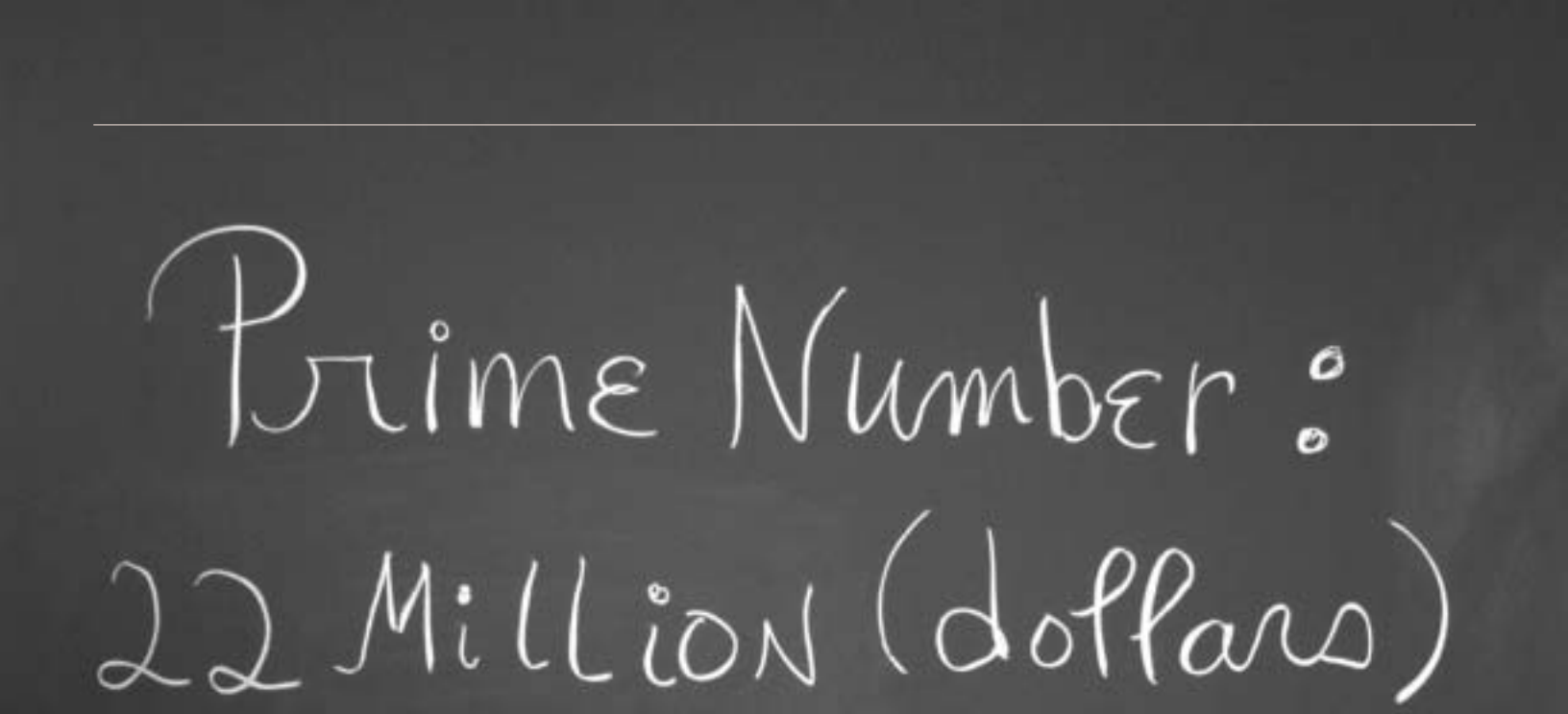

NSF bolsters math and science education in Appalachia

"The NSF doesn't just walk in your door every day and plunk down $22 million," says Wimberly Royster from his office in UK's new Ralph G. Anderson Building. "And in a way it's a challenge. They're saying, 'Here's the money you asked for—now let's see if you can do what you said you could.'"

The five-year grant, which is part of NSF's $240 million Math and Science Partnership program, is one of the largest single awards in UK's history.

