INVESTING IN INNOVATION (i3)

when teachers learn, **students achieve**

ASSET Regional Professional Development Centers for Advancing STEM Education in Pennsylvania

ASSET STEM Education

ASET
STEM Education

MISSION: ***To advance teaching and learning to engage, inspire and empower all learners.***

VISION: ***ASSET STEM Education™ will continue to systemically improve education by equipping educators with effective tools and strategies to create innovative and relevant learning environments so all students acquire the knowledge and skills needed to work, live, contribute and lead in a global community.***

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"When I started as principal, I was blown away by the level of professional development that our elementary teachers were getting from ASSET. It was really second to none. I was a classroom teacher for 10 years and hadn't been exposed to anything like it. I think that, through inquiry, ASSET has given us a pathway to effectively prepare our students for the 21st century. [It has] given me hope that we're moving in the right direction."

COREY GROFF
East Pennsboro Area School District

Contributors to this report include Ryan Rydzewski and A to Z communications, inc.

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leading innovation

Recently, my grandson told me about an experiment he performed as part of ASSET's "Engineer Your Summer Fun" Day Camp. He and his friends set a broken marker in a coffee filter. Together, they poured water over it and watched as the filter separated the marker's ink into different component colors.

"Interesting," I said. "What do they call that?"

"Chromatography!" he answered with all the confidence and enthusiasm of an 8-year-old learner. He remembered the term because he had experienced chromatography first-hand—the markers and coffee filters gave him a foundation on which to build his understanding. Later, as his camp counselors asked increasingly complex, thought-provoking questions, my grandson applied his concrete experience to an abstract concept.

His experience, in other words, became knowledge.

The process of experiential learning through guided questioning—also known as **inquiry-based learning**—informs much of we do at ASSET STEM Education™ (ASSET), from designing and facilitating high-quality professional development to researching tomorrow's innovative instructional techniques. But ASSET goes beyond mere experiential learning, fostering teachers as targets and agents of change to build student ownership of knowledge. First launched as a pilot program in two Pennsylvania school districts, ASSET has evolved and grown over the course of more than two decades to become what it is today: a national thought leader and solution provider in STEM education.

From 2010 to 2015, ASSET had the privilege of partnering with hundreds of educators across Pennsylvania as part of a national effort to raise student performance and achieve other positive educational outcomes. Thanks to a generous $20.2 million grant through the U.S. Department of Education Investing in Innovation (i3) initiative, ASSET provided five years of rigorous professional development to more than 400 teachers and administrators. To date, ASSET's i3 project has impacted more than 38,000 Pennsylvania students, many of whom attend high-poverty schools in underserved areas.

What follows is the story of ASSET's impact. Through our i3 project, ASSET has helped redefine what STEM education looks like in K-6 classrooms. Today we continue to convene educators, businesses, universities, parents and communities in pursuit of our mission: **advancing teaching and learning by engaging, inspiring and empowering all learners**.

ASSET has seen incredible success among its partner schools, and we look forward to applying our organizational knowledge with new collaborators as together we advance education. This is an exhilarating

time for educators—community leaders are discussing science, technology, engineering and math (STEM) skills and inquiry-based learning in ways we never would have imagined 20 years ago. Schools and districts are forming regional coalitions, tapping into each other's resources, and thinking about learning in new, innovative ways. Blended learning and flipped classrooms are making headway. More learning is taking place online. These are exciting conversations, and ASSET is proud to help lead the discussions and develop customized solutions. As an organization, we have long believed that the best way to make an impact is to do so collectively—by working together, we can give students the tools they need for success in an ever-developing world.

Of course, much work remains to be done. But the excitement in my grandson's voice tells me that we are headed in the right direction.

DR. CYNTHIA PULKOWSKI
Executive Director
ASSET STEM Education

ASSET
STEM Education
INNOVATING FOR THE FUTURE

ASSET's core values:

- ***We value all educators as innovators and agents of change to advance the learning experience.***
- ***We value all learners as engaged and active participants resulting in the pursuit of new opportunities for the future.***
- ***We value collective impact as a catalyst for powerful and sustainable improvement in education.***

setting the stage

There is excitement in the air at John S. Clarke Elementary Center in Pottsville, Pennsylvania. Students in Maria Larish's class have come to the end of their electricity unit, and they are about to demonstrate what they have learned by directing an electrical current through a homemade circuit.

The fourth-graders make a few last-minute adjustments, mapping the current's path from a battery pack at one end to a light bulb at the other. Then Ms. Larish gives the signal, and her students switch on the power. A moment later, the bulb lights up—a glowing testament to the students' success.

"You should've heard the screams," says Larish with a laugh. "It was like they'd won a million dollars."

Rich Boris, Larish's Assistant Principal, had stopped in to cheer on the students. "One of the first things that struck me was their excitement," he says. "Here was a fourth grade classroom, and they'd presented the results of their experiment in small groups, using charts to show exactly what they'd done. It was great to see the kids explain how they proved or disproved their hypotheses, and how they went through that process as a class."

Scenes like this have become common at John S. Clarke Elementary, where both teachers and administrators have completed five years of ASSET's Investing in Innovation project. The initiative focused on creating statewide professional learning communities aimed at boosting student achievement. As one of more than 400 participating teachers, Larish witnessed the initiative's impact first-hand. **"It's the most meaningful professional development we've had in years,"** she says. **"You walk down the hall and you see teachers and students doing things that we learned. Just seeing how excited the kids are about science now motivates us to keep going."**

That motivation will play a critical part in solving one of the most urgent, widespread problems facing American schools: the stagnant performance of today's students, particularly in science and math.

