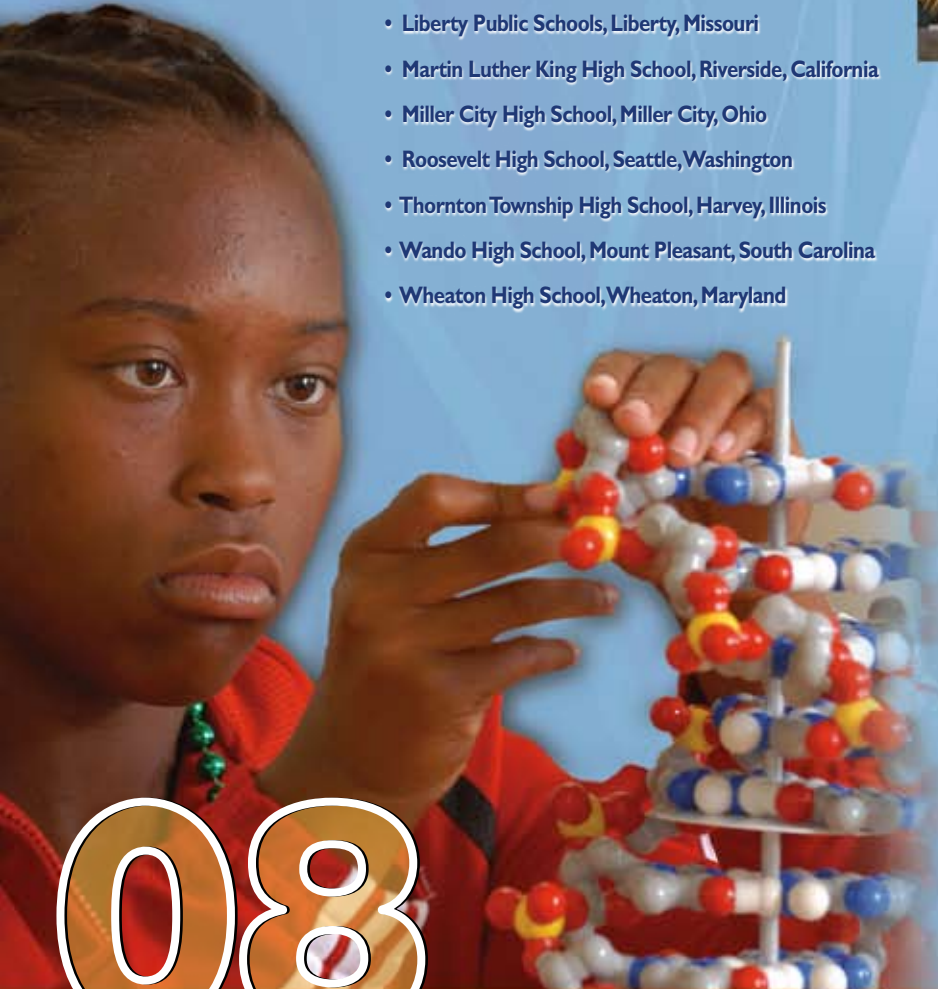


- Del Rio High School, Del Rio, Texas
- East Lake High School, Tarpon Springs, Florida
- Francis Tuttle Pre-engineering Academy, Oklahoma City, Oklahoma
- Greenfield-Central High School, Greenfield, Indiana
- Hawthorne High School, Hawthorne, California
- Kenosha Unified School District, Kenosha, Wisconsin
- Lancaster High School, Lancaster, California
- Liberty Public Schools, Liberty, Missouri
- Martin Luther King High School, Riverside, California
- Miller City High School, Miller City, Ohio
- Roosevelt High School, Seattle, Washington
- Thornton Township High School, Harvey, Illinois
- Wando High School, Mount Pleasant, South Carolina
- Wheaton High School, Wheaton, Maryland



08

PLTW in Action

2008 Model Schools Yearbook



Forging the Innovation Generation
www.pltw.org

Dear Colleague,

A little more than a decade has passed since a school improvement initiative called Project Lead The Way® (PLTW) was launched in a dozen schools in upstate New York. The idea was to address the shortage of engineers in the United States, but along the way it became clear that PLTW's rigorous and relevant curriculum, combined with project/problem-based instruction, could be an effective catalyst for education improvement at any school.

With the addition of its groundbreaking Biomedical Sciences curriculum this year, PLTW is now offered in nearly 3,000 schools in 50 states and the District of Columbia. More than 250,000 middle school and high school students are enrolled in the classes. More importantly, perhaps, studies measuring the impact of PLTW overwhelmingly reveal that the program works. For example, research shows that PLTW students are more likely than their peers to pursue science, technology, engineering, and mathematics (STEM) majors at the postsecondary level; to succeed in those challenging programs; and to enter a STEM field after graduation.

This yearbook, *PLTW in Action*, was created to celebrate PLTW, and to inspire new schools and districts to join the growing PLTW family. Although every PLTW school has a success story to share, we couldn't possibly include each one in a single yearbook. So instead, we chose to profile 14 PLTW districts and schools that illustrate how the program works at different institutions in varied geographical locations with diverse student populations.

Chances are you'll see a district or school similar to yours in one of the profiles. If you're already a member of the PLTW network, maybe you can adopt an idea from one of the model schools to enhance your program. And if you're a business or other organization considering partnering with PLTW, feel free to contact any of the model schools for more information, advice, or support.

We're delighted by PLTW's rapid growth throughout the country. It fuels our hope of transforming STEM education so that students graduate equipped to succeed in an increasingly competitive global economy.

Please join us in the effort to forge the innovation generation, and generations of engineers and scientists to come, by becoming part of the PLTW network of schools.



Richard Blais

Richard Blais

Richard Blais
Vice President, Project Lead The Way



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THE SCHOOLS



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■ Thornton Township High School, Harvey, Illinois	Page 12
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■ Francis Tuttle Pre-engineering Academy, Oklahoma City, Oklahoma	Page 14
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■ Greenfield-Central High School, Greenfield, Indiana	Page 16
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PLTW in Action: 2008 Model Schools Yearbook
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PLTW: All Over the Map

PLTW's relevant and rigorous curricula are making changes in the culture of schools, improving the quality of life and economic vitality of every state in America.

▲ 2008 PLTW Models of Success

- A • Del Rio High School, Del Rio, Texas
- B • Roosevelt High School, Seattle, Washington
- C • Thornton Township High School, Harvey, Illinois
- D • Francis Tuttle Pre-engineering Academy, Oklahoma City, Oklahoma
- E • Greenfield-Central High School, Greenfield, Indiana
- F • Kenosha Unified School District, Kenosha, Wisconsin
- G • Wheaton High School, Wheaton, Maryland
- H • East Lake High School, Tarpon Springs, Florida
- I • Wando High School, Mount Pleasant, South Carolina
- J • Miller City High School, Miller City, Ohio
- K • Liberty Public Schools, Liberty, Missouri
- L • Hawthorne High School, Hawthorne, California
- M • Martin Luther King High School, Riverside, California
- N • Lancaster High School, Lancaster, California

● 2007 PLTW Models of Success

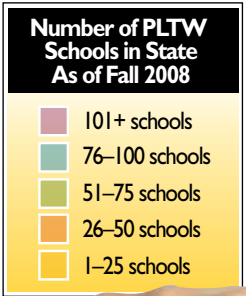
- O • Mountlake Terrace High School, Mountlake Terrace, Washington
- P • Cooley Middle School, Roseville, California
- Q • Milwaukee Public Schools, Milwaukee, Wisconsin
- R • Lake Fenton Middle School, Lake Fenton, Michigan
- S • Lafayette Jefferson High School, Lafayette, Indiana
- T • Saratoga Springs High School, Saratoga Springs, New York
- U • The Science Academy of South Texas, Mercedes, Texas
- V • Mountain View High School, Meridian, Idaho
- W • Coronado High School, Colorado Springs, Colorado
- X • Morton High School, Morton, Illinois
- Y • Nichols Junior High School, Arlington, Texas

■ PLTW National Affiliates

- | | |
|---|---|
| 1 • Arizona State University | 18 • San Diego State University |
| 2 • Arkansas Tech University | 19 • Seattle University |
| 3 • Duke University | 20 • Sinclair Community College |
| 4 • Eastern Michigan University | 21 • University of Colorado at Colorado Springs |
| 5 • Georgia Southern University | 22 • University of Illinois |
| 6 • Iowa State University | 23 • University of Iowa |
| 7 • Milwaukee School of Engineering | 24 • University of Kentucky |
| 8 • Missouri University of Science and Technology | 25 • University of Maryland at Baltimore County |
| 9 • New Hampshire Technical Institute | 26 • University of Minnesota |
| 10 • New Mexico State University | 27 • University of Nebraska at Lincoln |
| 11 • Oklahoma State University | 28 • University of New Haven |
| 12 • Old Dominion University | 29 • University of South Carolina |
| 13 • Oregon Institute of Technology | 30 • University of Tennessee at Chattanooga |
| 14 • The Pennsylvania State University | 31 • University of Texas at Tyler |
| 15 • Purdue University | 32 • West Virginia University |
| 16 • Rochester Institute of Technology | 33 • Wichita State University |
| 17 • Rowan University | 34 • Worcester Polytechnic Institute |

As of Fall 2008 PLTW By the Numbers

- States: 50 and the District of Columbia
- High schools: 1,990
- Middle schools: 900
- Teachers trained: 7,000+
- Counselors trained: 7,000+
- Students enrolled: 250,000+
- Past students: 500,000+





THE PLTW NETWORK

Project Lead The Way® (PLTW)

- Began in 1997 as a school-improvement initiative designed to address the shortage of engineers in the United States
- Is a not-for-profit national organization that promotes courses in STEM subjects for middle school and high school students
- Forms partnerships with public schools, higher education institutions, and the private sector to increase the quantity and quality of engineering graduates from the U.S. education system

Schools and School Districts

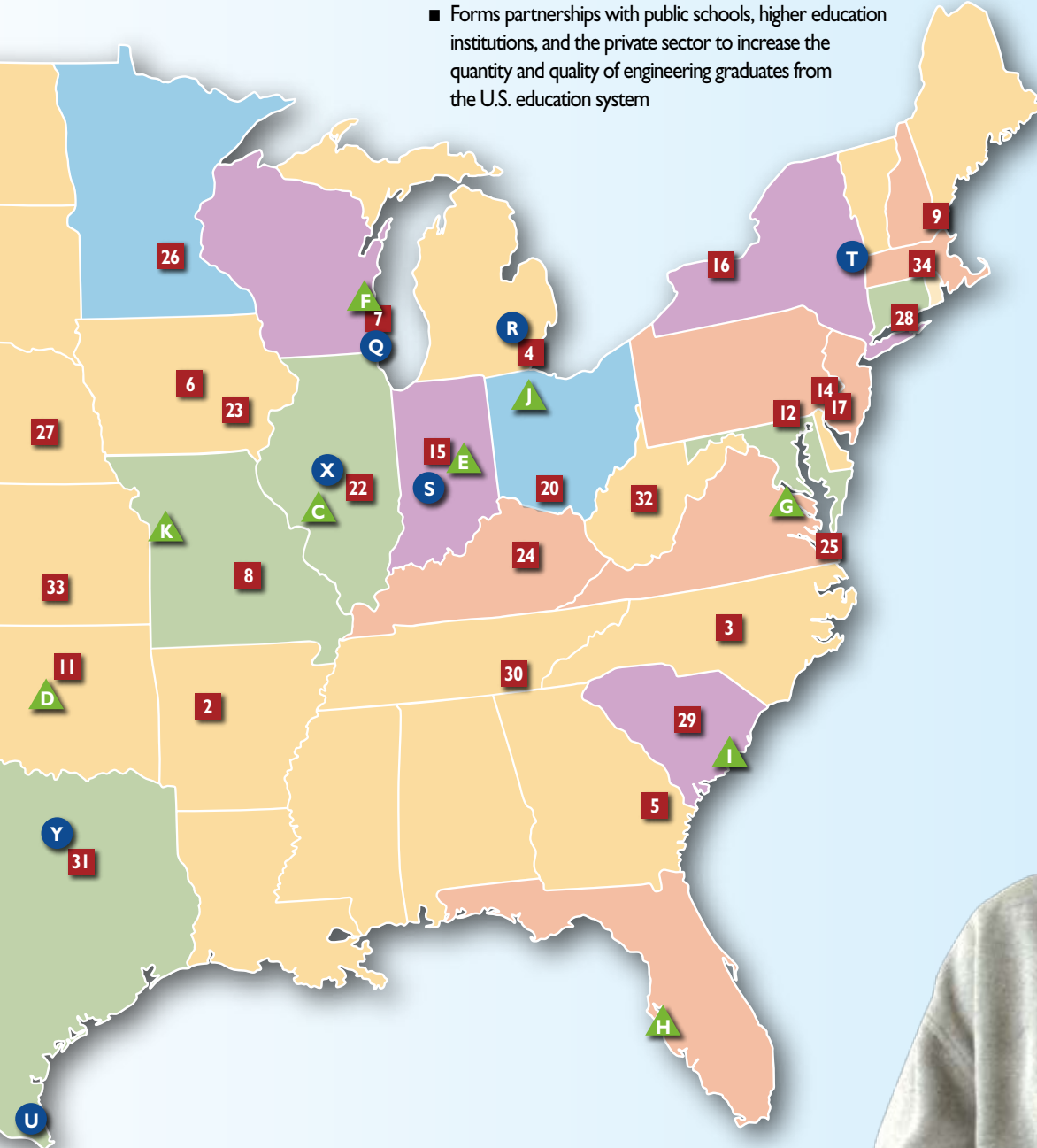
- Partner with colleges and universities
- Institute course sequences
- Leverage funds to gain additional resources
- Operate partnership teams
- Serve as models for other districts

Colleges and Universities

- Provide strategic leadership
- Involve industry
- Provide mentors and training for teachers
- Assist with building partnership teams
- Leverage funds to gain additional resources

Business and Industry

- Provide advisors, supporters, mentors
- Provide financial support
- Assist colleges and school districts in achieving the mission of PLTW



“I like Project Lead The Way because it’s based on technology. The world’s future, I believe, is based on technology.”

—KORINNE GREIDANUS

Kenosha School of Technology Enhanced Curriculum, Kenosha, Wisconsin

curricu

How PLTW Works

Project Lead The Way® (PLTW) curricula and courses are available for both middle schools and high schools.

Gateway To Technology (GTT) is an activity-oriented, five-unit middle school program designed to help all students explore math, science, and technology.

The PLTW Pathway To Engineering™

curriculum offers an eight-course opportunity for high school students seeking a more in-depth, hands-on knowledge of engineering and engineering technology-based careers.

A second sequence of courses, the PLTW Biomedical Sciences program, was piloted in selected schools during the 2007–08 school year, and was made available nationwide

in the fall of 2008. The four-course program is designed to engage high school students and prepare them for the postsecondary education and training necessary for success in a wide variety of careers, including physician, nurse, veterinarian, scientific and pharmaceutical researcher, therapist, and technician.

middle school



PLTW Gateway To Technology

Gateway To Technology™ (GTT) is an activity-oriented program designed to challenge and engage the natural curiosity of middle school students, and is taught in conjunction with a rigorous academic curriculum.

