

**Testimony of
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**Before the House Committee on Science, Space and Technology
Subcommittee on Research**

**Hearing on
STEM Education: Industry and Philanthropic Initiatives
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Good morning members of the committee, fellow witnesses and distinguished guests. My name is Vince Bertram, and I am the President and CEO of Project Lead The Way, which is headquartered in Indianapolis, Indiana. I am honored to be here, and I would like to personally thank Congressman Larry Bucshon for his invitation to participate today.

Project Lead The Way (PLTW) is the nation's leading provider of rigorous and innovative STEM (science, technology, engineering and math) education curricular programs used in schools. PLTW has more than 4,700 schools and impacts 500,000 students in all 50 states including the District of Columbia.

As a 501(c)(3) charitable organization, PLTW exists to prepare students for the global economy through its world-class curriculum, high-quality professional development, and an engaged network of educators, students, universities, and professionals.

PLTW launched in 1997 in 12 high schools in upstate New York as a program designed to address the shortage of engineering students at the college level. There is a tremendous skills gap facing the United States. The United States Department of Commerce estimates that the number of STEM jobs will grow 17 percent by 2018 versus 9.8 percent for all other fields. By 2018, the United States will have more than 1.2 million unfilled STEM jobs. According to a March 5 article in EdWeek titled "Why STEM Education Must Start in Early Childhood," there is one applicant for every 1.9 STEM jobs, while there are 3.6 applicants for every one job across all fields. While this may sound like an outstanding opportunity for American students, it will mean nothing if we do not adequately prepare our students to fill these jobs. Employers report that they are unable to find the talent required to fill these STEM-related jobs. America's STEM crisis must be addressed swiftly. If we are to succeed as a nation, we must adequately prepare our students for success in post-secondary education and careers. PLTW's work is centered on building a pipeline of well-educated and well-trained STEM professionals.

Students in PLTW programs create, design, build, discover, collaborate, and solve problems while applying core concepts from math, and other academic areas. The hands-on, project-based engineering and biomedical sciences courses engage students on multiple levels, expose them to areas of study that they typically do not pursue and provide them with the foundation to continue on a proven path to college and career success.

PLTW classrooms are innovation zones where students work together to apply academic content in a real-world context. PLTW appeals to a diverse group of students because it is team oriented, project-based, and does not intimidate students or deter their participation. The curriculum is founded upon fundamental problem-solving and critical-thinking skills taught in both traditional settings and career and technical classrooms. Additionally, PLTW programs have been successfully implemented in a range of school sizes and types, including public, private, charter, parochial, urban, suburban, and rural schools. PLTW programs integrate rigorous academic standards and STEM principles to create a model for 21st century learning.

On a consistent basis, PLTW curriculum is positively impacting students and their ability to succeed in achieving their desired educational and career goals. In addition to academic skills, students learn 21st century learning skills

pertinent to becoming highly qualified professionals. Our students learn how to communicate effectively, work in teams, facilitate discussions, practice professional conduct, think critically, and problem-solve solutions.

Story of Josh, a PLTW graduate from Francis Tuttle Technology Center in Oklahoma City, Oklahoma:

In a recent interview, Josh described his PLTW experience as engineering driven with rigorous math and science emphasis. He talked about how the program helped students develop their presentation and communication skills while solving meaningful problems.

Josh's Engineering Design and Development project was driven by a problem he dealt with at work concerning shoe theft. Through his work at Kohl's Department Store, he collected actual data and enlisted the help of the store manager and security. Josh led a student team that designed an RFID (Radio Frequency Identification) inventory system with the help of professionals in the field and his own intense research. They prototyped the solution and presented their working solution to several other business CEOs.

The summer after his senior year of high school, he completed an internship at Surgery Logistics, creating a connection between the company's vision and communication values to RFID and NFC (Near Field Communication) in the health care environment.

Josh is finishing his freshman year at Oklahoma State University. He has started his own company, RFID Edge, which promotes STEM and education for the secondary education sector on RFID and NFC. He is an Intern at the Riata Center for Entrepreneurship at OSU and is in the Freshman Research Program. Additionally, Josh serves on the Freshman Representative Council for the College of Engineering and is a member of the Entrepreneurship Club.

Josh's current goal is to become a Thiel Fellow and engage in research.