Job markets for those with scientific degrees are growing three times faster than others.[v]

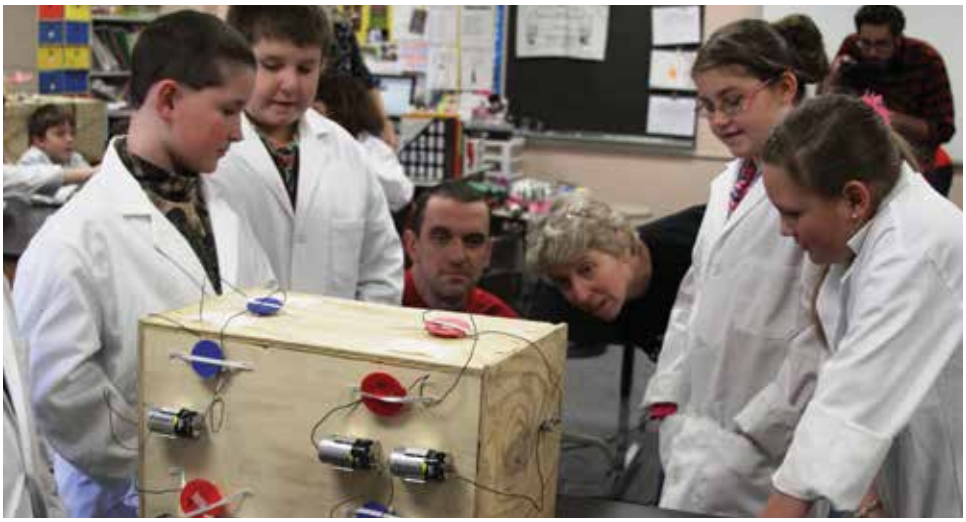
Technological advances and a globalized economy are driving increased demand for STEM knowledge and skills in the workforce—the majority of the 30 fastest-growing occupations in the United States require substantial STEM backgrounds.[i] Sadly, just 44 percent of American high school graduates are prepared for college-level math and only 36 percent are ready for college-level science.[ii] From a global perspective, the United States ranks 27th in math and 20th in science among developed nations.[iii]

The 21st century will require more innovation, more creative problem solving and more scientific know-how than any other in history. A report commissioned by the William and Flora Hewitt Foundation predicts that two-thirds of today's students will be asked to fill positions

that have not been created yet, solving complex issues, such as climate change and widespread food shortages.[iv]

In spite of the growing importance of STEM competencies, many American school districts have deprioritized science. With the well-intentioned advent of accountability standards and state testing has come a heavy emphasis on reading and math, sometimes to the exclusion of science class. Unfortunately, the shift has been counterproductive.

As Timothy Kretchman, Director of Curriculum and Instruction for the Meyersdale Area School District, says, **"If you want a reason to read, you need to teach science. If you want a reason to write, you need to teach science.** It gives the kids something that they can find excitement and motivation in. That excitement, sadly, is gone from so many elementary and middle schools…Science is unfortunately looked at as an extra these days."



Fourth graders demonstrate houses they wired as a culminating experience on electric circuits to Timothy Kretchman, Director of Curriculum and Instruction, Meyersdale Area School District.

Reigniting Science Education

In 1994, the Bayer Corporation—in conjunction with several other businesses, education organizations and community advocates—launched an independent nonprofit called Allegheny Schools Science Education & Technology. Better known as ASSET, the organization aimed to bolster science education in Allegheny County. It began as a pilot program in two Pennsylvania school districts, on a mission to continuously improve teaching and learning by helping schools implement exemplary STEM programs.

By 2001, ASSET had partnered with 34 school districts, designing and facilitating high-quality professional development for elementary science teachers. It was during this time that ASSET changed its acronym to Achieving Student Success Through Excellence in Teaching and honed its organizational focus on **inquiry**—a style of learning in which students develop an understanding of the world through a process of observing and questioning. Educators shed outdated, passive pedagogies; the teacher does less direct teaching and more modeling, guiding and facilitating. The teacher's questions are open-ended and encourage investigation, prompting students to develop hypotheses, test ideas, define appropriate vocabulary and

defend their conclusions. Studies show that the results of this hands-on, student-centered approach include a deepened understanding of scientific content, sharpened problem-solving skills and a palpable love of science—exactly what experts predict the 21st century will require.

***Inquiry-based learning* asks students to formulate ideas and to communicate what they've learned based on the evidence.**

Helping districts get there takes time, dedication and expertise. "We're focused on systemic change," says Dr. Cynthia Pulkowski, ASSET's Executive Director. "We're trying to change a very industrialized, parochial model. If you're looking for change in how student learning is being delivered, then you need to guide educators along that avenue, too." To that end, ASSET's professional development (PD) offerings model inquiry by making teachers active participants in their own learning. "The focus has to be on the learner, not the presenter," Pulkowski says. ASSET's PD asks teachers to navigate lessons the same way their students will: by asking questions, devising and debating hypotheses, and reflecting on changes in their thinking.

This approach has proven immensely popular with educators. In 2001, when a National Science Foundation grant expired, ASSET transitioned to a fee-for-service model with all 34 partner districts continuing their participation as paying members.

***Exemplary STEM programs*, as defined by the Smithsonian Science Education Center, require five key components[vii]:**

- ***Standards-based curriculum materials***
- ***Ongoing, rigorous professional development for teachers***
- ***Centralized materials support***
- ***Effective assessment of students and programs***
- ***Involvement of school administrators and community stakeholders***

Scaling Up Success

In 2006, ASSET, in partnership with the Pennsylvania Department of Education, designed, implemented and managed an initiative called *Science: It's Elementary (SIE)*, an effort to improve student achievement and teacher development in science classrooms from Kindergarten through 6th grade. *SIE* gave underserved schools access to the hands-on curriculum materials and comprehensive PD that ASSET had developed and refined over the previous decade, giving special priority to rural, low-performing, or otherwise high-needs schools.

"ASSET went from a $2 million organization to a $12 million organization almost overnight," Pulkowski says. To scale up its organizational infrastructure, ASSET hired and partnered with experts that both enhanced the organization's programs and helped manage a massive statewide undertaking. Daylong professional development courses became two- or three-day institutes that allowed teachers to deepen their content knowledge and boost their pedagogical confidence.

By 2010, ASSET had impacted 5,000 teachers and more than 140,000 students across 180 Pennsylvanian school districts. Analyses of student achievement among participating schools had shown increases not only in science, but in mathematics and reading as well. Educators reported that science had once again become a priority in their schools and classrooms. President Barack Obama praised *SIE* for supporting inquiry-based learning in Pennsylvania schools; the National Science Resources Center (now the Smithsonian Science Education Center) called ASSET "a model for the nation." Four years and $50 million into *SIE*, the program had become a highly-visible success story in American education.

The project generated an extraordinary amount of momentum—community partners, including social service agencies and parents had joined forces with ASSET

During professional development, teachers are active participants in their own learning.

throughout the course of the initiative, and volunteers were devoting more than 4,000 hours each year to help refurbish ASSET's hands-on materials for classrooms across the state. ASSET's Pulkowski explains that *SIE* had been designed with this kind of sustainability in mind: "It was all about the people on the ground," she says. "Sustainability is not always connected to money—it's connected to the desire, the planning and the capability of the educators we've developed."

