Consider the issues Americans face today: national and personal debt, global warming, homeland security, stem cell research … even instructions from a physician, or decisions about which phone plan is least costly. Whatever the topic or circumstance, intelligent decisions—at home, at work, and in the voting booth—are best made from a foundation of basic scientific and mathematical competence.
About the Foundation

The Claude Worthington Benedum Foundation is an independent foundation established in 1944 by Michael and Sarah Benedum, natives respectively of Bridgeport and Blacksville, West Virginia. The Foundation’s policy is to allocate no less than five percent of the market value of its assets each year in support of its charitable activities, including the grants program. The Foundation’s assets at year-end 2006 totaled $425,575,685. Since its inception in 1944, the Foundation has made over 6,900 grants totaling almost $316,000,000.
2007 marked the 50th anniversary of *Sputnik*. Those of us over a certain age can well remember the shock that all Americans felt at losing the first leg of the Space Race—the race to launch a satellite—to the Soviet Union. The recognition that the U.S. might have squandered the lead in space technology, with ominous implications in the dark days of the Cold War, spurred the country into action. President Kennedy's call for the U.S. to land a man on the moon within ten years and the focused national commitment that resulted in achievement of that goal are well known. Less well remembered are the efforts to upgrade math and science education. At least for a time, there also was a dedicated commitment to assure the nation's competitive future, through strengthening our schools and colleges in order to produce more scientists and engineers.

Whether those efforts were fully effective is debatable. What is not in doubt 50 years later is the fact that the quality of American education in science, technology, engineering, and mathematics is again being questioned. While nothing as dramatic as the launch of *Sputnik* has occurred, several reports (most notably the National Academies' *Rising Above the Gathering Storm*), prominent publications (such as Tom Friedman's *The World is Flat*), and comparatively mediocre results on international math and science tests all make it clear that America's position in the global economy is threatened by the failure of our education system to produce enough expert, technologically creative talent. Other countries are fielding workforces that not only cost less, but in some cases innovate more, and the trend is accelerating.

Many voices are calling for a major effort in what has come to be called “STEM” education—Science, Technology, Engineering, and Mathematics—to address the looming competitive issue. Even if there were no such challenge, it makes great sense to improve education in these areas, especially because research in pedagogy demonstrates that successful learning takes place when students can design and create. STEM programs take advantage of that fact, using engineering—building things and solving problems—and technology to enhance the teaching of science and mathematics.

The Benedum Foundation's service region faces daunting economic challenges, which make it absolutely essential that the workforce in our region be as capable as possible. We believe that the STEM approach is critically important to the development of citizens who can produce the excellence and innovation that our economy requires. That is why the Benedum Foundation supports a variety of STEM education programs. The story that follows includes profiles of three of those programs, selected because they represent how education can draw on assets that are sometimes overlooked to provide more effective instruction, and because they are emblematic of what we believe is the best in STEM education.

William P. Getty, President
When I compare our high schools to what I see when I’m traveling abroad, I am terrified for our workforce of tomorrow.”

Bill Gates, Chairman, Microsoft Corporation

In 2005, for the first time ever, the U.S. patent office granted more than half of all patents (51%) to foreign nationals or foreign companies.

In 2005, U.S. 8th-grade students scored 12th in the International Math and Science Study—behind countries including Singapore, Japan, Taiwan, South Korea, and Hong Kong.

68% of parents and 64% of elementary school teachers in the U.S. don’t consider themselves to be scientifically literate.
For years, individuals and organizations talked about how America’s place in the global economy might be declining—but in 2007 a powerful report kicked the conversation into overdrive.

*Rising Above the Gathering Storm* is a nonpartisan publication produced under the aegis of the National Academies of Sciences and Engineering and the Institute of Medicine. Its conclusions were drawn by a respected panel from fields including industry, academia, government, and more.

Its basic message: America is simply not doing enough to prepare our future workforce for jobs in the global marketplace.

