

science IMPACT



**CARNEGIE
SCIENCE
CENTER**

One of the four Carnegie Museums of Pittsburgh



In this workshop, a mother and daughter work together to string the fingers of a prosthetic hand.

Fab Lab ‘Making’ an Impact in Pittsburgh

Digital Makerspace Fosters Critical Thinking, Builds Creativity

A group of teenagers carefully loads a spool of yellow plastic thread into the 3D printer that will transform their computer-designed prototypes into prosthetic hands to help children in need. For these students, Fab Lab Carnegie Science Center is a workshop to bring their ideas to life as a part of e-Nabling the Future, a program that’s changing the world of prosthetics.

When Fab Lab Manager **Liz Whitewolf** first heard about e-Nabling the Future, she immediately wanted to bring the program to Fab Lab Carnegie Science Center. She learned that prosthetic hands are expensive, and as children grow they need ever-bigger sizes, which adds to the cost. But 3D-printed hands, which attach at the wrist with Velcro, can be less expensive and quicker to produce.

“I wanted to use the equipment in our Fab Lab for good,” Whitewolf said. “The ability to help somebody else through 3D printing

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is an incredible opportunity. Plus, teenagers are the creators of these hands. Teenagers are making a social impact in a tangible way. Young people are creating devices to help other young people – it is powerful to watch them at work.”

After completion, the 3D-printed prosthetic hands were sent to the Prosthetic Kids Hand Challenge, which will match the prosthetics with recipients.

Though Fab Lab Carnegie Science Center is only a year old, it’s already making an impact on Pittsburgh and beyond.

Fab Lab offers workshops for children ages 6 and up and adults, including special programs like e-Nabling the Future, public workshops, field trips, teacher professional development sessions, summer camps, corporate team-building workshops, free Fab Lab open workshops, and a Mobile Fab Lab. With state-of-the-art equipment, such

as 3D printers, laser cutters, computers and software, sewing machines and more, Fab Lab Carnegie Science Center is helping to build maker skills in all ages.

Makerspaces are playing an important role in Pittsburgh as the city evolves into a hub of scientific and technological development. Fab Lab Carnegie Science Center, which is supported by Chevron as part of its Appalachia Partnership Initiative, joins a global network of more than 500 Fab Labs. This cutting-edge digital makerspace teaches students to use and apply the engineering design process. Using high-tech software, students model their ideas for prototypes, then test their work, re-design, and test again. This iterative process helps develop the critical thinking skills necessary for today’s jobs and jobs of the future.

Creativity is a crucial and valuable 21st century skill. Building creativity requires a blurred boundary between formal disciplines and between in-school and out-of-school learning environments, according to a report from the Fab Foundation, which supports the growth of the international Fab Lab network, including the launch of Fab Lab Carnegie Science Center.

“Young people are creating devices to help other young people – it is powerful to watch them at work.”

Through their experiences in Fab Lab, students head back to the classroom primed and ready to learn. Students are not only learning specific course content included in Pennsylvania, Common Core, and Next Generation Science Standards; they also practice problem-solving, innovation, and teamwork that will aid them throughout their education, careers, and life. ■

directors' note



One of the cherished privileges we enjoy as co-directors of Carnegie Science Center is meeting a broad array of regional corporate leaders. The corporate community in Pittsburgh has been very supportive of our STEM education programs, largely because they see the value in inspiring kids of all ages in hands-on activities involving science and technology. But as we get into deeper conversations, we're often surprised at *their* surprise in just how closely and consistently we work with schools to further STEM education in our region.

One conversation last spring comes to mind. We were meeting with a local business leader and telling him about our Fab Lab, Carnegie STEM Girls programs, SciTech Days, Student Energy Summit, our Future City middle school engineering competition and the Chain Reaction Contraption high school engineering competition. We let him know that we were ramping up for our annual science fair, newly sponsored this year by Covestro, during which 1,200 kids would be competing. All told, we said, we see nearly 90,000 kids each year in focused STEM programs and competitions.

We continued – and in full disclosure, we were asking for his organization's financial support. We also work with teachers and school administrators, we said, and detailed for him the evolution of our Carnegie STEM Excellence Pathway, which helps schools and school districts all over the nation improve their STEM education practices and offerings. In addition to providing schools a continuous

quality improvement tool, we provide teacher professional development to assist in the process and coach schools along the way. We've done workshops throughout the region, we said, as well as in 16 other states where schools wanted to be part of the process.

There was a long moment of silence. "I had no idea," he said simply. "People think they know what the Science Center does, but there's this deeper engagement. You are really helping schools to do their job, but instead of receiving dedicated funds, you have to ask people like me for the resources to do this great work." He pretty much nailed it.

Time and again, we have similar conversations. Many people in the community who visit the Science Center with their children or grandchildren are unaware of our deeper mission in STEM education and career awareness as we seek to engage corporations and educators to grow and nurture the next-generation STEM workforce for our region. We never tire of the conversations, and we love to showcase the extraordinary work of our STEM education staff.

