

Spring 2009

Department of Biological and Agricultural Engineering  
At the University of Arkansas



From the  
Department Head  
Dr. Carl L. Griffis

In July 2008, I took over as Interim Department Head of the Department of Biological and Agricultural Engineering. Former Department Head, Dr. Lalit Verma, was named Interim Dean of the Dale Bumpers College of Agricultural, Food, and Life Sciences, (more information on page 3). I look forward to serving as Department Head while working to increase student enrollments in both the undergraduate and graduate programs.

This is an exciting time for Biological and Agricultural Engineering and I hope that you will be enjoying reading about the new research, student projects, and faculty and staff that have joined us over the last year.

In the latter part of 2008, the department was visited by ABET evaluators who looked at both our undergraduate program in Biological Engineering and our MS program in Biomedical Engineering. We don't have their final report yet, but all of us were particularly proud of the reports we presented on our faculty, our facilities, and especially our students. As always if you have any questions about the Department or our programs feel free to email us at [baeg@uark.edu](mailto:baeg@uark.edu) and we look forward to hearing from you.

## Water Resources Center Moves to Division of Agriculture

Environmental and sustainability initiatives of the Division of Agriculture were strengthened in 2008 with the addition of the Arkansas Water Resources Center (AWRC) to the Division family.

AWRC Director Brian Haggard, associate professor of biological and agricultural engineering, said the center is one of 54 institutes established through the Water Resources Act of 1964 for water resources research at land-grant universities. The center is part of a national network of water institutes working with local, state and federal agencies and industries.

Haggard joined the Department of Biological and Agricultural Engineering in January 2006 as an associate professor. He was previously a hydrologist for the US Geological Survey in the Oklahoma Water Science Center and with the Poultry Production and Product Safety Research Unit of the USDA Agricultural Research Service at the U of A. He has a B.S. degree from the University of Missouri at Rolla, a master's degree in environmental soil and water science from Arkansas, and a Ph.D. in biosystems engineering from Oklahoma State.

Haggard said the center's mission is to arrange for competent research on water issues, aid the entry of new research scientists into water resources fields, help to train future water scientists and engineers, and transfer results of sponsored research to water managers and the public.

Research, training and information dissemination are supported partially with U.S. Geological Survey institute program funds. Additionally, AWRC ob-

tains and administers grants from state and federal agencies and others. Research affiliations usually involve a cooperative partnership focusing on a water topic requiring near-term answers. Through the years, AWRC projects have focused on irrigation and runoff, innovative domestic wastewater disposal systems, ground-water modeling and land-use mapping, erosion and pollution, water quality and ecosystems.

AWRC operates a water quality laboratory (WQL), which provides water quality analysis and training for students. The WQL is accredited for the analysis of water samples by the Arkansas Department of Environmental Quality and offers a variety of analytical packages as well as individual tests.

Information on water research and other water-resource-related topics are disseminated by the center through public presentations, conferences and publications. AWRC sponsors an annual conference attended by about 100-150 researchers, students, agency personnel and interested citizens to hear about results of current research and hot topics in water resources throughout the state. The next AWRC Annual Conference will be held April 14-15, 2009, in Fayetteville. For more information contact [awrc@uark.edu](mailto:awrc@uark.edu). See page 12.

Staff members in addition to Haggard include Leslie Bartsch, AWRC project manager; Keith Trost, WQL manager; Jennifer Purtle, WQL lab technician; Wade Cash, AWRC field services technician; and Stephanie Williamson, WQL quality assurance reviewer.



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# Matlock to Chair Committee Developing National Sustainable Agriculture Standard

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The standards committee that is spearheading the development of a national standard for sustainable agriculture elected its leadership Nov. 3. Marty Matlock, director of the Center of Agricultural and Rural Sustainability in the University of Arkansas System's Division of Agriculture, was elected chairman. Ronald Moore, Moore Farms and American Soybean Association, will serve as vice-chair. Will Healy, Research and Technical Manager at Ball Innovations, will serve as secretary; and Grace Gershuny, representing the Organic Trade Association (OTA), is vice-secretary.

The standards committee officers were elected by members of the standards committee and appointed by Leonardo Academy, the neutral, third-

party American National Standards Institute (ANSI) accredited organization facilitating the development process for the Scientific Certification System (SCS-001) sustainable agriculture standard. "Leonardo Academy is very pleased that such a diverse group of individuals has been elected to lead the workings of the standards committee," said Michael Army, president of Leonardo Academy.

"This leadership exemplifies the depth of agricultural expertise and range of viewpoints represented on the committee. We look forward to working with the committee's leadership as it guides the discussion and consensus-building on the many issues that need to be addressed as the standard

development process moves forward."

As chairman of the standards committee, Matlock will work with the committee to identify and deliberate the issues that will be considered for inclusion in the sustainable agriculture standard, as well as to assign tasks to committee members and subcommittees to foster progress on issues under consideration. Among his more challenging responsibilities will be to guide the committee in identifying which issues can be agreed upon at the outset and to help steer a path of consensus on the more difficult issues raised by committee members and stakeholders.

"Sustainable production of agricultural products is the one of the most challenging issues our generation faces. There will be 9.5 million people coming to dinner by 2050. The decisions we make today will determine how we feed them and their children, how we eat

**"Sustainable production of agricultural products is the one of the most challenging issues our generation faces."**

tomorrow and how future generations eat--from now to eternity," Matlock said.