*Gathering Storm* makes clear that the issue isn’t abstract and theoretical: it’s real and immediate. Facts from *Gathering Storm* and similar reports can be seen throughout this publication, but consider some basic—and alarming—issues:

- America’s students are competing poorly with their counterparts in other countries. Science and math achievement, the wellspring of innovation and economic progress, is on a long downhill trajectory.

- American jobs are migrating offshore—a trend that is expected to continue because labor is cheaper and workers are more accomplished in other countries.

- The pace of innovation is slowing in America and accelerating elsewhere.
THINKING THEIR WAY THROUGH THE DAY

In a world where workers increasingly need to think their way through the day, America is losing ground. Gathering Storm says baldly, “We are worried about the future prosperity of the United States.”

Beyond the potential for a declining standard of living, there’s another crucial issue: weakness in basic math and science can fuel a decline in thoughtful citizenship. Learning for the Future, a Committee for Economic Development report issued not long before Gathering Storm, says, “The increasing complexity of daily life also requires a citizenry that is scientifically literate.”

Consider the issues Americans face today: national and personal debt … global warming … homeland security … stem cell research … even instructions from a physician, or decisions about which phone plan is least costly. Whatever the topic or circumstance, intelligent decisions — at home, at work, and in the voting booth — are best made from a foundation of basic scientific and mathematical competence.

Charles M. Vest, President Emeritus of the Massachusetts Institute of Technology, President of the National Academy of Engineering — and a West Virginia native and WVU alumnus — is one of the authors of Gathering Storm. He says, “These are issues of both workforce development and quality of life — and if our country is to continue to enjoy the standard of living previous generations worked to achieve, we have to get serious about the situation. We must deal with it.”

To that end, Gathering Storm and other reports make major recommendations in several areas, including research, innovation policy, and — especially — education. The emphasis is invariably on “STEM” disciplines: Science, Technology, Engineering, and Mathematics.

Oddly enough, while everyone agrees on what the letters represent, there’s disagreement about exactly what qualifies as a “STEM program.”
A few advocates believe that programs in any of the four disciplines—science, technology, engineering, and mathematics—qualify as STEM efforts. They stress that America needs, for instance, continuing effort in pure science and pure mathematics; without those, there’d be no applications and innovations.

But most, while acknowledging the importance of pure science and math, believe that true STEM programs integrate all four disciplines, with engineering and technology putting math and science to work solving problems. These advocates say that STEM programs are natural curriculum integrators, with the prospect of a hands-on technology and engineering project answering the eternal student question: “Why do I have to learn this?”

Most students, they say, are more willing to learn (and more apt to retain) math and science principles when they see for themselves that, for example, they need to learn geometry to be able to design and build a safe, strong bridge, or they need to understand gear ratios to be able to build the fastest robot.

Additionally, advocates of the integrated STEM program approach say that typical STEM projects come as close as a school situation can to the work environment.

Dr. Dan Engstrom says that’s important. An Associate Professor in California University of Pennsylvania’s Applied Engineering and Technology Department, Engstrom created a program in which K-12 teachers visit manufacturing and technology businesses—the world of work for which they’re preparing students. “What we hear consistently,” says Engstrom, “is that the 21st-century workforce needs—and too often does not have—three abilities: to think, to make good decisions, and to work well with other people. Good STEM programs address all of those.”
In South Korea, 38% of all undergraduates receive their degrees in natural science or engineering. In France, it’s 47%; in China, 50%; and in Singapore, 67%. In the U.S., the number is 15%.

“We go where the smart people are. Now our business operations are two-thirds in the U.S. and one-third overseas. But that ratio will flip over the next 10 years.”

Howard High, Intel spokesman

U.S. 15-year-olds ranked 24th out of those from 40 countries who participated in the 2003 Program for International Student Assessment exam, which assessed students’ ability to apply math concepts to real-world problems.

According to a recent survey, 86% of U.S. voters believe that the U.S. must increase the number of workers with a background in science and math, or America’s ability to compete in the global economy will be diminished.
Despite the range of definitions, there is wide agreement that innovation flows from the STEM disciplines—and that therefore resources should flow toward those disciplines.