Ron Baillie and Ann Metzger
Henry Buhl, Jr., Co-Directors



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CarnegieScienceCenter.org

Carnegie Science Center delights, educates, and inspires through interactive experiences in science and technology. By making science both relevant and fun, the Science Center's goal is to increase science literacy in the region and motivate young people to seek careers in STEM (science, technology, engineering, and math).

The Science Center also serves as a town square for community dialogue on science and its social implications and seeks to showcase regional science and technology advances.

One of the four Carnegie Museums of Pittsburgh, the Science Center is Pittsburgh's premier science exploration destination, reaching more than 700,000 people annually through its hands-on exhibits, camps, classes, and off-site education programs.

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Fab Lab participants work with Fab Lab leaders to learn how 3D printing works.

Fab Lab a Vehicle for Inquiry-Based Learning

Teacher Professional Development Opportunities focus on Engineering Design Process

Fab Lab's cross-disciplinary approach to learning is already resonating with teachers who laud the impact Fab Lab, including its mobile Fab Lab component, has had on their students.

"I have been teaching for 23 years, and I can honestly tell you that this was one of the most phenomenal experiences I have ever had with my students," said **Jennifer Kudrick**, a teacher at Stanwood Elementary in New Stanton, a rural suburb east of Pittsburgh. "Through this amazing program, [mobile Fab Lab coordinator] **Jon Doctorick** involved the students in investigation and design, math, writing, public speaking, and reading. The program also provided excellent student motivation and a rich classroom environment."

Teachers can bring Fab Lab Carnegie Science Center into their classrooms with the mobile Fab Lab, a 28-foot Fab Lab trailer, which contains duplicates of the equipment in the on-site lab. Each mobile Fab Lab experience includes teacher professional development.

At Fab Lab professional development workshops, teachers gain a better understanding of the design and engineering practices that

they are expected to teach and that employers require, but with which many teachers have little or no experience.

Fab Lab's intro to Fab Lab professional development sessions during the 2015-2016 school year provided interactive workshops for teachers to explore the various technologies the Fab Lab has to offer.

For this upcoming year, in addition to Intro to Fab Lab, professionals can also enroll in a two-part session explaining how to implement a makerspace into their classroom or school.

"The Fab Lab enables us to help schools through the entire education process. It starts with training the teachers to use Fab Lab equipment, so they can grow children into engaged learners," **Jason Brown**, Carnegie Science Center's Director of Science and Education said. "Along the way, we're also teaching educators how to incorporate inquiry-based learning and student questions into their classrooms."

In addition to the brainpower Fab Lab develops, it also offers a space to develop tangible products related to course content,

design T-shirts, create signs, produce movies, build robots, engineer machines, create microcircuits, and imagine 3D art.

“Through this amazing program, **Jon Doctorick** involved the students in math, investigation & design, writing, public speaking, and reading.”

Schoolchildren – and adults, too – can learn how to design items using open-source software and then turn their virtual creations into real, tangible objects with digital fabrication and rapid prototyping machines. ■



During Girls Rock Science Weekend at Carnegie Science Center, a representative from the Pittsburgh Police Department explains how bomb detection equipment works.

Science Center Programs Encourage Girls to Get Excited about STEM

Engaging, educating, and embracing girls as architects of change has long been a part of Carnegie Science Center's mission.

"Women make up about 50 percent of the workforce in the United States but hold only 25 percent of STEM jobs. Carnegie Science Center is working to reverse this disturbing trend through a wide range of programs," said Director of STEM Programs **Linda Ortenzo**. "We strive to create programming that provides a spark of inspiration and that encourages girls to consider STEM careers."

The Science Center's Carnegie STEM Girls comprises several initiatives, both on-site and off-site, to inspire girls to consider STEM careers:

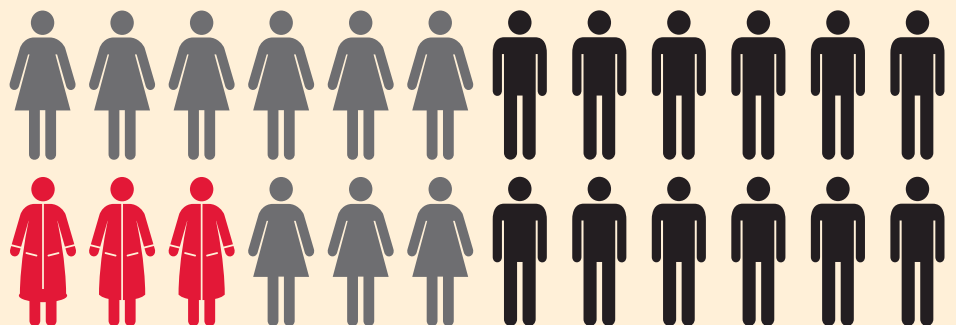
- **Tour Your Future** brings girls into the workplaces of female STEM professionals for a first-hand look at STEM careers from women who can serve as role models. Tour Your Future invites girls ages 11–17 to meet female STEM professionals in diverse careers ranging from zoology to chemistry and cyber security to surgery.