The program is divided into five independent nine-week units. Schools can choose to spread the GTT units through grades six through eight, or teach most units in the seventh or eighth grade. Each unit contains performance objectives and suggested assessment methods.

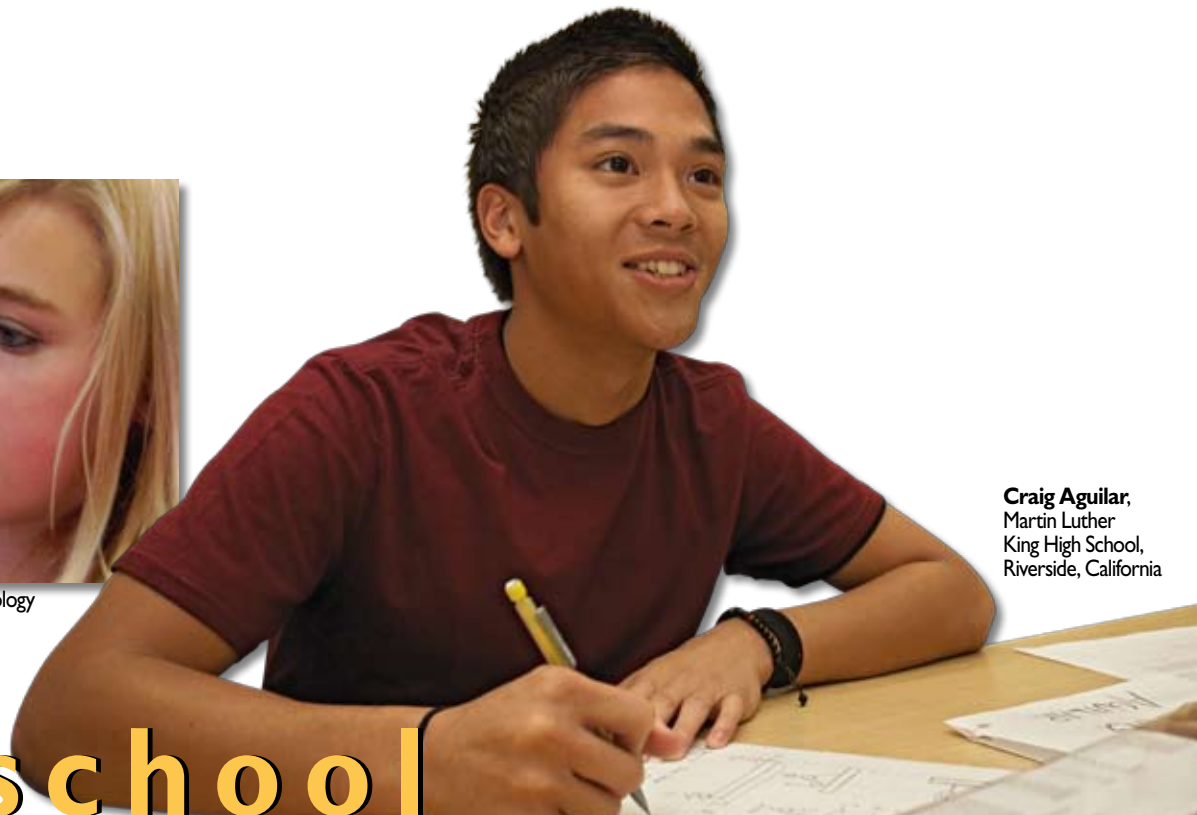
- **Design and Modeling** introduces students to the design process. Using design briefs, students create models and documentation to solve problems.
- **The Magic of Electrons** gives students the opportunity to explore the science of electricity, the movement of atoms, circuit design, and sensing devices.
- **The Science of Technology** teaches students about the mechanics of motion, the conversion of energy, and energy transfer.
- **Automation and Robotics** explores the history and development of automation and robotics while teaching students about structures, energy transfer, machine automation, and computer control systems.
- **Flight and Space**, which was developed with NASA, introduces students to the technology of aeronautics, propulsion, and rocketry.

Ryley Powell, Kenosha School of Technology Enhanced Curriculum, Kenosha, Wisconsin

lum



Kyra Vandervelde, Kenosha School of Technology
Enhanced Curriculum, Kenosha, Wisconsin



Craig Aguilar,
Martin Luther
King High School,
Riverside, California

high school

PLTW Pathway To Engineering

The Project Lead The Way® (PLTW) Pathway To Engineering™ curriculum is designed as a four-year sequence that will fit into any student schedule, and is taught in conjunction with traditional math and science courses. The program is divided into eight rigorous, relevant, reality-based courses.

FOUNDATION COURSES

- **Introduction to Engineering Design (IED)** allows students to use sophisticated 3D modeling software to improve existing products, invent new ones, and communicate the details of the products to others.
- **Principles of Engineering (POE)** uses student activities, projects, and problems to explore the wide variety of careers in engineering and technology and examine various technology systems and manufacturing processes.
- **Digital Electronics (DE)** uses computer simulations to teach students about the logic of electronics as they design, test, and construct circuits and devices.

SPECIALIZATION COURSES

- **Computer Integrated Manufacturing (CIM)** gives students the opportunity to employ automation, control systems, sensing devices, computer programming, and robotics to efficiently mass-produce a product using a 3D model.
- **Civil Engineering and Architecture (CEA)** provides an overview of the fields of civil engineering and architecture, emphasizing the interrelationship of the two fields.
- **Biotechnical Engineering (BE)** employs relevant projects from biotechnology, bioengineering, biomedical engineering, and biomolecular engineering to teach students to apply and develop secondary-level knowledge and skills in biology, physics, technology, and mathematics.
- **Aerospace Engineering (AE)** uses hands-on engineering projects and problems to teach students about aerodynamics, astronautics, space-life sciences, and systems engineering.

CAPSTONE COURSE

- **Engineering Design and Development (EDD)** gives students the opportunity to work in teams to solve problems of their own choosing. Under the guidance of a community mentor, teams employ all the skills and knowledge gained through previous coursework to brainstorm, research, construct, and test a model in real-life situations (or simulations); document their designs; and present and defend the designs to a panel of experts.



Madeline Grose (left),
Nickolas Haussmann
(center), and **Benjamin
Carpenter**, Roosevelt High
School, Seattle, Washington

curriculum



Grassy Reynolds,
Greenfield-Central High School,
Greenfield, Indiana



high school

PLTW Biomedical Sciences

The Project Lead The Way® (PLTW) High School Biomedical Sciences program engages students in rigorous and relevant hands-on problems related to the human body, cell biology, genetics, disease, and other biomedical science topics.

There are no prerequisites to enter the program. It is a sequence of four courses, each building on the previous one and all aligned with appropriate national learning standards.

COURSES

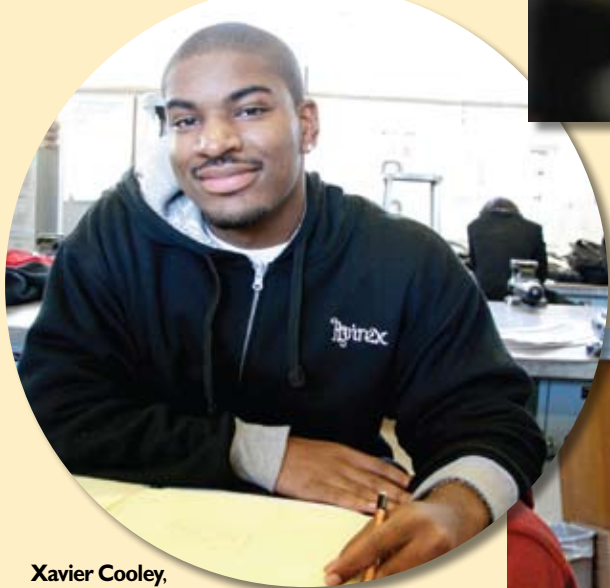
- **Principles of the Biomedical Sciences™** introduces students to the program and builds the scientific foundation for success in subsequent courses through hands-on projects and problems involving the study of human medicine, research processes, and bioinformatics.
- **Human Body Systems™** explores basic human physiology, especially as it relates to human health. Students use a variety of monitors to examine body systems, and design and build systems to monitor body functions.
- **Medical Interventions™** uses student projects to investigate various medical interventions that extend and improve quality of life, including gene therapy, pharmacology, surgery, prosthetics, rehabilitation, and supportive care.
- **BMS Capstone Course:** Students will design and conduct experiments related to the diagnosis, treatment, and prevention of disease or illness. They will apply their knowledge and skills to answer questions or solve problems related to biomedical science.



Jalesa Gainesb (above); **Justin Choe** (left); **Paige Beighle** (below left); and **Zach Stanley**, Francis Tuttle Biosciences and Medicine Academy, Oklahoma City, Oklahoma



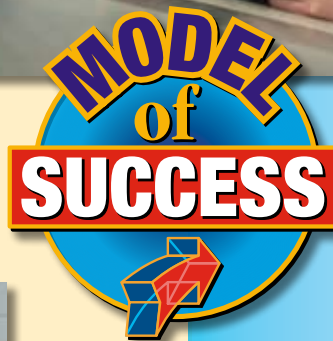
introduction



Xavier Cooley,
Hawthorne High School,
Hawthorne, California



Robert Baldwin,
Wando High School,
Mount Pleasant, South Carolina



Eric Rieman, Miller City High School,
Miller City, Ohio

Whether your school or district is rural or urban, whether it is affluent or economically challenged, whether it serves less than 500 students or more than 5,000, the flexible Project Lead The Way® (PLTW) curriculum can work for it.

While there are hundreds of PLTW success stories to share, we've narrowed our model schools and districts to 14 that offer a glimpse of PLTW in action in a wide variety of school settings. Wherever you're located and whatever student population you serve, chances are you will see a similar school among the featured PLTW models. Use these PLTW programs for encouragement, advice, ideas, and support as you build your own PLTW model of success.



Andrew Kim, Wheaton High School,
Wheaton, Maryland



Amber Frauhiger, Lancaster High School,
Lancaster, California



TEAM Texas



PROFILE

Del Rio High School
Del Rio, TX 78842

- PLTW start date: 2005
- 2007–08 PLTW students: 184

Info:
Dianne Treviño
dianne.trevino@sfdr-cisd.org

At southwest Texas's Del Rio High School, Brad Billeaudeau teaches Introduction to Engineering Design (IED), Computer Integrated Manufacturing (CIM), and Engineering Design and Development (EDD) in a portable building, in two rooms divided by a big glass wall. One room has woodworking tools along one side, CNC mills and a robotic arm on the other. The other room contains 24 computer workstations, a 3D prototyping printer, a plotter, and an assortment of Fischertechnik tools. Next door in the main building, Billeaudeau's colleague Bill Davis teaches Principles of Engineering (POE) and Digital Electronics (DE). Davis's classroom

contains 24 computer workstations, a stress analyzer, and an oscilloscope, along with an array of project bays and display shelves.

"We have about every single piece of optional equipment you can have," says Billeaudeau. "We've totally redesigned two

classrooms—and it's specifically for Project Lead The Way. Our administration is fully behind this program."

Indeed, Project Lead The Way® (PLTW) at Del Rio has support all the way up the line. One of 35 Texas schools to join the program in 2005, and now part of a Texas network of about 150 schools, Del Rio High School and its community see PLTW as an investment in their immediate economic future.

The San Felipe–Del Rio Consolidated Independent School District encompasses the

“The program has also made me want to be an engineer. I had never even thought of it until I got into this class.”

—WHITNEY MONTGOMERY
Senior, Del Rio High School, Del Rio, Texas



Del Rio High School senior **Jonathan Lombrano** machines a part as an intern at a local business. Owner and PLTW advisor **Mike Wrob** (right) says, "For us at Marathon Heater, it's become a grow-your-own-engineers program."

Sophomores such as **Georgina Pena** (left) and **Ayla Hernandez** take Introduction to Engineering Design (IED) after Principles of Engineering (POE), which is offered at Del Rio's award-winning Freshman School.



city of Del Rio and several miles of high desert along the Rio Grande. Del Rio shares a border with Ciudad Acuña, Mexico, which lies just across the International Bridge and is home to numerous maquiladoras, or twin plants—factories that import materials and equipment from the United States, assemble or manufacture goods, then export them back to the United States. Del Rio's per capita income currently runs at about 60 percent of the national rate. According to a 2006 report on Rio Grande border economies, the high school dropout rate in Del Rio's Val Verde County was causing a per capita income loss of \$2,276.

“We’re seeing that this program serves any student, not just your cream of the crop.”

—DIANNE TREVIÑO

CTE Coordinator, San Felipe–Del Rio Consolidated Independent School District, Del Rio, Texas

Dianne Treviño coordinates career and technical education for the district. She says that when the district went looking for curriculum that would help develop the local manufacturing workforce, PLTW stood out. “The twin plants are interested in apprenticeship programs with our students right now,” says Treviño. “They’re also looking at Del Rio kids to come back as university graduates. They want to hire top management. We liked the CIM course in particular for that reason.”

Davis and Billeaudeau, a math teacher and a tech systems teacher, attended their first PLTW Summer Training Institute (STI) in Houston in 2005. They continue to attend PLTW STIs as Del Rio High School adds courses.

Six months into the program’s first year, City Councilman Mike Wrob was recruited to the high school’s PLTW advisory council by Billeaudeau. Wrob hired high school junior Jonathan Lombrano as an intern for his company, Marathon Heater. It was hardly a leap of faith, says Wrob, a mechanical engineer. “When I saw what those kids were doing, I was amazed. I wasn’t doing that kind of work until I was a sophomore in college.”

Lombrano’s current assignment involves designing, and later machining, heater parts. While he works, more PLTW seniors arrive. They have come to see whether a certain silicone rubber heater in Marathon’s inventory belongs in their capstone course project: constructing a device that keeps paintballs from freezing.

Wrob says the advisory council is eager to expand its membership, perhaps involving other areas of commerce and industry. “Most of the manufacturing here would be with the maquiladoras,” he explains. “But even that’s changing. Now the maquiladoras are working on hiring more Mexican nationals.”

In step with Del Rio itself, the PLTW program is changing. Billeaudeau’s and Davis’s five classes now serve 184 students—more than five times the number when the program began in 2005. As two of its most gregarious assets, the teachers recruit at the Rotary Club one day and at area private schools the next. Within the high school, the students do the work of building the ranks. Says Davis, “They bring their friends to our classrooms—who in turn bring their parents—and ask, ‘How do I get into this program?’”

Unlike many PLTW schools, Del Rio High School currently offers POE to its freshman class. “Some of the literature suggested that more females will stay in the program that

way,” says Billeaudeau. “Also, all our kids take geometry as freshmen, and we want them to have that under their belts when they take IED as sophomores.”

The 15 students who became Del Rio’s first “PLTW graduates” in spring 2008 were recruited from the tech systems class Billeaudeau used to teach districtwide. “They just took their SATs,” he says. “They’re looking at Rice, Texas A&M, UT Tyler—the state hub for PLTW.” Davis believes the feedback from those seniors will produce another wave of commitment to engineering at Del Rio High—via parents.