There’s movement in that direction—in government, business, and other sectors. A few examples:

- The U.S. Department of Energy’s Office of Science—charged with helping to re-hone America’s innovation edge—is ramping up its National Laboratories’ outreach work with local schools.

- The National Science Foundation is funding STEM core curriculum programs through its Division of Elementary, Secondary, and Informal Education.

- The America COMPETES Act, which zipped through Congress in August 2007 with strong bipartisan support, will fund STEM-related programs and partnerships in a range of areas.

- One by one, states are making STEM-related plans and directing more resources toward STEM programs.

- Universities and colleges are opening their doors and redoubling efforts with STEM-related outreach programs. Carnegie Mellon’s robotics programs are a prime example but by no means the only one.

- Businesses are moving aggressively to partner in STEM programs. Bayer Corporation, with its multifaceted “Making Science Make Sense” initiative, is one stellar example, but there are many others. One of them is the Pittsburgh Technology Council Catalyst Connection’s “Adventures in Technology” program, in which teams of high school students work with area businesses to solve real-world problems. Charles Vest believes there is great sense in involving businesses in STEM work: “One of the worthiest ends of education is to prepare people to participate in the workforce at all levels, and business benefits greatly from a quality workforce.”
K–12 — “ACTION CENTRAL” FOR STEM

However, it’s the K–12 schools that are “action central” for STEM programs—because that’s where student interest in the STEM disciplines is formed (or not), nurtured (or not), and expanded (or not).

*Gathering Storm* and every other relevant report call for significant change in America’s schools, which were originally set up to educate workers for agrarian life and industrial-age factories—and which in many ways have not changed much since then.

But, finally, change is beginning to percolate through the K–12 world.

“No Child Left Behind,” which shifted public school funds toward literacy and math—some say at the expense of science programs—now requires state science standards and measurement of student progress. Baseline testing is just beginning in selected grade levels, so it’s too early to assess progress.

Entire schools are focusing on STEM-related areas—Pittsburgh, for example, is working to get its new science and technology high school up and running for the 2009–10 academic year.

And new STEM curricula are being created at warp speed.

The best STEM-related programs have a fundamental element in common: they involve experiential, hands-on learning, and they are inquiry-based—students don’t just passively listen to lectures; instead, they face a challenge or solve a problem, applying what they have already learned and learning much more along the way.

The approach isn’t new. In the 4th century, Aristotle said, “Nothing is in the mind that is not first in the hand.” And a half-century ago, philosopher–psychologist Jean Piaget promoted the idea that children learn actively, and they do so best through direct experience with the physical world.

That’s how STEM programs work. They present students with engaging material, and have them participate in a collaborative work environment, broadening and deepening their science and math knowledge as they design and build things that interest them. STEM projects include, for example: building robotic arm
In 2001 (the most recent year for which data are available), U.S. industry spent more on tort litigation than on research and development.

“Second only to a weapon of mass destruction detonating in an American city, we can think of nothing more dangerous than a failure to manage properly science, technology, and education for the common good over the next quarter-century.”

U.S. Commission on National Security for the 21st Century

Over two-thirds of employers report that U.S. high school graduates are “deficient” in almost all essential workplace skills.

The U.S. is today a net importer of high-technology products. Its trade balance in high-tech manufactured goods shifted from plus $54 billion in 1990 to negative $50 billion in 2001.
During 2004, China overtook the United States to become the leading exporter of information-technology products.

In a recent survey, 9 in 10 Americans said that a strong national science and technology capability is a critical component of U.S. security at home and abroad.

In 2000, 93% of U.S. students in grades 5–9 were taught physical science by a teacher lacking a major or certification in the physical sciences (chemistry, geology, general science, or physics).

Only 61% of 12th-graders in 2000 agreed with the statement that “math is useful for solving problems.”
grippers out of styrofoam and string … designing electrical circuits and then wiring a “house” made of shoeboxes … and designing and modeling a lunar colony able to sustain human life.

FROM PASSIVITY TO CREATIVITY

In quality STEM programs, you don’t see kids sitting bored and inattentive; you see questioning, investigation, discussion, collaboration, creativity — and success in applying science and math knowledge.