Vice-Chair Ronald Moore stressed the importance of a sustainability standard in meeting this challenge. "It is vitally important that production agriculture from the Midwest is represented during the process of developing a standard for sustainable agriculture," he noted. "The farmers that I represent are the environmental stewards of millions of acres of land, so it is an advantage for all stakeholders to have farmer input and leadership on this committee. All sectors of agriculture must work together on a final standard that is socially responsible, environmentally sound, and economically viable today-and in the

future-for the production of low cost, high quality food, feed, fiber, and fuel."

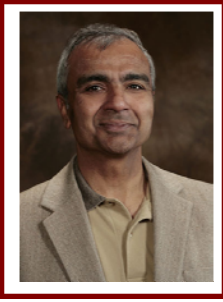
Will Healy, committee secretary, believes that defining sustainability is crucial to the industry of agriculture. "The problem today is that the agricultural heritage of America is being lost," he said. "There are a lot of misunderstandings, misconceptions and misinformation generated about what we as growers do and how this impacts the nation's food system. Identifying a framework and set of indicators for sustainability will give us all a target to move toward, improving production systems and products that are not only better for the environment but for growers and consumers also."

Committee Vice-Secretary Grace Gershuny noted that the theory and practice of organic agriculture has been at the leading edge of the concept of sustainability from its inception. "Many of us believe organic should be recognized as the foundation of this current discussion around standards for Sustainable Agriculture," she said. "I believe that it is important for OTA, which has the mission to 'promote and protect the growth of organic trade, to benefit the environment, farmers, the public and the economy,' to actively engage in this discussion."

One of the most distinguishing aspects of this open, consensus process for developing a national standard is that it provides a forum for discussing and vetting differences in opinion over what sustainability means across all sectors of agriculture. While ideas vary on a number of issues, Healy stresses that, "We are all concerned about water consumption, land use, chemical inputs. This process allows us to come together as a group and to send a common message that the agricultural industry is concerned about sustainable production and that we want to move forward in a positive way."



# Lalit Verma Named Interim Dean



Lalit Verma, head of the department of biological and agricultural engineering, has been named interim dean of Bumpers College and associate vice president for

agriculture--academic programs in the University of Arkansas System's Division of Agriculture. His appointment is effective July 1.

Carl Griffis will serve as interim head of the biological and agricultural engineering department.

Verma will succeed Greg Weideman, who is leaving the university to take the position of dean and director of the College of Agriculture and Natural Resources at the University of Connecticut.

"Lalit Verma has shown what he can accomplish as an academic leader. He helped to build a relatively small department into a vibrant and growing program," said chancellor-elect G. David Gearhart. "He will bring these same leadership skills to Bumpers College

during this interim period. I am grateful to Dr. Verma for accepting this important interim position."

"Dr. Verma has provided outstanding leadership in his department to match his contributions to his profession. We look forward to working with him in his new role," said Milo Shult, university system vice president for agriculture.

"I am very excited about this great opportunity," said Verma. "I look forward to working with all of my colleagues in our exceptional Bumpers College faculty. Together we will continue to improve and promote agriculture in Arkansas, in the nation and in the world."

Verma came to the University of Arkansas in 2000 as head of the biological and agricultural engineering department. He is internationally recognized for his research in rice and forage post-harvest engineering and technology. He holds a patent awarded for the "Process for Parboiling Rice" and led research on "Electrotechnology in Cereal Grains Processing." These focused on utilizing microwave energy for rice parboiling that enabled rice and

food processing operations to save energy, time and cost.

Among his many academic and professional honors, Verma received the President's Citation from the American Society of Agricultural Engineers in 2000 for his leadership in developing accreditation criteria for educational programs that involve engineering in agricultural, food and biological systems. He was named Engineer of the Year for the Louisiana section of the A.S.A.E. in 2001, and Outstanding Engineer for the Arkansas section in 2003. He was named president of the Institute of Biological Engineering in 2004.

Verma has a B.S. degree in agricultural engineering from J. N. Agricultural University in India, an M.S. degree in agricultural engineering from Montana State University, and a Ph.D. degree in engineering from the University of Nebraska. He served on the faculty of the biological and agricultural engineering department at Louisiana State University for 20 years, including eight years as the department chair.

## Notables

- Mahendra Kavdia, assistant professor of biomedical engineering, received the College of Engineering's 2008 Imhoff Outstanding Researcher Award. Kavdia has enthusiastically supported the college's efforts to develop and launch the master of science program in biomedical engineering. He has established a state-of-the-art computational biology and biomedical engineering lab and actively collaborates with several colleges on the Fayetteville campus, as well as colleagues at the University of Arkansas for Medical Sciences and the University of Alabama.
- Kavdia also received the 2008 Arthur C. Guyton Award for Excellence in Integrative Physiology and Medicine. The award of approximately \$15,000 is designated for use in the recipient's research program.
- Sreekala Bajwa received the 2008 Outstanding Engineer Award from ASABE-AR section.
- Yun Wang, M.S. Student, won first place of the IBE (Institute of Biological Engineering) 2008 Graduate Student Poster Competition, March 6-9, 2008, Chapel Hill, NC. Her presentation title is "An optimized interdigitated array microelectrode based immunosensor for detection of avian influenza viruses".
- Min Li, Ph.D. Student, won the travel award of the Graduate Student Presentations in the Society for Risk Analysis 2008 Annual Meeting, December 7-10, 2008, Boston, MA. Her poster title is "Quantitative risk assessment for Listeria monocytogenes reduction on poultry products during post-package thermal processing".