While many STEM programs only focus on the top or bottom 10 percent of students, PLTW aspires to prepare all students in grades 6 through 12 at various learning levels. The PLTW model accommodates a range of implementations and provides flexibility at a local level. PLTW supports the U.S. workforce by exposing students to STEM disciplines and building a pipeline for future professionals.

Over the years, PLTW has experienced steady growth across the nation. PLTW has created a successful, replicable model for program implementations within schools of all types including public, private, magnet, independent, and charter, as well as specialized academies targeting specific groups such as females and underrepresented minorities. This effective model has been replicated on a national scale, and has grown at a rate of more than 26 percent per year in the last four years.

Toppenish High School, Toppenish, Washington:

Toppenish High School is located in rural Washington at the heart of the Yakima Nation. Since becoming principal in 2009, Trevor Greene has transformed the school culture into one that expects success. He expanded academic opportunities for his students, many of whom had never been expected to succeed, let alone graduate high school. Greene added rigorous courses, including 27 PLTW engineering and biomedical science courses, a Microsoft IT Academy course, and a robotics course. Greene is also increasing student interest and success in postsecondary education. He created opportunities for students to earn up to 30 hours of college credit by the time they graduate high school. He has also prioritized parental and community involvement, reaching out to migrant families and the Yakima Nation on the very reservation where he grew up. In 2013, Greene was named the MetLife/NASSP High School Principal of the Year, one of the highest honors given to secondary educators.

Project Lead The Way Programs

PLTW's approach, called activities-, project-, and problem-based (APPB) learning, centers on hands-on, real-world projects that help students understand how the information and skills they are learning in the classroom may be applied in everyday life. PLTW's programs are comprehensive and standards-based, yet flexible and customizable so that schools and school districts can meet their curricular needs. PLTW offers three different programs:

PLTW Gateway To Technology (GTT) is a middle school program offered in six independent, nine-week units and is designed to help students explore math, science, and technology. This activity-oriented program challenges and engages the natural curiosity of middle school students and is taught in conjunction with a rigorous academic curriculum.

PLTW Pathway To Engineering (PTE) is a four-year high school sequence taught in conjunction with traditional math and science courses. PTE's eight courses, including Principals of Engineering and Civil Engineering and Architecture, provide students with in-depth, hands-on knowledge of engineering and technology-based careers.

PLTW Biomedical Sciences Program (BMS) is a four-year sequence of science-based courses that introduce high school students to the human body, cell biology, genetics, disease, and other biomedical topics. The program prepares students for the postsecondary education and training necessary for success in a wide variety of positions, including physician, nurse, pharmaceutical researcher, and technician.

PLTW's curriculum is regularly evaluated and improved by our team of curriculum writers with significant input from industry, post-secondary, and educational leaders. We are currently making noteworthy improvements through the addition a computer science and software engineering course as well as a rigorous, project-based elementary STEM program.

Project Lead The Way Goals

Goal #1: Every student in America will have access to PLTW programs. Currently, PLTW is being implemented in 2,189 school districts across the country, which is a significant step toward providing access to America's students. PLTW aspires to increase student access by setting a goal to be in every school district in America.

Goal #2: PLTW will increase the pipeline of students prepared for the global economy. PLTW currently prepares more than 500,000 students annually to be critical thinkers and problem solvers in high-demand careers.

Hilliard Davidson High School, Hilliard, Ohio:

Beyond access and preparation, we must recruit, encourage, and inspire more students through these studies. Hilliard Davidson High School near Columbus, Ohio is a model for recruiting and inspiring more girls in engineering studies. After three years of teaching PLTW engineering courses, instructor Bill Kuch noticed a problem – out of the 80 students in his four engineering classes, only eight were female. “The girls who were in the classes were incredibly successful and were staying in the program,” Kuch said. “So we started brainstorming and thought, ‘What if we had an all-female Introduction to Engineering Design course?’” Kuch discovered that The Ohio State University (OSU) has a Women in Engineering (WiE) department to mentor the female engineering majors. He partnered with OSU's WiE department to create Hilliard Davidson's own Women in Engineering program, replicating some of OSU's female outreach efforts: inviting female engineers to speak to the class and act as mentors to the students and recruiting girls to engineering before they enter high school.

Hilliard Davidson High School has realized significant improvement in a short period of time. One year after beginning the WiE course sections, their female enrollment increased from eight percent to 26 percent. In the first year, all female engineering students passed the End of Course Assessment. The girls' average score was 91 percent, which was higher than the boys' 86 percent average.