“The word is spreading,” says Billeaudeau. 



Bill Davis **Brad Billeaudeau**

BIG IDEAS

WITH Bill & Brad

Bill: Some of our kids are taking AP calculus and PLTW’s Engineering Design and Development course and such. If they had stuck with just the academic route, they never would have gained any hands-on use of tools for building things.

Brad: PLTW gives them a better opportunity to become problem solvers. They’ve gone through four years and five subjects worth of actual hands-on building, solving problems, making it work, looking at problems in a different way.



Transparent Process

PROFILE

Roosevelt High School
Seattle, WA 98115

- PLTW start date: 2006
- 2007–08 PLTW students: 89

Info:
Karl Ruff
kwruff@seattleschool.org



Like the approach of PLTW teacher **Karl Ruff** (inset), this robotic hand replica involves many disciplines within the field of engineering—including Roosevelt student **Ariel Green's** favorite: “programming stuff on the computer.”

Seattle’s historic Roosevelt high school reopened in the fall of 2006 after a two-year, \$80 million remodel. There was a skylighted library, a performing arts center with ergonomically designed seating, and a synthetic playing field. There was a public plaza. And in two classrooms, there were boxes full of equipment for a new program at Roosevelt called Project Lead The Way® (PLTW).

Teacher Karl Ruff remembers it well: “People wanted to know where the woodshop went.”

Ruff was new then, too. He had started out as a teacher “early in life,” but then left education for the private sector. So when he returned to teaching, he was able to launch the PLTW program at Roosevelt using 16 years of real-world process engineering. Students in Ruff’s classes use the Inventor software Ruff encountered while a training manager at Boeing, along with a host of other tools and approaches Ruff has introduced from the business world. Ruff’s colleagues in the Seattle School District say his teaching reflects the unique perspective that a teacher from outside the mainstream of education can bring to a school via the innovative curriculum that is Project Lead The Way.

Ruff is ideally positioned. Technology education is being reinvented. Academic standards increasingly reflect workplace expectations. Problem solving, critical thinking, and conflict resolution are becoming as valuable as industry-specific skills. PLTW is considered a “flagship program” of the Seattle public schools’ career and technical education efforts. Even so, in 2006



“I love this class because you get a lot of freedom. Everyone has to figure stuff out for themselves. Mr. Ruff doesn’t limit us.”

—BEN CARPENTER
PLTW Student, Roosevelt High School, Seattle, Washington



there was only one technical education teacher training program in Washington state, and only one engineering teacher for the courses at Roosevelt.

Initially, the yearlong PLTW courses conflicted with some half-year courses at Roosevelt. Ruff recalls, "I would have 25 students sign up and, because of scheduling conflicts, only 11 be able to take both the first and second halves." Even so, the teacher doubled up on PLTW's Summer Training Institutes—"a baptism of fire," he calls them—so as to be able to offer more PLTW courses. This past year, Ruff taught a



Roosevelt High School PLTW students **Margaret Burke** (above), **Ben Carpenter** (far left), and **Adrian Bardue**, riding Seattle public transit to a University of Washington robotics lab, are among the first in the state to enjoy the unique real-world STEM learning opportunities PLTW offers.

sequence of two CAD drafting courses along with Introduction to Engineering Design (IED), Computer Integrated Manufacturing (CIM), and Digital Electronics (DE). In order to solve the difficult scheduling issues, rather than placing the students himself, Ruff used a technique from his management background that allowed students to come to their own agreement about who would take which classes. "I took signups," he says. "Then I

held a caucus of the students, stipulating minimum total enrollment for each class. Students sorted it out themselves."

Ruff praises the liberating design of the PLTW curriculum. "It's put together by teachers—you can just tell," he says. "Because PLTW is so hands-on, students are more engaged. I just don't spend a lot of time talking. They have access to the PowerPoint. They go for it. I don't have to be 'the sage on the stage.'"

Instead, says Ruff, he's free to facilitate work in progress. "When you're stuck, that's when I'm available," he says. "Beginners need constant attention. In the more advanced classes, you give them the tool—but when they need you, be there immediately. They'll want to know not 'what,' but 'which of these three?' PLTW frees me to help both kinds of students at the same time."

Ruff believes the value of discussion—as opposed to lecturing, for example—can't be overestimated in engineering. "At Boeing, the conversations we had about design challenges were extremely important. They would lead, for example, to changes in certification requirements. One thing employers want is something that can be modified later. You don't want to paint yourself into a corner. A student's attitude is more like 'ready, fire, aim.' Once they realize, 'I should've used a revolute instead of a prism,' I can have that high-level conversation with them."

Roosevelt plans to add another PLTW class this fall. It will strain the available resources, but Ruff is philosophical. "To have learning take place, you need a critical mass," he says. "You need that in order to get energy and momentum." Storage space, and room for everyone to see firsthand how projects come together, are also of the essence. Roosevelt High School might have replaced its woodworking area, but Ruff says his PLTW room still resembles a shop. "It has to," he says. "I have to have a transparent process. When the students come into my room, I want them to know exactly what to do." 🚀



Scientist **Yoky Matsuoka** opens her University of Washington lab—and a window onto the future—to PLTW students from Seattle's Roosevelt High School.

Show of Hands



One of Roosevelt High School's urban Seattle neighbors is the University of Washington. Early in 2008 Karl Ruff and his PLTW students paid a visit to the university's unique Neurobotics Laboratory.

The lab's director, Associate Professor Yoky Matsuoka, was named a MacArthur Fellow in 2007 for her research in neuroscience and robotics. Among other projects, she is currently developing a prosthetic hand that would respond to the brain's neural signals. Her research is closing the gap between advanced technology and the needs of people whose mobility is restricted. As Matsuoka oriented students to the "robot-human closed-loop system," they got glimpses of how the scientist's work—and her mind—combined mechanical engineering and bioengineering, computer science and neuroscience, and robotics with altruism and a love of learning.

"Best of all," says Ruff, "they got to touch stuff."

The students got a feel for the research through hands-on interaction with the ingeniously developed equipment at three lab stations. Progressing from a high-speed photography station that captures locations in 3D space, to the anatomically correct robotic hand, to a lever-based feedback-distortion simulator—to the city bus back to Roosevelt—some central questions took shape: What do we know? How do we learn it?



Michael MacAuley (left) and **Domika Marczak**, Roosevelt High School, Seattle, Washington

Empowered



PROFILE

Thornton Township
High School
Harvey, IL 60426

- PLTW start date: 2004
- 2007–08 PLTW students: 220

Info:
Michael Sinde
sinde.michael@district205.net

Thornton Township High School PLTW teacher and Career and Technical Education Coordinator **Michael R. Sinde**, with **J. Kamala Buckner**, superintendent of High School District 205, are working to lead the way with small learning communities.

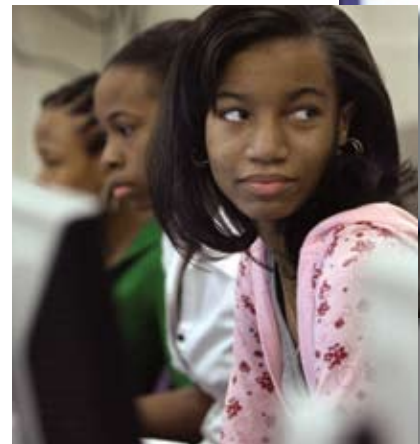


Project Lead The Way is really one of the shining lights at Thornton,” says **Michael Sinde**. He won’t accept any credit for the program’s success, even though he has taught Project Lead The Way® (PLTW) since its 2004 debut at Thornton Township High School in Harvey, Illinois, one of the poorest communities in the Chicago area. Instead, Sinde lays responsibility for the many achievements of his PLTW students at their feet—along with full responsibility for learning. It’s an approach to teaching that seems ideally suited to the hands-on discovery-oriented curriculum of PLTW. It lets—rather than makes—Thornton students shine.

“I’ve been really lucky,” Sinde says. “In my first couple of years I’ve gotten students who are motivated.” Nine out of the top 10 seniors to graduate from Thornton in 2007 were Sinde’s first PLTW students. Julian Corona, now a freshman at the University of Notre Dame considering a double major in mechanical engineering and industrial design, was salutatorian of that class. He took to the self-directed style of his PLTW courses right away, he says, “but a lot of the other students didn’t like it at first. They were used to teachers telling them what to do. Later in the year as it progressed, they would start to like it,” he recalls. “It got us all thinking.”

As a sophomore, Corona had begun with one of two sections of Introduction to Engineering Design (IED). The program has since expanded to multiple sections of four courses; Civil Engineering and Architecture (CEA) was added this year. PLTW at Thornton is solidly backed by grants from the Illinois State Department of Commerce and Economic Opportunity and the Kern Family Foundation, grants awarded after sweeping reforms turned the 2,600-student comprehensive school into a set of small learning communities.

At Thornton Township High School in Harvey, Illinois, 50 percent of PLTW students are girls. At right: **Liliana Garcia-Rios**. Below: **Shyette Edwards**.



“I see students who didn’t understand and later want to retake courses. They begin to see a purpose to their education.”

—**DR. J. KAMALA BUCKNER**
Superintendent, Harvey, Illinois, High School District 205

Turbine Dreams



Through the PLTW program at Thornton Township High School, students apply their knowledge and skills to improving their immediate surroundings. Here are notes from one ongoing project.


a stepping-stone. The new students have really benefited from being around the PLTW kids, and they're definitely raising our PLTW enrollment. The kids who aren't in it are saying, "Where do I sign up?"

With this cross-pollination by the so-called math, English, and social studies (MESS) team, more core-subject teachers are reporting on the program's success. "Our calculus teacher has seen a huge, huge improvement, says Sinde. "Now that his students are on the computer rotating pictures and seeing things in three different dimensions, he's finding it easier to work with that [tool while] teaching calculus.

Collaborative projects, a hallmark of small learning communities, take wing in Sinde's PLTW concentration. "What makes this program special is some of the stuff the kids do outside the class. They've been to an exhibition called Black Creativity, about African American engineers. They've been to a local facility where they learned how to make Ethernet cables. They've been out to the airport to fly on the weekends—three-quarters of them had never been on a plane before."

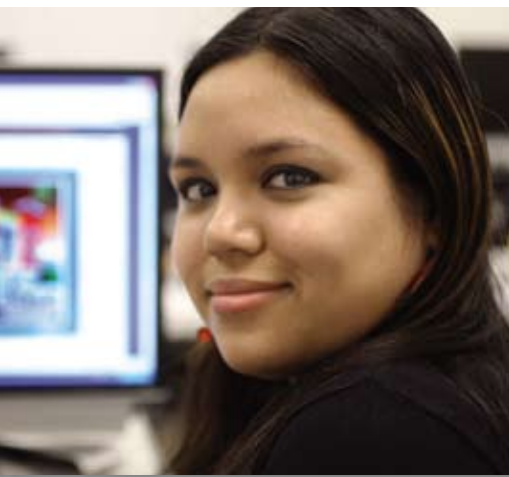
When visitors, in turn, come to Thornton, they're greeted with customized posters and PowerPoint presentations that Sinde's PLTW students have created using their newfound digital skills. Recently, Dan Ustian, CEO of national transport company Navistar and a Thornton alum, came to the high school as a guest speaker and left as a PLTW program partner: "He was so impressed with what the kids were doing," Sinde says. "But this isn't just something we do from 8:30 until 3 every day."

Sinde requires his students to do 10 hours of community service per credit. They help out at homeless shelters, at their churches, and at local businesses. "We're fortunate that we have had alumni come to speak. That we have new computers and new technology.

"Our students need to give back," Sinde says—raising the bar for some of the most challenged high school students in urban America—"because they've been so fortunate." 

Sinde credits his students with a leap of faith in getting PLTW off to a great start at Thornton. "After all," he says, "I was encouraging them to sign up for a class that we didn't even know the name of yet." Together, Sinde—whose background is teaching math—and some 40 students figured out the Fischertechnik and other tools. "I was learning just as they were," he says. "They were soldering, and I was standing next to them learning how to solder."

At first, says Sinde, "the kids recruited their friends. We were still well over 50 percent male. In the last year, though, we really saw the number of girls jump up. My kids went to each of the feeder middle schools to talk up PLTW." His students also assisted at a STEPS (Science, Technology, and Engineering Preview Summer)



camp to introduce rising ninth graders to engineering, and to PLTW at Thornton. The result? About 50 percent of the school's current PLTW students are female.

There's a waiting list to use the equipment in Sinde's labs. That's in part because this year, to streamline opportunities, core academic classes are being taught in Sinde's building, and now dozens of other students share the teachers, the space, and the equipment. The adjustments continue, says Sinde. Not all the students, he reports, can type well enough to update their mandatory blogs on the computer. But, he says, "it's

Questions for students

- Are we selling this power back to the grid?
- How much does a windmill cost?
 - High-end model: \$1 million+
 - KY school paid \$25,000

Michael Sinde:
"We're hoping to have something that the kids build, as opposed to something people come and put in..."

Fall 2007

- See alternative energy project at national tech-prep conference.
- Students at Russell High School in Russell, KY, use windmill to power computer labs.

Winter 2007

- Students, teachers on Thornton's MESS Team study feasibility.
- Economics teacher leads cost-benefit analysis.
- Physics teacher measures local weather variables.

March 2008

- Grant application forward.
- Preliminary research done.
- Students' windmill models complete.
- Test wind!

Career and Technical Education Coordinator **Michael R. Sinde** and PLTW student **Brendan Gilbert** solve a problem at Thornton Township High School in Harvey, Illinois.





Master Planned



PROFILE

Francis Tuttle
Pre-engineering
Academy
Oklahoma City, OK 73134

- PLTW start date: 2003
- 2007–08 PLTW students: 150

Info:
Malcolm Fowler
mfowler@francistuttle.org

Of the 86 students to graduate from Francis Tuttle Pre-engineering Academy in its first four years, 81 have enrolled in engineering colleges.

The academy's success proves the wisdom of the adage, "Begin with the end in mind." The tuition-free high school career academy is one of several master-planned in a partnership between Oklahoma's Department of Career and Technology Education and universities, with the specific goal of preparing students for college engineering degree programs.

The plan strategically places pre-engineering academies in Oklahoma's shared-time technology centers, which offer built-in equipment,



instructional staff for consultation, and local and statewide networks with business and industry. Students from high schools in surrounding school districts take engineering, math, and science courses three hours a day on the tech center campuses and get the rest of their academics—and extracurricular activities—at their "home" high schools.

"It's phenomenal," says PLTW director **Malcolm Fowler** (right) of the program's success at the shared-tech center. Student **Jake Fister** (below) demonstrates sublimation at an open house for the Pre-engineering Academy.



Francis Tuttle Technology Center's Portland Campus, a thriving, 12-year-old facility in a suburb of Oklahoma City, was the first academy site. From the beginning, at the recommendation of the initiative's higher education partners, the academy emphasized excellence in math and science, offering honors and advanced placement-level courses only. Recalls campus director Malcolm Fowler, however, "the key in making everything come together was Project Lead The Way® (PLTW).