While the approach is certainly appealing, the jackpot question, of course, is this: Does it work?

The evidence says yes. Two quick examples: (1) a wide-ranging study of inquiry-based learning vs. traditional teaching found that student achievement levels were 13% higher in the inquiry-based situations, and (2) in Delaware — an ideal testbed because of its small size — a statewide science education reform centered on inquiry-based learning has caused a surge in student test scores, including among minority students.

It’s clear that a good STEM program — especially one that integrates all the disciplines in hands-on learning situations — can make a difference.

This report looks at three emblematic STEM programs: one in West Virginia and two in Southwestern Pennsylvania; one based at an Intermediate Unit and two at universities; all of them multi-faceted, all thoughtful — and all working to help change the “stormy” forecast.
The learners wrestle with the problem: how to design a model of the first-ever lunar colony. How might people live, eat, sleep, and do their jobs in the moon’s hostile environment? Working in teams, the learners draw on disciplines including math, chemistry, biology, physics, botany, and more. They shape styrofoam and plastic, and cut string, wire, and foil. There is laughter and debate and great focus—and ultimately each team presents an innovative and workable design.
These learners aren’t K–12 students — they’re veteran science and tech ed teachers experiencing a new STEM course module they’ll soon be teaching to their middle school students.

The teachers are all from school districts served by Southwestern Pennsylvania’s Intermediate Unit 1 (IU1), the regional educational support agency for the 25 school districts in Washington, Greene, and Fayette Counties.

IU1 is a leader in helping current teachers become “STEM-savvy”—a key to successful implementation of STEM programs.

PUTTING THE BUILDING BLOCKS TO WORK

Nancy Tsups is Director of IU1’s new Center for STEM Education, funded by Benedum. She says, “For many of today’s teachers, what they learned in school doesn’t look like the STEM subjects today’s students need to learn—and for some teachers that’s actually intimidating.

“There’s new content, of course, but the ways of teaching and learning are also different. The emphasis isn’t on rote memorization and regurgitating facts; it’s on experiential problem-solving. Certainly students have to know the basic building blocks, but now they put the building blocks to work.”

The Intermediate Unit isn’t a newcomer to the new ways. More than a decade ago, IU1 introduced 16 of its school districts to the “Science Matters” program, which featured hands-on science kits designed to spur exploration and discovery.
Tsupro, who directed Science Matters for the IU, says that University of Pittsburgh researchers tested 5th-grade students using the program and compared their achievement with that of other students. The Science Matters 5th graders performed as well as 7th-grade U.S. peers.

A newer IU1-disseminated robotics engineering program, created by Carnegie Mellon’s National Robotics Engineering Center, has also produced positive results, with students achieving a firm grasp of basic pre-engineering skills.

And this year the IU is introducing a K–12 curriculum called Engineering by Design; the lunar colony project is one small part of that curriculum.

In IU1 school districts—as in most places across the country—adoption of any new curriculum materials is voluntary. Districts that embrace the new curricula send their teachers to the IU for training in both the materials and the methods involved. “If you don’t offer a strong professional development component, all you have is a box of materials that’s apt to sit unused in the classrooms,” says Tsupro. “It’s through professional development that teachers develop understanding, ownership, and enthusiasm.”

But even in districts that choose to stay with traditional curricula, teachers who perceive value in the newer content and methods can become adept at both.
MORE THAN 700 WAYS TO UPDATE

The IU offers more than 700 courses and workshops that can help teachers update knowledge and skills. The teachers can earn credits toward either master’s degree equivalency certificates or meeting continuing professional development requirements.

This year, with Benedum support, the IU is reformulating course offerings into comprehensive “pathways”—groups of courses and workshops designed to help teachers develop a deep understanding of content as well as knowledge about best practices in communicating that content to students.

One example: in the pathway titled Science, courses are clustered into groups called Content, Pedagogy (methods), Assessment, Curriculum, Leadership, and Outreach. Under each group are multiple courses and workshops. Some courses and workshops—particularly those in Pedagogy—appear in multiple pathways.