As *SIE* came to a close, ASSET began to think about how its success might be enhanced and expanded. The job, after all, was far from finished: despite *SIE*'s impressive scale, only a third of Pennsylvania's school districts had been able to participate; educators who benefited from the statewide initiative, meanwhile, were left wanting more. As a "learning organization"—one marked by continuous transformation and improvement—ASSET wondered how it could build on this experience to take teachers deeper into content, pedagogy and leadership. How might it impact Pennsylvania's students?

Embracing the Opportunity

In 2010, the U.S. Department of Education (DOE) announced an initiative called Investing in Innovation—a grant competition providing nearly $650 million to applicants with records of advancing student achievement. The competition, also known as i3, was launched to combat what President Obama had called "the crisis in all American schools"—namely, the static performance of today's students relative to those in other developed countries. i3 grants would help schools and nonprofits develop, validate and scale up innovative programs that could prepare students for 21st-century challenges.

It was an opportunity for ASSET to build upon *SIE* by expanding and enhancing what had already shown marked success. The ASSET team crafted an application in which they explained their plan for raising student achievement by training a statewide network of high-quality educators versed in content and pedagogy, based in inquiry. Teachers in low-income or rural schools would receive special selection preference

ASSET's i3 project used a two-pronged approach:

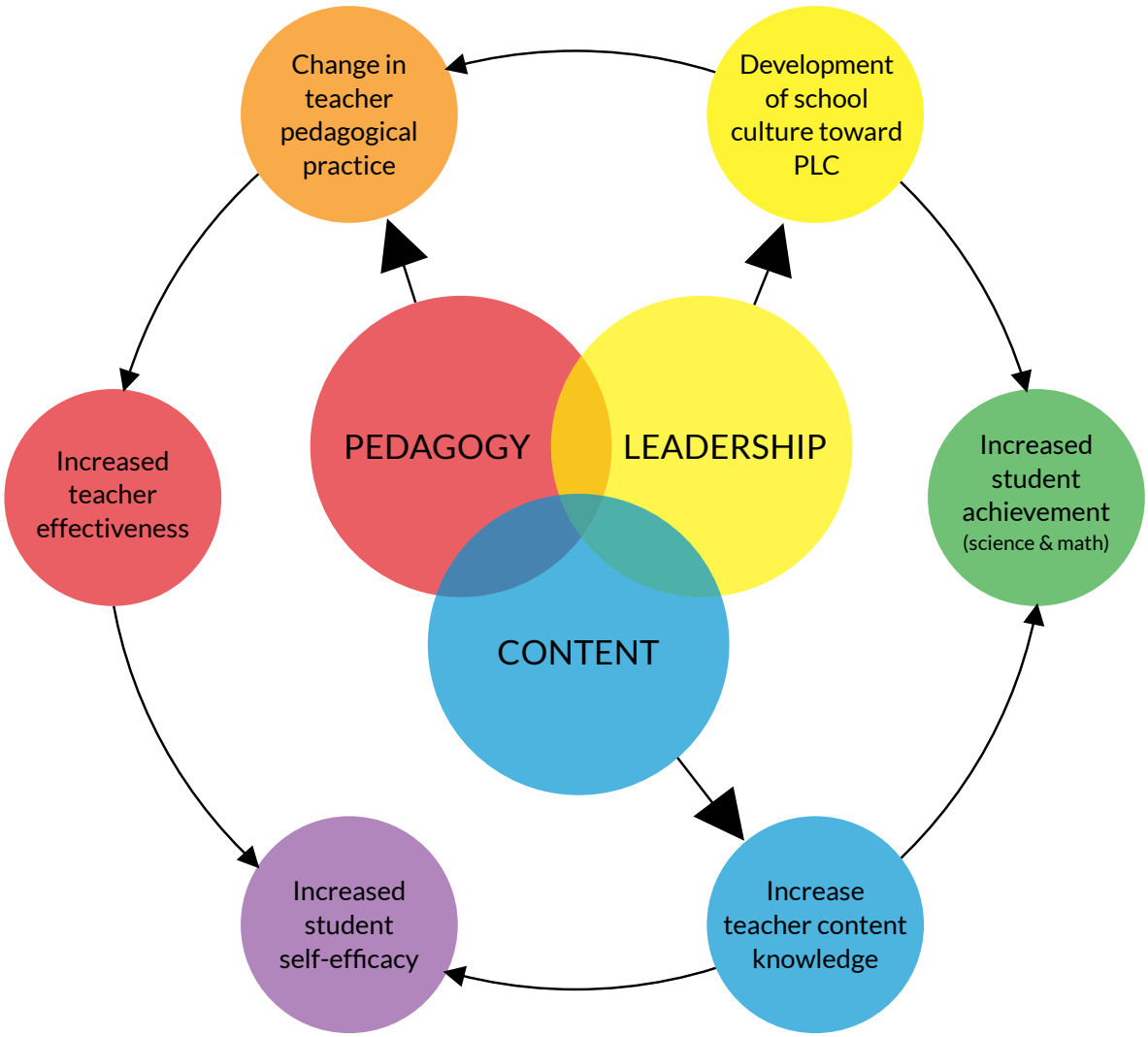
- ***Strategy #1: Establish strategically placed Regional Professional Development Centers and Satellite Sites across Pennsylvania to provide teachers with access to ASSET's comprehensive professional development.***
- ***Strategy #2: Fully subsidize an Advanced Professional Development program that builds on and sustains the* Science: It's Elementary *initiative, targeting teachers in high-needs and rural schools.***

in order to help high-needs schools overcome challenges such as geographic isolation, funding shortages, and difficulty attracting and retaining scientifically trained teachers.

More than 1,700 organizations applied for i3 grants in the program's first year. ASSET's application was among the most highly rated, and in 2010 the organization became one of just 49 that qualified for funding. In order to secure the grant, each eligible organization was required to raise a 20% match within five weeks of the DOE's announcement. "The outpouring of support from our community was just tremendous—it was incredibly humbling," says Pulkowski. ASSET raised $5.7 million in matching funds, largely consisting of in-kind gifts and contributed labor to be applied in full toward the i3 grant *(see back cover for a full list of supporters)*.

