

Mentoring Matters

Hands-on instruction pays off

By Susan Ray

Mentoring has never been more important in the field of science, where the number of students pursuing degrees in natural sciences and engineering is declining, and where finding enough qualified K-12 science teachers remains a constant struggle.

Without the teachers to inspire the interest and without role models to show students what being a scientist is all about, economists and science leaders say the U.S. is at risk of losing the top spot as the world's greatest innovator of new technology, the very thing that affords Americans their high standard of living.

The Magnet Lab takes very seriously its responsibility to help groom the next generation of scientists and has developed an extensive educational outreach program that capitalizes on lab resources.

The key to the success of the lab's educational outreach programs are the scientist mentors who volunteer their time – and lots of it – to ensure students and teachers leave the lab with lasting lessons.

"We are completely dependent on the mentors, and I am grateful to them every day," said Patricia Dixon, who directs the lab's Center for Integrating Research & Learning. "There's often a lot of talk about how successful our programs are, but what underlies that success, what makes it possible, is the incredible commitment the scientists make to these students and teachers. We really could not do it without them."

'An adventure in science'

Bob Goddard has been mentoring students at the Magnet Lab for 10 years.

The lab reaches out to the community in myriad ways, but the middle school mentorship and research experiences for teachers and undergraduates are its signature programs.

For the middle school mentorship, between 12 and 17 students from Tallahassee's School of Arts and Sciences conduct a semester-long research project at the Mag Lab. Working with lab scientists, they see firsthand how real-world science is conducted and what kinds of careers they could pursue in the field.

Bob Goddard, who runs the lab's Microanalysis Laboratory, has mentored students, primarily middle schoolers, for 10 of his 11 years at the lab. From SpongeBob figurines and 3D displays to pictures of insects magnified many times over, he knows how to get students' attention. And while he has it, he's going to get them interested in science. He identifies the students' strengths and works from there, giving them daily doses of science that build confidence.

"They don't always realize when they come in that this is an adventure in actual science," Goddard said. "I show them how to use the tools, but they choose the adventure."

His middle school students have looked at rust, stainless steel – and even french fries – under high-powered microscopes, and the lessons they learn can be applied to more than science.

"I try to tell these kids, if there's something you don't know, find out. And if you have an idea and the data doesn't support it, that's not failure. That just means you go in a different direction," said Goddard. "That's the adventure."

Teaching kids how to learn and familiarizing them with the scientific method is a recurrent theme among the lab's mentors.

"Beyond what I teach kids about how to work in a lab and how to use a microscope, I'm trying to teach them how to learn in general," said Mike Davidson, an optical microscopist and longtime mentor. "In science, things screw up on a daily basis. The most important thing is how you react, how you learn from each screw-up how to anticipate what might happen the next time."

Active participation key to success

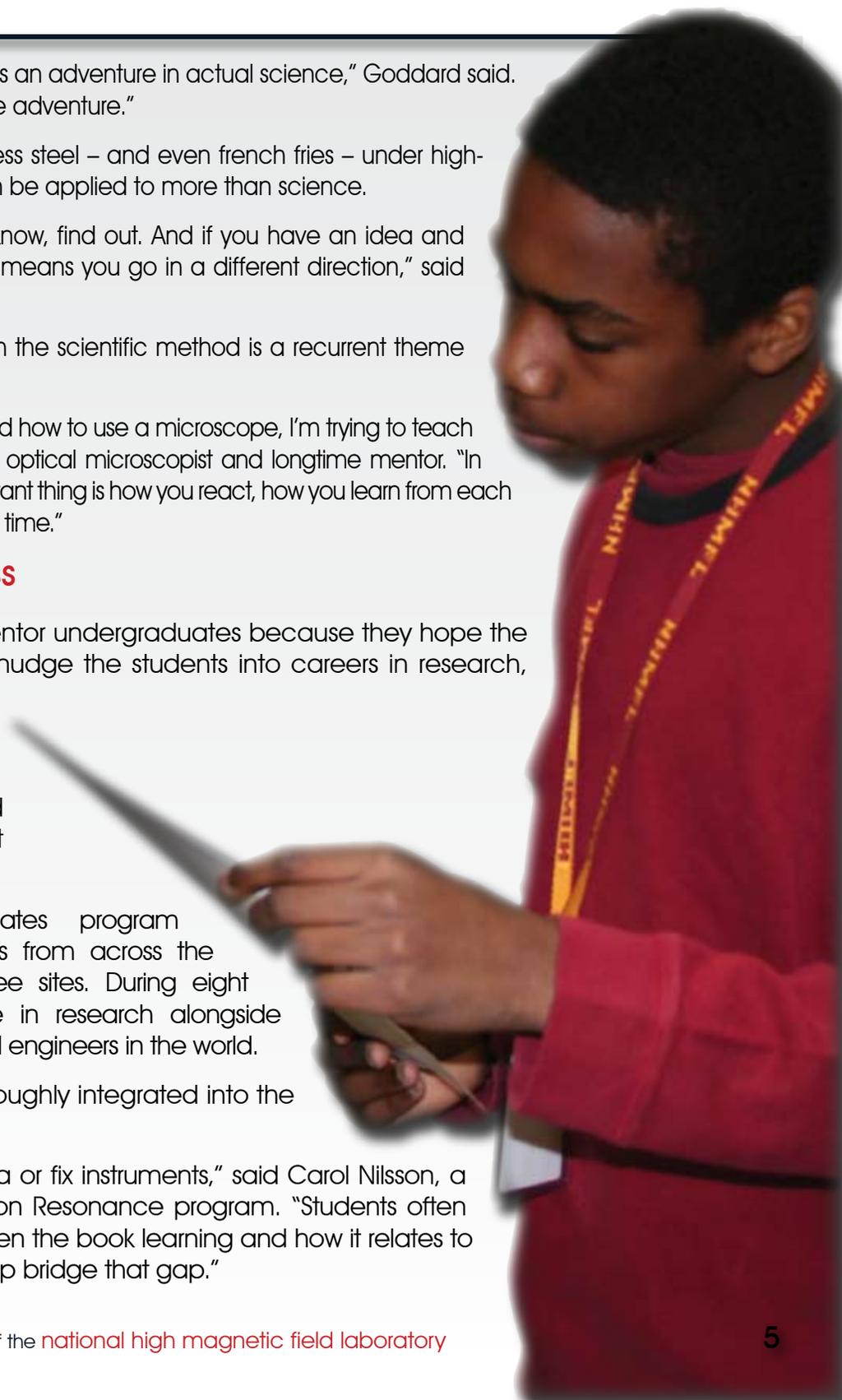
While it's true that many of the lab's scientists mentor undergraduates because they hope the experience will leave a lasting impression and nudge the students into careers in research, it's also true that the undergraduates do real work and contribute to the scientists' research in meaningful ways.

