



Rensselaer programs inspire the next generation to pursue careers in engineering, technology, math, and the sciences.

Pipeline to the *future*

On a recent day during an after-school program at Troy's Doyle Middle School, two seventh-grade girls cheerfully greeted a visitor, eagerly explaining their newest robotic creation, "the plug," a nano device used to repair blood vessels.

Of course, the colorful model, made from child-favorite LEGO® plastic bricks along with the toymaker's sophisticated computer technology, wasn't small enough to fit inside an actual vein or artery to plug up tissue damage. But the imagination and the students' ability to grasp the concept behind the nanorobot model, and their determination to build it, constitute the epitome of what Bill Clark has worked to accomplish in his eight years as a technology education teacher at the middle school.

"These two girls took it upon themselves to conduct research via the Internet and come up with what they thought would be a good solution to a medical problem using nanotechnology. I was amazed," says Clark, who coached the two girls along with six other students as a team for the international LEGO FIRST Nano Quest Challenge. FIRST (For Inspiration and Recognition of Science and Technology) was founded by inventor and entrepreneur Dean Kamen.

In early December, after months of preparation and practice, the students joined 23 teams of youngsters ages 9 to 14 from around the Capital Region to compete in the regional competition that took place at Rensselaer's Darrin Communications Center. The finalists will attend the FIRST LEGO League World Festival at the Georgia Dome in Atlanta in April. BY JODI ACKERMAN FRANK



LIGHTING THE SPARK Rensselaer's Center for Initiatives in Pre-College Education (CIPCE) has adopted the event in partnership with General Electric for the last three years to spark an interest in mathematics, science, and engineering among local middle school students. The competition is one of a number of K-12 pipeline programs across campus that build upon the Institute's traditional strengths to foster innovations in interactive learning, educational technologies, and teacher education.

"What we do is take what Rensselaer does so well in science, technology, and engineering design and transfer that to the elementary and secondary classrooms," says Lester Rubinfeld, professor of mathematical sciences and director of CIPCE.

For the Nano Quest Challenge, the student teams designed, built, and programmed a set of LEGO MINDSTORMS™ robots to explore the uses of nanotechnology. The teams focused on areas in which nanotechnology could have or is already having an impact, such as medicine, computers, and the environment. The robots were made from standard LEGO parts and a computerized unit that controls the motors and sensors.

adds that the introduction of Vex technology provides the next level of a continuous K-12 pipeline effort.

For the LEGO program, Rensselaer undergraduates work in local schools and Boys and Girls Clubs to facilitate after-school robotics activities. While there, they mentor students on how to design, construct, and program robotics to accomplish engineering challenges, and at the end of the fall term, these students get to test their skills with one another during the FIRST LEGO League Tournament.

"These and other K-12 programs that Rensselaer offers are opportunities to engage students in technology and science," Schoch says. "They see it, feel it, and get immediate feedback that they can take back to the drawing board. That's something they're not getting enough of in the classroom."

THE QUIET CRISIS For several years President Shirley Ann Jackson has been warning of a looming gap in the science and engineering workforce, driven primarily by three factors. Those who responded to President John F. Kennedy's historic call to action following the launch of the

"If we are to succeed in closing this emerging gap, all of us must get engaged in the effort to excite, encourage, and prepare young people to pursue careers in science, math, and engineering," President Jackson says. "We must have a cadre of teachers and mentors at all levels who have the necessary skills to help these students excel. And it must be a priority. Society must value science and those who do it."

The programs were written by the students using the ROBOLAB™ software developed by LEGO and Tufts University that incorporates a special version of the software LabVIEW created by Rensselaer trustee Jeffrey Kodosky '70, co-founder of National Instruments, who has been an enthusiastic supporter of CIPCE's K-12 robotic efforts.

"Building robotics is a great way to inspire students, boys as well as girls, to learn science, technology, engineering, and math," Kodosky says. "By making software that is accessible to our young students, we at National Instruments are learning how to make our professional tools even easier to use. And, working on robotic toys is just plain fun—for students and for us as the developers."