In all, ASSET was awarded $20.2 million. In 2010, the organization officially launched its i3 initiative, called ***ASSET Regional Professional Development Centers for Advancing STEM Education in Pennsylvania***.

ASSET STEM Education i3 Model



This diagram shows how ASSET's three-pronged approach to STEM education contributes to desirable learning outcomes and advances student achievement.

Link to complete logic model: **http://assetinc.org/publications/367**

fostering collaborative school cultures

Preparing today's students for tomorrow's challenges requires a radical rethinking of classroom pedagogy. Educators encourage learners to engage with content in new and unfamiliar ways. Long-held assumptions are challenged, instructional techniques are explored, and classrooms become communities where teachers and students experiment, explore and learn together. Navigating these cultural, philosophical and pedagogical shifts requires exceptional collaboration among a school's teachers and administrators. Over the five-year course of its i3 initiative, ASSET has become a nationally recognized leader in fostering such supportive, cooperative school environments.

A key aspect of the organization's i3 programming focused on the development of Professional Learning Communities (PLCs)—collaborative structures that have gained near-universal support from the education community. A 2011 report commissioned by WestEd, an education research consortium, notes that PLCs "create a culture of success in schools [that leads] to teaching improvements and student learning gains." PLCs also promote cross-disciplinary and cross-grade level collaboration, contributing to the school-wide changes necessary for transforming a student's learning environment.[viii]

A Professional Learning Community (PLC) is typically defined as a group of three or more teachers who engage in content-specific professional development over an extended period of time.

ASSET's i3 project helped schools and districts create spaces where this transformation could occur. "If you want to do that," Pulkowski explains, "then you have to work on the environment for teachers and administrators at the same time. Teachers might want to try all these wonderful strategies in their classrooms, but if their administrators don't give them the latitude to test things out, or if a principal walks in expecting to see students seated in quiet rows instead of being up and moving and talking, then teachers aren't going to experiment. It would affect their environment in a negative way." ASSET's Leadership Academies—three-day conferences that focused on different aspects of effective PLCs—brought teachers and administrators together in order to help school teams develop shared visions of student success.

Scaling the Learning Curve

For many, the process was initially jarring. "Thinking back to PLC implementation, it wasn't easy," says Corey Groff of East Pennsboro Area School District. For years, grade-level meetings at Groff's school had focused on field trips and scheduling rather than on data and student learning. "The most difficult part [of PLC meetings] was making sure that I continued to support my teachers by letting them know if they were moving in the right direction or if they needed to change course a little bit and get back on track."

As teachers and administrators developed a culture of shared leadership, however, their environment started to change.

"We'd gotten this great professional development on PLCs," says Groff. "So I said, 'Let's do them right. Let's implement this with fidelity and see where it takes us.' I worked with the grade-level leaders a lot to say, 'Can we pull it back in? Can we focus on this?' And I have to tell you, collaboration is probably one of our school's greatest strengths now. **The PLC process is very explicit—it's very focused on student achievement and teaching practices, and it's just great to see that.**"

Groff's story illustrates how an ASSET partner school gradually created a culture that allowed both teachers and students to thrive. "We're hearing from teachers now about the changes they've seen," says ASSET's Pulkowski. "It's been tremendous. They're extremely excited about their work, and a lot of that is due to their administrators encouraging them to collaborate and innovate. They're having whole-school conversations; they're looking at student data. Their whole environment has changed."

PLCs strive to answer four critical questions[ix]:

1. ***What do we want our students to learn?***
2. ***How will we know whether each student has learned?***
3. ***How will we respond when some students do not learn?***
4. ***How can we extend and enrich learning for students who have demonstrated success?***

Students from an i3 recipient school justify their learning to Mrs. Kimberly Berkley. Mrs. Berkley believes all learning begins with good questions.

Empowering Teachers

Erin Minick, a 1st grade teacher at West Creek Hills Elementary School in Camp Hill, explains how ASSET's programming has changed her school: "I feel more empowered. Yes, I teach, but I have a voice and a professional opinion that needs to be heard and shared with other colleagues. I think the PLC has been a great avenue to do that." ASSET's Leadership Academies also helped her school team form closer, more supportive relationships, she says. "After going through those three years of the Leadership Academy, it's allowed me to really look at my colleagues in a different light. You know, when you go through the training together, and you realize how different you are from someone you've worked beside for 10 years, you start to think about ways you can adjust for that. My friend and I always joke about it. I'm very time-oriented, whereas she has no concept of time at all, and she's okay with that. And so we try to find a balance in our meetings and our PLCs because she knows that's me and I know that's her. We know each other well enough to make it work."

When teachers understand each other, they're more comfortable collaborating and innovating. "Having the opportunity to be so collaborative with my colleagues has

set the professional tone that I can experiment with something in my classroom," says Leesa DeMartyn, another 1st grade teacher at West Creek Hills. "I can go to my colleagues and say, 'I've tried this.' And because of that professional culture, we can look reflectively at what I've tried and how it might help other teachers. We can look at what I've done—and I can get [my colleagues'] professional input. It's made a big difference."

Fostering Transformative Teamwork

As learning environments improved among ASSET's partner schools, PLCs continued to evolve—often in ways that educators never expected. "I'm bragging about this one," says Dina Davis, Principal of MaST Community Charter in Philadelphia. MaST Community's PLC, which initially consisted of teachers in grades three through six, eventually expanded to include Davis's entire team as more and more teachers got involved. "So I created this kind of rotating schedule," she says. "Some of [the teachers' meeting time] was time I allotted, but some was their own—meaning teachers had to be willing to stay after school. It wasn't something that I ordered or mandated. But now even our art and music and computer teachers participate. It's like this master schedule of collaboration."

Other schools report similar enthusiasm, particularly among teachers who feel less like isolated actors and more like part of a team. "It used to be 'my' students," says Tricia Murin, a teacher at Jackson Elementary School in Johnstown. "I'd have 25 students and they were 'my' students. And now they're not 'my' students—they're 'our' students. K to 5, all 238 of them—they're our students, and we all want them to be successful."

