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

By the Numbers
As of Fall 2008
- 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+

Number of PLTW Schools in State As of Fall 2008
- 101+ schools
- 76–100 schools
- 51–75 schools
- 26–50 schools
- 1–25 schools
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
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.

How PLTW Works

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.
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.
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.
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.
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 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.

“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
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.
Seatttle'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 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.”

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 Neuro Robotics 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?
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.

“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
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, Engineering, and Mathematics) 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 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.”

Michael Sinde:
“We’re hoping to have something that the kids build, as opposed to something people come and put in…”

Career and Technical Education Coordinator Michael R. Sinde and PLTW student Brendan Gilbert solve a problem at Thornton Township High School in Harvey, Illinois.
Francis Tuttle Pre-engineering Academy, Oklahoma City, Oklahoma

Master Planned

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.

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.
Given that the academy's 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."

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 GrrTech program, pairing her with a female chemical engineering 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."

"From extreme small town to extreme big-time college, the experience was key for me in being able to survive here."
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.”

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.”

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

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

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

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.
Kenosha Unified School District, Kenosha, Wisconsin

K–16 Continuum

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.”

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.

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
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, can earn college 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.”
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.”

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 in Engineering Program

<table>
<thead>
<tr>
<th># of Scholarships</th>
<th>School</th>
<th>Program</th>
<th>Total $ Awarded</th>
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</thead>
<tbody>
<tr>
<td>3</td>
<td>Cornell University</td>
<td>Mechanical Engineering</td>
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<td>1</td>
<td>DeVry University</td>
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<td>Frostburg State</td>
<td>Mech./Elect. Engineering</td>
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<tr>
<td>1</td>
<td>MIT</td>
<td>Mechanical Engineering</td>
<td>$151,000.00</td>
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<tr>
<td>1</td>
<td>McDaniel</td>
<td>Chemical Engineering</td>
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<td>1</td>
<td>Michigan State</td>
<td>Accounting</td>
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<td>Penn State</td>
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<td>1</td>
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<td>Nuclear Engineering</td>
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<tr>
<td>1</td>
<td>Virginia Tech</td>
<td>Mechanical Engineering</td>
<td>$96,000.00</td>
</tr>
</tbody>
</table>

**Total $1,610,000.00**

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.

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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.

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.”

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

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**—SHANE R. STROUP**

Engineering Academy Head, Wheaton High School, Wheaton, Maryland
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 Engineering Academy is preparing kids for jobs that may not even exist yet.”

—DAVID BARNES
Director of Workforce Education, Pinellas County Schools, Florida
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.”
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.
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, “they get a feel for the program,” says Kennedy, “and parents are so impressed.”
The Long View

Miller City High School, Miller City, 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 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

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
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.”

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.

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

“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

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 Valent, 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, Valent says.

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 Lindsey (second from right) makes her point.

Photo courtesy of Anna Faltermeier/Liberty Tribune

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Photo courtesy of Anna Faltermeier/Liberty Tribune
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.
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, 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-
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.”
**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. • edgcam.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

**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
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

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
**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.  

[napequity.org/EEES.htm](http://napequity.org/EEES.htm)

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**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](http://goarmy.com)

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**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](http://kffdn.org)

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**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](http://kauffman.org)

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**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](http://sreb.org)

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**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](http://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

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
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.

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.

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

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

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