Royster is the project director of this initiative, called the Appalachian Mathematics and Science Partnership (AMSP), one of several projects that will contribute to President George Bush's plan for national education reform detailed in the No Child Left Behind Act. Royster, an emeritus professor of mathematics at UK as well as a former vice president for research, underscores the point that although this award was given to UK, the

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success of the project totally hinges on the concept of partnership.

"This has to be a team effort," he says, "and everybody on the team has a vital role to play." The players include teachers, administrators and guidance counselors in 52 school districts in Kentucky, Virginia and Tennessee; administrators and faculty at nine area colleges and universities; and various regional agencies. It's a team of hundreds, with a common goal: strengthen and reform central Appalachian students' performance in mathematics and science from pre-school through undergraduate education.

Are students who tackle problems in math and science in these rural school districts not up to par with kids elsewhere in the country? Paul Eakin, the project's principal investigator, believes that there are deficiencies in aptitude and motivation, but that these are not problems unique to Appalachia. "I'd say there are endemic urban/rural realities. But there are clearly unique challenges in educating students in rural areas."

Eakin, a math professor at UK since 1969, says that a quick look at a map of Appalachia reveals one of these challenges. "The biggest barrier we're facing is geography. Our program will support 12,000 teachers scattered over a 35,000-square-mile area. That's huge. And winter weather in the mountains not only results in many more 'snow days' than in other regions, but also disrupts support and professional development for teachers."

"Because teachers are so isolated, it's difficult for many of them to get to in-service training sites, for one thing," says Ron Atwood, the science program director for this project and the "elder statesman" in the College of Education (he's been at UK since 1966). "The fact that many students in this region 'fall behind' in math and science—what's sometimes called the 'achievement gap'—has to do not only with the geography but also with limited funding for schools and lack of instructional materials. It doesn't have anything to do with the talent of teachers. There are some very capable and dedicated teachers out there."

As AMSP gets off the ground this spring, UK will partner with eight other institutions of higher learning—Eastern Kentucky, Kentucky State, and Morehead State universities, Pikeville College, Union College, the University of Virginia's College at Wise, the University of Tennessee, and Somerset Community College, along with the Kentucky Science and Technology Corporation—in an effort to supply both pre-service and in-service training, and more consistent and well-targeted course design and development.

"Rural science teachers are difficult to get and difficult to keep," says Eakin. "One thing UK can specifically address through this program is the preparation of math and science teachers. And we want to try to increase the attractiveness of the teaching profession as viewed by our students who come from that region."

Atwood is excited about the new direction UK and the partner universities and colleges will be taking in their content preparation for teachers. "The idea is for all partner higher-ed institutions to have more viable science courses for prospective teachers. And this is the place to address the problem—the most inexpensive place to address the problem."

By "viable," Atwood means nothing less than a radical shift from the traditional "chalk-and-talk" approach to training teachers to a hands-on approach—a well-planned series of course activities that produce data for analysis and that help students build an understanding of key concepts.

"We need to change our pre-service programs so that teachers are well prepared to approach their students in this way. More hands-on and more '*minds-on*' activities, especially for elementary and middle school teachers in sciences," he says. The idea is for all the higher-ed partners to work on hands-on approaches to teaching math and science, and then pool their ideas. A more effective standards-based curriculum across the partner institutions is the ultimate goal.

Carl Lee, mathematics program director of the project and a professor of math at UK, says another important aspect of the new partnership is a commitment to community and parental involvement. "It's important that a student's parents feel involved, and we want the parents to know what's going on in the classroom and to help their kids with homework."

So how do parents who can't tell a scalene triangle from an ice cream cone help their kids with math and science?

"Well," Lee says, "technology can help with that. And members of the math department here have recently developed a free Web site here in the UK math department—mathclass.org. It's a site parents and their students can log on to and work through homework problems." Lee adds that there's immediate feedback on this site for the results of student work, which includes the Kentucky Early Mathematics Testing Program to provide on-line testing to help high school students determine their preparedness for learning college-level mathematics. Eakin says that the plan, through the mathematics and science partnership, is to make this available to every teacher in the region, and to students and parents. "We make CDs of whole courses, and recently we've edged into making DVDs as well," he adds.