“What’s encouraging is that teachers from a wide range of disciplines enroll in these courses,” says Tsupros. “In a methods course, you might get—for instance—a science teacher, a math teacher, a social studies teacher, and an English teacher. That’s enriching because they bring different things to the table—and often, when they’re back at their schools, they end up teaming for cross-curricular work, looking at the same kinds of content from the perspectives of their different disciplines. That’s great for learning.”
The Pathways teachers are experts. Sometimes they are actually developers of the new curricula—for instance, Robin Shoop of Carnegie Mellon’s National Robotics Engineering Center, or Dan Engstrom of California University of Pennsylvania. “Universities are major partners in the STEM effort at the IU,” says Tsupros—whose own offices are in space donated by Washington & Jefferson College.

The professional development doesn’t stop when the workshops and courses end. There’s plenty of followup—in person, by email, and online. It’s labor-intensive—but it works.

“Gradually, things change—sometimes one district at a time, sometimes one teacher at a time,” says Tsupros. “You can see it happening. It’s good for the districts, for the teachers, and—especially—for the students.”
In a quiet suburb of Huntington, the one-story red brick school looks like any other. But inside, something unusual is happening: a professor, a master teacher, and several college elementary ed majors are working with LEGO® robots. The goal: to help the college students learn leading-edge ways to help young children grasp challenging STEM content.
Remember the old saying “Well begun is half done”? At West Virginia’s Marshall University, elementary education majors will begin their careers knowing a good deal about STEM subjects and the best ways to teach them.

It wasn’t always that way. At Marshall, as at most colleges and universities, elementary ed majors used to take a couple of basic science classes—period. But today’s Marshall curriculum requires that the future teachers also take a rigorous course in ways to teach STEM-related subjects, and then practice what they’ve learned—before they start their first jobs.

Tina Cartwright, the College of Education and Human Services Assistant Professor who created the new teaching methods course, says, “Some of the students approach this class with ‘fear and trembling.’ Most don’t have great memories from their own early science classes, where they just read from a textbook and filled out uninteresting worksheets. We try to show them it doesn’t have to be—and in fact shouldn’t be—that way.”

In the course, the students learn a range of methods to accommodate different learning styles. They also become aware of community, business, and government resources they can draw on to make STEM topics come alive for their students. Then, still before graduation, they put into practice what they’ve learned. There are a number of opportunities for the practicum, but none better than the University’s new Harless 21st Century Model School at Kellogg Elementary.
EMBEDDED IN ITS COUNTY AND ITS CULTURE

The K–5 model school, inaugurated just this year, may be unique in the country: while it’s operated by the University, it’s not university-owned—it’s a real public school embedded in its county and its culture—and it’s humming with STEM topics and technologies.

Students were randomly selected to attend the school, and teachers from across Wayne County volunteered for the program, undergoing intensive training before the school opened and continuing throughout the school year.

The curriculum is heavy on math, science, and pre-engineering activities (including the LEGO® robots) and the classrooms are loaded with the latest and best technologies. Those include, for instance, internet access, global positioning systems, and videoconferencing—which is often used by Tina Cartwright’s future teachers to observe and interact with model school teachers in their classrooms.

Another high-tech device at the model school is “Sympodium,” a classroom polling device that allows a teacher to instantly assess students’ grasp of material, so teaching strategies can be adjusted accordingly.

Debbie Workman is a 33-year classroom veteran and lead teacher at the model school. She says, “I taught in the traditional way for years, and gradually saw that students do much better with hands-on activities and inquiry-based learning. It’s great that the Marshall students are starting their careers
The K–5 model school and the Marshall science methods course are both part of the University’s overall STEM effort, directed by Dr. Stan Maynard, Associate Dean for the College of Education and Human Services. Funding comes primarily from the West Virginia Department of Education, with additional support from sources that include corporate partners, the Wayne County public schools, and Benedum.

The overall STEM effort is ambitious. The K–5 model school will be expanded to include grades 6–8, and a STEM Academy for grades 9–12 is being planned. It will be housed on Marshall’s campus, and will serve the entire state (and perhaps beyond). Initially only day students will be accommodated, but eventually boarders will also attend. Expertise at the STEM high school will be shared with other West Virginia schools via videoconferencing, making the school a “virtual STEM magnet.”

