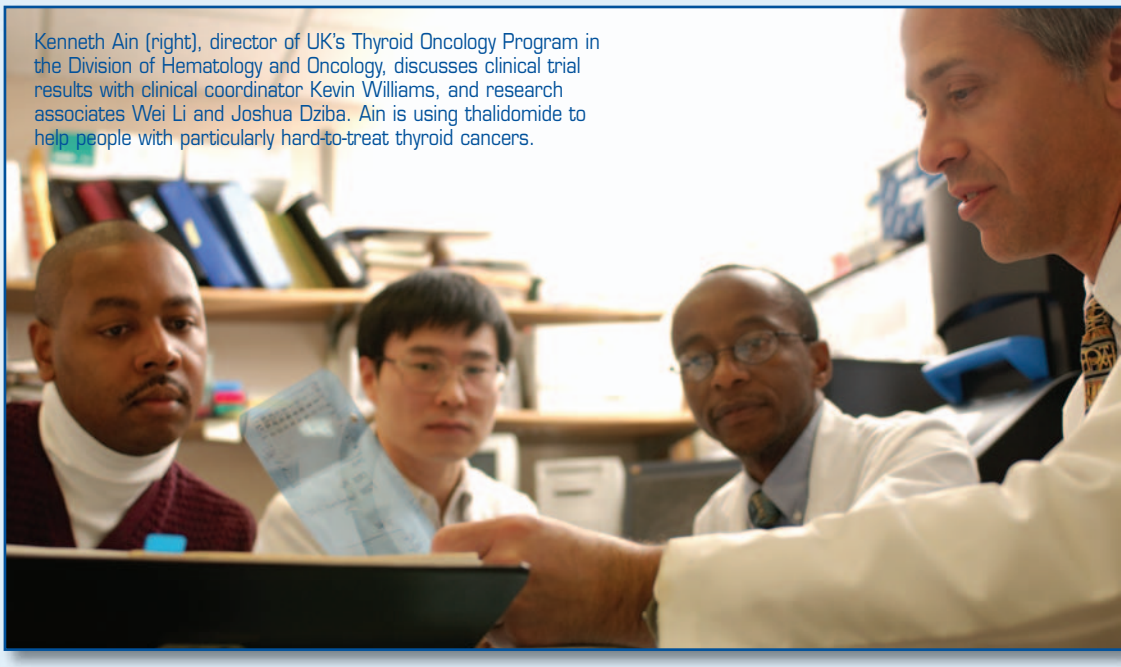
On the lookout for cancer killers, molecular biologist Vivek Rangnekar and his research group found just what they were looking for. During a search for cancer-killing genes, the researchers identified a gene, Par-4, that selectively kills most cancer cells but not normal cells. Cancer cells derived from lung cancer, prostate cancer, breast cancer, and melanoma have been studied so far, and have been found to be susceptible to the action of Par-4. By delivering this gene into solid tumors in animals, the scientists succeeded in causing rapid shrinking in the size of tumors. The researchers are also combining Par-4 with radiation therapy and chemotherapy to cause maximum regression of tumors. It is estimated that it takes between four to eight years before work that begins in labs is tested in humans.

Selective Cell Death Combats Prostate Cancer

Natasha Kyprianou, the James F. Hardymon Chair in Urology Research, and her team are working to better understand two diseases of the aging human prostate: prostate cancer and benign enlargement. Cancer is uncontrolled cell growth. Normal growth of the prostate gland is maintained by a balance between cell proliferation and cell death that is regulated by an interactive signaling between hormones and growth factors. During tumor growth an imbalance in these signaling pathways results in reduced cell death. The researchers are triggering tumor-selective cell death by targeting specific events in its progression, which can provide the genetic basis for new therapies. Successful identification of key regulators of cell death will lead to novel treatments for patients with advanced prostate cancer and to diagnostic markers of tumor progression.

Repairing Cancer-Caused Spinal Injury

One of the most dreaded complications of cancer occurs when the tumor spreads to the spine. Spinal cord compression affects up to 15 percent of cancer patients, and even with radiation therapy most of these patients became paraplegic. A recently completed NIH-funded clinical trial has radically improved the outcome of cancer patients with spinal cord compression. The study, led by Roy A. Patchell, chief of neuro-oncology at UK, compared radical decompressive surgery plus radiation to radiation alone. The study was halted at the midway point because of an overwhelmingly positive result favoring surgery. Surgically treated patients were able to walk four times further than patients treated with radiation alone. Patients who could not walk when the study began were three times more likely to walk again after surgery. There was also a 12-fold reduction in the need for narcotic pain relievers in the surgical patients.



Kenneth Ain (right), director of UK's Thyroid Oncology Program in the Division of Hematology and Oncology, discusses clinical trial results with clinical coordinator Kevin Williams, and research associates Wei Li and Joshua Dziba. Ain is using thalidomide to help people with particularly hard-to-treat thyroid cancers.

Detecting Early-Stage Lung Cancer

In a pilot study targeting Kentucky's Appalachian region, Andre Baron in UK's School of Public Health and his team are working to detect early-stage lung cancer. Focusing on counties in northeastern Kentucky – Boyd, Carter, Greenup, Elliott, and Lawrence – the researchers plan to determine if common procedures such as CT scans can be improved through a highly specific blood test. At the UK Chandler Medical Center, Baron is also looking at both lung-cancer-specific and more general "protein" markers. High-technology proteomics equipment allows separation of many thousands of proteins in patients' blood. In the future, Baron hopes CT scans and blood-marker tests will become standard in lung cancer diagnosis and prognosis.

Fighting Leukemia

Leukemias and lymphomas together are the third leading cause of cancer death in Kentucky and in the United States. Now backed with a grant from the NIH, Subbarao Bondada and his colleagues from the Department of Microbiology, Immunology and Molecular Genetics are using transgenic mice to study genes and immune cells that affect the growth of lymphomas. UK researchers are also continuing work on a common therapy for leukemia – bone marrow transplantation – to discover how it can be made more effective to treat certain forms of leukemias.