# Engineering For Life!



## Departmental Faculty

### Department Head:

Dr. Carl Griffis  
clg@uark.edu

### Professors:

Dr. Yanbin Li  
yanbinli@uark.edu

Dr. Otto J. Loewer  
ojl@uark.edu

Dr. Lalit Verma  
lverma@uark.edu

### Associate Professors:

Dr. Sreekala Bajwa  
sgbajwa@uark.edu

Dr. D. Julie Carrier  
carrier@uark.edu

Dr. Tom Costello  
tac@uark.edu

Dr. Brian Haggard  
haggard@uark.edu

Dr. Jin-Woo Kim  
jwkim@uark.edu

Dr. Marty Matlock  
mmatlock@uark.edu

Dr. G. Scott Osborn  
gsosborn@uark.edu

### Assistant Professors:

Dr. Mahendra Kavdia  
mkavdia@uark.edu

Dr. Kaiming Ye  
kye@uark.edu

Dr. Sha Jin Ye  
sjin@uark.edu

Dr. David Zharov

## Grants Awarded

- B. Haggard and A. Sharpley. Illinois River Watershed Partnership. Development of the Watershed Management Plan for the Upper Illinois River Watershed. \$211,000.
- B. Haggard and M. Matlock. Beaver Water District. Watershed investigative support to the Beaver Water District. \$50,000.
- B. Haggard. Illinois River Watershed Partnership. Watershed Investigative Support to the Illinois River Watershed Partnership. \$117,180
- B. Haggard. US Environmental Protection Agency. Nutrient Criteria Development in the Red River Basin: Phase I. \$90,000
- B. Haggard. US Geological Survey. Arkansas Water Resources Center Program Administration, \$11,450
- B. Haggard. US Geological Survey. Arkansas Water Resources Center Information Transfer. \$10,550
- Carrier Extraction of stilbenoids P3 NSF EPSCOR 2008 \$87,500
- Carrier Hemicellulose during Pretreatment NSF CBET 2008 \$296,000
- D. Gardisser. Arkansas Corn and Grain Sorghum Board. Practicality Evaluation of Grain Storage Techniques. \$30,500.
- S. Bajwa. Cotton Incorporated. Application of Cotton Gin Waste and Recycled Cotton Bale Wrap in Lignocellulosic Composites (LCC). \$18,883.
- Jin-Woo Kim, Mary Savin. National Institutes of Health. Point Source Ozonation to Minimize Antibiotic Resistance. \$126,613.
- D. Carrier. USDA CSREES NRICGP Equipment Grant. Acquisition of an HPLC/RI/ELSD Station to Enhance Research on Hemicellulose Depolymerization. \$41,041.
- Marty Matlock. Cotton Incorporated. Evaluation of Sustainable Cotton Production Practices from an Energy Perspective: Part II - Green House Gas Emissions. \$30,000
- M. Matlock. Smithsonian Institution. Mississippi River Algal Turf Scrubber Subproject. \$77,900.
- Y. Liang. Desert King. Air Quality Research. \$4,350.
- M. Matlock. Arkansas Natural Resources Commission. Implementation of Low Impact Development BMPs to Control Sediment from Urban Development in Fayetteville, Ark. \$130,000.
- S. G. Bajwa. Cotton Incorporated. Application of Cotton Gin Waste and Recycled Cotton Bale Wrap in Lignocellulosic Composites (LCC). \$18,883.
- S. G. Bajwa. USDA. An ammonia emission mitigation system for commercial broiler houses. \$97,123
- Yanbin Li and Andrew Wang (Ocean Nanotech LLC) received a NSF/STTR grant, Magnetic Nanoparticle Microfluidics for High Efficient Capture, Separation and Concentration of Foodborne Pathogens, \$150,000, 7/2008 – 6/2009.
- Yanbin Li received a USDA/NRI grant, Nanowire Switch and Nanoelectrode/Nanofluidics Based Biosensor for Rapid Screening of Avian Influenza Virus, \$455,308, 10/2008 – 9/2010. This is an interdisciplinary research project in collaboration with Huan-guang Lu and Tony Huang at Penn State University.

## New Projects

- S.G. Bajwa. Application of Cotton Gin Waste and Recycled Cotton Bale Wrap in Lignocellulosic Composites (LCC).
- J.D. Carrier. Acquisition of an HPLC/RI/ELSD Station to Enhance Research on Hemicellulose Depolymerization.