Hilliard Davidson High School's Women in Engineering program has also led to increased female retention in engineering courses as the girls progress through high school. Not only did more girls register for the freshman year course, all but two continued on to the next course the following year. In addition, five girls chose to take an additional engineering course. Forty percent of Hilliard Davidson High School's freshman year engineering students are now females. Programs such as this build a pipeline of talented female engineering students for colleges and universities.

Evaluation

Several independent research studies indicate that PLTW students (both secondary and postsecondary) are outperforming their peers in school, and they are more focused on attending college than non-PLTW students. In general, research studies indicate that PLTW students are more likely to consider careers as scientists, technology experts, engineers, mathematicians, healthcare providers, and researchers compared to their non-PLTW peers. The studies are all unique in terms of design. While some studies are regionally or locally focused within school districts, others examine and track PLTW alumni and their performance in college.

In November 2012, Dr. Robert Tai, Associate Professor at the University of Virginia collected and analyzed more than 30 studies and reports on PLTW. Tai's report states, "Research on PLTW programs across the U.S. offers evidence that PLTW contributes to raising student achievement and motivation in science and engineering, both of which are essential to success in these career fields (<http://goo.gl/0BpUz>)."

PLTW measures student knowledge, skills, and habits of mind through nationally administered End of Course Assessments and project-based assessments. The data collected is utilized to evaluate program effectiveness and to provide direction to PLTW on how to drive continuous improvement by modifying the curriculum or providing additional teacher training. PLTW, in partnership with State Leaders and University Affiliates, also has a national school certification process and training for counselors and administrators designed to drive quality assurance and improvement for program implementation.

While formal, classroom assessments can go a long way in evaluating student performance and aptitude, another critical means of evaluating student performance and program quality is through the experiences students have beyond the classroom walls. Ultimately, we want to prepare students to go on to do meaningful work in the community and marketplace.

Pike Central High School, Petersburg, Indiana:

Pike County is a rural community in south central Indiana. Pike Central High School students were inspired by the natural disasters they saw in the media. They worked together to develop an emergency shelter with solar power and a water filtration system in the Project Lead The Way shop at Pike Central High School. Jessica, Colton, Anna and others in the class won first place for the project at MIT and also presented the shelter to President Obama at the White House Science Fair.

More than 50 percent of Pike Central students are enrolled in PLTW courses, including both Biomedical Sciences and Pathway to Engineering programs. On a recent visit to the class, students presented a range of projects including the award-winning emergency shelter, mobile apps for southwest Indiana businesses, a method for killing E. coli bacteria in water, and a Humvee that was being transformed into a remotely-controlled vehicle.

The Pike County Chamber of Commerce and Economic Growth and Development Council believe in and support PLTW. Paul Lake, the executive director of the Economic Growth and Development Council, stated, "PLTW is important not just to Pike County, but to Indiana and the nation as a whole. The best and brightest are coming up through school, and we need to figure out a way to foster their

entrepreneurialism and innovation in our communities, rather than sending them off to a large city to chase a job.”

Gulliver Preparatory School, Miami, Florida:

Students at Gulliver Preparatory School designed and manufactured a clean energy water filtration system to send to, Haiti in July 2012. After several devastating natural disasters, the country of Haiti remains the poorest country in the Western hemisphere, while holding the highest number of infant mortalities, mainly due to the prevalence of waterborne diseases.

Previously, Gulliver Engineering students designed a water filtration system to send to St. Damien Pediatric Hospital in Haiti. The 2010 earthquake forced the students to redesign and reinforce their design, as well as change its planned destination as the hospital crumbled during the devastatingly powerful tremors. The former water purification system found a new home and currently supports over three hundred children housed by the organization Friends of the Orphans.

The design team this year analyzed the previous device and found that with UV lights, wires, and a necessary electrical outlet to support the purifier, it proved too complex and fragile. As accessibility of clean, potable water remains a major issue in Haiti, the team decided to create a new water purification system, one that did not need an external energy source and could provide water to users who desperately need this vital resource with ease.

A group of engineering seniors conceptualized Operation Gulliver International, an extension of the Gulliver engineering department that would give a home to the students who wanted to make an impact on a global scale, starting with the country of Haiti and their idealized water purification system.