In countries that outrank the United States in science and math, structured collaboration between teachers and administrators is a given.[viii]

Some schools are experimenting with new styles of leadership altogether. "We've turned over some of the meetings to the teachers themselves," says Brad Evans, a 2nd grade teacher at Francis H. Sheckler Elementary in Catasauqua. "It's a huge change from the past, when [meetings were] always administrator-led. That's kind of given us some ownership over what we're going to talk about. We report back to everybody so they know what we've done, but it's kind of neat to give people the ability to lead and see what happens. I mean, we've created such momentum. [That] would probably be the biggest improvement I've seen in our school district—our teachers work better together, because they realize they're in the trenches with one another."

Sharing Leadership

The systems of shared leadership developed among educators during ASSET's Leadership Academies have also helped school teams weather the challenges of principal turnover. "We've had three different administrators in the five years of the grant," says Erin Minick. But because of the stability that PLCs provide, Minick's school team has been able to maintain its momentum and enthusiasm through

Over the course of the i3 project, ASSET found that the top-performing PLCs shared characteristics that aligned with the five conditions of collective impact:

1. ***A common agenda.*** ***Teachers and administrators had a shared vision of success, a common understanding of the problem, and a joint approach to solutions.***
2. ***Common strategies for measuring and reporting success.***
3. ***Mutually reinforcing activities. Educators worked together to coordinate delivery of differentiated activities according to an established plan of action.***
4. ***Continuous communication. School teams engaged in frequent and structured open communication in order to build trust and motivation.***
5. ***A backbone of support. Each member played a role in guiding the team's vision, devising its strategies, and supporting its chosen activities.***[x]

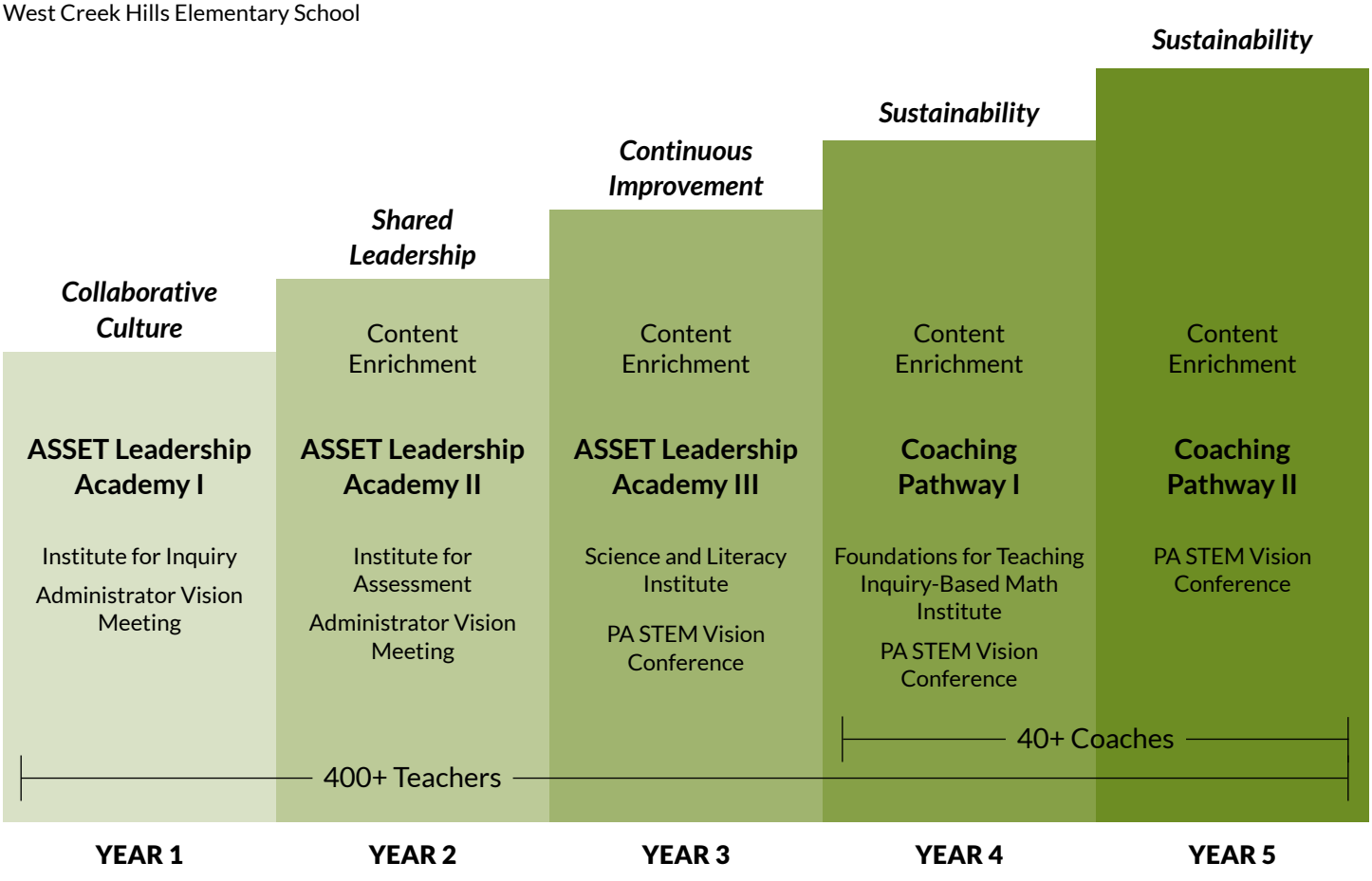
"Having a professional learning community has created a culture of collaboration. We look at student data and really roll up our sleeves and work as colleagues together and say, 'What are we going to do to help all of these students move and achieve?' You no longer feel like you're standing on an island."

LEESA DeMARTYN
1st grade teacher,
West Creek Hills Elementary School

times of uncertainty. "When [new principals] come in and hear about the great work that we've done with ASSET in our professional development," says Minick, "they're receptive…they're eager to hear and listen to what we've learned and what we're doing in our schools. They're very open to having conversations about what's happening and our professional growth and the student learning that's occurring as a result."

Educators are even taking this on themselves, working to sustain—and in some cases, expand—the progress they've seen in their schools. Jennifer Mesoras, Principal of Cambria Elementary School explains how she sold her district's middle school on the idea of PLCs. **"They know that the PLC is a huge thing in our building, in the elementary school,"** she says. **"Our scores since we've been involved in [ASSET's i3 initiative] have been amazing—they just keep going up, and I know it's because of what we're learning.** Our middle school started having PLCs now, and it's incredible to be able to share that with them."