The same day as the LEGO regional contest, another smaller, but equally as engaging competition took place between Rensselaer sophomores and high school students nearby in the George M. Low Center for Industrial Innovation. About 150 students competed against one another in "The Game," which incorporated the Vex Robotic Design System (see, also, page 2). The technology is similar to LEGO's, but the programming is more advanced, and the robots are larger, made of metal, and have more motors and sensors.

When Rubinfeld learned about the Vex competition, he approached the organizers, Larry Ruff, systems engineer and laboratory supervisor, and Paul Schoch, associate professor of electrical, computer, and systems engineering, to investigate whether Vex would be a good technology to incorporate in a summer program to attract students in grades 8-10.

"So far Vex been a good fit with all the teams, and I think it would be appropriate for the younger students as well," says Ruff, who incorporated the contest as part of his Introduction to Engineering Design course.

Schoch, who also is involved with CIPCE's LEGO Robotics Program,

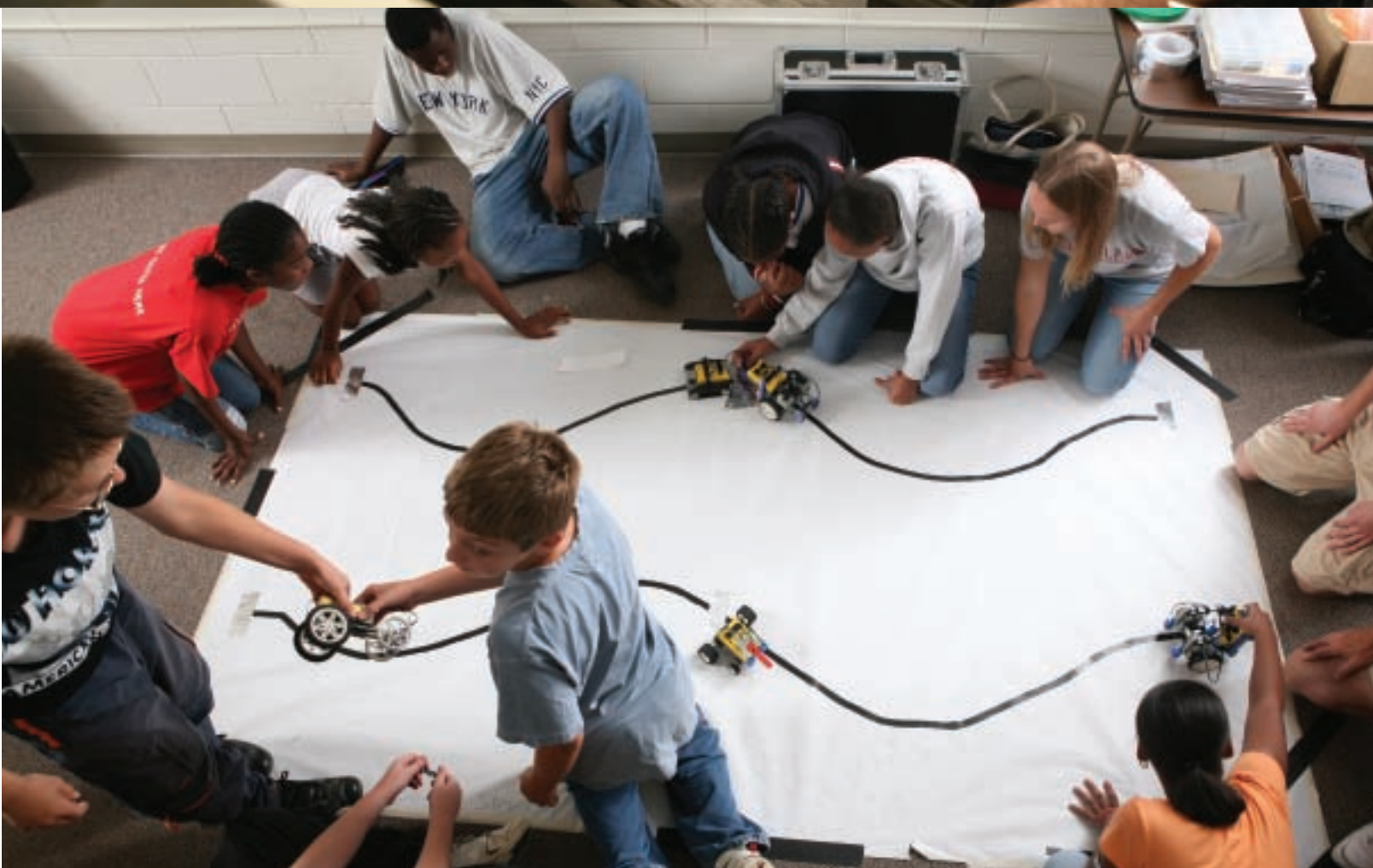
Sputnik satellite and became the scientists and engineers whose work has fueled the U.S. economy for a generation are on the verge of retiring in record numbers. As a nation of immigrants, the United States has relied on students, professors, and researchers who came from abroad to study and remain, but in a "flattening" world offering expanding opportunities, their numbers are decreasing. In addition, not enough young people in this country are being excited and prepared to pursue careers in science and engineering. These factors, in combination with the decreasing federal commitment to funding basic research, are what President Jackson describes as the "quiet crisis."