**BRINGING THE WORLD INTO CLASSROOMS—AND VICE VERSA**

“Often kids coming out of rural or impoverished schools have never had a chance to interact with a scientist or an engineer. Those are the kinds of walls contemporary technology like videoconferencing can help us break down,” says Maynard. “Basically we can teach 21st-century content in a 21st-century context,
using technology to bring the world into classrooms, and bring students from the classroom into the world. It’s powerful stuff.”

Once the entire K–12 STEM model is in place, Maynard envisions undertaking significant research, because, he says, “If you don’t have data, all you have is another opinion, and education is full of those.” Research results will be disseminated throughout the state and beyond. The goal: to motivate other schools to adopt newly developed best practices — or in fact to replicate the entire model, including the supporting technologies. Maynard says that cost is not necessarily a major obstacle, both because funding partners are available and because some current funding can be used more efficiently.

Every part of Marshall’s STEM effort — including the work with the undergraduate elementary education majors — is aimed at what Maynard calls “de-privatizing teaching.” By that he means working toward ending the old tradition of one teacher in one classroom with students learning individually behind one closed door.

“It’s time,” he says, “for every school to become a collegial learning community — students learning in teams, teachers working cooperatively, and whole schools sharing their expertise. It’s time to end this academic isolationism, and share both the process of teaching and learning and the knowledge about what works and what doesn’t.

“When that happens, everyone will benefit.”
It’s Saturday morning on a university campus near the Pittsburgh International Airport, but the teams of middle school students are oblivious to the roar of jets. In jeans and hoodies, with shining hair and tentative makeup, these girls are focused on Barbie® dolls—but they’re not playing. Each team has designed a bungee jump for its Barbie, and now they’re applying physics and math to record their progress and optimize the jumps.
The venue is a Robert Morris University (RMU) workshop for girls in grades 6–9 — the age when girls are apt to fall away from early interest in STEM-related disciplines. The workshop’s purpose is to feed that interest, and perhaps even expand it. The familiar dolls help defuse any unease with the prospect of physics and math — and it works: constructing the Barbie® bungees provokes laughter, which soon segues into energetic engagement with measurement, graphing, and prediction.

The workshop was part of a daylong Benedum-supported conference for young women interested in STEM careers. The event was a version of “Expanding Your Horizons,” since 1976 the granddaddy — or grandmama — of female-oriented science/math conferences.

At the RMU event, more than 200 girls from grades 6–9 gathered for a high-energy day that included a choice of workshops (for instance, “Perfume Science” and “Is There a Robot in Your Future?”), events for parents and teachers, and a career fair. There was high enthusiasm — the only negative comment overheard was about the “dorky” safety glasses required in the robotics lab.

A WHITE MALE IN A LAB COAT
The reason for the “girls only” event: Research by the National Science Foundation shows that, in elementary school, equal numbers of boys and girls like science — but stereotypes persist, and when young students are asked to
Jennifer Parsons, Outreach Programs Specialist and organizer of the conference, says, “A few years ago, some middle school girls were asked what they wanted to be when they grew up, and they said ‘Britney Spears.’ We think that conferences like this one, with positive female role models as workshop leaders and as career fair participants, can show young girls that there are many other possibilities open to them, and some of the best ones are in the STEM disciplines.”

Robert Morris University — along with many other colleges and universities in Southwestern Pennsylvania and West Virginia — does considerable STEM-related outreach to K–12 students, both boys and girls.

That’s important for two reasons. Gathering Storm cites the need to enlarge the pipeline of students prepared for college work in STEM disciplines — and the parallel Learning for the Future report says, “The classroom alone is not always sufficient to meet the needs of inquisitive students.” That, of course, is especially true in schools that have not yet adopted a STEM emphasis.