Targeting Hard-to-Treat Thyroid Cancer

Thyroid cancer researcher Kenneth Ain is enlisting the aid of a drug with a once-despised reputation: thalidomide. Half a century ago, some pregnant women who took thalidomide as a sedative gave birth to babies with missing or shortened limbs, and the drug was banned. However, Ain, director of the Thyroid Cancer Research Laboratory at the Lexington Veterans Affairs Medical Center, believes the drug can help people with particularly hard-to-treat thyroid cancers. Ain and his team are conducting a clinical trial using thalidomide to treat two types of thyroid cancers unresponsive to radioiodine, the traditional treatment. Of the first 17 patients who took the drug daily, 13 experienced either a plateau or a decline in tumor size, and for half of these patients benefits continued for seven months. The patients lived approximately four and a half months longer than those who did not respond to the thalidomide. Since then, Ain has seen similar results with a larger number of patients. Clinical research like this starts with a small number of patients and then grows, each time adding to the knowledge of the safety and effectiveness of the therapy before it is made available to the public.

For more information on UK's Markey Cancer Center, see www.mc.uky.edu/markey.

University of Kentucky

Coldstream Research Campus: Cultivating a Spirit of Growth

The University of Kentucky has launched a new era of development at our Coldstream Research Campus. Coldstream's role in establishing new science and technology-based businesses has been redefined and reestablished under the umbrella of the university's new research and economic development administration.

Coldstream's new executive director will provide a strong link between the university's intellectual capital and high-tech startups while facilitating the relocation or expansion of a mix of established commercial businesses.

Another exciting development was the recent groundbreaking for UK's new $12 million Center for Pharmaceutical Science and Technology building, scheduled to open in March 2005. We invite you to read more about the CPST, which was established as a Center of Excellence at UK in 1986, and the plans for the new facility at Coldstream in this feature.

We are excited about the new spirit of growth at UK's Coldstream Research Campus.

— Dr. Wendy Baldwin
Executive Vice President
for Research

Nearly 800 people are employed at Coldstream in a mix of science and technology-based businesses and service/retail support businesses.

About Coldstream

The UK Coldstream Research Campus is the location for the University of Kentucky's development of knowledge-based firms. Once a prominent Bluegrass horse farm, today's Coldstream provides a synergetic research campus environment for science and technology-focused businesses, and University of Kentucky faculty, staff and students.

Coldstream is located just minutes away from the campus of the University of Kentucky. UK is one of the few universities in the country that include the colleges of agriculture and engineering along with a complete medical center in one central location. UK has a strong, dynamic multidisciplinary research enterprise and an emphasis on emerging technologies that is reflected in the university's patent portfolio in the areas of pharmaceuticals and therapeutics, plant biotechnology, and environmental energy and manufacturing technologies.

Owned and operated by UK, Coldstream is situated on 735 acres in the heart of the beautiful, pastoral Kentucky Bluegrass. The master plan for Coldstream emphasizes the attractive natural setting of the site, including 225 acres of open space for recreation such as walking, jogging and biking. Coldstream is conveniently located at the crossroads of I-75 and I-64, and is within a day's drive or overnight shipment to 75 percent of the nation's businesses. The property is bounded on the north by I-75/I-64 and accessible from Exit 115.

Coldstream and President Lee T. Todd Jr.

In 1981, while a UK professor of electrical engineering, Lee Todd

UK's new $12 million Center for Pharmaceutical Science and Technology for sterile drug manufacturing will open in March 2005. UK will continue non-sterile product manufacturing at the CPST facility on campus shown here.

founded Projectron Inc. to manufacture projection cathode ray tubes (CRTs) for the flight-simulation industry. The Projectron picture tube was used in approximately 90 percent of commercial flight simulators as well as numerous military simulators. In 1990, Projectron was sold to Hughes Aircraft Company. Dr. Todd convinced Hughes to move its other CRT operations in California and New York to Kentucky. He worked with the University of Kentucky and state government officials to start UK's Coldstream Research Campus with Hughes Display Products as the first tenant. The 165,000-square-foot research and manufacturing facility for Hughes Aircraft, now known as Lexel Imaging Systems, is still a tenant at Coldstream.

Kentucky Technology Center

The University of Kentucky calls Coldstream's Kentucky Technology Center the "mini-campus." This portion of Coldstream, consisting of 27 acres, was established as a nexus for new technology-based companies that also require limited space, such as start-ups from UK. Currently a complex of six buildings, the Kentucky Technology Center when completed will be seven multi-tenant buildings with a total of nearly 110,000 square feet of laboratory and office space. The current 10 tenants include a variety of engineering and life sciences companies (see Coldstream tenants list identified as KTC).

UK's CPST Expands to Coldstream

On its hopeful way to FDA approval, a drug is poked and prodded, weighed and measured. Every move it makes is analyzed and reanalyzed. The process is tricky, time-consuming and daunting. But at UK's Center for Pharmaceutical Science and Technology (CPST), this process is streamlined in the manner of one-stop shopping.

And clients like university researchers, biotech companies, pharmaceutical companies, and the NIH will soon have two locations to shop: the current CPST facility in the College of Pharmacy building on UK's campus for non-sterile product manufacturing and the new location at Coldstream for sterile manufacturing.

UK broke ground on the $12 million CPST facility at Coldstream in December. The 20,000-square-foot manufacturing center is scheduled to open in March 2005.

"We can work with anyone from the idea stage all the way through Phase I and early Phase II manufacturing of a drug for clinical trials," says Mike Jay, director of the center and a professor in UK's College of Pharmacy.

The CPST, which opened its doors in 1986, has formulated drugs into injectable liquids, freeze-dried products, tablets and capsules, and dermatological products, and has produced up to 5,000 units at a time. UK is one of only two university-based, FDA-registered pharmaceutical manufacturing centers with the unique ability to freeze-dry products. To date, the CPST has completed over 200 contract projects.

"We hope to add more than 40 staff to the new center in the next 12 to 18 months," says Frank Manella, CPST managing director, "and if things go according to plan, we could be up to around 100 staff at Coldstream by 2007."

He adds that the CPST has increased client billings from $200,000 in 1996 to $1.5 million last year. "And we plan to take it even higher – to $10 million by 2007."