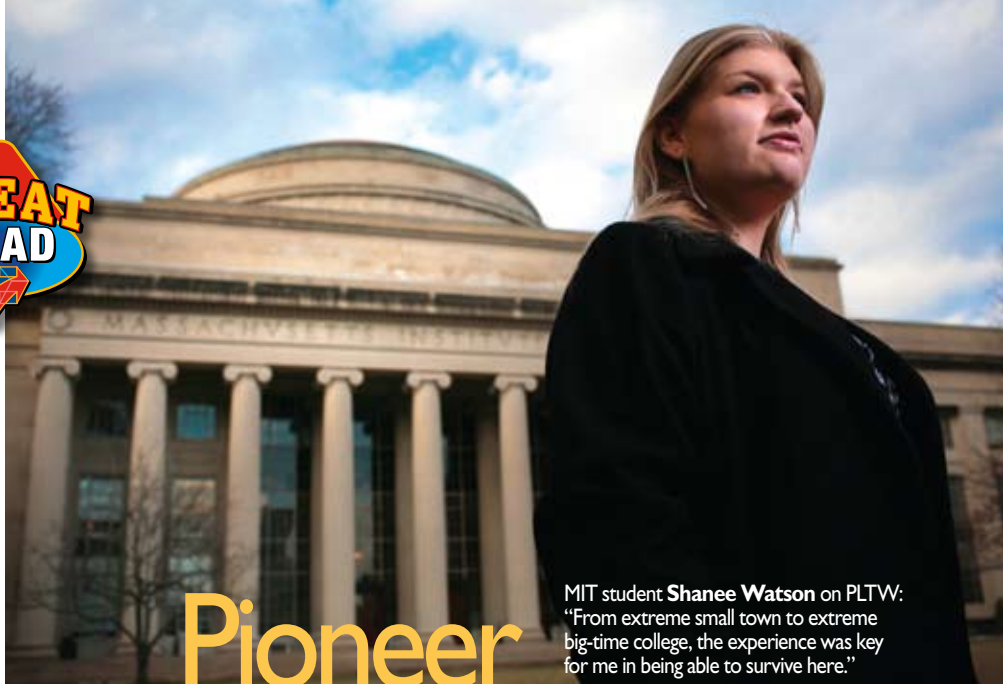
“The math and science emphasis came first for us, but right on its heels was PLTW. It's a three-legged stool.”

—MALCOLM FOWLER
Director, Portland Campus
Francis Tuttle Technology Center

"Since the school districts we serve have some of the highest SAT and ACT scores in the state, we knew we needed to offer high-level math and science," says Fowler. "We started out by hiring the best math and science teachers we could find. PLTW had told us that their intensive summer training would enable a good teacher to teach PLTW properly. We found that to be correct."

Every academic teacher at the Francis Tuttle Pre-engineering Academy is certified in PLTW and teaches at least one of six offered engineering courses. "We're also very fortunate that some of our teachers certified in math and science are also engineers," says Fowler.

Partner schools Oklahoma State University, the University of Oklahoma, and Oklahoma Christian University have signed on to track the progress of academy students for five years of higher education—one way of measuring the impact of the statewide partnership plan.



Pioneer


MIT student **Shanee Watson** on PLTW: "From extreme small town to extreme big-time college, the experience was key for me in being able to survive here."

Given that the academies initiative exists in part to introduce students to engineering, it's natural that applicants might initially be more drawn to Francis Tuttle's math and science program. For many of them, Fowler says, "PLTW fills in the missing pieces of the puzzle. Students find out they really like these applications." Similarly, "One of the most exciting things is seeing students who you just know would never have taken beyond an Algebra II course elsewhere get up to AP Calculus."

Fowler stresses, however, that the academy delivers its challenging math and science curriculum in order to add value to engineering—not the other way around. The academy pulls out all the stops to support students who might be struggling with the core subjects.

Campus Assistant Director Danny King points to "relationships: the third R, after rigor and relevance. Even though we're teaching with rigor, we have the ability to be nurturing," he says. "Our teachers go so far above and beyond. They stay late, come in early, come in Saturdays for tutoring, so that if a student hits that wall, we've got the relationship with them and their parents that can help us get over the hurdle. There is no doubt that some of those students stay because of PLTW."

"The synergy that the teachers have overflows to the students," adds Fowler. "We all get fired up about it. In the 20 years I've been teaching, I've never seen anything this exciting."

The success of Francis Tuttle's Pre-engineering Academy has led the Oklahoma Department of Career and Technology Education to apply the formula of PLTW plus advanced math and science at 10 other technology centers in Oklahoma. In the fall of 2007 the Francis Tuttle Biosciences and Medicine Academy opened its doors on the nearby Rockwell Campus, responding to a critical statewide workforce shortage in health care with a program designed around PLTW's brand-new Biomedical Sciences curriculum. 



What's so great about the PLTW curriculum? Biomedical Sciences students **Lashay Hodge** (left) and **Jalesa Gaines** agree: "It's the hands-on experiences."

SHANEE WATSON

From tiny Crescent, Oklahoma (population: 1,300), Shanee (pronounced Sha-NAY) Watson entered Francis Tuttle Pre-engineering Academy in 2005. Today a second-year chemical engineering major on a full scholarship to the Massachusetts Institute of Technology, Watson says she could not have made the leap without Project Lead The Way.

Watson had MIT in her sights, but not necessarily engineering, when she began her first engineering class at the academy. "One of the very first things we did was to research different types of engineering," she recalls. "I liked chemical engineering right from the start: from the small scale—how microscopic things could make everyday objects—to large-scale things, like heat transfer and the separation process."

How's the heat at MIT? "It's pretty intense," says Watson. "But the social environment is really conducive to learning and helping each other out. The way we work is collaborative," she says, adding that PLTW prepared her for this, as well as for an emphasis on projects. "The entire senior year in chemical engineering is one big project-based class."

The academy gave Watson another head start through the GirlTech program, pairing her with a female chemical engineer mentor in her junior year. As a summer intern at her mentor's company, Watson assisted with field-testing explosives. She also mined some important professional skills. "I learned so much about the lab experience," she says, "and about etiquette in the office, having meetings, all that."

Her work-experience strategy for college is to intern in a different field of chemical engineering every summer—preferably back in Oklahoma. Watson is the eldest child, and the first person to attend a university, in her family. Her mother has an associate degree from Francis Tuttle's career-tech center. Her father, an oil-field worker, was recently disabled by an injury on the job. Watson is eager to try pharmaceutical engineering. "I think it's the biology involved," she says. "Making these compounds in bulk that, in little pill form, will make someone feel better."

Greenfield-Central High School, Greenfield, Indiana

IN

ON a ROLL



PROFILE

Greenfield-Central High School
Greenfield, IN 46140

- **PLTW start date: 2003**
- **2007–08 PLTW students: 175**

Info:
Steve Bryant
sbryant@gcsc.k12.in.us

Collaboration between the state and higher education gives Indiana's PLTW teachers, like **Mark Holzhausen** (right), and students, like senior **Kelly McNab** (below), a boost.



In 35 years of teaching, Mark Holzhausen had seen technical education programs come and go at Greenfield-Central High School. But a funny thing happened when the Indianapolis-area school began Project Lead The Way® (PLTW), he says. “I quit looking forward to retirement.”

It was the students' high level of engagement, says Holzhausen. “I was hooked right away.”

Holzhausen, who directs PLTW at Greenfield-Central and is also a licensed school counselor, says he gets energy from teaching Introduction to Engineering Design (IED) and Principles of Engineering (POE). “In PLTW, the kids are self-motivated. They challenge the teacher to know more and to work harder, and we challenge them the same way.”

That reciprocal dynamic marks the growth of the program at Greenfield-Central, one of more than 230 Indiana PLTW

schools. The seven PLTW courses Greenfield-Central currently offers its 1,300 students—including the Principles of the Biomedical Sciences™ course, piloted this year—are designated as technology education courses by the state. As such, they represent the most recent phase of a 30-year evolution at the school, during which a one-room manufacturing class has become a Science, Technology, Engineering, and Mathematics (STEM) academy with 10,500+ square feet of laboratory, seminar, and office space.

“We started PLTW in 2003 with one section of IED,” Holzhausen recalls. “Those

14 students became our PLTW ambassadors. We went to ninth-grade career classes and to middle schools and sold it there. For the four years I had those kids, they felt like they owned the program.”

Greenfield-Central has been adding courses ever since, taught by Holzhausen and five math and science teachers—two of whom are also PLTW master teachers. “One of the most significant reasons PLTW works,” says Holzhausen, “is we are doing it totally across the curriculum. A group of us used to stay after school for hours every week to meet over the curriculum. Last year we wrote common planning time for teachers into our grant request.”

“*This class has taught me the engineering side of science.*”

—**LANDON BAKER**
Senior, Greenfield-Central High School,
Greenfield, Indiana

Holzhausen says schoolwide support and enthusiasm for the program encourages students at all levels to try engineering—and stick with it against the odds. “I’ve had a few kids come through PLTW who were really struggling,” he says. “But all of them found portions they could succeed in. A couple came to every study hall so they could double up on their classroom time, and eventually they got so good at [the] Inventor [software], they were showing the other kids stuff.” Although those students chose not to pursue additional PLTW classes, they passed the course. “What’s important,” says Holzhausen, “is they were successful.”





BIO MANiA!

Greenfield-Central, High School (GCHS) one of 15 Indiana high schools that piloted PLTW's Principles of the Biomedical Sciences™ course in the 2007–08 school year; also piloted the PLTW Pathway To Engineering™ course, Biotechnical Engineering (BE), in 2006.


PLTW Master Teacher and Science Department Chair John Rihm has degrees in biology and physiology as well as education. He also has experience teaching both popular PLTW “bio” courses to GCHS students. Here is Rihm’s selective look at some essential differences and similarities that highlight reasons to offer, or take, both courses.



In the PLTW program, “hands on” can apply to every stage of a project. **Darius Burke** (far left) and **Ryan Emery** do research in the Biomedical Sciences lab, and **Spence House** (top) fires up a PowerPoint for a Partnership Team meeting.

	BIOTECHNICAL ENGINEERING	PRINCIPLES OF THE BIOMEDICAL SCIENCES™
PLTW Curriculum	Pathway To Engineering™	Biomedical Sciences
For Those Who	Know they have a flair for engineering	Are interested in health care
Course Requirements	Have completed two engineering courses	Algebra I course completed by grade 9; biology course completed by grade 10
Typical Unit	Environmental and Agricultural Engineering Overview: abiotic and biotic factors	Heart Attack: sickle-cell anemia
Typical Project	Reverse-engineer a molecule	Study molecules / learn concept of genes
Cool Model	Fuming chamber for lifting prints from evidence	A blood protein
Class Special	Genetic engineering research using “knockout strains” provided by university partner	Write a conclusive essay based on the effects of consuming sports drinks
Power Partner	Purdue University offers dual-credit biotech course	Hancock Regional Hospital provides mentorships, contacts for research questions

Greenfield-Central’s PLTW students experience success in numerous dimensions. The 2007–08 school year was the second in which a contingent from the school demonstrated projects and software and chatted up legislators at the Indiana Statehouse. When the PLTW partnership team of 20 gathers four times a year, its student members do the lion’s share of presentations. “They actually run the meeting,” Holzhausen says. “They also present at conferences”—for example, breaking ground as delegates to the 2006 International Technology Education Association meeting. Efforts like these elicit not only program connections, but also the full faith of partners in students’ workplace viability and learning skills. Companies that recruit from partner universities now look to Greenfield-Central for interns, part-time employees, and co-op collaborators.

Holzhausen says that although the corporate development side of his role as Greenfield-Central’s PLTW team leader is increasing, he’s loath to give up any classroom time. “Folks have seen what teaching PLTW has done for my attitude, my motivation, my energy level,” he laughs. Early in 2008, the Engineering & Technology Educators of Indiana named Holzhausen the group’s Teacher of the Year. With PLTW, he’s clearly on a roll. 



Teacher **John Rihm** has Greenfield-Central PLTW students, such as **Renee Wu** (left) and **Katie Clarke**, keep career journals, where the newest jobs in STEM fields come under close scrutiny.

K-16 Continuum

Engineering readiness is a continuum. In Kenosha, it starts with K-5 GTT prep and comes full circle with undergraduate teacher training in PLTW. Below, kindergartner **Hunter Runyard** holds the thread tight.



Less than an hour south of Milwaukee and north of Chicago lies the Kenosha Unified School District (KUSD), the third largest in Wisconsin.

As in many large districts throughout the nation, demographics have played havoc with school enrollment. Despite school overcrowding and staff shortages in the KUSD, Project Lead The Way® (PLTW) has grown steadily since 2004, multiplying the K-16 options for the district's 22,000+ students.

Introducing the program was the easy part, according to Greg Wright, KUSD career, technical, and service learning coordinator. In 2004, "the need was demonstrable," he says. Although the district had operated a high school tech academy for more than six years, says Wright, "we had never gotten high-level students to connect with tech ed, partly because none of our career and technical education courses were articulated with a technical college or a university. The kids who were on our pre-engineering pathway weren't as successful as we'd hoped once they got to the Marquette University School of Engineering (MSOE) or the University of Wisconsin at Stout."

State PLTW Affiliate Director John Farrow, engineering professor emeritus at MSOE, helped Wright understand the PLTW certification process. "He showed me how to sell it here in Kenosha and how to put together a partnership team," says Wright. "That's the first thing I did."



In their first six months of PLTW's GTT program, middle school students at Kenosha School of Technology Enhanced Curriculum leapt an average of one and a half grade levels in math. Above, kindergartner **Kiersten Hall** shows seventh grader **Robbie Rock** the next step in their "buddy project."

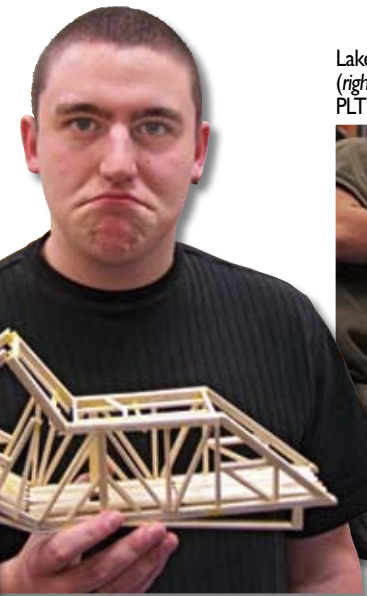
In large part because of the work of the Kern Family Foundation (*see box*), a statewide network of support for PLTW was in place. Besides universities and colleges, public and private organizations backed the program, including state education and workforce agencies, and the Greater Milwaukee, Bradley, Oconomowoc Community, and Anne Marie foundations.

Through the Kenosha Area Business Association, Wright found an ideal PLTW program partner in the owner of the industrial park where LakeView Technology Academy leased space. Wright says that, along with co-tenant Gateway Technical College, "they were really interested in making this work."