## Articles Published

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- Bajwa, S. G., J. Kandaswamy, and J. K. Apple. 2008. The effect of scanning angle on measured reflectance and tenderness prediction in beef longissimus thoracis steaks. *Transactions of the ASABE* 51(1): 351-357.
- Bruner D, Carrier DJ, Belesky D, Pote D and Ares A. (2008). "Yield components and nutritive value of Robinia pseudoacacia and Albizia julibrissin in Arkansas, USA". *Agroforestry Systems* 72: 51-62.
- Casey, K.D., R.S. Gates, Wheeler, E.F., H. Xin, Y. Liang, A. J. Pescatore., M.J. Ford. 2008. On-farm ventilation fan performance evaluations and implications. *Journal of Applied Poultry Research*. 17(2): 283-295.
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- Li, D., K. Xu, J. Wang, Z. Ye, Y. Ying and Y. Li. 2008. Quartz crystal Au electrode-based electrochemical immunosensor for rapid detection of *E. coli* O157:H7. *Trans. ASABE* 51(5):1847-1852.
- Li, H., H. Xin, Y. Liang and R.T. Burns. 2008. Reduction of ammonia emission from stored laying hen manure using additives: zeolite, Al+Clear, Ferrix-3 and PLT. *Journal of Applied Poultry Research* 17:421-431.
- Liang, Y., H.G. Gollany, R.W. Rickman, S.L. Albrecht, R.F. Follett, W.W. Wilhelm, J.M. Novak, and C.L. Douglas, Jr. Simulating Soil Organic Matter with CQESTR (v.2.0): Model Description and Validation against Long-term Experiments across North America. *Ecological Modeling*. (Accepted)
- Liang, Y., H.G. Gollany, R.W. Rickman, S.L. Albrecht, R.F. Follett, W.W. Wilhelm, J.M. Novak, and C.L. Douglas, Jr. 2008. CQESTR simulation of management practice effects on long-term soil organic carbon. *Soil Sci. Society of American Journal* 72(5): 1486-1492.
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- Mutlu, E., I. Chaubey, H. Hexmoor, and S. G. Bajwa. 2008. Comparison of artificial neural network models for hydrologic predictions at multiple gauging stations in agricultural watersheds. *Hydrological Processes* 22(26): 5097-5106.
- Singh, N. K., S. G. Bajwa, and I. Chaubey. 2008. Removal of surface reflectance from above-water visible-near infrared spectroscopic measurements. *Applied Spectroscopy* 62(9): 1013-1021.
- Toor, G.S., Harmel, R.D., Haggard, B.E., and Schmidt, G. 2008. Regression methodology with low-frequency water quality sampling to estimate constituent loads for ephemeral watersheds. *Journal of Environmental Quality* 37: 1847-1854.
- Topper, P.A., E.F. Wheeler, J.S. Zajaczkowski, R.S. Gates, H. Xin, Y. Liang, K.D. Casey. 2008. Ammonia emission from two empty broiler houses with built-up litter. *Transactions of the ASAE* 51 (1): 219-225.
- Varshney, M., and Y. Li. 2008. Review: Interdigitated array microelectrodes based impedance biosensors for detection of bacterial cells. *Biosens. & Bioelectron.* (in press, available on-line, October 17, 2008).
- Vaughn K, Carrier DJ, Howard L, King J. and Clausen E. (2008). "Extraction of lycopene from watermelon using supercritical fluid extraction (SFE)". *Bioresource Technology* 99: 7835-7841.
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# Building Body Parts

by: Matthew S. Brizzi, featured in Research Frontiers

On a Thursday morning, an 11-year-old girl in the Dominican Republic entered a medical clinic with the assistance of crutches, which had been a necessary part of her life as a foot amputee. On the following Friday afternoon she walked out of the clinic crutch-free, using a commercial-grade prosthetic foot from the United States brought to the clinic by doctors working for Physicians for Peace.

While this effort meets the immediate needs of a few patients, it is not a viable long-term solution to treat the hundreds of amputees in the country needing prosthetics, but a University of Arkansas biological engineering faculty member and his students hope to change that.

The two major causes of amputations in the Dominican Republic are diabetes and vehicle accidents, and the country doesn't have an adequate emergency medical system to care for the victims of these circumstances.

Doctors usually opt to amputate a leg that has been badly damaged in an accident rather than try to save it, because if they tried to save it and the patient doesn't receive adequate follow-up care, infections and other complications might develop, putting the patient's life at risk.

"Physicians for Peace is meeting most of their needs, but it's not sustainable," explained Tom Costello, associate professor of biological and agricultural engineering, an academic department housed jointly in the College of Engineering and the Division of Agriculture. "They're dependent on the tie-in from the U.S., and Physicians for Peace would like to move on to another country or another clinic and leave this current clinic in some kind of a situation that they could handle on their own.

"So what we're trying to do is come up with prosthetic designs that are relatively simple and easy to manufacture that they could make cheaply in their own country and not have to rely on commercial parts from the U.S., which are very, very expensive. Many affected couldn't do it. They'd be on crutches instead of walking around."

Costello said the idea to work with the clinic and Physicians for Peace came from his students. At the beginning of every fall semester, he challenges senior biological engineering majors in his senior design class to use their engineering knowledge to solve a problem.

"Some of the students were interested in prosthetics," he recalled. "So they started searching around and came across this idea of a need in developing countries and how it's probably more practical for us to design simple things for them than it would be for us to try to compete with prosthetic companies that spend millions of dollars on research and development. In the process of doing that, they ran across Physicians for Peace. They contacted them and discovered they were in the midst of working with a clinic in the Dominican Republic."

This marks the third year Costello has had students in his senior design class working to engineer and manufacture prosthetics. In 2006 his students de-



*Engineering students work in the laboratory with Tom Costello, associate professor of biological and agricultural engineering, to create low-cost prosthetic limbs for disadvantaged children in the Dominican Republic.*

signed an arm that earned them a national design award from the Rehabilitation Engineering and Assistive Technology Society of North America.

After traveling to the clinic in Santo Domingo, Asociación Dominicana de Rehabilitación, Costello learned that the Dominicans are in greater need of lower extremity prosthetics and assigned 2007 students to design a knee, a foot and a machine to test them.

Julie Abbott, Audrey Bearden and Linda Tarantino worked together to design and manufacture a foot. Sarah Beavers and Matt Walker were on the team responsible for the knee. And the third team, charged with making a testing machine, was Nathan Helms and Aaron Strobel.