Ken Roberts, dean of the College of Pharmacy, says he hopes the CPST's new facility at Coldstream will entice the building of commercial manufacturing facilities at the research campus, as well as provide the opportunity for pharmaceutical scientists educated at the College of Pharmacy to put their skills to work right here at home. "Historically, too many of the top College of Pharmacy's Ph.D. graduates leave Kentucky for pharmaceutical manufacturing jobs, and we'd like to see that stop," he says.

UK Coldstream Research Campus Tenants

UK's Coldstream Research Campus enjoys a mix of science and technology companies as well as service/retail support businesses. Kentucky Technology Center tenants are identified as KTC. Approximately 800 people are employed at Coldstream.

- Century Exploration Company
- E&H Integrated Systems (KTC)
- Embassy Suites Hotel Lexington
- EnviRes L.L.C. (KTC)
- Fovioptics Inc. (KTC)
- HDM Pharmacy L.L.C. (KTC)
- IBM Global Services
- IDEXX Veterinary Services Inc., dba Equine Biodiagnostics (KTC)
- Intranasal Technology Inc. (KTC)
- Kentucky Center for Education and Development
- Kentucky Technology Inc.
- Lexel Imaging Systems Inc.
- Maharishi College of Vedic Medicine
- PEH Engineers/Strand Associates (KTC)
- Secat Inc. (KTC)
- Sterling Ventures L.L.C. (KTC)
- Transcendental Meditation Program
- Tribo Flow Separations L.L.C. (KTC)
- UK Livestock Disease Diagnostic Center
- Veda Design L.L.C.

For more information on UK's Coldstream Research Campus, visit www.uky.edu/Coldstream.

University of Louisville

Proteomics Peeks into Disease

U of L is helping scientists unlock key to diseases

For more than a decade, the Human Genome Project charted the human body's 34,000 genes. Genes can produce an untold number of proteins – estimated to range from 500,000 to 2 million – that help carry out our bodies' most basic functions.

When something goes awry, disease can occur. But the project raised more questions than it answered.

That's where a proteomics scientist such as Dr. Jon Klein comes in.

Klein is director of the University of Louisville's Core Proteomics Laboratory and, according to the readers of Genome Technology magazine, one of the most influential people in his field.

"Ultimately it is the proteins that do the work in cells," he says, "so if we are going to study abnormalities in the human body we need to understand the accumulation of abnormal proteins that cause the mechanisms of disease."

New technology such as that found in U of L's proteomics laboratory soon will be able to "drill deeper" into the human proteome. The lab was the first of its kind on a college campus when it opened in 1997 and remains one of the nation's most advanced.

Currently, the lab develops and applies state-of-the-art techniques to study proteins. For example, Klein says a sophisticated two-dimensional gel electrophoresis process was recently used to help researchers examine proteins in the kidneys of a patient with high blood pressure. They found a big decrease in a protein that causes blood vessels to relax.

"With proteomics we can get right to the levers that move the cell around and cause diseases," he explains.

The proteomics lab currently is collaborating on this and other research with 13 U of L faculty members, eight faculty at universities across the country and one professor in Berlin. It has received major grants from the National Institutes of Health and the Veterans Administration.

In addition, the Kentucky Office for the New Economy is funding a facility on the Health Sciences Campus where Klein trains professors from all Kentucky universities on proteomics. The goal is to enable them to do better research when they return to their home institutions.

Drug companies are very interested in proteomics, too, and for good reason, Klein notes.

"We hope proteomics will help us understand disease mechanisms a lot faster and shorten the time to develop new therapies."

Dr. Jon Klein prepares protein samples for analysis at U of L's Core Proteomics Laboratory.

Tom Fougerousse, U of L photo

For more information,
go to http://kdpnw.kdp-baptist.louisville.edu/proteomelab/about.htm

University of Louisville

Finding the Answers

U of L researchers making strides against cancer

U of L's James Graham Brown Cancer Center is charting a course of unprecedented achievement under Donald Miller's (pictured) guidance.

Two recent grants are helping the University of Louisville's James Graham Brown Cancer Center make significant leaps toward a major goal – attaining designation by the National Cancer Institute (NCI) as a comprehensive cancer center.

In September, five investigators at the center received $11.1 million from the National Institutes of Health Center of Biomedical Research Excellence (COBRE) program. Then in November the Kentucky Office for the New Economy announced that it was awarding the center a one-year, $2 million grant to advance its cancer research.

The comprehensive cancer center designation is important for what it means to cancer research and patients as well as the region's economy. It is awarded to a select few centers in the nation that have demonstrated excellence in research, education and patient care.

The National Cancer Act of 1971 created the Cancer Centers Program to encourage major institutions to build multidisciplinary research programs designed to reduce the number of cancer-related cases and deaths each year. Comprehensive cancer centers are the highest ranking of these and offer the broadest range of services, including research-basic, clinical, and prevention and control, along with a strong body of interactive research bridging these areas.

In addition, the centers provide information, outreach and education to health-care professionals and the lay community. Best of all, they offer area patients access to the latest cancer treatments and care.

U of L's COBRE grant recipients will use their funds for projects covering a gamut of cancer-related work including groundbreaking X-ray crystallography technology that allows them to examine cancer-related molecules in three dimensions. Sen. Mitch McConnell secured equipment that will help the investigators carry out their research under the $11.1 million grant.

Along with the therapeutic impact of the researchers' work are the economic dividends it brings to the state. Aptamera, a Louisville biotechnology company founded by U of L's Paula Bates, John Trent and Donald Miller (director of the Brown Cancer Center), is just one such entrepreneurial outgrowth.

In September AGRO 100, a new treatment developed by Bates and Trent, was given to a human at the Brown Cancer Center. The trial, which has now completed its enrollment, is the first human testing of new compounds called GROs (guanine-rich oligonucleo-tides).

"Laboratory tests show that GROs work by a new mechanism that is completely different from other agents currently used to treat cancer," Bates says. "These compounds are very effective in blocking the growth of cancer cells, but have little effect on the growth of normal cells."