The ASSET Leadership & Professional Development Pathway



ASSET's five-year i3 program fostered continuous educator growth through Leadership Academies, Content Enrichment and advanced professional development.

- *Teachers participated in **26 days** PD over 5 years*
- *Coaches participated in **36 days** PD over 5 years*
- *Administrators participated in **up to 16 days** PD over 5 years*

developing expert educators

While ASSET's partner schools gradually improved their instructional environments through collaborative PLCs, educators were also immersed in another kind of learning: comprehensive professional development. Over the course of the i3 initiative, more than 400 teachers and administrators attended ASSET's institutes and content enrichment sessions—multi-day courses aimed at ramping up educators' knowledge and pedagogical skills.

"ASSET has always believed in ongoing professional development," Cynthia Pulkowski says. "We're all lifelong learners, and we're in this together. ASSET's job is to help educators emphasize the science and math inherent in all academic subjects, because the basic fact is that the world works that way—it works according to models and systems." Understanding those systems, Pulkowski says, requires STEM skills as a matter of course. "There's math in music; there's engineering in art," she says. "Once you grasp STEM principles, you can deconstruct and reconstruct how a piece of music functions or how a work of art exists. You can innovate; you can problem solve. You can create. "

Developing students' creative problem-solving skills requires a somewhat counterintuitive approach. As educator Diane Ravitch notes in her 2010 book, *The Death and Life of the Great American School System*, problem-solving strategies alone aren't enough—students also need a strong well of content knowledge from which to draw.[xi] To that end, ASSET's institutes focused on strengthening teachers' pedagogical skills, while content enrichment sessions deepened their scientific knowledge.

Digging Deeper

In the summer of 2011, educators convened for **ASSET's Institute for Inquiry**, the first of four institutes focused on enhancing teachers' pedagogy. After an introduction to inquiry and its key concepts, ASSET's facilitators engaged the teachers to build their understanding of what inquiry-based instruction looks like in the classroom. Teachers learned to facilitate student learning through lessons centered on skills like observing, questioning, investigating and hypothesizing, using language like "I notice" and "I wonder" to spark students' curiosity. Sessions emphasized the importance of open-ended questioning as the key to deeper thinking.

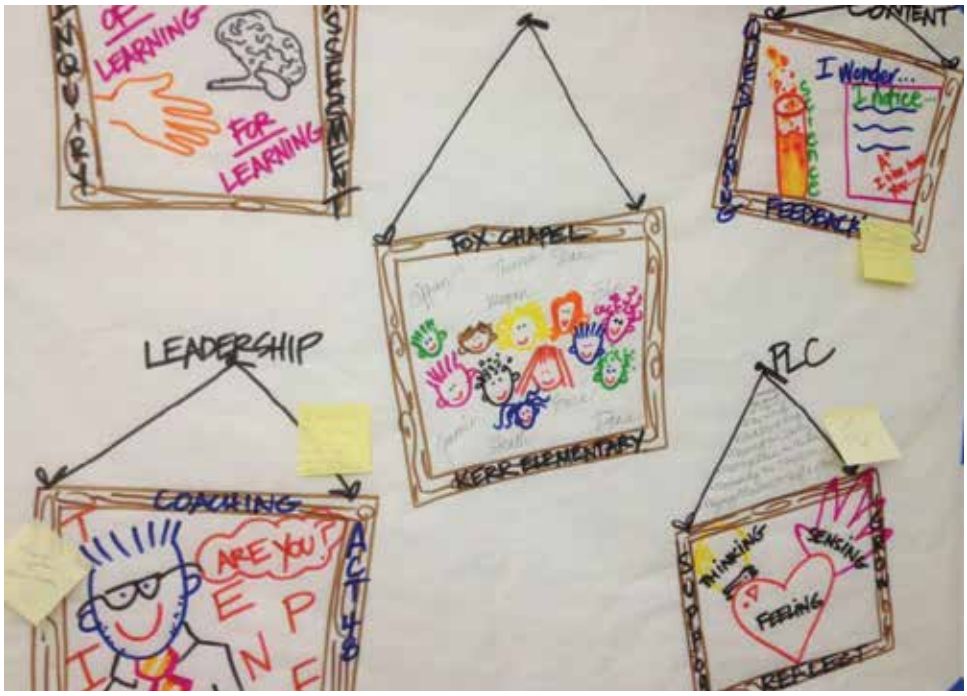
For many educators, the sessions were revelatory. "Honestly, before I can't say I ever really thought about inquiry in the first-grade classroom," says Erin Minick of West Creek Hills. "I couldn't fathom first-graders doing this. But after going through the professional development and trying some of the inquiry strategies with my students, I'm amazed. Yes, they can do this; yes, they want to learn more. **When you give them the tools to learn and ask questions and explore, that's when you see the real learning start to happen.**"

Knowing What Learners Know

The momentum continued to build over the course of several Institutes. **ASSET's Institute for Assessment** introduced teachers to the concept of formative assessment (ongoing measurement of learning throughout a lesson). When implemented effectively, this type of assessment helps students develop metacognitive skills, which allow them to become self-regulated thinkers and learners—recognizing when they understand a concept and independently taking action when they need help or clarification.

"For five years, we've all been instructed in the same content, which allows us to have common discussions with each other. We've been on the same page, and we've seen tremendous improvement in our PSSA scores. One common denominator is that we've all been involved with ASSET for eight years—five years with the i3 initiative and three years with **Science: It's Elementary.** *All fingers point to our experience with ASSET and its programs and workshops as the reason for our success. We've been able to obtain the knowledge needed to lead our children to success."*

BRAD EVANS
2nd grade teacher,
Francis H. Sheckler Elementary School



Educators from i3 schools illustrate how collaborative culture has benefited their teaching.

Recent research shows that formative assessment can have a significant impact on student achievement.[xii] Rather than gauging what students have learned via a single end-of-unit test, educators can use observations, conversations and other forms of assessment to both inform their instruction and decide on appropriate next steps. "I notice myself checking in a lot more with my kids on a daily basis," says Erin Minick of the Institute for Assessment. "I ask, 'How do you think you did on math today? I want you to think about it and give Mrs. Minick a reading.'" Students in Minick's classroom raise green, yellow or red flags to indicate how well they understand a concept. "I tell them, 'It's okay if you're red—that just tells me that you need a little more help.'"

