

# RESEARCH BRIEFS

## Increasing Student Learning

WKU is helping the Kentucky Education Professional Standards Board (EPSB) improve teachers' abilities to increase student learning. Western is administering research projects to a number of public and private higher education institutions under a \$3.9 million grant from the Board. Dr. Sam Evans, Dean of the College of Education and Behavioral Sciences, directs WKU's portion of this project. He is working with content specialists in teacher education, Dr. Richard Roberts; humanities, Dr. Larry Snyder; and science, Dr. Richard Gelderman.

The project has three parts: supporting curriculum review at universities to improve teachers' content knowledge; collecting and analyzing data to evaluate the priorities and objectives; and enhancing the existing Kentucky Teacher Internship Program by adding a mentoring component the first year and using teacher standards to develop ways to determine how new teacher performance affects student learning.

Phil Rogers, director of the division of testing, research and internship for the EPSB was instrumental in awarding this master agreement to WKU. In making the award Dr. Rogers commented that: "I don't know of another institu-



Dr. Sam Evans

tion that is set up like Western with a research foundation, except for the University of Kentucky." Acting as the fiscal agent for the award, Western's research foundation has disseminated fifteen subgrants to participating universities and school districts, and coordinated overall management and research functions of the participants. Dr. Evans remarks that: "We feel really positive about what the standards board is trying to do. We offered to assist. They had a need and we stepped up to fill that need." The selection resulted from the research foundation's winning bid that established a long history of handling large grants such as this one.

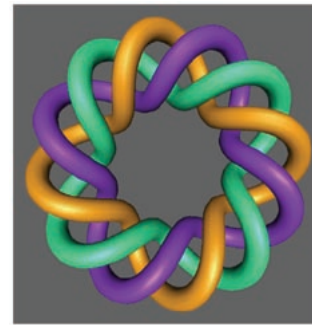
The project will fund the time to involve teachers and mentors in a more direct relationship than is now possible. Mentoring makes a huge difference in the success of new teachers, according to Dr. Evans, "I don't know of any other profession where a first-year worker is expected to do the same work as a twenty-six-year veteran." The results of these mentoring experiences will no doubt improve the research about mentoring to improve teacher-student relations and establish even better learning environments.

(This story is adapted from Scott Sisco, "WKU efforts designed to improve teachers," *The Park City Daily News*, June 19, 2004, pp. 1A, 6A.)

## Knotty Problems

Dr. Claus Ernst, Professor of Mathematics in the Ogden College of Science and Engineering, is one of three principal investigators of a \$100,000 grant awarded by the National Science Foundation. The award enables Dr. Ernst to partner with a colleague at Charlotte, Dr. Yuanan Diao, and a computer science professor at WKU, Dr. Uta Ziegler, to compute the rope length of large, thick knots. The grant is split between the two campuses and WKU's share

is almost \$75,000. Both Professors Diao and Ernst are working in the field of topology. "Topo" is a (Greek) word element meaning "place" or "location" and "logy" is a (Greek) word element meaning "discourse" or "study." Thus topology is the science of studying the geometry of location of objects. One special area of topology is called knot theory, the science of knots. Knot theory is the mathematical theory of the three-dimensional configuration of flexible rings and strings. Dr. Ziegler's area of expertise is artificial intelligence and



she will handle the programming to support pure mathematical research. The emphasis of this project is to develop new methods in the area of computational geometry based on collaboration between researchers in computer science and mathematics.

The project is entitled "Computation of Rope Length of Large Thick Knots." The main question can be phrased intuitively as follows: Given a rope with a fixed length and a fixed thickness, then how many complicated knots can be tied with this rope. (An exact mathematical formulation of these concepts is complicated and beyond the scope of this article.) This research project focuses on developing algorithms and a computer program to obtain an estimate of the rope-length of large, thick knots. The algorithm under development uses a radically different new approach to determine this

estimate of the rope-length of knots. This new approach will enable the computation of estimates on the rope-length for much more complicated knots than was previously possible.