Tarantino's chief role was to design, manufacture and test a foot that could be made of inexpensive components and easily replicated in the Dominican Republic. The design she developed is a

fiberglass laminate that is constructed by cutting out strips of fiberglass, soaking them in a bonding compound, laying them on top of each other in a wooden mold covered in duct tape and using a hydraulic press to exert enough force to bond the layers together.

Tarantino, who was raised in Venezuela and speaks Spanish, traveled to the Dominican Republic twice. As a junior, she accompanied the senior class before her to serve as a translator and discover how to best fulfill the amputees' needs. The second time, she went as a senior to gather technical information. She spoke with patients about issues with their current prosthetics and learned what materials and tools were available to the clinic that could be used to make prosthetics.

Both trips taught her lessons she wouldn't have learned otherwise.

"In my major, you have the engineering part, and you also have the close relationships with the clients," she reflected. "The people are your clients. I have to work with patients and ask for feedback from doctors. That part of these trips was great

because I got exposure to building that relationship with the client as an engineer."

Walker was responsible for designing and building a knee that could be easily produced in the Dominican Republic. He came up with a single-axis knee that is less bulky, although less stable, than multiple-axis knees typically used by commercial manufacturers. He decided to go with the sleeker design after receiving feedback that it is preferred by Dominican patients and more compatible with social norms.

While he didn't have an opportunity to travel to the Dominican Republic, his experience on a team charged with devising a solution was a valuable aspect of his education.

"It's helped me learn a lot more of how to take lead of a team," he said. "It was a great experience because I got to learn how to go through designing, prototyping, building, testing, all that stuff that engineers do. So I really got to see everything in a practical application."

This article can also be found at: <http://researchfrontiers.uark.edu/13584.php>

## 2008 Student Winners

Two Senior Design groups placed top in the nation at the 2008 G. B. Gunlogson Student Environmental Design Open Competition held at the annual American Society of Agricultural and Biological Engineers Meeting. The ASABE meeting was held in Rhode Island.

"Design of a Continuous Biodiesel Production Process" placed second and included team members, Ashley Wiedower, Jacob Irwin, and Aung Khaing. The group was directed by Dr. Julie Carrier and Dr. Tom Costello.

"Green Development Design: Habitat for Humanity" placed third and included team members, Jeff Burns, David Gershner, and Rusty Tate. The group was directed by Dr. Marty Matlock and Dr. Tom Costello.

## New Faculty and Staff



In January 2009, Dr. Sha Jin joined the department as an Assistant Professor in Biomedical Engineering. Dr. Jin received her

Ph.D. degree in Bioengineering and Informatics from Kyushu Institute of Technology, Japan in 1996. She has been a postdoctoral associate in University of Osaka, Japan and University of Pittsburgh Medical School. Her research focuses on drug discovery for preventing and treating HIV infection. Building

upon her many years of work in lentivirus, she is developing an engineering approach to systematically screen for small molecules from nature product extracts that can effectively inhibit HIV reverse transcription and protease activities so that the viral load in the blood and lymphoid tissues can be controlled to an undetectable level. Nature product extracts represent a new category of alternative medicines fighting against AIDS. They exhibit low toxicity, minor side-effects, and are more cost-effective than synthetic drugs.

Joshua Skinner joined the department as the Administrator and Accounting Tech in July 2008. Josh handles and redirects

incoming phone calls, walk-ins, and assists professors with various tasks. Josh enters and submits hourly payroll, maintains and updates several



of the departmental expenditures and assists the department's Fiscal Manager. Josh also takes care of all administrative and financial work for the UA Economic Development Institute.



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# Engineering Academy Inducts Four Alumni

By: Fred Miller

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The Arkansas Academy of Biological and Agricultural Engineering inducted four Bumpers College alumni at an April 11 banquet: Karl VanDevender of Little Rock, Pat Bass of Little Rock, Darrell Holmes of Houston, Texas, and Jonathan Pote of Starkville, Miss.

Karl VanDevender, extension professor of biological and agricultural engineering at the University of Arkansas, received B.S. and M.S. degrees in agricultural engineering from Mississippi State University and a Ph.D. from the University of Arkansas in 1992.

VanDevender is leader of the livestock and poultry waste management program for the U of A System's Division of Agriculture. He serves as an ex-officio member of the Arkansas Pork Producers Board of Directors, is an active member in the American Society of Agricultural and Biological Engineers and a member of the National Pork Board's swine educators advisory group. He also serves in the Southeast Region Extension Water Quality Working Group.

Pat Bass has his own consulting firm, Bass Engineering Inc., and also partners with Sullivan and Associates as a principal engineering specialist. He earned a bachelor's degree in agricultural engineering at the U of A and has graduate training in both geotechnical engineering and advanced irrigation methods from the U of A and Utah State University. He has more than 20 years experience with watershed projects in Oklahoma and Arkansas.

Bass is a registered professional engineer in both Arkansas and Oklahoma and a registered land surveyor in Oklahoma. He served in numerous capacities during his 33 years with the National Resources Conservation Service, includ-

ing assistant state conservation engineer, special project leader, state water management engineer, area engineer, project engineer and agriculture engineer in Arkansas and Oklahoma.

Darrell Holmes earned a bachelor's degree in agricultural engineering from the U of A in 1981. He studied toward an M.B.A. from Rice University's Jones Business School in Houston.

Holmes made notable achievements in the energy services industry since he began his career with Halliburton En-

burton.