"If we can prove that the drug is safe, effectively stunts tumor growth and causes fewer unpleasant side effects for the patient, we will have won a significant battle in the war on cancer," Dr. Damian Laber, a U of L medical oncologist and principal investigator of the trial, adds.

The GRO is just one of the technologies being developed by Aptamera.

Note: The University of Louisville Research Foundation and Donald Miller hold a financial interest in Aptamera. Multiple steps to ensure patient protection and research integrity have been taken consistent with the university's policy for oversight of institutional financial interests in research.

For more information, go to http://www.louisville.edu/hsc/news/RECORD-BREAKING_11_1_MILLION_GRANT.shtml

University of Louisville

Boosting the Learning Curve

Research helps children do their best

Educators at the University of Louisville are helping to maximize our children's learning potential by researching learning disabilities and development in infants and young children. They also are looking at new ways to teach old subjects and help children learn better overall.

Dennis Molfese, chair of the psychological and brain sciences department, and Bucks for Brains faculty member Victoria Molfese, director of the Interdisciplinary Center for Research in Early Childhood Issues and Initiatives, for example, have been assessing newborns' brain waves to see how the babies respond to speech and non-speech sounds.

This enables them to identify at birth nearly 80 percent of the children who will develop language or cognitive disabilities later in life and allow earlier intervention with a much better chance of success.

Their work is being supported through funding secured by Rep. Anne Northup and Sen. Mitch McConnell.

Professor Carolyn Mervis also is studying language and cognitive development in children with developmental disabilities such as Williams and Down's syndromes. Her research has helped clarify the relationship between language and cognition and led to changes in early intervention strategies that should help these children reach their full intellectual potential.

Victoria and Dennis Molfese map preschoolers' mathematics, reading and language skills to assess their developmental status early on.

Tom Fougerousse, U of L photo

Psychology professor Barbara Burns is yet another U of L researcher doing early childhood studies, examining how attention and cognitive development might be delayed due to a child's growing up in poverty or by a medical condition such as lead poisoning. She and the Jefferson County Schools/ Head Start have partnered up to identify early signs of attention deficit in 3-year-olds and how this might later affect the child's adjustment to school and academic achievement.

Solving the Problem

Solving a major math problem – the dire need for more and better mathematics and science teachers in America's classrooms – also is a concern of U of L researchers.

A new center that opened last year at the College of Education and Human Development is helping universities produce better-prepared teachers in those areas and creating programs to help current math and science teachers become more proficient. Among the goals of the Center for Research in Mathematics and Science Teacher Development are conducting research on mathematics and science teacher development and building model programs for teacher development.

Currently the center is working with colleagues at the University of Tennessee, Ohio University, Marshall University, the University of Kentucky and the Appalachian Rural Systemic Initiative to better prepare teachers in Appalachia. The strategy uses a combination of advanced degree programs in math education throughout the region and research connecting mathematics and rural education. It also hopes to spur mathematicians, educators and classroom teachers in collaborating on creating innovative courses and programs.

In addition, the center is working with the Jefferson County Public Schools and the Ohio Valley Educational Cooperative to recruit more math and science teachers into the area and enhance teacher education programs at U of L.

Funding for the center, directed by mathematics education professor Bill Bush, has been provided by the National Science Foundation, the U.S. Department of Education and other federal sources. To date, Sen. Mitch McConnell has secured two rounds of earmarks to support the center and its work.

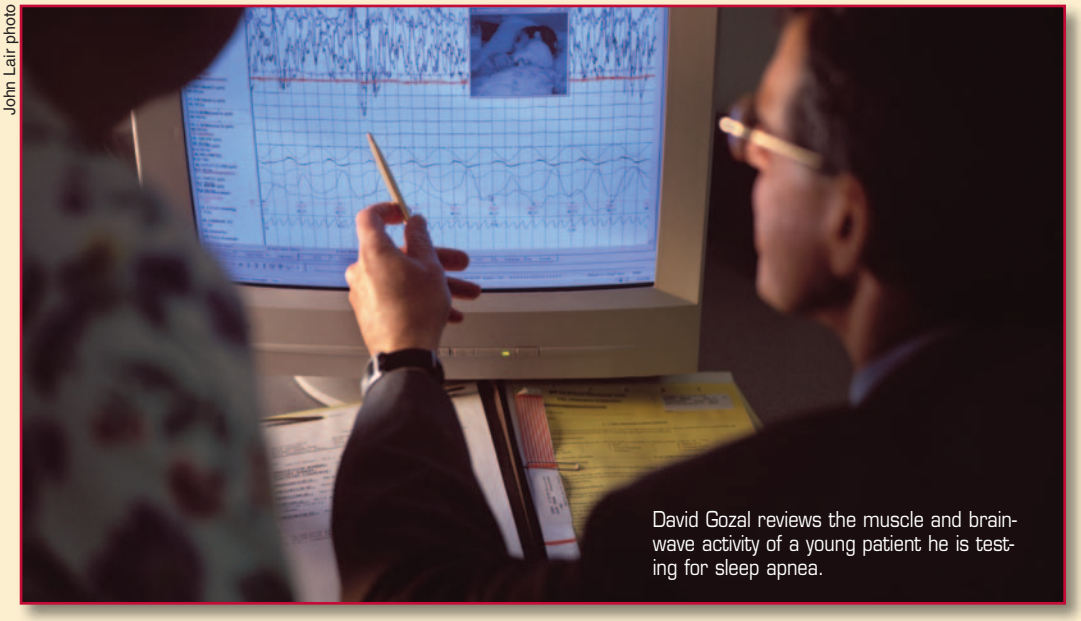
For more information, go to http://www.louisville.edu/home/schools-depts.html#cehd

University of Louisville

Improving Children's Health

Kids come first in U of L studies

John Lair photo



David Gozal reviews the muscle and brain-wave activity of a young patient he is testing for sleep apnea.

If you think snoring is funny, don't tell David Gozal. His research into children's sleep disorders shows that snoring can lead to behavioral problems and learning deficiencies.

His program is one of many at U of L intent on bettering our children's health.

Sleep apnea, caused mostly by large tonsils or adenoids that block the airway during sleep, affects about 2 percent of all children. While snoring is the main symptom, the body's level of oxygen also declines, Gozal explains.