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The need for such a math site arose, in part, out of earlier work that Royster and UK's outreach unit in the Appalachian Center did through a program called the Appalachian Rural Systemic Initiative, or ARSI. "In a sense, ARSI was a precursor to this newer and broader-based NSF program," says Stephen Henderson, who currently directs ARSI, which is housed at the Kentucky Science & Technology Center in downtown Lexington. Over the last seven years this program has helped build a network of schools and a network of support through "research collaboratives"—at UK, the University of Tennessee, Ohio University, Marshall University, and the University of Virginia's College at Wise.

"We've spent an enormous amount of time providing training and support for teachers and instructional supervisors through the ARSI program and now plan to also include principals and counselors in leadership training in the math and science instructional arena," says Henderson. The idea of "leadership training for principals" in mathematics and science might seem a little odd, admits Henderson, who is continuing with the ARSI program and also, now, serving as director of program delivery for AMSP. "What we're doing is trying to show them what they should be seeing when they monitor math and science classes in their school, and how to help teachers improve instruction. The hands-on approach just looks different than what they're used to seeing."

Henderson and Royster emphasize another benefit of the groundwork that's been laid through ARSI—the extensive data they've collected on rural Appalachian schools.

"A major reason we got this larger grant is that we had all kinds of data on these schools. This fact separated us from most of the other institutions that applied for funding," says Royster, who has served as principal investigator of ARSI since its beginning in 1995. Almost all of the data, he explains, supported UK's claim in the grant proposal that significant work needed to be done in these rural Appalachian schools to help students understand—and use—math and science.

Staff from ARSI created a set of indicators to assess how students' performance in math and science aligned

Wimberly Royster (front right) emphasizes the fact that the success of the Appalachian Mathematics and Science Partnership, supported by $22 million from the National Science Foundation, hinges on teamwork. The UK team includes Royster and (clockwise) Stephen Henderson, Ron Atwood, Paul Eakin, and Carl Lee.

with state standards. Consultants from Inverness Research Associates reviewed 56 schools' assessments in math and science, 19 were assessed in science only, and 21 in math only.

Among the findings were that fewer than half the schools have math and/or science curriculum closely aligned with state standards and that instruction throughout the region lacks an emphasis on higher-order thinking skills—students have little opportunity to engage in serious problem solving in mathematics or inquiry-learning in science.

"One of the conclusions the data led us to," Royster says, "is that to improve instructional practices, better curricula and in-depth professional development are needed, particularly in math. Yet most districts lack the capacity to provide these two critical elements."

"ARSI has had a tremendous impact on our district, from K through 12," says Jennifer Francis, who teaches in a Powell County elementary school. "When ARSI came into our county five years ago, we didn't have formalized curriculum. Teachers were using textbooks in some schools and kits in others to teach science. ARSI helped us align our curriculum, and once that was in place provided support with teacher partners to improve instructional strategies and locate resources to support us."

Joe Bailey, who teaches in Whitley County, Kentucky, also applauds ARSI. "We benefited by getting resources at our school in the form of a real, live scientist. Now, through the ARSI contacts, an astronomer comes to our school once or twice a year from the University of Tennessee. We don't have telescopes or that expertise, so bringing him in has benefited our students tremendously." Bailey, who serves now as a math and science coordinator with ARSI, adds that before this program was available in his district, test scores were in decline, and Whitley County was threatened with a state takeover. Since ARSI support has been in place, test scores have started going up. "This year we had five of eight schools meet their goals," he says, "an impressive improvement."

Brenda Edwards, who directs the ARSI Resource Collaborative at the University of Virginia's College at Wise, Virginia, says, "Just like ARSI, this new and expanded program will benefit the students, and that's the bottom line," she says. "We've collected data on the impact of ARSI, and it's shown us that more than 70 percent of students involved in the program improved significantly in both math and science, 20 percent improved in one or the other, and only three percent showed no improvement at all. Students are also now taking more high-level math and science and doing well in these subjects—and coming to college better prepared."

"The number-one goal as I see it is to get more students interested and excited about science and math," says Henderson. "We have to recognize that it's critical in today's world that young people have a better understanding of math and science, and can make better-informed decisions. From mutated corn raised for pharmaceutical use to cloning to stock-market decisions, we need an educated population. That's my wish. And with the magnitude of this project and the money we have, I think we can make some real things happen."■