Jonathan W. Pote is a professor of agricultural and biological engineering and associate director of the Mississippi Agricultural and Forestry Experiment Station at Mississippi State University. His research areas are water chemistry, water quality, water management and conservation, aquaculture, and environmental planning.

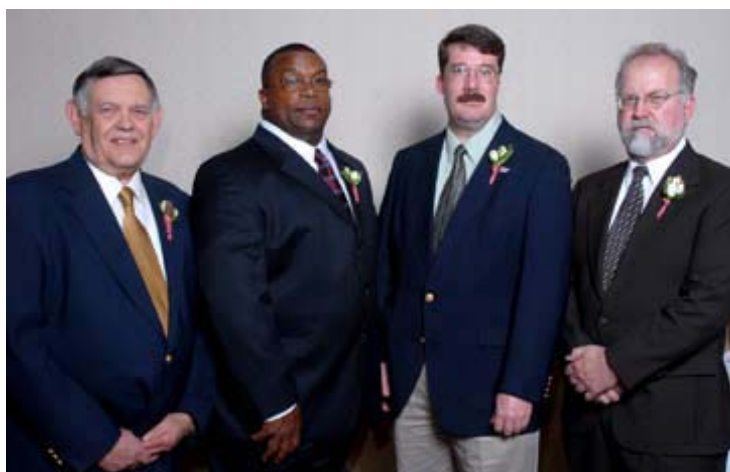
Pote received a Ph.D. degree in biological and agricultural engineering at the U of A in 1984. He received a B.S. degree in chemistry at Hendrix College in 1975 and an M.S. degree in environmental engineering and water resources at Oregon State University in 1975.

Pote's method of water conservation for the aquaculture industry has been adopted by the Natural Resources Conservation Service as a best management practice and is a major incentive program for the industry.

The Arkansas Academy of Biological and Agricultural Engineering was founded in 2002 by the department of biological and agricultural engineer-

ing. Members are eminent graduates or supporters of the biological and agricultural engineering program of the University of Arkansas.

News releases and photos are available online at <http://arkansasagnews.uark.edu/392.htm>



*2008 inductees to the Arkansas Academy of Biological and Agricultural Engineers are, from left, Pat Bass of Little Rock, Darrell Holmes of Houston, Texas, Karl VanDevender of Little Rock and Jonathan Pote of Starkville, Miss.*

ergy Services in 1981. He worked in several locations in Oklahoma and Texas and is presently the region technology manager for Hexion Specialty Chemicals (Oilfield Technology Group) in Houston.

Holmes has more than 26 years experience in the oil and gas industry and extensive background in quality and management systems including Lean and Six Sigma Quality methodology.

Holmes' accomplishments include the development of global standards and processes and the "Done Right Index" to track total service quality, both for Halli-



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# Cancer-Fighting ‘Nanobombs’

By: Fred Miller

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A professor of biological and agricultural engineering for the University of Arkansas System’s Division of Agriculture, Kim is attacking cancer with a new type of nanoparticle that he developed to find and destroy cancer cells.

Such particles are so small that they are measured in nanometers, or one-billionth of a meter. There are 25,400,000 nanometers in 1 inch.

In his research, Kim works on really small things with really big names: nano-scale bio/abio interfacing technology, which includes nanobiotechnology and nanomedicine; nucleic acid technology, for DNA-based nanotechnology and DNA computing; and biocatalysis and molecular biological engineering.

Kim was conducting research using carbon nanotubes to kill illness-causing bacteria like *Escherichia coli* when it occurred to him that the same technique could be used to kill cancer cells.

The technique involves coating nanoparticles with antibodies that attach themselves to specific cells – in Kim’s research, breast cancer cells – like organic Velcro. Once they are attached to the target cells, the particles are heated with laser light to kill the cells. With sufficient laser intensity, the nanoparticles actually explode, earning them the name “nanobombs” in Internet discussions of related research efforts.

The trick, Kim said, was to find a nanoparticle that was safe for use in humans and also responded to laser light by heating up.

“Gold has obvious advantages,” Kim said, “because it is bio-safe and approved by the FDA for use in human health applications.”

The problem with gold, Kim said, is that it only responds to lasers operating in the visible light spectrum. At sufficiently high intensity to cause a reaction in gold nanoparticles, visible light lasers will damage human tissue.

“We needed a particle that responded to a spectrum of light that had little or no effect on skin or other tissues,” Kim said.

He was already working with carbon nanotubes in his research with bacteria and knew they responded well to near infrared lasers. At low to medium intensity, sufficient for a response in the carbon nanotubes, NIR lasers did little or no harm to human tissues. But carbon nanotubes were not approved for use in human health applications.

Kim needed a new kind of nanoparticle, so he made one. He learned how to coat carbon nanotubes with gold nanoparticles and dubbed the new hybrid material golden carbon nanotubes, or GNTs. At 10 nanometers wide by 100 nanometers long, it would take more than 645 billion golden carbon nanotubes to cover 1 square inch.

The new material is not only safe for use in humans, it has increased sensitivity to near infrared light.

Vladimer P. Zharov, professor of physics at the University of Arkansas for Medical Sciences and an expert in phototherapy, has tested the GNTs in lab

mice and demonstrated that they are effective in diagnosing cancer as well as killing the cells.