"When that happens a child awakens, takes a breath and goes back to sleep. The cycle can occur up to 700 times a night and leaves its victims feeling very fatigued.

"We're dealing with a major epidemic that people don't recognize," he adds, "one with major consequences from lower intelligence and self-esteem to hypertension, strokes and heart attacks."

As director of the Kosair Children's Hospital Research Institute at U of L, Gozal is leading a group of researchers in determining whether removing the tonsils or adenoids of affected preschoolers can cure sleep apnea and, thus, eradicate learning deficiencies. Preliminary findings show they're on the right track.

But it's a tricky call, Gozal says. If the diagnosis is too late, the child loses a substantial number of IQ points no matter what you do. On the other hand, doctors don't want to perform unnecessary surgery, especially on young children.

"So we need to define exactly the cost-benefit ratio of when to intervene," he says.

Since coming to U of L in 1999 Gozal has built one of the country's top pediatric sleep clinical programs and grown the new institute's research budget to about $4 million annually, primarily through federal grants. Better still, he has helped scores of Kentucky children improve their sleep and, thus, their ability to learn.

But Gozal says he and the institute's other researchers are just warming up.

Gozal, for example, is examining other sleep-related problems including sudden infant death syndrome. The findings could lead to new drugs or therapies that protect the brain from sleep apnea without surgical intervention.

At the same time, Paul Epstein heads up a team studying childhood diabetes, including heart problems in those with severe diabetes.

Other research programs in pediatric cancer, developmental biology and outcomes research are expected to follow.

Both Gozal and Epstein occupy positions funded in part by the state's Research Challenge Trust Fund (Bucks for Brains). In addition, Sen. Mitch McConnell and Rep. Anne Northup have secured funding to support Gozal's research.

Cures for the Womb

While the Kosair Children's Hospital Research Institute is tackling health problems in young children, the U of L Birth Defects Center, under the direction of Robert Greene, is trying to prevent them entirely by treating problems before the child is born. The center's work is backed by the National Institutes of Health, the Centers for Disease Control and the Environmental Protection Agency. Sen. Mitch McConnell and Rep. Anne Northup also were instrumental in securing funding.

Researchers at the center focus on the most common birth defects in the United States today – those affecting the head and neck. Among the conditions being studied is cleft palate, which though rarely life-threatening is often part of a syndrome that can lead to more serious malformations including dental, hearing and speech problems.

"We're looking for genetic and environmental culprits that will enable us to consider intervention and, hopefully, prevention," says researcher M. Michele Pisano.

"We hope this research will result in a tangible improvement in our ability to diagnosis birth defects," Greene adds, "and lead to intervention strategies that result in reduction of the frequency of birth defects."

For his part, David Gozal thinks that few things would be more rewarding than to see U of L rise to the top of the pediatric research ranks.

"Children are our future," he says. "I think that is a worthy investment."

For more information, go to http://pediatrics.louisville.edu/load_division.php?division=div_kosair_children and http://www.louisville.edu/hsc/birthdefectscenter/

University of Louisville

Bigger Is Better

Ample high-tech research space aids U of L in attracting and spurring great researchers

Ironically, it sometimes takes a bigger building to make smaller high-tech devices.

When the University of Louisville opened its 1,000-square-foot Lutz Microtechnology Cleanroom in 1997, researchers finally had a proper environment in which to create devices smaller than a human hair for medical, industrial and military applications and more. In no time the lab was swamped with projects by scientists and students from across campus as well as industrial clients and academic researchers outside U of L.

Tiny devices, including bedside diagnostics, "invisible" microphones and detectors that can sniff out bombs are some of the technologies being developed.

And there's much more to come.

That's one reason why U of L continues to invest in state-of-the-art research facilities. All will serve as catalysts for high-tech startup businesses in the area. They include:

- The Belknap Research Building opening on Belknap Campus in 2005. The 106,000-square-foot, $41 million space will bring together more than 40 campus researchers conducting studies in nanotechnology, biomechanics, cellular biology, physics, cancer and genetics. Funding comes from the state of Kentucky, bonds and private donations. Federal support secured by Sen. Mitch McConnell will also help fund a new cleanroom there, seven times the size of that in Lutz Hall.
- The Donald E. Baxter, M.D. Biomedical Research Building, which opened in 1999 on the Health Sciences Campus (HSC) in downtown Louisville.
- The Delia B. Baxter Biomedical Research Building, which opened in 2003 next to the Donald E. Baxter building. The newest Baxter Building has more than 130,000 square feet on five levels and houses 48 wet labs, 48 support labs, conference facilities and an expanded Research Resources Center. It is home to teams conducting studies in aging, oncology, molecular cardiology, genetics and molecular medicine, bioengineering and pediatrics.
- Plans for another research building at HSC to support the growing needs for up-to-date space are currently under way.

U of L's research facilities also serve as catalysts for new high-tech businesses. The latest facility is being built on the main campus.

University of Louisville

Restoring Function

Undoing the devastation of spinal cord injury is U of L's goal

Researchers from the University of Louisville's neurological surgery department and the Kentucky Spinal Cord Injury Research Center are working to undo the devastation of spinal cord injuries.

Key to restoring a patient's function is finding a way to regrow the spinal cord. The U of L researchers are involved in several such efforts that show great promise.

For example, a research team headed by Scott Whittemore, the center's scientific director, is using a combination of cellular and molecular biology techniques to find how to grow and genetically manipulate cells needed to repair an injury. At the same time, clinical director Christopher Shields heads a lab focused on surgical intervention and new therapies to prevent cells in an injured spinal cord from dying in the days after the initial injury.

Xiao-Ming Xu is studying ways to repair an injured cord using microfabricated chambers filled with cells that regenerate when combined with the proper growth factors while Fred Roisen is looking into the therapeutic value to the central nervous system of stem cells grown from adult olfactory tissue cells (those in the nose). His long-term goal is to develop a procedure by which spinal cord injury victims or patients with neurodegenerative diseases can provide their own donor tissue.