After numerous design modifications and construction improvements, the team arrived at their current design. Contaminated water is taken in by an intake hose connected to a mechanical hand pump, and then pushed through a quad-filtration system connected by PVC pipe. The water is then purified and stored in a fifteen-gallon tank that can be pressurized (via a second mechanically-powered air pump), to be released through three non-contact spigots, or released in large quantities by opening a dunk valve. The whole system is mounted on a hand truck and thus allows individuals to gather dirty water, purify and store it, drink by a non-contact siphoning system and transport this vital resource from home to water source and back again.

The Gulliver team won an award in the Spirit of Innovation Challenge sponsored by the Conrad Foundation. Additionally, Gulliver students Ian, Laura, and their classmates, along with Master Teacher Claude Charron, were presented with the Heart of Haiti award in further recognition of their project and the impact their work was having on the people of Haiti.

Partnerships

PLTW is the leading non-profit provider of innovative, rigorous, and relevant STEM education programs. The exponential growth in programs nationwide derives from the development of engaging and immersive curriculum that impacts the lives of students. PLTW provides the curriculum, but relies on the expertise of individual teachers to make the coursework interactive, engaging, innovative, and challenging for students. From students in the classroom to parents, volunteers, school principals, and educators, PLTW has inspired thousands of Americans to take part in improving our schools and advancing their curricula. More than 12,500 teachers and 10,000 high school counselors have undergone advanced training with PLTW.

Our network includes 450 Core Training Instructors who are among the best and brightest STEM educators in the country. PLTW has cultivated partnerships with more than 200 institutions of higher learning to create additional

opportunities for our students and teachers. PLTW designs curriculum and professional development that make direct connections to the world of engineering and health sciences. However, PLTW programs work best where there are strong community champions that partner with their schools. With a focus on building the STEM pipeline, these partnership teams provide advocacy for the administration, resources and equipment for the classrooms, mentors and role models for students, and local relevance and guidance for the teachers.

PLTW has also developed strategic external partnerships that enhance and enrich its programs and initiatives. Some of those partnerships have included the National Academy Foundation, National Action Council for Minority Engineers, National Association of Manufacturing, Technology Student Association, and Skills USA. PLTW is able to provide the most cutting-edge, comprehensive STEM education programs and cultivate a larger STEM community by creating a collaborative network. PLTW is committed to improving communication across school districts and states. By sharing our creativity, ideas, and knowledge, we create a stronger organization and a more meaningful experience for students, parents, educators, and all those who play a part in making PLTW a success.

PLTW's mission is also advanced by financial partnerships with companies all over the country who have an interest in recruiting a highly skilled and well educated workforce. The following companies have contributed \$250,000 or more to support local schools and PLTW national: 3M, American Electric Power (AEP), American Society of Manufacturing Engineers (ASME), BellSouth, Bemis Company Foundation, Cargill, Chevron, Dart Foundation, Dow Corning Foundation, Ewing Marion Kauffman Foundation, Golden LEAF Foundation, Intel, John S. and James L. Knight Foundation, Kern Family Foundation, Lockheed Martin, Northrup Grumman, Pentair Foundation, Qualcomm, Rockwell Automation, Science Applications International Corporation (SAIC), Society of Manufacturing Engineers Education Foundation, and Sprint Foundation.

Toyota AMT Program, Georgetown, Kentucky; Princeton, Indiana; Buffalo, West Virginia:

One example of a PLTW partnership that has shared value for all involved is the relationship between Toyota, Bluegrass Community and Technical College, the University of Kentucky, the Kentucky Association of Manufacturers, and PLTW. This model is a scalable solution addressing the STEM education and workforce needs of Kentucky. The University of Kentucky trains teachers and supports the 130 PLTW schools in the commonwealth. Toyota actively recruits from these schools so it can access the workforce it needs. PLTW students who are recruited to Toyota enter the Advanced Manufacturing Technician program and start working toward a two-year degree on the Bluegrass Community and Technical College campus, specially designed for more effective technical education. Toyota and the Kentucky Association of Manufacturers have outlined a model that not only works for Kentucky but is being expanded to other states with Toyota operations. By working together, these industry and educational leaders are meeting local and regional needs for education and economic development.