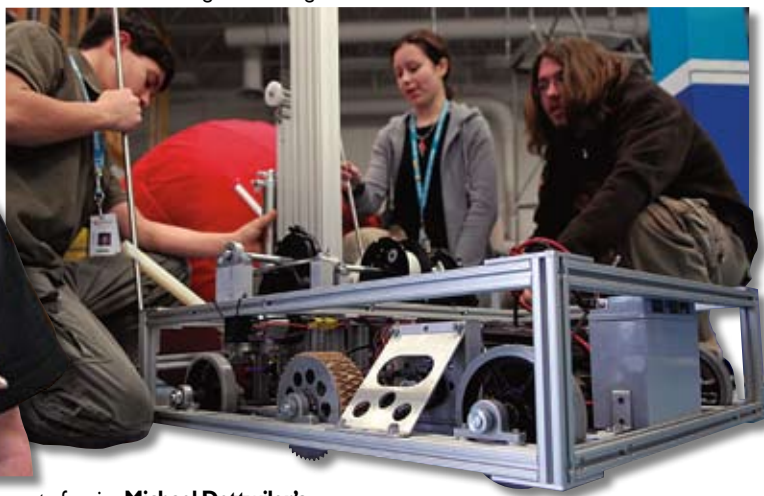
“*The bar is raised on us every single day in education. What do we, as teachers, need to do to get those minds turning?***”**

—DR. ANGELA ANDERSSON

Principal, Kenosha School of Technology Enhanced Curriculum, Kenosha, Wisconsin



LakeView Technology Academy students **Danielle Shada** and **David Schmidt** (right) tune up a robotic rig for extra credit. Team member **Lucas Zahn** (left) sees PLTW as a vehicle—"to get into college so I can work in the humanoid robotics field."




Analyzing an engineering failure is part of senior **Michael Dettwiler's** POE class at LakeView Technology Academy, where PLTW students can start earning college credit in their junior year.

Juniors and seniors at LakeView Technology Academy currently take their PLTW and other pre-engineering courses through Gateway Technical College. They, and some 200 other KUSD students a year, can earn credit for one year of a two-year associate degree. Thanks to parallel articulation with MSOE, the credits also can be applied toward one semester in an engineering university.

At Mary D. Bradford and George Nelson Tremper high schools, "two great, big comprehensives," according to Wright, the district offers Introduction to Engineering Design (IED), Principles of Engineering (POE), and Digital Electronics (DE) on a schedule that meshes with LakeView's more advanced offerings: Computer Integrated Manufacturing (CIM), the capstone course Engineering Design and Development (EDD), and, new for 2008, Civil Engineering and Architecture (CEA), Aerospace Engineering (AE), and Principles of the Biomedical

Sciences.™ Students from Bradford and Tremper travel to LakeView Academy for these advanced classes.

At the other end of the K-16 engineering pipeline, the district opened the Kenosha School of Technology Enhanced Curriculum (KTEC) in 2007. KTEC offers students a curriculum focused on science, technology, engineering, and mathematics (STEM) skills and the use of technology in day-to-day learning. Children begin learning research and information literacy skills in kindergarten, study flight and space in grades three through five, and, in grades six through eight, study Pre-Algebra and Algebra I to ensure success in the PLTW Gateway To Technology™ (GTT) courses they are taking—and beyond.

"I'd say we're at 400 to 500 kids in PLTW at this time," Wright reflects. "Our numbers aren't big at this point. But I think the quality's there." 



PROFILE

Kenosha Unified School District
Kenosha, Wisconsin

■ 2007-08 PLTW students:
Approximately 400

Info:
Greg Wright
gwright@kUSD.edu

HIGH SCHOOLS

LakeView Technology Academy
Pleasant Prairie, WI 53158
■ PLTW start date: 2004

Mary D. Bradford High School
Kenosha, WI 53144
■ PLTW start date: 2005

George Nelson Tremper High School
Kenosha, WI 53143
■ PLTW start date: 2005

K-8 SCHOOL

Kenosha School of Technology Enhanced Curriculum
Kenosha, WI 53140
■ PLTW start date: 2007

Kern Family Foundation: Filling the Teacher Pipeline

When the Kern Family Foundation began to support Project Lead The Way in 2004, only two of Wisconsin's high schools were implementing the program. In 2007-08, 131 Wisconsin high schools and middle schools offered PLTW, with an additional 26 registered to do so in 2008-09.

The foundation was established by Robert and Patricia Kern, founders of Generac Power Systems, Inc., in Waukesha, Wisconsin, to address lagging American competitiveness and innovation in science, technology, and engineering. Besides directly funding high school and middle school PLTW programs in Wisconsin, Iowa, Illinois, and Minnesota with multiyear competitive grants, the foundation works with these states' leaders to support and sustain the program on a larger, longer-term scale.



As part of that effort in Wisconsin, the Kern Family Foundation is a participant in establishing a technology education scholarship for would-be PLTW teachers attending the University of Wisconsin at Stout. Incoming freshmen in 2007 and 2008 who declare a major in technology education with an emphasis in pre-engineering are eligible for a four-year award of \$2,500 per year.

The goal is to encourage some PLTW students to pursue careers in teaching, and then prepare them to go back into the classroom as instructors. According to Todd Burns

of UW-Stout's Office of University Advancement, progress is being made. The Kern Family Foundation's donation came with a challenge to raise additional funds. As of early 2008, says Burns, "we're very close to matching the foundation's three-to-one challenge." He adds that the university's industry donor base has been particularly responsive. "They recognize that with these scholarships [they] are investing not only in a student, but in their prospective students, and in the future of the economy of this state."



PR-Positive



PROFILE

Wheaton High School
 Wheaton, MD 20906

- PLTW start date: 2003
- 2007–08 PLTW students: 350

Info:
Shane Stroup
 shane_r_stroup@mcpsmd.org

A single classroom at Montgomery County's poorest high school has yielded \$1.6 million in college scholarships for its students."

Wheaton High School's Project Lead The Way® (PLTW) program made the *Washington Post* on Sunday, June 3, 2007, with that feature, headlined "Engineering Program Builds Road to College."

In the past few years, the culturally diverse D.C.-area school has done an academic 180-degree turn using career counseling, training for standardized tests, and signature academies to reverse decades of low achievement. It's an irresistible story, but no story tells itself. Wheaton staff and students agree that PLTW makes public relations second nature.

"One reason we work hard to share our achievements is because we're a high school of choice," says Wheaton Principal Kevin Lowndes. Students from nine feeder middle schools in the district can pick any one of five high schools to attend. To advance Wheaton's unique offerings, which include several career academies, Lowndes

meets five times a year with leaders of the school's Academy of Engineering. "We talk about how we're going to get the word out to students and families. About what's been successful and what to plan for next."

Lowndes says the academy team did a great job this year in explaining the pre-engineering program in targeted visits to the middle school market. Director Shane Stroup joined the PLTW advisory board of one school that has its own engineering emphasis. "We also partnered our clubs," says Lowndes. "Now, our high school cocurricular robotics clubs are mentoring middle school clubs."



PLTW's project-based group learning makes the news because it's timely, says Wheaton teacher **Shane Stroup**. "Nobody works in a vacuum anymore." Above, student **Roy Watson** prepares a Sea Perch, a remote-control submersible developed by the MIT Sea Grant college program, for competition against seven other schools at Maryland's Naval Surface Warfare Center on a Young Scientist and Engineer Day, 2008.



To raise the profile of PLTW, business partners need to see the program in action, says teacher **Shane Stroup**. Above, visiting architect **Chris Hillegas** shares true stories of civil engineering in Dubai with Wheaton CEA students (from left) **Fidelina Gonzalez**, **Tiffany McLean**, **Leandro Manuel**, **David Ochoa**, **Daniel Ortiz**, and **Karla Osorio**. Inset: **Thomas Paci**, a pre-construction manager, addresses the group.

The angle for the media, according to Lowndes, is that Wheaton's academies are not magnets. "They are all-inclusive," he says. "All our students do well." Those students are 56 percent Hispanic, 25 percent African American, 10 percent Asian, and 9 percent white. Roughly half qualify for reduced-fee lunches. Since 2002, the number of Wheaton students taking AP classes and tests has tripled. More important, those students proportionally represent the racial makeup of the school. "PLTW has been great [in terms of] the county mission of us getting students into more rigorous classes," says Lowndes. Using a customized FileMaker Pro database, "we're able to demonstrate to people that the academy pathways help kids get into AP classes."

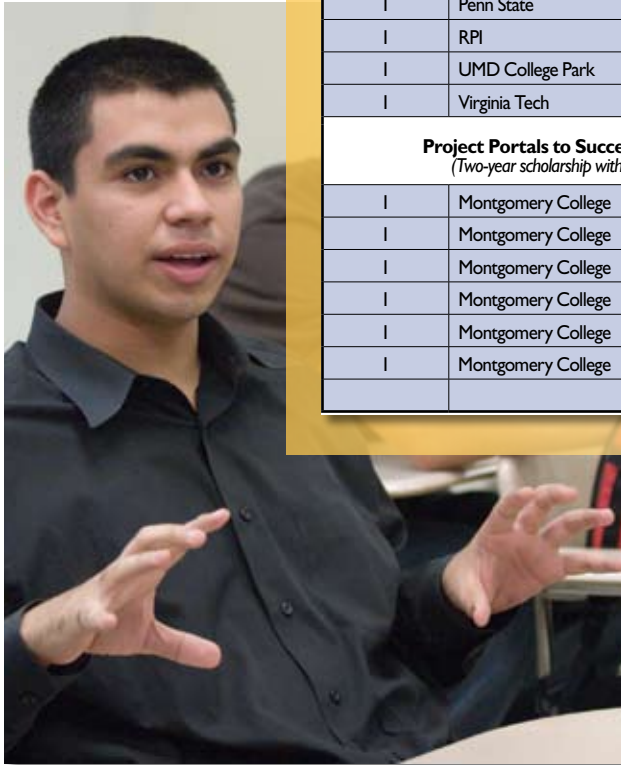
What's even more convincing? According to Lowndes: "Face time with students. We regularly explain to our kids how important it is for us to get more students into PLTW. When they talk about the benefits of the program, people believe it. Our kids love PLTW. The more opportunity they have to speak about it, the more they speak."



Project Portals to Success

Six of the big winners in Wheaton's first "PLTW graduating class" got \$12,000 scholarships to a groundbreaking program close to home. Maryland's Montgomery College has one of the largest and most successful engineering transfer programs in the country, and will usher some 745 current students into engineering at four-year colleges and universities over the next two years. Where colleges once used math and science to "weed out" students, Project Portals to Success reaches back through the pipeline to recruit women and minority high school students, then gives them specialized support in science, technology, engineering, and mathematics (STEM) "gateway" courses to ensure they complete engineering majors.

# of Scholarships	School	Program	Total \$ Awarded
3	Cornell University	Mechanical Engineering	\$494,400.00
1	DeVry University	Electrical Engineering	\$72,000.00
1	Frostburg State	Mech./Elect. Engineering	\$80,000.00
1	MIT	Mechanical Engineering	\$151,000.00
1	McDaniel	Chemical Engineering	\$8,000.00
1	Ohio University	Accounting	\$68,000.00
1	Penn State	Computer Engineering	\$48,000.00
1	Penn State	Nuclear Engineering	\$48,000.00
1	RPI	Mechanical Engineering	\$96,000.00
1	UMD College Park	Electrical Engineering	\$80,000.00
1	Virginia Tech	Mechanical Engineering	\$96,000.00
Project Portals to Success in Engineering Program <i>(Two-year scholarship with possible additional two years)</i>			
1	Montgomery College	Aeronautical\Civil Eng.	\$12,000.00
1	Montgomery College	Computer Engineering	\$12,000.00
1	Montgomery College	Aeronautical Engineering	\$12,000.00
1	Montgomery College	Mechanical Engineering	\$12,000.00
1	Montgomery College	Electrical Engineering	\$12,000.00
1	Montgomery College	Architectural Engineering	\$12,000.00
Total			\$1,610,000.00



With visiting mentors, student **Julio Deras** discusses the design of a church he attends. Of the 26 students in Wheaton's first "PLTW graduating class," six were female and all but three belonged to underrepresented minority groups. In the chart above: the stellar scholarship winnings that put them in the news.

“Our visiting partners take one look at students working together and say, ‘That’s how we work in private industry!’”

—SHANE R. STROUP

Engineering Academy Head, Wheaton High School, Wheaton, Maryland


Wheaton's engineering students win grins from middle school audiences, hold forth to the Montgomery Public School Board, and shine at city council meetings. "Two years ago, we tried briefing a student for a meeting and it was a disaster," Lowndes laughs. "It didn't come out naturally. Leaving them to say what they want to say and how [they want] to say it is the best thing we can do."

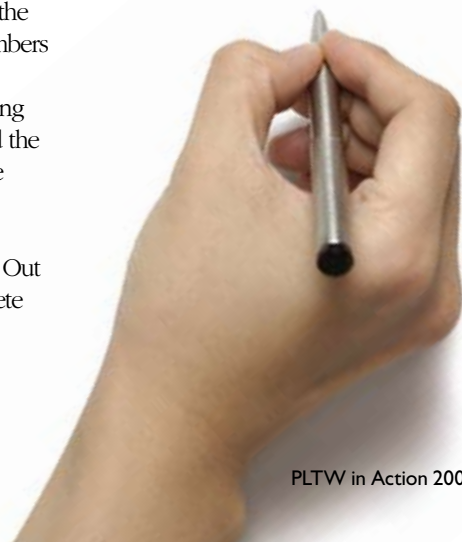
Showing, rather than telling, is also powerful. "The great thing about PLTW is it really is student focused and project based," says Lowndes. "And it's still unique that way. It's the first thing people notice when they come to our classrooms: The students are working together in groups. Then they

look at what the kids are working on, the computer, the product. And they become convinced."

Washington Post reporter Daniel DeVise came to Wheaton last spring on an unrelated assignment. Lowndes walked DeVise to the PLTW classrooms so he could meet members of the senior class who'd been getting acceptance letters from the top engineering schools in the country. "I let the kids and the teacher tell the story," Lowndes says. The reporter wrote that one up instead.

Academy Director Shane Stroup had taught those seniors from the beginning. Out of that first class of 26 students to complete the PLTW program, he recalls, half are

the first in their families to go to college. "Three girls in engineering at Cornell. A full scholarship to MIT. Offers from Stanford and Harvard. Duke, Rensselaer, Penn State.... That was an outstanding class." 



D.I.Y.



PROFILE

East Lake High School
Tarpon Springs, FL 34688

- PLTW start date: 2002
- 2007–08 PLTW students: 202

Info:
Paul Wahnish
barefo6529@aol.com

In 2001, East Lake High School in Tarpon Springs, Florida, offered one engineering class. In 2006, 21 students graduated from the school's Academy of Engineering with four years of Project Lead The Way® (PLTW) courses, and several college credits, under their belts, while 237 middle schoolers from throughout Pinellas County clamored for one of the 72 first-year PLTW slots.

According to David Barnes, director of Pinellas County Schools' Office of Workforce Education, PLTW answered an immediate community need for instruction in manufacturing engineering. "We have a number of smaller industries here," says Barnes. "Exposure to things like robotics and hydraulics didn't exist in any curriculum but Project Lead The Way's."