Neurosurgery and anatomical science professor Stephen Onifer wants to bridge the gap at the damaged site by transplanting peripheral nerves so that they form a link across the injured site, while neurological surgery professor David Magnuson is researching circuits that control walking and how to replace injured neurons in the spine with cells that will allow the circuitry to function once again.

Whittemore, Shields and Xu are supported through the state's Research Challenge Trust Fund (Bucks for Brains). The center itself is funded through Kentucky's Spinal Cord and Head Injury Research Trust and several outside sources, including the university's first National Institutes of Health Center of Biomedical Research Excellence (COBRE) grant.

U of L's spinal cord researchers offer new hope to those with spinal cord injuries or disease.

Two of the center's four scientists who received the COBRE grant three years ago have since received their own NIH grants, worth nearly $2 million. This freed up their original funding to be used for funding two new scientists.

"COBRE funding enables established investigators like Whittemore to mentor others in focused research areas so they can develop collaborations and preliminary results to make them nationally competitive for individual research grants," says Nancy Martin, U of L's senior vice president for research. "Individual research grants are the bread and butter of university research funding and provide important resources for our research mission."

For more information,
go to http://www.kscirc.org/

University of Louisville

This Time With Heart

Cardiovascular innovation at the University of Louisville

The Cardiovascular Innovation Institute and breakthrough research in environmental cardiology are just two ways the University of Louisville is getting to the heart of the matter when it comes to improving Kentucky's quality of life.

With the institute, U of L, Jewish Hospital and Kentucky's Office for the New Economy are teaming up to study and treat heart failure, the only cardiovascular disease still on the rise in the United States.

There are more than 500,000 new cases and 300,000 deaths attributed to heart failure each year in the United States. Economically it is crippling, too – the American Heart Association estimates the cost to the nation will be $24.3 billion in 2003

Building on the successes of Laman Gray's work with ventricular assist devices (VADs) and artificial hearts, the institute will include an expanded research facility plus four floors of research, training and administrative space when it opens in early 2005.

"Our initial focus is to integrate biosensors with cardiac devices," explains Gray, the institute's medical director. "If we can get sensors to regulate devices such as pacemakers or VADs to better respond to increased demand for blood flow – for walking up steps, for example – then we'll vastly improve our patients' quality of life."

The institute's facility will be equipped with the latest technology through two appropriations from the U.S. Department of Health and Human Services secured by Sen. Mitch McConnell, along with another pending as seed money to support research there.

"The institute is the latest example of our commitment to leverage state dollars with federal and private funds," says U of L President James Ramsey. "This leveraging assures a higher and faster return on each entity's investment."

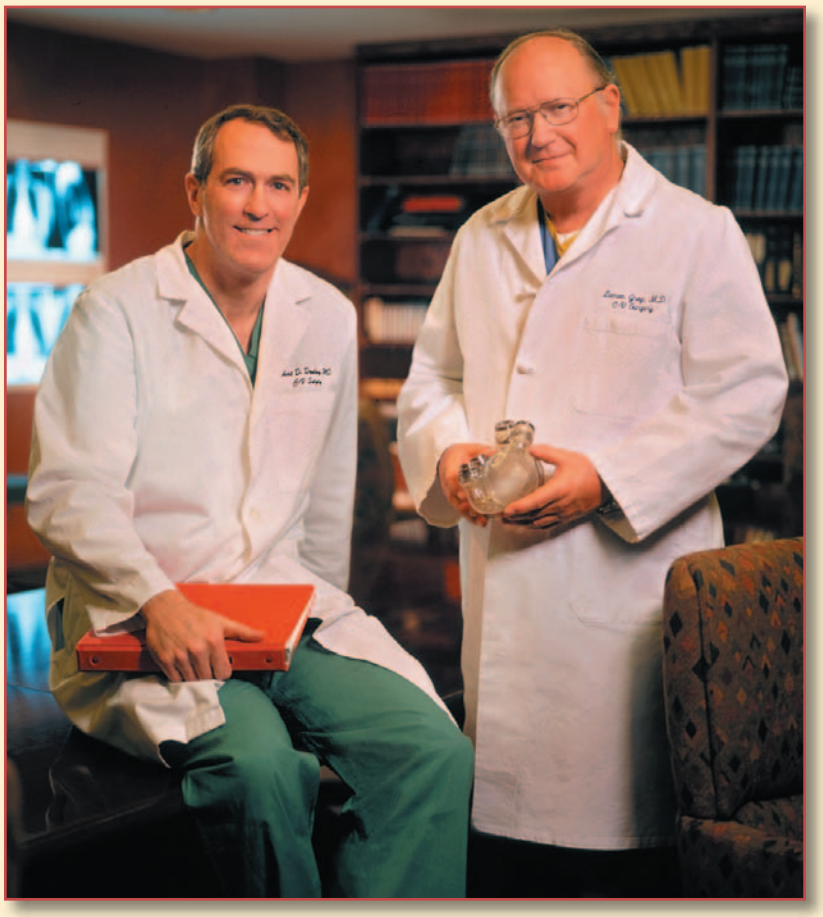
Birthplace of a Field

The university also is getting the most out of its first-ever National Institutes of Health Program Project Grant to support a new research discipline: environmental cardiology. The National Institute of Environmental Health Sciences awarded U of L the five-year, $7 million grant to fund four projects.

According to Aruni Bhatnagar, project leader and a professor of medicine in U of L's cardiology division, over the last decade studies have shown a relationship between air pollution and daily death rates.

"Of the 300,000 sudden cardiac deaths each year an estimated 60,000 to 80,000 may be linked to air pollution," he says. However, he adds, few studies have looked at how specific components of air pollution affect heart disease.

Each project funded by the grant involves determining the effects of different aldehydes on the heart. Aldehydes, a group of chemicals found in high quantities in exhaust fumes and cigarette smoke, make up more than 50 percent of the organic air pollution in most cities.



U of L's Cardiovascular Innovation Institute will build on the successes of doctors Laman Gray (right) and Robert Dowling and their colleagues.

Ramsey believes the program represents another milestone for the university.

To be selected as the scientific 'birthplace' for environmental cardiology – an entirely new discipline – demonstrates the level of research excellence and national recognition that U of L has achieved," he says.