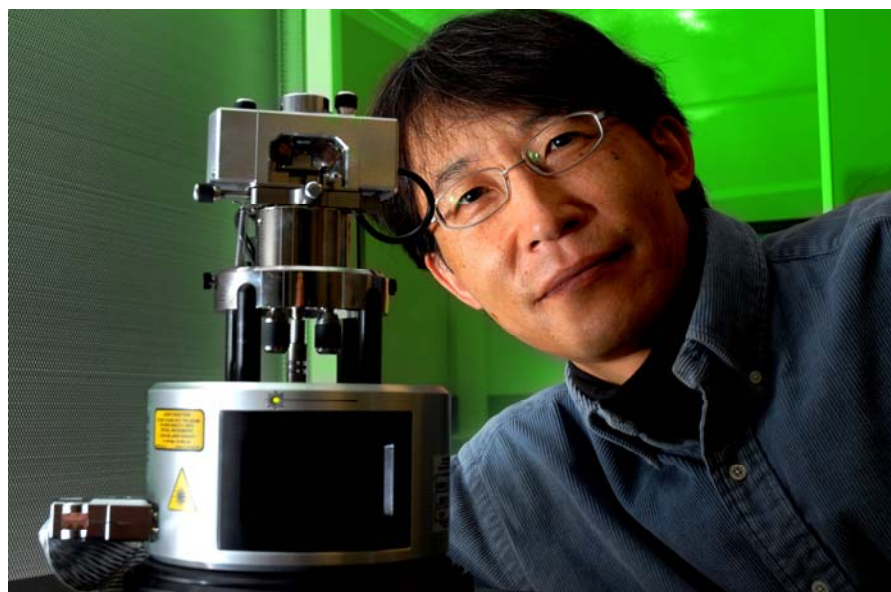
The GNT particles are injected into the suspect tissue and irradiated with a low-intensity NIR laser, Kim said. Diagnostic images are recorded from the heat they generate. If no cancer cells are present, the particles are dispersed randomly. If cancer cells are present, the particles will mass around them.

“Then the laser intensity can be turned up and the heated particles kill the cancer cells,” Kim said.

Zharov’s research shows that the diagnosis and therapy can be conducted well within the established safety range for NIR laser intensity.

Kim’s technical name for this patent-pending technique is nanoparticle-assisted photo-thermal diagnosis and therapy. He grins and agrees that “nanobomb” is simpler.

Kim is working to expand the utility of the golden carbon nanotubes to diagnose and treat other types of cancer, as well as other health uses.



Dr. Jin-Woo Kim



# Center for Agricultural and Rural Sustainability

By: Fred Miller

Sustainability is manifested at the University of Arkansas System's Division of Agriculture in myriad agricultural, ecological and community projects aimed at improving life for Arkansans.

The division's Center for Agricultural and Rural Sustainability, or CARS, links research and extension programs with this underlying theme. "We are focusing on sustainability as an underlying objective in a variety of programs and projects," says Mark Cochran, director of the Division's statewide Agricultural Experiment Station. Cochran and Ivory Lyles, director of the Division's Cooperative Extension Service, are encouraging faculty members to make sustainability a priority, as in the following projects.

- An experimental algae farm at the Springdale wastewater treatment plant may demonstrate an effective means of producing alternative fuels while cleaning water in Arkansas' rivers and streams.

- Research on high tunnel production of blackberries and raspberries shows that production seasons can be extended, opening new market possibilities that would improve the viability of small farms.

- A study of green roofs will determine the best plants and growing medium that, when installed on rooftops, helps reduce storm water runoff, cools urban environments and reduces energy costs with minimal maintenance.

A comprehensive list of projects related to sustainability could fill a book with chapters on animal and plant agriculture, food processing, the environment, water resources, human health and nutrition, biotechnology, nanotechnology, education, and agricultural and rural economics, Cochran says. Marty Matlock, bio-

logical and agricultural engineer, and ecosystem services leader for CARS, defines sustainability as contributing to lasting prosperity through use of resources in a manner that sustains their value for future generations.

ing idea is to re-grow small-scale agriculture that is profitable. To do this, producers must be linked to markets."

Sustainable prosperity requires taking care of the natural resources, such as availability of clean water, on which all Arkansans depend.

"To achieve this," Matlock explains, "we must balance the demands of Arkansas' communities, agricultural production systems and ecosystems, because they are all connected."

Matlock says CARS serves as a mechanism within the Division of Agriculture to organize teams that can rapidly respond to emerging challenges.

"It's about getting to the table fast enough," Matlock says. "If people want to know who to talk to about a problem, the center provides a point of contact with a team of

experts."

Tom Riley, director of public policy for the Arkansas Cooperative Extension Service and policy leader for CARS, says the division has been looking at sustainability issues in agriculture since the 1990s. "We're trying to get our agricultural and rural communities more involved in sustainability," he says.

Riley describes sustainability as a way of paying attention to the environment while providing affordable food and maintaining the viability of agriculture, community, economy and education.

"Within CARS, we're looking at it from



*Green roof study — Biological engineer Brian Haggard, top left, and graduate student Channon Toland test chemical content in runoff water from a mock green roof at the University of Arkansas Division of Agriculture's Watershed Research and Education Center. The study is a joint research project of the Division of Agriculture and the UA, Fayetteville, School of Architecture's landscape architecture program.*

"The structure is designed to support, in a coherent manner, all the small projects and big projects we're already doing," Matlock says. "Our goal is to increase the prosperity of Arkansans by enhancing sustainable practices across the rural economy."

The poorest in Arkansas live in rural communities, Matlock says. For that reason, CARS efforts are explicitly aimed at meeting the challenges of rural prosperity.