Throughout the 200-year history of knot theory there have been connections between knots and physical sciences. Physicists undertook the first systematic study of knots in the late nineteenth century motivated by a theory of matter consisting of knotted vortex atoms. Since the discovery of knotted circular DNA in the middle 1970s, the area of physical knot theory (dealing with knots that can occur in nature which are either made out of ropes or molecules) received much attention from mathematicians as well as scientists. In the laboratory biologists can use particular enzymes (topoisomerase) to generate complicated knotted circular DNA molecules of any knot type they desire. This is evidence that in nature (for in example in ourselves) there exist mechanisms to create complicated knotted molecules. An obvious question arises: What is the



Dr. Claus Ernst

reason for nature to deal with knotted molecules? What is the biological relevance of knotted DNA molecules? Theoretical results about thick knots help us to answer questions about the world of knotted molecules and are thus of interest to chemists and biologists.

## Improving on Wood

Dr. Chris Byrne, Assistant Professor, Department of Engineering, Ogden College of Science and Technology, has been awarded a grant of \$75,000 from the Kentucky Science and Technology Corporation. The grant is entitled "Development of Cellulose-Derived-Composites," and is part of the KSTC's Commercial Investment Fund, a statewide program to fund new businesses and start them on the way to commercial success.

Professor Byrne will develop a new class of materials with unique characteristics from material he has already patented and that has drawn international attention. The project will advance this young technology by focusing on development of the material production process while trying to establish the first commercial use of the technology.

He will produce carbon-polymer composites to establish market potential in the specialty wood-products arena. The exceptional beauty

of the Cellulose-Derived-Composites (CDCs) may boost them into acceptance if he can produce cost effective derivatives.

The project not only may create a new wood type for commercial use, but it educates engineering students who are involved in each step. Since the formation of a business is another primary outcome, students will also learn about establishing a business and what it takes to do so.

What consumers may see as a result of the project is a new, inexpensive, stronger, and beautiful wood



*Dr. Chris Byrne*

ceramic that has a variety of uses under high temperatures. Dr. Byrne believes that his product will have a significant market application in decorative applications. CDC ceramic materials could impact industrial processing equipment, and the aerospace, transportation and communications industries. Applications to these industries include wear resistant seals and bearings, cutting and abrasive tooling, reflectors, high temperature resistant structures and filters, and protective shields, all at lower costs than present applications.

## New Researcher

The absence of funds has not deterred WKU's Department of Biology from hiring key faculty to press on with research. The Kentucky Statewide EPSCoR Research Startup Fund program has made WKU able to hire a tenure-track researcher to involve undergraduate and graduate students in hands-on research. The funding was awarded to Steve Huskey, Assistant Professor of Biology, for nearly \$50,000. The EPSCoR program is an experimental

program to stimulate competitive research to increase research and economic development in the state.

This new tenure-seeking faculty member will extend Biology's strengths in physiology, biomechanics, and possibly developmental biology. The new scholar will complement existing research emphases in ecology, population genetics and systematics, physiology, cell biology, and biomedical sciences. Since the department has hired a scholar with many talents, Dr. Huskey will be able to interact collaboratively with researchers in other areas such as human biology and engineering. For example, Dr. Huskey will be able to establish a program in functional morphology, a field that uses anatomy, mechanical engineering, and animal behavior to measure organismal performance, which will have the potential to create partnerships with biologists in other institutions across the state, one goal of the EPSCoR program.

This position will enhance the department's ability to serve its large pool of majors. Students pursuing

pre-medical and other pre-professional degree programs will receive relevant experiential opportunities. Students enrolled in physical therapy will learn tools and techniques to measure human performance. Others may get opportunities to conduct experiments on live animals while recording their behaviors. This position will add another dimension to research and instruction, in addition to molecular and cell biology, where there are already strengths.

Dr. Huskey expects that his research will provide expertise in current areas of concern for the nation. He expects to bring technical expertise in high-speed video image analysis that can be extended to questions outside the biological sciences, such as ballistics, analysis of combustible materials, and crash testing. Biology will thus be able to fulfill its role as a bridge to other sciences. Students participating in these programs will acquire an uncommon skill set making them more marketable and able to contribute to the science and technology workforce in Kentucky.



*Dr. Steve Huskey*