Connecting Science and Literacy

ASSET's Science and Literacy Institute led educators through research-based best practices that built connections between science and literacy. Educators learned how to integrate resources such as non-fictional text into their instruction, empowering students to read about science concepts and then interpret and discuss what they read to develop understanding. The teachers also were shown ways that students could apply this acquired knowledge through concrete experiences (e.g., experiments) to test the accuracy of their conclusions. As a final step, the educators discovered strategies to help students connect their experiential findings back to the text to support or refute their initial assumptions. Teachers were equipped to ask driving questions such as, *how did your final results align or misalign with your earlier conclusions from the text?*; *what cues from the text prompted you to reach those conclusions?* and *how did experiential learning change or reinforce your initial understanding?*

This process was based in leading research on how students learn. Through successful implementation, it can address all literacy components, including reading, writing, speaking and listening.

Developing Math Proficiencies

ASSET's Math Institute focused on facilitating math lessons that moved students from concrete, first-hand experiences (with manipulatives, for example) to representational understanding (using charts, tables and graphs) to abstract reasoning (the use of formulas and algorithms). As in science, students learn mathematics best through open-ended questioning, meta-cognition and supportive instruction informed by ongoing assessment.

"Historically, we haven't let students struggle," Pulkowski says. "A lot of times, we give them a set of concrete steps to follow that don't require much thinking. Instead, we need to say, 'You know what? We're going to uncover the content together.' Students need to have that struggle. Not to the point of frustration—a good instructor knows when to give students more information and help them over a hurdle—but we need to build that persistence."

"It really made me think about the simple questions we sometimes ask children—the kind that ask for a one-word response or can only have one right answer," says Erin Minick. "After going to the Math Institute and using more open-ended questions with multiple possible answers, [I realized] it's okay for students to share their ideas with each other and to discuss how they came to their conclusions."

The cross-curricular applicability of ASSET's Institutes led to increased student achievement across the board, says Timothy Kretchman. "We've seen nice improvements in writing, math and reading. It's a moving target with all the changes in state testing, but we're leaning on [ASSET's PD] to help us through those transitions." [New learning standards] expect students to apply what they're learning, and that's exactly what you do in science. You apply your ability to read. You apply your ability to do mathematics."

Enriching Content

In addition to the summer Institutes, educators also attended content enrichment sessions that focused on particular domains: the Nature of Science; Life Science; Engineering and Technology; and Physical Science. Rather than simply providing tools for delivering content, these sessions were designed to give educators themselves a deeper understanding of scientific concepts—that way, teachers felt more prepared to discuss complex ideas with students.

ASSET's content enrichment courses targeted advanced scientific content. The Life Science course, for example, guided educators through explorations of multi-faceted concepts, such as biotic (living) versus abiotic (non-living). The Engineering and Technology course gave participants an opportunity to apply the Engineering Design Process through hands-on activities using science and math content. The Physical Science course examined the big ideas of energy, force and motion as teachers built their own Rube Goldberg machines. Finally, in the Nature of Science course, educators dug into philosophical questions of science, examining sound methods of interpreting and applying scientific data.

According to Leesa DeMartyn of West Creek Hills, "We went to ASSET's professional development sessions to build our repertoire—our pedagogy, our delivery, and our understanding."

"[ASSET's] i3 initiative is hands-down the best professional development I've ever had as an educator. It's just so positive. You take so much with you. It's not like you go to a workshop for a day and then never think about it again—it sticks with you. It's become a way of life for us. The strategies, the content, everything we've taken back with us—it's just been amazing. Amazing. I would do it all over again in a heartbeat."

JENNIFER MESORAS
Principal,
Cambria Elementary School

cultivating coaches, sustaining change

"How do we sustain all this great professional development that we've been offered?" asks East Pennsboro Area School District's Corey Groff. "I don't want to see that go by the wayside. I want to see us continue to utilize these things that we've learned about."

In order to support schools beyond i3's five-year scope, ASSET asked each partner to select one or two teachers to complete an instructional coaching pathway—a series of sessions designed to create lasting change agents in each participating school. In all, more than 40 coaches-in-training focused on the science and math practices they'd been taught throughout the initiative, learning how to effectively observe classrooms, to give meaningful feedback, and to facilitate ongoing PD for their colleagues.

In order to support the ongoing work of instructional coaches, ASSET developed a statewide professional learning community focused on helping coaches institutionalize best practices at their schools.

Both teachers and administrators have expressed enthusiasm for in-house instructional coaching. "From what I've seen so far from our coaches, they've been doing a great job sustaining instructional strategies," says Groff. "They're consistently doing lunch-and-learns, peer observations, things like that. We have a great menu of instructional strategies that we've learned through ASSET, and [the coaches] keep them fresh in teachers' minds."

Erin Minick of West Creek Hills credits the coaching pathway with allowing her to help maintain stability at her school during tough transitions. "I give it all to the instructional coaching role that I've taken on," she says. "It's up to the instructional coach to sit down with new principals and catch them up on five years' worth of a grant. I explain where we are and why [ASSET's PD] is important to sustain. That's helped a lot in making sure that teachers' voices are heard."

Instructional coaches have also helped schools maintain their focus on inquiry through periods of teacher turnover. "We have a lot of new science teachers coming in, and we all know that inquiry-based instruction can be difficult when you're starting out," says Anthony Teti, a coach at Propel Montour in Pittsburgh. "[The coaching pathway] has given us that framework for support in order to ease some of their frustration. [The other coach and I] want to keep that ball rolling. We've seen the benefits. We've seen the support from other teachers, because we feel we're meeting a lot of their needs with this whole program and process."

Delivering Focused Feedback

Instructional coaches provide an unparalleled level of school-specific support, delivering feedback and PD that's sensitive to a team's unique context and needs. Cheryl Burt of East Pennsboro Elementary School recalls the moment she realized her coaching role's potential: "When I first volunteered, I wasn't sure exactly what the coaching job was going to be," she says. "I think many of us came to the first conference and thought that they were going to hand us a job description. Sometimes it was a little bit frustrating and confusing—we'd say to each other, 'Is this really what they want us to do?' And then through the activities and the discussions they'd planned and the articles they had us read, I realized that they were leading us down the same path we'd taken our students down—a path of inquiry. It was a real 'ah-ha!' moment. I came to see how meaningful the coaching role could be—instead of running through a checklist, I could solve problems unique to my school. It made the role so much more meaningful."

supporting education improvement

"It was seamless for me. As I looked at my long-term goals, they really matched some of the things that ASSET was trying to incorporate into their trainings and their workshops. I think our visions were similar. I was skeptical at first, but I definitely bought into it, and I think my staff did, too," says Jeff DeJulia, principal at Musser Elementary School.