Engagement

PLTW creates excitement about STEM careers by adding relevance to learning. Our curriculum utilizes the same real-world technology used by STEM professionals. PLTW instructors also make intentional connections between students and STEM professionals in their communities. In PLTW capstone courses, students identify the problem they would like to solve, which amplifies their engagement and passion to learn. Students explore exciting STEM careers in each PLTW course, which dispels negative misconceptions about STEM. This exploration often exposes students to fields they never previously considered.

Through their PLTW partnership teams, schools make deep connections to their local STEM community. Some of the ways they do this is by working intimately with their local STEM community to (1) select PLTW courses that align with the local economic needs, (2) provide relevant field trips and speakers for each PLTW course, (3) create service learning or previous industry projects as to replace PLTW projects while covering all learning objectives, and (4) serve as mentors for students – especially on projects where the local community has specific subject matter expertise. PLTW has found that most businesses and STEM professionals take great pride in their local communities and relate well to the concept of “creating home grown talent.” On a larger scale, PLTW has

partnered with companies like Lockheed Martin, with locations in more than 500 U.S. cities, to bring their engineers into classrooms throughout the nation.

It is through our engaged network, world-class curriculum, and high quality professional development that PLTW has become the preeminent STEM solution nationwide. Only through the continued promotion of these ideals can PLTW continue engaging new students and help them meet their full potential. Thank you for providing this opportunity to highlight the great work of PLTW students, educators, and partners. Your attention to this issue is promising. As a nation, we must be open to innovative ideas that erase barriers to success for future generations.

Support for PLTW

PLTW has been approached by partners around the country looking for a leader in the STEM education field. In addition, many prominent leaders have highlighted the impact of PLTW's programs.

- U.S. Secretary of Education Arne Duncan called PLTW a “great model of the new CTE” in comments at Harvard Graduate School of Education’s 2011 “Pathways to Prosperity” conference.
- Former U.S. Secretary of State Hillary Clinton introduced PLTW to her fellow Senators in a 2005 letter in which she described PLTW as a “promising program that is both changing the lives of middle and high school students nationwide and helping to build a workforce that meets the needs of the 21st century.”
- Congressman Paul D. Tonko (D, NY) toured PLTW classrooms in January 2011. Tonko commented on the numerous professional opportunities available to PLTW students and said, “If we’re going to win this global race, we need to enter it with investments in human infrastructure, capital infrastructure, and physical infrastructure, and the way to begin with that is to really introduce it into the learning curve. I wish I had programs like this when I was in high school.”
- PLTW was named a K-12 Best Practice Program in 2010 by Bayer Corporation’s “Making Science Make Sense” initiative, which is part of Bayer’s “Planting the Seeds for a Diverse U.S. STEM Pipeline: A Compendium of Best Practice K-12 STEM Education Programs.”
- The National Academy of Engineering, the National Academy of Sciences, and the Institute of Medicine all recognized PLTW in the 2005 report, “Rising Above the Gathering Storm: Engaging and Employing America for a Brighter Economic Future” as a model for its recommendation of creating “K-12 curriculum materials based on world-class standards.”
- The Harvard Graduate School of Education listed PLTW as a model of 21st century career and technical education in their February 2011 Pathways to Prosperity paper. The paper stated, “In recent years, we’ve witnessed the emergence of a growing number of rigorous, high-quality national models that demonstrate what career and technical education can achieve in the 21st century. Take Project Lead The Way...this approach is clearly engaging students. Some 80 percent of those who complete the program say they will study engineering, technology or computer science in college, and their retention rate in these courses is higher than that of students who did not complete PLTW.”
- Chevron’s partnership with PLTW has led to record expansion in schools in California. Chevron’s Manager of Global Partnerships and Programs, Matt Lonner, said, “Chevron believes that STEM education is at the heart not only of California’s future, but the future of our company. Project Lead The Way has proved very successful in its programs to engage students in science and technology and reinvigorate these critical subjects in the nation’s schools. We’re proud to be partnering with Project Lead the Way to drive innovative solutions and create opportunities to inspire students to pursue careers in STEM fields.”
- Lori Schaefer, Director of Business Development at Agri-Industrial Plastics Company, discussed the role of business in STEM education, “The benefit of business involvement is to become part of the solution. We have a place at the table to impact a real problem. Instead of sitting back and thinking that this is education's problem to solve, we participated.....and as a result the business community was 100% committed to the success of PLTW.”