Robert Morris University “gets” STEM: A few years ago, it merged several academic entities to create the School of Engineering, Mathematics, and Science (SEMS). RMU also understands outreach: The school was a founder of the
now the University is applying those insights to STEM outreach. SEMS Dean Winston Erevelles says, “We try to make all the outreach activities interesting and fun, but at their core they’re developing STEM discipline skills in a problem-solving, team-oriented environment that reflects situations in the real world of work.”

The STEM outreach takes several forms.

The first is promoting awareness—Erevelles calls it “flying the STEM flag.” It can include, for example: RMU faculty going into schools to make presentations on STEM careers … opportunities for students to “shadow” RMU faculty members … events for middle and high school faculty and administrators … and RMU faculty members “adopting” schools and mentoring students interested in STEM careers.

A second form is RMU’s Summer Institute, scheduled to launch in 2008. At these residential camps for high school and middle school students, the students will do hands-on activities in areas including animatronics, building race cars, and forensics; they’ll visit companies working in STEM areas; and, in the evenings, they’ll have fun socializing.
A third kind of outreach is Saturday workshops for middle and high school students. Topics might include, for example, modern lab instrumentation, LEGO® MINDSTORMS™ robotics, computer-aided engineering, and math and science competitions. The workshops are scheduled year-round, and include special events like the conference that featured the Barbie bungee project.

Winston Erevelles cheerfully acknowledges that the outreach work, while effectively promoting the STEM disciplines, is also de facto recruiting for RMU. But he says, “Let’s face it— all of us who work in outreach know that students may or may not come to our university. However, the work we do around STEM topics results in the students becoming more interested and more knowledgeable—and being better prepared for wherever they go. Ultimately this is a victory for STEM professions—and for all of us working to make our nation more competitive.”
CONCLUSION

So, in Southwestern Pennsylvania and in West Virginia, STEM is taking root and growing rapidly.

With funding through the National Governor’s Association and the TEAM PA Foundation, five or more regional STEM centers will be developed in Pennsylvania. The Pittsburgh Technology Council’s Catalyst Connection has been named the Southwestern Pennsylvania convener.

Meanwhile, the Catalyst Connection is one member of an informal, evolving STEM network, convened by Benedum and so far including Carnegie Mellon University’s National Robotics Engineering Center, Bayer, the Technology Collaborative, Robert Morris University, and Intermediate Unit 1. The idea is to share ideas and develop complementary efforts.

STEM is also surfacing in nontraditional community settings. One example, funded by Benedum, is based at The Mattress Factory, an installation art museum on Pittsburgh’s North Side. In the two-year program, teachers from Washington, Greene, and Fayette Counties will experience installation art in some depth, and then will develop lesson plans that make the link between installation art and the STEM disciplines. Mini-grants will bring students and teachers to The Mattress Factory to experience and create. “You can’t make installation art without knowing some math, some physics, and often other sciences, too, and often technology is involved,” says Mattress Factory Education Director Anna Fitzpatrick.

While there is cause for optimism, there are also grounds for caution.

Scaling up successful programs is exceptionally difficult because of the decentralized nature of American education — there are nearly 15,000 school
systems in the U.S., with the average district comprising only about six schools. School districts have enormous autonomy to make decisions, and those decisions can be wise ... or not.

Funding can be an issue. Some excellent curricula are available at reasonable cost, but it's always necessary to commit resources for training, materials, and ongoing support. Some school districts simply don't have those resources, and need to be creative in partnering with — for instance — businesses and higher education institutions, and in writing grant proposals for the needed funding. Some districts are overwhelmed by those processes, and others simply don’t embrace change.

Charles Vest, the West Virginian who is an author of Gathering Storm, sounds another cautionary note. “There have been a few disheartening surveys showing that parents don’t fully understand the importance of K–12 science and math education,” he says. “There’s an undertone of ‘There are big problems in some places but everything’s fine at our kids’ school.’”

Despite the caveats, Vest comes down on the side of optimism, saying, “On the other hand, I think there’s great concern about what global competition is going to mean for this country, and that concern is energizing. More people are advocating for the significant resources needed. It’s a matter of will and a matter of money. We need plenty of both. The increasing global competition is very real — and we have to be serious about getting out ahead of it.”