Paul Wahnish was a retired engineer running a handful of businesses and substitute teaching when East Lake's principal offered him a full-time teaching position. Wahnish responded with a five-year plan to build a PLTW-based engineering program. He had no trouble securing permission for it, he says, especially after Pinellas County went from neighborhood zoning to a school choice plan that included a network of magnet and career academies. "Getting the money," he says, "was the challenge."

Wahnish, who holds certifications in both teaching and engineering and had also been to law school, went into high gear. "I started a summer workshop to teach young community kids science, technology, engineering, and mathematics (STEM) subjects," he says. "I was new to the area, so I put together flyers and put them in the mailbox of every home in the vicinity of the high school. We charged for the workshop, and used the money we raised there to fund a 501(C)(3)—a nonprofit, with its own board of directors. The nonprofit's purpose was to free me up to talk to business and industry about the importance of STEM programs. At the same time, the workshops were generating enthusiasm for STEM with the young folks. We raised \$35,000 the first year, and have every year since then."

Thanks to the partnership of companies such as Jabil Circuit, Honeywell, and Raytheon, the academy acquired \$35,000 state-of-the-art mills, a brand-new Dell lab, and a Dimension printer—"magnificent equipment," according to Wahnish. "But the space that I took over was a huge classroom, divided in half with a temporary wall. On the other side was a personal fitness suite."

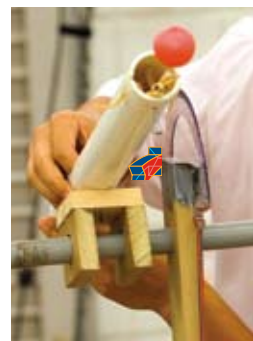
East Lake High School sophomores (from left) **Javon Bostic**, **Jill Ginnetti**, **Mitchell Maloney**, and **Kyle LeValley** ensure that robotic arm "Brutus" does their bidding. Thanks to the five-year plan of teacher **Paul Wahnish**, PLTW at East Lake runs like a well-oiled machine.



“East Lake Engineering Academy is preparing kids for jobs that may not even exist yet.”

—DAVID BARNES

Director of Workforce Education, Pinellas County Schools, Florida






PLTW students **Reed Smarelli** (left) and **Becky Bodine** are among only 72 Pinellas County freshmen who secured a place in East Lake's popular Engineering Academy for 2007–08. More than three times that number applied.

There were power cords hanging from the ceiling, and a concrete floor. I got a bid on tearing down part of one wall and putting a door into another part," Wahnish says, "and decided I could do it myself for less."

Fast-forward to the summer of 2008: Four weeklong sessions of workshops fill the renovated space. Throughout June and July, different groups of rising fourth, fifth, and sixth graders meet daily from 9 to 5. Each builds a robot from a kit, uses it to perform assigned tasks, and enters it into competition on the final day. Workshop leaders are young-adult "mentors"—college students from the PLTW affiliate University of Florida who have backgrounds in engineering, physics, and math—employed by the nonprofit. A spin-off summer workshop, the Girls FIRST Robotics Program, is held off site for girls age 11 to 15. Girls are given problems to solve; then, in small groups, build robots that will carry out their solutions. During the school year, East Lake students who belong to the robotics team mentor middle school and elementary school students in an after-school LEGO League robot-building program that takes place over 10 weeks throughout Pinellas County.

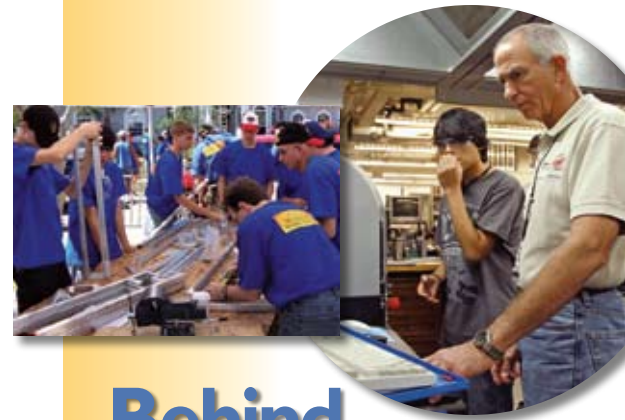
Wahnish believes the combination of PLTW and his own development process holds promise for many communities. "I've talked to tech ed teachers at national and regional meetings," he says, "and resoundingly, all over the country, the biggest challenge faced by these programs is their ability to sustain them. I like to think I've established a footprint of funding that could be applied anywhere." 



Launching PLTW at East Lake was the easy part, says **Paul Wahnish**. "There is enough interesting engineering that if you had the money to do it, you could do it anywhere." At left: **Carlos Resendez** eyes a missile's trajectory from a trebuchet the PLTW class built.



PLTW teacher **Paul Wahnish**, one on one with student **Bryan Cruzado** (below) and with the PLTW team for an 18-hour build on a local set for ABC's *Extreme Makeover: Home Edition*.



Behind the Scenes WITH PLTW

Not long after teacher Paul Wahnish had laid down new carpeting in the PLTW lab at East Lake High School, he got a call from Hollywood asking him and his engineering students to participate in a home makeover for an ABC-TV reality show benefiting a local family. The father had been accidentally blinded, says Wahnish. "His 12-year-old son said that when he grew up he wanted to design robotic eyes so his dad could see again. Our job was to design the boy's room based on a robotics theme."

Wahnish first enlisted the manufacturing technology company Honeywell as a sponsor for the room-remodeling effort. Then, he recalls, "about the third day into filming the program, I called a contact at the University of Florida at Tampa, and got to work on a scholarship for the boy, Charlie Doolan."

Days later, Wahnish drove to the set with a University of Florida plaque pledging \$60,000 and an additional check for \$6,000, to cover textbooks, from PLTW. "They presented it to Charlie on the show," Wahnish recalls. After the episode aired a few months later during sweeps week, the school board expressed renewed interest in funding East Lake's engineering academy.

Today, says Wahnish, "we're in the process of implementing a PLTW program in the south part of the county, where Charlie Doolan may be going to school."



As the 2007–08 school year ended, East Lake's Engineering Academy was poised to be named a "Center of Excellence." The business-driven effort recognizes programs that prepare students for high-wage, high-demand jobs in the Tampa Bay Area. Senior **Ashley Lawrence** waits for the ball to drop.



Winning Spirit

PROFILE

Wando High School
Mount Pleasant, SC 29466

- PLTW start date: 2001
- 2007–08 PLTW students: 300

Info:
Deborah Kennedy
Deborah_Kennedy@charleston.k12.sc.us

At Wando High School, the competitive spirit seems to run in the water fountain. Students at the suburban Charleston, South Carolina, school regularly win major competitions and awards in areas as varied as the student newspaper, the marching band, and the swim team—and the “engineering kids” in Wando’s Project Lead The Way® (PLTW) program are no exception. In the past year alone, they’ve been contenders in local bridge-building and robotics competitions held by the Citadel, the military college of South Carolina; regional winners of the National Women in Construction CAD design/drafting competition; and the 2007 Toshiba ExploraVision competition national champions.

“Competitions are such a great way to motivate the kids,” says Deborah Kennedy, one of five PLTW instructors at Wando—and one of four

with an engineering degree. “They get so excited. It’s awesome.” Kennedy teaches Introduction to Engineering Design (IED), Civil Engineering and Architecture (CEA), Engineering Design and Development (EDD), and AP calculus to 10th through 12th graders in Wando’s School of Math, Science, and Engineering. (Wando students are asked to pick a major, and a pathway such as pre-engineering, in one of four career-related “schools of study.” It’s a way to personalize the experience of being in a large high school, and to narrow Wando’s 250 course offerings.)

Wando’s cocurricular offerings also abound, and although many pre-engineering students get involved in competitions through its engineering club, Kennedy says teachers encourage participation through their classes. Kennedy’s entire EDD section entered the ExploraVision competition eventually won by a Wando team of three. It was a class assignment. “All our entries got some kind of recognition at the regional level,” she recalls. “Two got honorable mentions, which means they were in the top 10 percent.” Each of the three seniors who won the contest—which challenges students to explore future technologies—received a \$10,000 savings bond, a trip to Washington, D.C., for the awards weekend, and, says Kennedy, “an unbelievable reaction” from the Mount Pleasant community.



Control, coherence, and connectedness make for a resilient structure. Wando High School PLTW students and their community advisors build an architectural model, part of a Destination Imagination competition entry. Above: Engineer **Dennis Knight**, architect **Nick Winter**, and construction manager **Lauren Bush** advise students **Jennifer Kennedy**, **Dilly Hughes**, and **Kelsey Timmerman**. At right: **Bradley Kennedy**, **Kevin Carlson**, and **Matt Davidson** set up the stress analyzer to load-test the building.





Warrior Girls ♥ PLTW

Female enrollment in PLTW recently hit a high-water mark in this low-country high school: 25 percent of Wando's 2007 Introduction to Engineering Design (IED) class were girls. How does the faculty get and keep girls in engineering? Three strategies from teacher (and civil engineer) Deborah Kennedy:

1. Social Security

Grads of Wando's girls-only Science Technology and Engineering Preview Summer (STEPS) program for rising ninth graders not only were more likely to enroll in PLTW, but seemed more comfortable and confident in IED classes—where, according to Kennedy, “other students were asking them how to do things.”

2. Girl Appeal

On Career Days, ninth-grade girls get a separate engineering presentation, emphasizing the field's girl-preferred values—such as the ability to make a difference in the world, and having a good work environment—and disciplines, such as environmental, civil, and biotechnical engineering.

3. PLTW to Go

Middle school girls attend orientation in actual PLTW classes where they design/build a simple playhouse, PLTW students model it in REVIT or Inventor software, and the visitors get to take the model home. “They get a feel for the program,” says Kennedy, “and parents are so impressed.”



STEPS Camp field-trippers sit parallel to the new Ravenel Bridge in Charleston, South Carolina. The summer camp links rising ninth- and 10th-grade girls from throughout the school district to Wando's PLTW program.

“I've learned I want to be an architect. I didn't think it was something I could do. PLTW showed me what kind of stuff I need to focus on to get into the field.”

—HANNAH DWYER
Sophomore, Wando High School
Mount Pleasant, South Carolina




They were overdue for a celebration. In 2001, Kennedy and a Wando colleague had won a \$60,000 grant to launch four sections of IED. The school has added a class each year, and five to six sections per class, since then. The December 2004 issue of *Charleston Business* magazine reported: “Project Lead The Way has started to make serious inroads in regional high schools.” That year, the Charleston County School District formed a PLTW advisory council with representatives from high schools, the county superintendent's office, engineering companies, and affiliated colleges.

Carl Mittelstadt of BP's Cooper River petrochemical plant chaired the original council, and has watched Wando's PLTW program grow through five years of student visits on “Engineer Shadow Day” and a progressive escalation of corporate giving. He says Wando's PLTW program has received numerous contributions through a BP program in which each of the plant's 400 employees designates an annual contribution of \$500 to a worthy charity. On top of that, the BP Foundation offers a matching grant for the donation, and

will also match a donation of service hours with cash—an overall gift of up to several thousand dollars per year. Mittelstadt says the donations are not a reward so much as a result. “The good things that have come of that program, particularly the encouragement of minority youth and females in engineering, have made giving easy,” he says. “It's been more of a pull than a push.”

When Wando won big at the ExploraVision contest, says Mittelstadt, “it definitely created a broader awareness of Project Lead The Way. But even if the group hadn't done as well, the program would have been a first choice for BP to contribute to.” In January the company presented Wando High School with a \$25,000

check to fund competitions, field trips, and on-site experiences related to the engineering program.

Kennedy says parents, too, were “just thrilled about the competition results,” and that the school administration, always supportive, seems to have new enthusiasm for PLTW. “At this point,” she says, “I think they're really proud. I just had a couple of counselors come through my PLTW classroom to observe. They want to be there firsthand so they can tell kids and parents what's actually currently happening in the class.” That would be project-based learning as usual: teamwork increasing personal commitment, content becoming more relevant, creativity flowing. 



The Long View



PROFILE

Miller City High School
Miller City, OH 45864

- PLTW start date: 2003
- 2007–08 PLTW students: 183

Info:
Stephen Peck
ml_peck@noacsc.org

“Pathway education is really the way things are going in the future, and Miller City students in this PLTW program are ahead of the curve.”

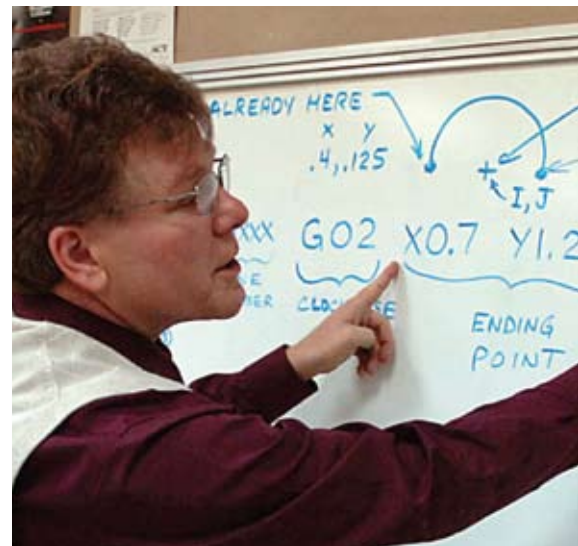
—DAVID BROWN
Engineering Department Chair
James A. Rhodes State College, Lima, Ohio

Stand on the roof of Miller City High School (MCHS) around noon on a school day and you can watch David Shaffer’s car for miles, heading south across the flat farmland to Lima, Ohio, an hour away. Shaffer, an employee of Rhodes State College, teaches Digital Engineering (DE) and Computer Integrated Manufacturing (CIM) to Miller City juniors and seniors every morning, and engineering technology courses to Rhodes State College students in the afternoons and evenings. Since he began the daily commute, enrollment in Project Lead The Way® (PLTW) has more than doubled. Half the high school takes either Pathways To Engineering™ or Biomedical Sciences courses. The entire 2007 “PLTW graduating class” is studying engineering in college. The five who are at Rhodes State can earn their associate degrees within a year, and bachelor’s degrees in another two—without leaving their hometown.

Like many an elegant solution, the memorandum



Miller City High School instructor **Bonnie Brooks** (left) and students **Jenna Peck** and **Sarah Carpenter** examine broken-down blood cells. About two-thirds of the students in Miller City’s pilot Biomedical Sciences program are female, the opposite of the breakdown in the school’s engineering courses.



Rhodes State College instructor **David Shaffer** sets up logic gates for a Miller City High School Digital Electronics (DE) class. The schools’ solution to the problem of scarce resources has also given students in other rural Ohio schools access to more options.