Making Materials Work

Good teachers need good classroom materials. In order to help educators improve their STEM instruction, ASSET's i3 programming included the Curriculum Alignment Planning Service (CAPS)—a guided process aimed at correcting misalignments between a teacher's materials and a school district's learning goals. "School districts write curricula based on a chosen set of standards—whether national, local or some mix of the two," explains Pulkowski. "But what often happens is that a teacher's materials aren't designed to meet the district's curricula." CAPS worked to fix this problem by helping districts identify gaps and deploy inquiry-based materials that were properly aligned to curricula.

"We're really excited about how our curriculum has come along. It just flows so nicely now," says Kimberly Berkley, a fourth grade teacher at Meyersdale Area Elementary School. This "flow"—the gradual, grade-by-grade building of students' conceptual understanding—ensures that learners have the background knowledge necessary for digging deeply into the content. "It starts in kindergarten and comes up all the way through [the other grade levels]," says Berkley. "In second grade, for example, they learn about soil. By the time they get to me and I teach the Land and Water module, they have a really deep understanding of the different components of soil."

And because CAPS helps districts align materials to curricula at every level of learning and in every academic domain, ASSET's partner schools report increased student achievement across multiple subjects. "Many of [my students] started without having much of any literacy in their home environment, but [now] they've surpassed expectations of their reading level," says Cheryl Burt, a teacher at East Pennsboro Elementary School. "And I think it has a lot to do with problem-solving and inquiry—not just in science, but in language arts and math as well."

Creating a Culture of Support

ASSET invited principals and administrators to attend professional development sessions alongside their teachers. Because inquiry-based learning often looks vastly different than what educators are used to, "It helped to have the principals there, so they'd understand the inquiry and pedagogy, too," says Pulkowski. This inclusive approach helped school teams normalize expectations around student learning outcomes, behavior and assessment. It also taught principals and administrators what to look for during classroom observations, thus sharpening their skills as instructional leaders.

"I have certain look-fors when I go into classrooms now," says Corey Groff of East Pennsboro Area School District. "I love going in and seeing [teachers] bring back all these things that they learned in their professional development. When I started as principal and I'd go in and do an observation, I'd kind of ask myself, 'Well, what am I looking for?' I think [ASSET] has helped me to focus on the assessment pieces, the inquiry pieces, and the student-centered approach to teaching. And it's impacted our practice because teachers know that I'm looking for those things, too."

Jennifer Mesoras was a teacher at Cambria Elementary School before becoming its principal halfway through i3. She credits ASSET's PD with changing her view of education. "It was such a great turning point to see [my former principal] so open to saying, 'You know? Try this. Go for it. Be loud. Make a mess. Who cares? The kids are learning.' As a teacher, that made me so much more relaxed…I hope I can keep that going as an administrator, because that was a great thing."

Participating teachers report that ASSET's inclusive professional development also increased their administrators' buy-in, which in turn increased the priority that schools placed on teacher development. "Our administrators have been very supportive of ASSET," says Leesa DeMartyn of West Creek Hills. "They've always made sure that we were able to attend all the PD that was offered to us through the i3 grant…I know that they definitely feel strongly that it was important for us, and that it was important for student learning as well."

Teachers engaged in hands-on professional development enjoy learning — just like their students.

validating a path to future success

From 2010 to 2015, ASSET's i3 initiative brought hands-on, inquiry-based STEM education to more than 38,000 Pennsylvania students. Participating educators at all levels continue to laud ASSET's programming, having seen their schools make significant strides in the areas of teacher practice, positive culture and student achievement. Participants report increased teacher effectiveness via better instruction technique, increased teacher content knowledge, a pipeline of teachers and coaches able to deliver ASSET's PD, the development of strategic PLCs, and increased administrator buy-in. Teachers now feel empowered as professionals and instructional leaders, and they continue to drive positive, sustainable change at their schools.

ASSET, too, is delighted with the i3 initiative's results. "Seeing so much student success has been thrilling," Pulkowski says. "As an organization, we couldn't be more exited. We have a wealth of experience—more than 20 years. I think we're in a great position now to start taking that experience to the next level and imparting what we know to policymakers and decision-makers."

With an increasing number of school districts around the country looking to organizations like ASSET for leadership and expertise, the future looks brighter than ever for STEM education. "The potential for positive impact is huge," Pulkowski says. "People realize that we need to focus on STEM and 21st-century skills. We need collaborators. We need problem-solvers. We need innovators. And I think we're going to get there. Working collectively will yield greater positive impacts." ■

"Our science PSSA scores are through the roof. More than 90 percent of our kids are proficient or advanced in science, and I think it absolutely has to do with ASSET and the professional development that we got for science education. The inquiry-based practices really get kids to think about what they're doing and learning. They reflect on their learning, too. Inquiry makes it stick, and that's what we really want. I think inquiry-based learning is here to stay."

COREY GROFF
East Pennsboro Area School District

"The kids take a lot more ownership of what they're doing [and] learning: 'This is how I see it, and I want you to see how I see it.' They can answer things. They can draw pictures and label them. And they can come up with meaningful reasons."

KRISTYN BLUM
1st grade teacher, John S. Clarke Elementary

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"Our i3 coaching meetings have taught me how to listen, encourage, and model for my peers. I feel efficacious about my coaching when I provide support and encouragement to my colleagues as we persevere in our efforts to have a positive impact on student achievement. My goals as a coach are to continue to inspire other teachers, to take on leadership roles, and to create a better culture for our school."

JEANNE HERRES
4th, 5th, and 6th grade science teacher,
Blossburg Elementary School

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Catasauqua Middle School

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Farrell Area Elementary School

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West Forest Elementary School
East Forest Elementary School

Fox Chapel Area School District
Kerr Elementary School

MaST Community Charter School
MaST Community Charter School

Meyersdale Area School District
Meyersdale Area Elementary School

Mountain View School District
Mountain View Elementary School

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