"We understand that prosperity is the ability to make a profit off small parcels of land," Matlock explains. "Our guid-



*Biofuel from Algae — Walter Adey, center, research scientist for the Smithsonian Institution's Natural History Museum, toured an algae biofuel test site with biological and agricultural engineers Marty Matlock, right, and Tom Costello and their students.*

ment of the product's environmental footprint. But environmental footprints alone aren't enough, she says. A standard method is needed that will establish a baseline and measure progress toward sustainability.

"We need to have some sort of universal sustainability metric so that everyone is on the same page," Popp says.

The Division of Agriculture faculty working with CARS are leading this effort nationally, Matlock says. They are leading the technical analysis of sustainability for the Colorado-based Keystone Center's "Field to Market: The Alliance for Sustainable Agricultural Outcomes," providing coordination and leadership for the Sustainable Value Network for Wal-Mart, and serving on the ANSI Standard Development Committee for Sustainable Agriculture.

Sustainability issues cross disciplines and borders. For this reason, Matlock says, CARS works closely with other centers and

institutions, including the Applied Sustainability Center in the U of A's Walton College of Business as well as many faculty in the College of Engineering. Many of the research projects are conducted in collaboration with scientists outside the Division of Agriculture, even outside of Arkansas.

"I'm excited about the multi-discipline approach to sustainability," Riley says. "Also, Arkansas' sustainability issues are not isolated, and related policies aren't isolated."

"The policy landscape influences our viability and sustainability," Riley says. "How successful we are in Arkansas depends on the policies of the states around us, as well as national and international policies."

"We're not arguing for a policy position," Riley explains, "but for educated policy choices."

"The measure of success for us is the mean prosperity level of Arkansas," Matlock says. "We are successful if Arkansas prosper."

the standpoint of integrated systems in agriculture, community life, transportation, economics and other systems," Riley says. "We're asking, what are the educational needs and opportunities? What are the roadblocks in government or policymaking?"

Jennie Popp, agricultural economist and CARS economy leader, says research on sustainability is not a new concept.

"What makes the need for this research different now is that consumers are focused on sustainability and businesses have adopted sustainability plans and initiatives," Popp says. "From the business side, they want to offer products that are produced in a sustainable manner and will give premiums for those and discounts to others."

Often, Popp says, these sustainability plans require information on traceability of products as well as some measure-



*Brian Haggard, Geneva Brion, Aaron Daigh and Michael Neil on a ENSC 4023 Water Quality Class Field Trip at Little Wildcat Creek within the Upper Illinois River Watershed; the students were evaluating the types of aquatic macroinvertebrates found.*



## NSF Grant Awarded for Sustainable Energy Research

Dr. Julie Carrier was awarded a National Science Foundation grant in the amount of \$296,000, in the summer of 2008. Dr. Carrier and her research group will study the effect of dilute acid pretreatment on sugar release from switchgrass's plant cell wall. Understanding how these sugars are released is important because this affects the subsequent ethanol fermentation step. More information to appear in the next newsletter but if you would like to discuss this research with Dr. Carrier please contact her at [carrier@uark.edu](mailto:carrier@uark.edu).

**U of A** UNIVERSITY OF ARKANSAS  
DIVISION OF AGRICULTURE

### Arkansas Water Resources Center 2009 Annual Research and Watershed Conference



## Save the Date

April 14-15, 2009  
Fayetteville, Arkansas

Photo courtesy of Terry Boyd Photography

## Department Of Biological & Agricultural Engineering

203 Engineering Hall  
University of Arkansas  
Fayetteville, Arkansas  
72701

479.575.2351 phone  
479.575.2846 fax  
baeg@uark.edu  
www.baeg.uark.edu

## Dale Bumpers College of Agricultural, Food and Life Sciences

479.575.2252  
www.bumperscollege.uark.edu

## College of Engineering

479.575.6012  
www.engr.uark.edu

## Division of Agriculture

501.671.2000  
www.uaex.edu

### The educational objectives of the Biological Engineering program are to produce graduates who:

- Effectively apply engineering to biological systems and phenomena (plant, animal, human, microbial, and ecosystem) with demonstrated proficiency in basic professional and personal skills.
- Are well prepared for diverse careers in biological engineering, life-long learning, and professional and ethical contributions to society through sustained accomplishments in biomedical engineering, ecological and biotechnology.

[www.baeg.uark.edu](http://www.baeg.uark.edu)

## Upcoming Events

January 12, 2009	First Day of Spring Classes
January 19, 2009	Martin Luther King Holiday
March 16– 20, 2009	Spring Break
March 20, 2009	Academic Offices Closed
April 17, 2009	Academy Banquet at Clarion Hotel, Fayetteville AR
May 1, 2009	Dead Day
May 2-8, 2009	Final Exams
May 9, 2009	Commencement

Several of the stories featured in this newsletter came from magazines published by the Division of Agriculture and the Dale Bumpers College of Agriculture, Food, and Life Sciences. They include:

### Discovery Student Journal

<http://bumperscollege.uark.edu/1974.htm>

### The Graduate Alumni Magazine

<http://arkansasagnews.uark.edu/399.htm>

### Arkansas Land and Life Magazine

<http://arkansasagnews.uark.edu/396.htm>

For more news from the Division and the Bumpers College Please visit:

<http://bumperscollege.uark.edu/48.htm>

For more news from the College of Engineering please visit:

<http://www.engr.uark.edu/22.php>