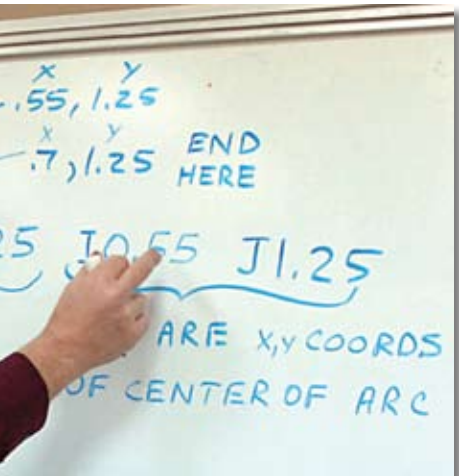
of understanding between Rhodes State College and MCHS was born of necessity. Rural Ohio communities have had to invest in technology education, scarce resources notwithstanding. They have had to take the long view.

“We’re a small school with a small faculty,” says Superintendent Bill Kreinbrink. Small but mighty: MCHS produces state champion teams in basketball and baseball, and also in the National FFA Organization soil judging. The school offers a rigorous college preparatory program. In 2003, when it began to offer PLTW, students had access to college-credit courses—just not in math and science.

“In particular,” says Kreinbrink, “we were seeing a real increase in demand for graduates of two-year manufacturing engineering and mechanical engineering programs. We wanted a program that would be inviting to students looking at engineering as a career, but also to students needing the motivation to go on to the postsecondary level in any field of study.”

Rhodes State College Engineering Department Chair David Brown says the messages students were getting may have been mixed. “In this area, many parents of high school-age kids had been unskilled laborers in the auto industry. They were telling their kids not to go into manufacturing,” says Brown.

“The fact is, this is not your father’s factory,” he continues. “In this corner of the state, we’re gaining in energy production and process operations. We now have two ethanol plants, and a newcomer, Global Energies, that will use gasification. There’s Procter & Gamble, the Husky refinery.... Twenty-four companies in the new West Central Ohio Advanced Manufacturing Consortium pay to



Instructor **David Shaffer** points out features of a digital trainer to Miller City High School students **Ashley Kohls** (left) and **Amanda Shnipke**. In northwestern Ohio, the shortest route from high school to engineering technology jobs is via PLTW.

gain access to students in PLTW and other programs,” says Brown.

Superintendent Kreinbrink says it was engineers on the PLTW advisory board who pointed out the similarity between that engineering curriculum and first-year courses at Rhodes State. With members of the Rhodes State faculty and Ohio’s Tech Prep Consortium, Kreinbrink found a way to afford a beefed-up PLTW program. In the bargain, he got a seamless transition to college for his students.

Under Ohio’s state Post Secondary Enrollment Options Program, the Miller City school district would lose state foundation funds for each Rhodes State pre-engineering course its high school students took—in effect paying tuition to the state. For offering the courses, the college would be subsidized at a higher rate. So Rhodes State chose to return some of that subsidy to Miller City High School. College officials also bent over backward to provide a dedicated instructor in the interest of learning continuity.

What was in it for the two-year community college? “There’s a brain drain in this area,” says David Brown. “Seventy-five percent of students who leave to get science, technology, engineering, and math (STEM) bachelor’s degrees never return. We don’t typically get the four-year engineering tech students. PLTW students are better prepared. They’re not going to hit the ‘math wall.’”

Counselor Stephen Peck says that PLTW is slowly changing the culture of MCHS. “It took about a year and a half to get everybody on line, to buy in,” he says, “because the entire staff is involved. We’ve raised the standards for academic coursework in the lower grades so that students will be prepared, and we’ve incorporated aspects of the program into other subjects: physics, English. It’s complementary.”

According to MCHS Principal Kevin McGlaughlin, ACT scores are already higher than in previous years. Miller City parents’ reaction so far? Says McGlaughlin: “They love us!”

That’s a critical reversal, according to Rhodes State College’s David Brown. “In the long term,” he says, “the purpose of this investment for us is to grow local talent and keep it local. If we get even 15 percent of the (PLTW) students, then we’re getting a benefit.”



COMPLEMENTARY Elective Courses

Kathy Sommers heads career and technology education for the state of Ohio and also helped broker Miller City High School’s arrangement with Rhodes State College. “Once we had crafted a solution with Miller City High School, we were able to take that model to other schools in rural Ohio,” she says. “This shows we can do creative things to give our students access to a lot of options.”

Inspired by the success of PLTW, a host of higher-education partners now offer three elective pre-engineering courses available to students in select high schools who have completed the three core PLTW courses. Each new course was developed under the leadership of the Ohio Department of Education and represents an economic driver in Ohio.



Ohio PLTW students, such as the three shown here demonstrating a work cell for PLTW State Leader **Kathy Sommers**, may be eligible for additional engineering enrichment.

COURSE	DEVELOPED WITH
■ Fuel Cell Technology	■ Case Western Reserve University ■ Ohio University ■ Stark State College ■ Hocking College
■ Materials Joining Technology	■ The Ohio State University Edison Welding Institute ■ Lorain County Community College ■ American Welding Society
■ Computational Science and Engineering	■ The Ohio State University Supercomputer Center ■ Capital University

For information, contact Kathy Sommers, Assistant Director, Tech Prep and Adult Education, Ohio Department of Education, at kathy.sommers@ode.state.oh.us.



Group Momentum



PROFILE

Liberty Public Schools
Liberty, Missouri

- PLTW start date: 2006
- 2007–08 PLTW students: Approximately 800

Info:
Colleen Jones
cjones@liberty.k12.mo.us

Liberty Junior High School
Liberty, MO 64068

South Valley Junior High School
Liberty, MO 64068

Liberty Senior High School
Liberty, MO 64068

The Kansas City bedroom community of Liberty, Missouri, has been growing like a teenager. Over the past eight years the Liberty school district has built seven schools and added classroom space to seven more. Now, rigorous engineering courses are filling out an expansive framework of high-level academics.

In one year, 800 students have enrolled in Pathway To Engineering™ and Gateway To Technology™ (GTT) courses in 28 sections at Liberty Senior High School, two junior high schools, and two district middle schools. How do you grow a program this fast? You approach it like the socially fluid digital natives of the Project Lead The Way® (PLTW) generation: collaboratively—and with technology.

“Our tech teachers were the first to bring PLTW to the attention of the administration,” says Colleen Jones, executive director of staff development for the district. Meantime, the Ewing Marion Kauffman Foundation was coming on board with grants for the program to match funding from other business, philanthropic, and community partners in the Kansas City area, all of which would be pooled with state and federal government money.

“It was all happening so fast,” says Jones. “We knew other districts would be applying for the same money we were.” At the same time, says Jones, they also knew the grants would fund districts on the basis of the number of pupils in



PLTW is designed to challenge and engage young people’s natural curiosity, and students of the program at Liberty Public Schools are encouraged to speak up. Above, junior **Sam Patel** (left) and sophomore **Bobby Kosorog** prepare an axle for their Liberty Senior High School PLTW class composite project, a flag-raising machine.

each. Instead of retreating to their district “silos,” Jones and her peers in North Kansas City and Park Hill made a radical decision: “We left the competition on the football field,” says Jones. The three districts collaborated to write the grant proposals.

With funding in place for PLTW foundation courses (see page 5) in 16 schools in eight



“It doesn’t really matter how smart you think you are. It just matters how smart you want to be. Project Lead The Way gives you that opportunity.”

—TONY MCBROOM

Gateway To Technology™ Student, Liberty Junior High School, Liberty, Missouri



“Because it’s a hands-on project, you get to learn from your mistakes. If you mess up, you have to be willing to try again.”

—ABIGAIL PREWITT
Gateway To Technology™ Student
Liberty Junior High School, Liberty, Missouri



districts throughout the Kansas City metro area, Jones and her colleagues registered for PLTW and got training under way in the summer of 2006. “In the process,” Jones says, “we all became very good friends.” They also inspired dozens of teachers and counselors to collaborate. Jones’s group requested and secured new means for raising the involvement of counselors, such as the option of holding accessible regional conferences as necessary, and today, teachers from Liberty, Park Hill, and North Kansas City visit one another’s engineering classrooms to critique teaching methods.

At the Liberty schools, the collaboration has extended across the curriculum. PLTW’s Introduction to Engineering Design (IED) course was simultaneously introduced at Liberty and South Valley junior high schools (grades eight and nine) and Liberty Senior High School (grades 10 through 12). Now, says Jones, “we’re working between PLTW and the math and

science teachers to align grade-level expectations.” The enthusiasm of Liberty’s original staff of four has spread to four more teachers who joined the staff in 2007, to accommodate an expanded offering that includes Digital Electronics (DE), Civil Engineering and Architecture (CEA), GTT for the eighth grade, and a STEPS class as an elective for students at Liberty’s two middle schools.

“My teachers are the true champions of this program,” says Jones. “They tell me they wish we could offer even more courses—that this has been the most enlightening phase in the course of their teaching careers.”

Liberty has also excelled at getting the word about PLTW to community “customers” of the program. The high school operates its own public cable channel that serves homes in the district. A school newsletter is e-mailed weekly to more than 3,500 readers. This year, Jones and her colleagues are working on a proposal to bring advanced online networking capability to all three districts so that PLTW students can learn online from the unusually high concentration of engineers in the Kansas City area.

While the Liberty School District decides on a bond issue for a second high school, PLTW is redefining a generation of students. Jones says that when her engineering-major son visited last year from Missouri University, her high school freshman son showed him things from Liberty High’s IED class that he hadn’t yet done in college.

Says Jones: “PLTW is how we make math and science real for this generation.” 

At an ACE Mentoring Program meeting in the media room of Liberty Senior High School, local engineers and PLTW students critique the design of an urban park. Sophomore **Rachel Lindsay** (second from right) makes her point.



Photo courtesy of Anna Faltermeier/Liberty Tribune

ACE Presentations with PLTW!



Along with its engineering program, Liberty Senior High School offers a complementary powerhouse of after-school mentoring. The ACE Mentoring Program of Greater Kansas City ran at maximum capacity in 2007–08, its first year at Liberty, and the majority of students participating also took PLTW classes. Mike Valentine is executive director of the local ACE chapter and a senior engineer at a branch of the national structural engineering firm Thornton-Tomasetti. Valentine guided Liberty students in designing an urban park for a national competition sponsored by the Construction Industry Round Table.

It was a hands-off role, he says. But “when there were 20 million ideas up in the air, we would jump in and say ‘stop.’” Valentine noticed Liberty students’ tech affinity right away, introduced them to Google SketchUp—a visualization tool popular with architects—and stood back.

“This is a group thing,” says Valentine. “You’ll have cliques. You’ll have people who are technically challenged in one area and brighter in others. I deal with that in projects that I work on every day.” Valentine says PLTW’s group approach to problem solving gives Team Liberty a head start in the engineering workplace as well as in competitions.

The team was required to submit their park plan in at least three dimensions. Students were judged less on their design solution than on the process and methods they used to arrive at it, and, above all, on their presentation. Here, says Valenti, is where Liberty really shone. “The kids in this group are not afraid to speak up. They knew how to sell it.” Although their entry did not make it past regional competition, the team gave it their all, Valenti says.

Hawthorne High School, Hawthorne, California

Martin Luther King High School, Riverside, California

Lancaster High School, Lancaster, California



California College Connection



PROFILES

Info:
Duane Crum
dcrum@engineering.sdsu.edu

Hawthorne High School
Hawthorne, CA 90250

- **PLTW start date: 2003**
- **2007–08 PLTW students: Approximately 90**

Lancaster High School
Lancaster, CA 93536

- **PLTW start date: 2004**
- **2007–08 PLTW students: 75**

Martin Luther King High School
Riverside, CA 92508

- **PLTW start date: 2000**
- **2007–08 PLTW students: 154**

In densely populated Southern California, three high schools in the communities of Hawthorne, Riverside, and Lancaster are an hour's drive—and worlds—apart. However, thriving Project Lead The Way® (PLTW) programs in all three schools are hooking students up to higher education throughout the state and beyond it.

Los Angeles County's Hawthorne High School began offering PLTW as the curriculum for a California Partnership Academy—a three-year “school within a school” in which at least 50

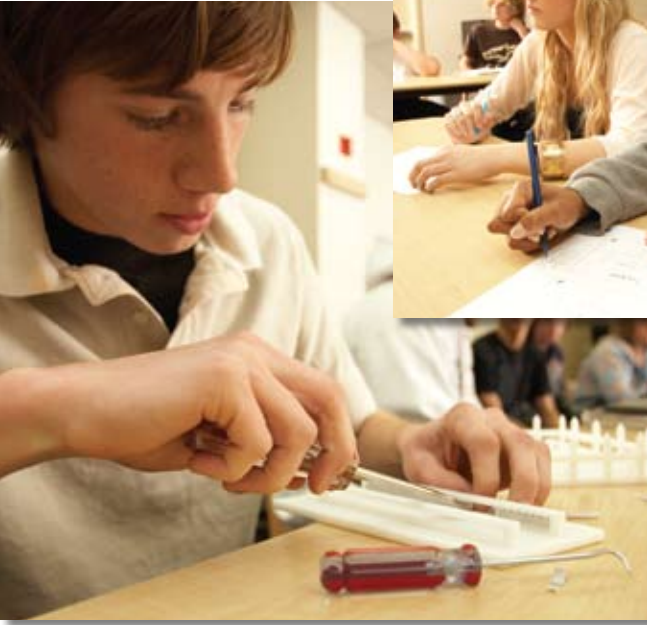
percent of students are at risk of dropping out. From 90 to 95 percent of all Hawthorne students fit that definition, says PLTW teacher Jeff Ordway.

“How do you teach engineering to kids who don't have algebra?” he asks. “You teach the concept. Why does this work the way it works? How? I make the kids justify their mousetrap cars conceptually—not mathematically. Then we do trial and error.” He adds, “I sneak the math in.”

The program meets innumerable needs. “Half these kids don't have a computer at home,”



“Being in a group encourages you to do more,” says Hawthorne High School PLTW student **Vanessa Garcia** (left). Above, Hawthorne students race mousetrap cars they built in teacher **Jeff Ordway's** Principles of Engineering (POE) class.



In California, jobs that rely on science, technology, engineering and mathematics are expected to grow at a faster rate than all other jobs, increasing by up to 25 percent between 2004 and 2014—the year PLTW students such as Martin Luther King High School's **Lauren Casten** (top, left), **Hillary Webb** (top, right), and **Dillon McDonald** expect to graduate from college.

armed with dual credits earned at Hawthorne and transferable to a number of state universities.

Over four years teaching PLTW, Ordway says he's seen the cross-curricular model bring Hawthorne's teachers together as well. "We've had some disappointments," he says. "We've watched some kids fall off the face of the earth. But the kids who've stuck it out are starting to feel like they're part of something special."

For the high-achieving students at Riverside's Martin Luther King High School, PLTW presents other challenges. "We have the kids of professional parents who are working all the time," says Engineering Department Chair Mike Martin, also a teacher and geologist. "A lot of them are video-game addicts. They learn stuff on the computer lickety-split, but it can really be a struggle for them to put [things] on a lathe."

Having a lathe at all is unusual for a school in the area. King was built in 1999. Since Martin put together the first PLTW partnership team in 2000, he has seen school after school in his district and others do away with vocational education. At the same time, says Martin, "so much work has gone into developing the PLTW curriculum that there's nothing else like it."