For more information, go to http://www.louisville.edu/hsc/news/CII.shtml and http://www.louisville.edu/hsc/news/ENVIRONMENTAL_CARDIOLOGY.shtml

University of Louisville

Moving Businesses Forward

Businesses profit in many ways from U of L's logistics studies

Whether mapping traffic flow across the state, helping organizations find the information they need to make better business decisions or getting the goods from the warehouse to the consumer's house quickly, problem-solving in logistics and distribution is a key issue in today's commerce.

That's where the University of Louisville comes in. Its researchers are engrossed in several key projects designed to help businesses operate more efficiently. And that, of course, leads to higher profits.

U of L's multidisciplinary Logistics and Distribution Institute (LODi), for example, is helping regional businesses by collaborating with them on how to supply their products in a timely, cost-effective manner. The answers may lie in the way materials flow within a factory or how a semi-truck is routed cross-country.

LODi merges dozens of campus experts in engineering, business, geography, mathematics and more, as well as supports the Center for Engineering Logistics and Distribution (a National Science Foundation-sponsored endeavor) and the UPS Center for Worldwide Supply Chain Management. "E-logistics" and customer relationship management are just some of the areas the institute's members are investigating.

As an example of logistics and distribution's broad impact, consider the collaborative work being done by Grzegorz Kubicki in the department of mathematics and Waldemar Karwowski from industrial engineering. They are examining how health-care delivery costs can be lowered by finding ways that enable hospitals to treat all of the patients who come through their doors, rather than having to direct some of them elsewhere for lack of the proper diagnostic equipment or specialist on staff.

Logistics and distribution is also important enough to warrant its own graduate program. This fall U of L began offering a certificate in that subject with the primary mission of supporting employees of Louisville-area companies such as UPS.

Finding a Way

Then there is U of L's Center for Geographic Information Systems. It has been helping faculty, staff and students serve business, industry and government through research and expanded map-making expertise since 1996.

GIS can organize huge amounts of data to benefit civil engineering firms, public utilities, community planning agencies and others by assembling, storing, manipulating and displaying geographically referenced information. Determining floodplains and finding cost-effective solutions to infrastructural engineering problems are just some of the projects in which the center is engaged.

U of L's faculty in the computer engineering and computer science department also are involved in a number of research efforts that will support advanced logistics and distribution through improvements to electronic commerce. Among these activities are distributed Web-based data mining, enhanced computer security encryption and secure communications protocols, mobile computing and improved reliability of software for electronic commerce.

These examples of the university's work in logistics and distribution demonstrate just one more way in which U of L partners with others to move not only their own businesses forward, but the state's economy and welfare, too.

A new certificate at U of L supports area businesses that are involved in logistics and distribution.

Murray State University

More Than College Ivy

Murray's real-time investigations

"The curious mind is welcomed here," says Murray State University junior, Nick Rexing of Evansville, Ind. He's enjoying the kinds of telecommunications research that he had hoped to find when he crossed the river into Kentucky. According to the experts, students are more attracted to research that will actually be used by society. Such is the case for Rexing. From students to faculty to alumni, he is surrounded by real-life examples of Murray State researchers rising to scientific challenges.

In recent memory, MSU physics graduate, Dr. Gene Ray, provided the technology for eradicating anthrax from the U.S. mail and sterilizing food for American soldiers. His Titan Corp. moved to the forefront following 9-11.

Murray State University gained top national rankings from *U.S.News & World Report* and *Kaplan* for its academic quality and affordability. That recognized excellence is now being joined by the university's growing reputation for "practical" research.

The new Alexander Hall marked a renaissance at Murray State University. Research is now front and center.

Telecommunications Systems Research

In today's world, knowing what services are available is essential to prospective homeowners and business operators looking for a place to locate. That information is now just a click away thanks to the Kentucky GIS Project being conducted through the Center for Telecommunications Systems Management (TSM) at Murray State University.

Michael Ramage, TSM special projects coordinator, and Nick Rexing, junior TSM major, are conducting research for this project. They have designed a web page where individuals identify what telecommunications services are available.

"Since most businesses today need access to broadband for communications, this study is important to those interested in economic development," said Dr. Phil Sparks, interim director of the TSM Center.

Murray State University researchers Michael Ramage and Nick Rexing are building a computerized mapping system that quickly identifies Kentucky resources.

Investigations relating to neurodegenerative diseases and seizures have the attention of MSU researcher, Dr. Ramesh Gupta.

Sports Violence – Players and Fans

Dr. Dan Wann, professor of psychology at Murray State, is a nationally known researcher of the increase of violence in sports, from both players and fans. Most recently, Wann appeared on the FOX Sports Net discussing his research into the factors involved in sports violence (causes, consequences and strategies for reducing them).

While it's okay to identify with a team, the danger comes, Wann has found, when the identification becomes so strong that the fans step over the line from fan to fanatic.

His prescription for this psychological ill? Spectators should concentrate more on the event and less on the outcome. Ensured safety at sporting events makes good entertainment and business sense.

Political Systems and Education

Dr. Gene Garfield, associate professor in the department of government, law and international affairs, has recently co-authored a book on an investigation into the connection between politics and education.

Policy and Politics in American Education examines that connection, and builds understanding and ideas for advancing educational policy-making.

Agribusiness Research

Foot and Mouth Disease

The Breathitt Veterinary Center (BVC), a division of Murray State University's school of agriculture, is involved in a number of research projects that benefit agribusiness, with one of the high-profile projects being Foot and Mouth Disease (FMD).

An outbreak of Foot and Mouth Disease in England in 2001 resulted in the slaughter of four million sheep and cattle. The incident was of great concern in the United States Department of Agriculture because of its possible effect on U.S. food producers and the economy.

"It's care-to-detail at the Breathitt Veterinary Center," according to Lisa Willis, senior laboratory assistant.

England turned to a team of international researchers, including MSU's Dr. Wade Northington, to eliminate Foot and Mouth Disease.

Dr. Wade Northington of the BVC was one of the veterinarians chosen to study the problem. His research with FMD is an important asset for the food producers of Kentucky.