"I have seen firsthand how productive and valuable they are," said Davidson. "They learn fast and stay focused."

The Research Experiences for Undergraduates program matches high-achieving undergraduate students from across the country with scientists at the Magnet Lab's three sites. During eight weeks in the summer, the students participate in research alongside some of the finest scientists, magnet designers and engineers in the world.

The students aren't just shadowing; they are thoroughly integrated into the research and development activities.

"They might do hands-on work, help analyze data or fix instruments," said Carol Nilsson, a scientist in the lab's Fourier Transform-Ion Cyclotron Resonance program. "Students often have a hard time bridging the connection between the book learning and how it relates to what's happening now. Research experiences help bridge that gap."



Mentoring Matters - cont.

That was the case for Nathaniel Falconer, who is now a laboratory assistant and probe developer in the lab's Nuclear Magnetic Resonance division. He participated in the 2003 REU program.

"My experience as an REU was excellent. I was exposed to many facets of the Magnet Lab," said Falconer, who was mentored by William Brey, an engineer. "Through mentorship, I was able to see the manifestation of what I learned in the classroom. It was definitely because of this experience that I chose my career path."

Manuel Ramos had a similar experience. He was an undergraduate at the University of Texas-El Paso when he participated in the 2003 REU program, and when the eight weeks were up, he knew graduate school and a career in research were in his future.

Teaching the teacher

The program with perhaps the greatest potential for enhancing science education and students' classroom learning is the Research Experiences for Teachers program. This six-week, summer residential program for teachers is modeled after the REU program and is one of the few programs of its kind in the country that accepts elementary school teachers. In addition to working directly with a scientist, teachers attend weekly seminars focusing on elements of science education, experimental design, the nature of science, process skills, communication in science and inquiry based teaching and learning.

"The teachers take it seriously because they understand the scientist is taking the time and making the effort to translate the work they are doing to the teachers to help them bring real-world science into the classroom," said Dixon.

"My mentors taught me how to design an experiment, the relevance of it, how to interpret the data and the most important thing — the purpose of such experiments," said Ramos, who was mentored by Justin Schwartz, Sastry Pamidi and Ulf Trociewitz. "I remember going back home and talking with my relatives about (my research experience). To me, it was like a real performance for a musician or a real art exhibition for an artist."

Now enrolled in the Ph.D. materials science program at UTEP, Ramos said the guidance and friendship offered by his mentors was just as valuable as the learning experience.

"I've decided to become a professor just like my mentors, because to mentor someone and to learn about things that are hidden in nature are experiences that last forever."

"Through this process, the teachers learn about inquiry, about the nature of working as a scientist and about the process of doing science. Teachers – and especially students – don't get that from a book."

Goddard, who also works with teachers, said that when teachers come in to his lab, he shows them the microscopes and tells them what he does. They learn by assisting him with images or other data he's working with. But the teachers, he said, come up with the ideas for how to relate what they've learned back to their students.

"I want teachers to have fun and to get a renewed appreciation for science," said Goddard. "A lot of teachers feel their knowledge of science is not adequate, but they leave here more confident because they have contributed to actual research."

Apart from sharing what they know with teachers, lab scientists help the teachers reconnect with their natural curiosity and remind them what it's like to be a student.

"I don't think the mentors have any idea how lasting this experience is, particularly for the teachers," said Dixon. "Think about all the teachers who have come through the Research Experiences for Teachers program, and how many students these teachers have touched since. It's enormous the impact lab mentors have on science education."

STAY INFORMED

For more information about the lab's educational outreach efforts, visit www.magnet.fsu.edu/education, contact Pat Dixon at 644-4707, or e-mail pdixon@magnet.fsu.edu.

OUTREACH BY THE NUMBERS

Number of teachers who have participated in the RET program since its inception in 1999: **128**

Number of undergraduates who have participated in the REU program between since its inception in 1999: **160**

Number of middle school students in the mentorship program since 2002: **72**

Number of classrooms visited by the Mag Lab science educators in the 2006-2007 school year: **329**

Number of classes served at the lab through tours and hands-on activities in the 2006-2007 school year: **32**

Number of people who visited the Magnet Lab's Open House in 2007: **3,500**