Martin Luther King High School students get the full benefit of that hands-on, high-tech curriculum through a four-year schedule that includes five PLTW courses. Over the years, Martin has guided enough Engineering Design and Development (EDD) "capstone" projects to fill a trade show. He increasingly encourages students to seek patents for exceptional work.

Senior Brittany Buchanan says her team's research has more than justified its effort to construct an easy-

Ordway explains. More importantly, he says, "PLTW allows me to teach kids how to think—an essential part of life that's missing in a lot of education."

After junior year, many academy students serve as interns, with longtime partner companies such as Northrop

Grumman and Disney Imagineering. Hawthorne's first engineering class of 20 graduated in the spring of 2007. Two graduates work in manufacturing, one is in a four-year program at California State University at Long Beach, and all but three of the rest are in community college,

CSU Engineering Colleges Initiative



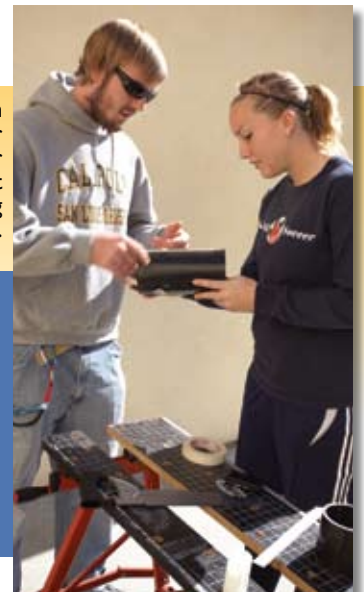
In 2007, the prestigious California State University (CSU) system was looking for ways to increase business's involvement with its 23 constituent universities. Deans from the colleges of engineering chose an innovative strategy: increase the number of high schools offering the Project Lead The Way program.

A network of eight staffed CSU PLTW Regional Centers now connects business and higher education through existing and prospective PLTW programs. Across the state, centers assist in putting together program partnership teams, counselor conferences, and scholarships. Through the initiative, some colleges of engineering have begun to offer PLTW students preferred admission.

Program Coordinator Bruce Westermo of San Diego State University says the goal is a well-coordinated statewide PLTW system. "Project Lead The Way really can sell itself. When people get into the classroom, they immediately see what it has to offer. This initiative shows them the way there."

College-bound athletes **Frank Sugden** and **Brittany Buchanan** engineer a better soccer goal net for their Engineering Design and Development (EDD) course at Martin Luther King High School in Riverside, California.

For information, contact:
Dr. Bruce Westermo
 Assistant Dean
 College of Engineering
 Director, PLTW Affiliate Institute
 San Diego State University
 5500 Campanile Drive
 San Diego CA 92182-1326
 619-594-7007
 westermo@engineering.sdsu.edu



on, easy-off net for a regulation-size soccer goal. Bound for California Baptist University on a combined engineering and soccer scholarship, Buchanan is in her third year of PLTW. She “doubled up” on courses as a sophomore because she didn’t know about the program as a freshman.


Martin recently took Buchanan and two other seniors to present the program to a middle school math class. “I told them that there’s a different way that girls and guys think and solve problems,” Buchanan says. “So having girls in the program and as engineers means you could come up with totally different solutions, sometimes even better solutions, than guys could come up with.”

Group skills, independent thinking: perhaps the PLTW programs at King and Hawthorne are not such distant cousins.

Somewhere in the middle, equidistant from those schools and about 70 miles north of Los Angeles, Lancaster High School’s PLTW program directly equips students for the world that is—literally—around them. Lancaster, a high-desert city bordering Edwards Air Force Base, is in the heart of the so-called Aerospace Valley. Air Force Plant 42, home of Boeing, Lockheed Martin, and Northrop Grumman, is 10 miles from the high school.

“Go outside and you’ll see military airplanes flying overhead on testing and training flights on any day of the week,” says PLTW teacher Kevin Spoelstra. “We get a lot of support from the defense contractor industry here. They’ve given thousands of discretionary dollars directly to the school for PLTW. During Engineering Week, I open up the classrooms to their professionals for two days.” Juniors and seniors also go off-site to meet those employers and set up contacts with mentors—for senior projects, internships, jobs—part of the community’s effort to grow its own engineers.

Even so, Spoelstra says, only about half of Lancaster seniors in a given year have college plans. Among the PLTW kids, that number is closer to 80 percent. Some enter engineering at Antelope Valley Community College. From there, they can transfer credits to colleges of engineering in the California State University network (see box on previous page).

Senior Amber Frauhiger is drawn to Columbia University’s Fu Foundation School of Engineering and Applied Science. “It has a really active, hands-on type of program that involves community work, which is really exciting to me,” she says. “Cal Poly San Luis Obispo’s program is really well known in Lancaster, and UC San Diego has a wonderful school that I’m looking at, too.” Whatever the school, Frauhiger knows she’ll major in mechanical engineering. “PLTW helped me figure out what I wanted to do.” 



Teacher **Kevin Spoelstra** (right) and students (from top) **Chandler Giles**, **Abbie Ramboa**, **Valerie Younan**, **Curtis Darby**, and **Amber Frauhiger** from the PLTW program at Lancaster High School wash planes as volunteers at the Joe Davies Heritage Airpark in Palmdale, California. The local economy relies heavily on engineering.



BUSINESS PARTNERS

Autodesk

Autodesk

Since 1999, international design technology company Autodesk has supported PLTW, making its highly advanced digital prototyping solutions available through substantial discounts, subscriptions, grant programs, training curriculum development, and community resources. • autodesk.com



Stratasys/Dimension

Through a generous grant program sponsored by Dimension, a business unit of StratasyS, as many as 20 PLTW network schools have been able to purchase state-of-the-art Dimension BST 768 3D printers—an opportunity that otherwise might have remained out of reach. • stratasys.com



Fischertechnik

Fischertechnik offers educational kits to schools and students at substantially reduced prices. The German building system's components are used by engineers throughout the world to model real-world machines and structures down to the last detail. • fischertechnik.com



Cengage Learning

In 2007, Cengage Learning, formerly Thomson Learning, acquired TrueOutcomes, LLC. Through the Cengage TrueOutcomes assessment, PLTW is able to collect significant data with which to measure and assess the success of PLTW students as compared to non-PLTW students. • cengage.com



Edgecam

Edgecam, considered the most advanced solids-based machining system available, allows PLTW students to mill out designs on a computer numerical control (CNC) machine that they have drawn on Autodesk Inventor, giving them real-world experience in manufacturing engineering. • edgecam.com



Intelitek

Intelitek's computer numerical control (CNC) machines and robots have been used in PLTW courses since 1996. Intelitek contributed to the development of the Computer Integrated Manufacturing (CIM) curriculum, trained master teachers, and is a charter member of the PLTW development team. • intelitek.com



National Instruments

Texas-based National Instruments (NI) supplies a variety of state-of-the-art software for PLTW students, as well as training to support PLTW programs. Tools include Multisim and LabVIEW software, used in both Pathway To Engineering™ and Biomedical Sciences program curricula. • ni.com



SPONSORSHIPS



Northrop Grumman

Through a \$45,000 grant from the Northrop Grumman Foundation, three PLTW public schools in San Diego's Poway Unified School District and two in Gloucester, Virginia, have been paired with engineer mentors from the global defense company. • northropgrumman.com



Intel

Intel offers cash grants and computer donations to PLTW schools, provides internships and job shadowing opportunities to students, and participates in special events designed to promote awareness of engineering and technology careers. • intel.com



SPONSORSHIPS *(continued)*



Lockheed Martin

Lockheed Martin generously supports PLTW through programs that include scholarships for PLTW graduates entering engineering majors, and content support and funding for the revision of PLTW's aerospace curriculum. • lockheedmartin.com



Rockwell Automation

Rockwell Automation is committed to increasing minority student participation in engineering. It funds several PLTW schools in Milwaukee and Cleveland, provides mentors for PLTW classrooms, and hosts special events for area PLTW schools. • rockwellautomation.com



Rolls-Royce

Rolls-Royce of Indianapolis provides 10-week, paid summer internships to PLTW teachers, offering them real-world engineering experience to share with their students. Rolls-Royce also provides funding to each teacher-intern's school to support its PLTW program. • rolls-royce.com



Sprint

In January 2008, the Sprint Foundation, philanthropic arm of Sprint Nextel, pledged \$250,000 over three years to help the Missouri University of Science and Technology (Missouri S&T) train precollege educators to teach the PLTW curriculum. • sprint.com

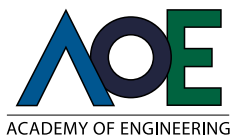


EDUCATION INITIATIVES



SME-EF Gateway Academies

The Society of Manufacturing Engineers Education Foundation (SME-EF) partners with PLTW on the Gateway Academies, coed day camps for middle school students that encourage enrollment in PLTW and interest in STEM careers. • sme.org



Academy of Engineering Collaboration

PLTW, the National Academy Foundation (NAF), and the National Action Council for Minorities in Engineering (NACME) have created a network of urban Academies of Engineering that offer PLTW curricula in a model developed specifically for urban high schools. • naf.org • nacme.org



The National Council for Agricultural Education

The National Council for Agricultural Education is adapting PLTW's project-based curriculum model to reinvent agricultural education in the United States. PLTW will consult throughout the process of building a framework for a national core curriculum in agriculture, food sciences, and natural resources. • teamaged.org



NASA (Dryden Flight Research Center; Goddard Space Flight Center)

The Dryden Flight Research Center of the National Aeronautics and Space Administration (NASA) and NASA's Goddard Space Flight Center have collaborated with PLTW to develop Aerospace Engineering curricula and fill the STEM pipeline.

• nasa.gov/centers/dryden/home/index.html • nasa.gov/centers/goddard/home/index.html



EDUCATION INITIATIVES *(continued)*



Engineering Equity Extension Service (EEES)

PLTW and the National Alliance for Partnerships in Equity (NAPE) Education Foundation are collaborating with the Engineering Equity Extension Service (EEES) to train master teachers in gender equity principles so as to increase the participation of girls in PLTW programs. • napequrity.org/EEES.htm



U.S. Army

Partnership between PLTW and the U.S. Army will enhance PLTW's engineering curriculum using a variety of gaming and simulation technologies developed through America's Army, the U.S. Army's online gaming project, americasarmy.com. • goarmy.com



FOUNDATIONS



Kern Family Foundation

The Waukesha, Wisconsin-based Kern Family Foundation is committed to its mission of preparing students for the challenges of the 21st century through values, education, and innovation. In its five-year history of supporting K-12 Science, Technology, Engineering, and Mathematics (STEM) initiatives, the foundation has invested \$10 million in grant awards, which have primarily gone to more than 300 schools in Wisconsin, Iowa, Illinois, and Minnesota as startup support for implementing PLTW. • kffdn.org



Ewing Marion Kauffman Foundation

Thanks, in part, to matching grants from the Kauffman Foundation totaling \$1.2 million, 18 schools in the Kansas City area have implemented PLTW curricula. Plans are under way to increase this number to more than 35 high schools and at least 10 middle schools over the next four years. In partnership with SME-EF, the foundation also supports Gateway Academies in Missouri and Kansas. • kauffman.org



Southern Regional Education Board

Founded in 1948, the Southern Regional Education Board (SREB) is a nonprofit, nonpartisan organization that works with leaders and policymakers in 16 member states to improve pre-K through postsecondary education. The SREB's High Schools That Work (HSTW), the largest school improvement initiative in the country, began in 1987 and is now in 1,300 schools throughout the nation, many of which also use PLTW curricula. • sreb.org



John S. and James L. Knight Foundation

Through a five-year, \$2 million grant from the John S. and James L. Knight Foundation, PLTW will expand into 18 middle schools and 9 high schools in the Wichita, Kansas, region, led by Wichita State University's College of Engineering. • knightfoundation.org



ASSOCIATION ENDORSEMENTS



Aerospace Industries Association • aia-aerospace.org



National Association of Manufacturers and the Manufacturing Institute • nam.org



National Defense Industrial Association • ndia.org



National Fluid Power Association • nfpa.com



MEMBERS



Center for the Advancement of Scholarship on Engineering Education (CASEE)
• nae.edu/casee



National Alliance for Partnerships in Equity (NAPE) • napequity.org



GOVERNMENT RELATIONS



Washington Partners

Washington Partners, LLC (WPLLC), is a government relations firm known for its expertise in education policy. WPLLC facilitates connections with like-minded agencies and organizations in Washington, D.C., shares the program's progress and results with stakeholders and lawmakers, and identifies links between federal policy and PLTW efforts and objectives. • wpllc.net



MARKETING AND COMMUNICATIONS



A3 Creative Group

A3 Creative Group, one of the nation's leading experts in education communications, is PLTW's exclusive communications provider. A3's work for PLTW includes producing all publications; overseeing all new-media communications projects; and continuing to expand the engineering network, build the Biomedical Sciences program network, and develop partnerships that unite nonprofit and for-profit organizations. • a3creativegroup.com





Cassie Hudson (left) and **Brittany Parrish**, Greenfield-Central High School, Greenfield, Indiana

Investing in Educators: The PLTW Professional Development and Support System

Forging the Innovation Generation would be impossible without qualified and motivated teachers. PLTW makes a tremendous investment in world-class professional development to ensure the success of its network. In addition, PLTW teachers can access ongoing peer and technical support at the local, state, regional, and national levels.

Before a teacher can be a PLTW instructor, he or she is required to attend an intensive, two-week PLTW Summer Training Institute. During these sessions, teachers experience the PLTW classes as their own students will, which gives them invaluable insights into how to make the courses as engaging as possible during the school year.

Registered PLTW teachers also have access to the Virtual Academy for Professional Development, which offers on-demand multimedia lessons and a subscription e-mail service for support and innovation that reaches a national network of PLTW educators.



For more information,
go to www.pltw.org.

Nationwide Support and Information Network

PLTW partner schools, teachers, and school counselors are part of a nationwide support and information network. This network includes PLTW state leaders, PLTW master teachers, and the PLTW national staff, who are all available to lend support and answer questions via e-mail or phone.

There is also a special PLTW professional development program and network for school counselors, including an annual statewide awareness conference and counselor's kit. The kit features a PLTW resource guide, promotional posters, handouts, and other helpful resource materials.



Brian Sexton (left) and **Lawrence DeCoud**, Martin Luther King High School, Riverside, California

Share Your PLTW Success Story

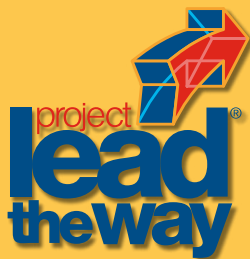
Is your PLTW program a “model of success”?

Let us know how PLTW works for you, and your school could be featured in the next edition of the PLTW yearbook, *PLTW in Action*.

Simply send your school's PLTW success story to Crickett Thomas-O'Dell at cthomasodell@pltw.org.

Please include your name and contact information.

Joseph Tatum,
Liberty Senior High
School, Liberty, Missouri



Forging the Innovation Generation

Phone: 518-877-6491 • Fax: 518-877-6260
747 Pierce Road • Clifton Park, NY 12065
www.pltw.org • E-mail: mail@pltw.org

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