"It is quiet because it takes decades to educate a scientist, mathematician, or an engineer, so the true impact unfolds only gradually, over time," says President Jackson. "It is a crisis because the discoveries and innovations of our science and engineering workforce create the new opportunities and industries which keep our economy thriving, provide for our security, and mitigate the global scourges that breed suffering and global instability."

President Jackson has been actively involved with other academic, corporate, and government leaders to bring national attention to this looming crisis. Numerous reports and policy papers—including from the

National Academies, the Council on Competitiveness, and the AAAS—have documented the problem, and detailed recommendations for change which include significant enhancements in math and science education and investments in

(Top) In the spring, 11th grade girls took part in the 10th annual Design Your Future Day. (Bottom) During the summer, nearly 75 middle school students came to campus to take part in CIPCE's LEGO Robotics Engineering Academy.



research. Legislative proposals based on recommendations in these reports have been introduced by bipartisan coalitions in the Congress and by President George W. Bush.

“The national conversation on this issue is now engaged,” President Jackson says. “Now it is time to turn rhetoric into reality. The clock is ticking. It is time to implement solutions, and those solutions must come from all sectors—academic, business, and government—and from all levels—national, state, and local.”

She urges a national focus on energy research as a focal point to excite and encourage greater interest in science and engineering careers. “Just as President Kennedy galvanized the nation in response to the Soviet launch of Sputnik, so too could the President around energy security,” she says. “Energy security is the space race of this millennium.”

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Closing the gap, President Jackson argues, also will require a national commitment to develop more of the talent of all citizens, especially what she calls the “underrepresented majority”—women, minorities, and those with disabilities who traditionally have been a disproportionately small part of the nation’s science, engineering, and technology workforce, but who now comprise the demographic majority in the U.S.

“There has been a huge demographic shift in our country, with women and minorities representing the new face of America. Along with this new reality, we have this enormous amount of talent that hasn’t been tapped,” says Kenneth Durgans, vice provost for the Office of Institute Diversity, which hosts Rensselaer’s annual Black Family Technology Awareness Day.

Earlier this year, more than 450 area students and their families participated in the event, which featured 19 workshops. Led by Rensselaer professors, students, and community organizations, the workshops included building roller coasters, creating a hot air balloon using household items, hands-on interactive sessions exploring engineering and chemistry science experiments, and a CIPCE robotics session.

“This is a special day designed to help eliminate the science and technology gap for members of the minority community,” Durgans says. “By showcasing science and technology in a fun and interactive way, we hope to motivate more minority students to pursue careers in these fields.”

WOMAN POWER Women now outnumber men in undergraduate collegiate enrollment and, together with minorities, make up more than half the U.S. workforce. Yet, they remain underrepresented in science and engineering careers.

“This really is a societal issue,” says Barbara Ruel, director of women in engineering and diversity at Rensselaer. “We need to spread the message that women can perform equally as well as men in science, technology, and especially in the engineering fields.”

Ruel has worked to effectively spread that message by recruiting and retaining women students, and by developing engaging programs that



(Top to bottom) LEGO Robotics summer camps, Exploring Engineering Day, Black Family Technology Awareness Day, and Design Your Future Day are part of Rensselaer’s effort to interest young people in pursuing occupations in the fields of science and engineering.