"The average farm in the Gisburn area had 1,000 sheep and 300 cattle," Northington said. "When you consider slaughtering the infected farm and all adjacent farms, the amount of animals involved is staggering."

It is easy to see that livestock slaughter such as Northington witnessed could be devastating to the business of Kentucky food producers and the state's economy.

Johne's Disease

The Breathitt Veterinary Center is also a key player in the fight against Johne's Disease, a contagious bacterial disease of beef and dairy cattle. The BVC has been designated as the Johne's Disease testing facility for Kentucky.

Johne's Disease may cost Kentucky cattle producers upwards of $250 per head per year through declining production – a huge economic loss for the state each year.

There is no cure for Johne's Disease, so research and program management are the key to maintaining herd health until eradication of the disease is achieved.

For more information, contact: Murray State University, P.O. Box 9, Murray, KY 42071, or call 1-800-272-4MSU.

Western Kentucky University

Innovative Enterprise

Western Kentucky University faculty help businesses create a strategic advance through information technology

BY BOB SKIPPER

Sheryl Hagan-Booth photo

Linda Johnson, president of the Center for Information Technology Enterprise, stands outside the CITE office in Bowling Green.

In the corner of Linda Johnson's office, amid the 42-inch flat plasma wall monitor and the two computers, sits on old Royal manual typewriter. As she talks about information technology, innovation and entrepreneurship, her 6-year-old son Will tries to "load" a sheet of paper into the front of the typewriter.

"Isn't that amazing," Dr. Johnson says as she inserts the paper into the rollers at the top. "He's only seen a computer printer before."

While Will has trouble adapting to the older technology, his mother's mission is just the opposite – trying to help more Kentuckians use information technology to their advantage.

As president of CITE – the Center for Information Technology Enterprise – and a member of the management and information systems faculty at Western Kentucky University, Dr. Johnson remains in the forefront of Kentucky's move into the "new economy."

Although she has published and lectured nationally and internationally, her interests are somewhat surprising.

"I have a passion for computer literacy," she said. When she joined the Western faculty in 1991, she said what she saw in the region "was a tremendous need for just basic computer skills among the students at Western, amongst individuals in our region and really throughout Kentucky." As a result of that, she participated with her colleagues in creating a number of innovative ways to teach computer literacy. They were one of the first programs in the country that developed a self-paced, Web-based, competency-based approach to computer literacy.

That type of forward thinking is what characterizes the information systems faculty in Western's Gordon Ford College of Business, Dr. Johnson said. "I think that I have been fortunate to lead a very entrepreneurial and innovative faculty for the past several years," she added. Prior to becoming president at CITE, Johnson served as professor and chair of the Information Systems program, WKU's fastest growing undergraduate program. While chair (1996-2001) the program grew from 125 to 285 students.

"Information technology is a very practice-driven field because it is relatively new," Dr. Johnson said. "I've always had a tremendous interest in tying together the practice of information technology strategy and policy, which is really my focus area, with what's going on in the classroom."

As the information systems faculty began integrating technology into the classroom, they also attracted attention from business and industry. "Businesses needed advice and they would call us," she sad. The faculty got together and talked about how they might help and came

up with the idea of creating CITE (www.citeinc.com), a private, non-profit 501 c3 company, which now has five full-time employees with plans to double its space and employment this year.

"What really excites me, and what I have enjoyed most about being creating a company and being president at CITE for the last 14 months, is the ability to help companies develop ways to compete in the new economy – help 'old economy' companies transition their existing business processes to 'new economy' processes," she said. "More than 80 percent of Kentucky's businesses are small businesses; unless we can help them be competitive in today's global economy, Kentucky is going to struggle economically. Creating a strategic advantage through information technology is what we do at CITE."

CITE also brings government into the equation. One of the first major projects Dr. Johnson landed was from the Governor's Office for the New Economy to spearhead connectkentucky. This three-year, $2.65 million public-private partnership is taking a look at the information superhighway in Kentucky: its condition, accessibility and who's using it.

"We have basically mapped the highway, which is one big fast lane running from Cincinnati through Louisville to Nashville and on to Atlanta, as you might expect based on where the global Internet commodity is," she said. Now, CITE is using GIS maps to assess the availability of high-speed on-ramps like DSL and cable modems. The information stored in a database will help Kentucky compete in the networked world of e-commerce.

"This is really important to economic developers because if you're trying to get a business to locate, businesses need access, high-speed on ramps to the Internet.

CITE is using a national model for their research in addition to developing the Web site for connectkentucky (www.connectkentucky.org). "We are responsible for the entire project work and are collaborating with Ohio, Maryland, Michigan and Wisconsin, particularly the Ohio Supercomputing Center," she said.

Even though she spends much of her time travelling on behalf of connectkentucky and CITE, being on the cutting edge has its challenges. She has found that while it is easy to create a business, finding the knowledge workers to scale the businesses is her greatest challenge.

Sheryl Hagan-Booth photo

An old Royal manual typewriter sits in Linda Johnson's office as a reminder of technology changes.

She cites Dr. Bill Brundage, Kentucky's New Economy commissioner, as saying that the new economy is about blurring the lines between higher education, business and industry.

"CITE really is that blur because it's a group of academics who are working with business people on their board and with government constituencies and we bring all of those parties to the table together," she said.

One of the accomplishments of which Dr. Johnson is most proud is receiving the first Vitale Award for Initiative, Innovation and Leadership, established in 1999 by Don Vitale, president of Manchester Capital in Bowling Green. Vitale, who helped the CITE concept to fruition and is on the company's board of directors, is a major proponent in the university's role in economic development.

"Innovation is the fuel for knowledge-based enterprises" such as e-commerce, Vitale said. "Great universities contribute to economic development by being the source of this fuel."

With Western being the fuel and CITE the engine carrying Kentucky into the new economy, Dr. Johnson continues to look for more drivers, often turning to WKU. Some of those drivers take the form of faculty consultants; student interns; others are graduate students and retired faculty.

"We like to hire our graduates and we like to keep smart people locally here with us," she said.

Sheryl Hagan-Booth photo

CITE President Linda Johnson leads a staff meeting in one of CITE's conference rooms.

For more information, contact:
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