- **STEM Stars**, an afterschool program, addresses barriers associated with middle school girls' engagement in STEM such as inadequate access. STEM Stars is a collaborative project of the YWCA Greater Pittsburgh's TechGYRLS program and Carnegie Science Center's GEMS (Girls Engage in Math and Science) program.
- **Girls Rock ScienceSM Weekend** presents dozens of STEM activities designed to empower girls and to encourage enthusiasm for STEM careers. Presented in partnership with local TV station KDKA, more than 30 local corporations and educational institutions bring engaging hands-on activity stations to give a first-hand look at STEM careers. The inaugural Girls Rock Science Weekend

drawed a crowd of 4,800 to explore robotics, dust for fingerprints, meet national TV personalities, and experiment with building materials.

- In addition to these on-site programs, the Science Center's CanTeen website (CanTeenGirl.org) features STEM games, challenges, experiments, and interviews with women in STEM careers.

In recognition of this work, the Science Center was honored in 2009 with the Association of Science-Technology Center's Roy L. Shafer Leading Edge Award for innovative programming for girls. The Science Center's commitment to innovative programming for girls continues to grow and deepen. ■



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GRANTS & AWARDS

- **Pirates Charities** supported baseball-themed science activities at the Science Center during summer 2016 with a \$125,000 gift. Programming included *Grand Slam Science!* shows twice daily each Friday, Saturday, and Sunday, daily stand-alone *Grand Slam Science!* demonstrations in Highmark SportsWorks®, two free admission days for children ages 4–13 sporting a youth baseball organization shirt or uniform, and a baseball-themed Fab Lab activity on select Fridays. Funds also supported development of a new permanent baseball exhibit in SportsWorks® called “Batter Up!”
- **PPG Industries Foundation** has provided \$175,000 to support a Science on the Road outreach program about aerospace. Science on the Road is Carnegie Science Center’s traveling program that brings dynamic science presentations to schools and community centers across the Pittsburgh region. In 2015 alone, Carnegie Science Center saw more than 170,000 students in a five-state area surrounding Pittsburgh.
- An \$85,000 grant from the **Buhl Foundation** funded Fab Lab projects for children located on the North Side of Pittsburgh where the Science Center is located. The funds will enhance STEM programming for 2016-2018.
- **Google** awarded Carnegie Science Center grants totaling \$200,000 to provide field trips to the Science Center for students from underserved schools. These Google field trips in 2016–2017 are covering the cost of student admission, transportation, and boxed lunches for all participants.
- The **EQT Foundation** provided \$155,000 for 2016 and 2017 Engineer the Future program. Engineer the Future is an annual event held at the Science Center in celebration of National Engineers Week. Its goal is to inspire students to consider engineering careers through hands-on activities and the opportunity to meet real engineers working in the region.
- **Duquesne Light** made a gift of \$100,000 to renew its status as a Founding Partner of the Chevron Center for STEM Education and Career Development and to support STEM programming and Science on the Road.
- With a grant of \$100,000, **Eaton** became a Founding Partner of the Science Center’s Chevron Center for STEM Education and Career Development and Presenting Sponsor of the 2016 Carnegie Science Awards. Funds will also support SciTech Days, the Covestro Pittsburgh Regional Science & Engineering Fair, and Carnegie STEM Girls programming.

BOARD SPOTLIGHT



Suzy Broadhurst

Suzy Broadhurst could spend all day walking around Carnegie Science Center and observing.

“I love watching the kids there. It’s so special to see children experiencing the exhibitions,” she said. “You know their little minds are going.”

Broadhurst, a board member at the Science Center and a trustee for Carnegie Museums of Pittsburgh, studied elementary education at Penn State University, so witnessing that spark of learning is dear to her heart. As part of the Science Center’s opening committee, she helped to launch the Science Center in 1991.

And now, she’s serving as the chair of *SPARK! A Campaign for Carnegie Science Center*, which will expand the museum and its programs for many generations to come.

In her work with the Science Center, she’s experienced many new exhibit openings, and she’s marveled as astronaut **Mike Fincke** called from space to talk with children visiting the Science Center. Fincke is a fellow native of the region and a supporter of Carnegie Science Center.

“He was all those miles and miles and miles away, and the kids were just mesmerized,” she said.

Broadhurst is retired from Eat’n Park Hospitality Group, where she served as the company’s Director of Corporate Giving.

In her free time now – when she’s not serving on the museum boards or as a trustee at the University of Pittsburgh – she enjoys golfing, traveling, gardening, reading, and trying new restaurants with her husband Jim. The couple has three sons and five grandchildren.

To her, being a Board member is a rewarding experience.

“At the Science Center, we’re helping to engage these children in something that’s really worthwhile,” she said. “We hope to inspire them to love science!”



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PARTNER SPOTLIGHT

Jerry MacCleary President, Covestro



Jerry MacCleary with some Greenlight for Girls participants.

Jerry MacCleary is president of Covestro LLC for North America. He also leads the Polyurethanes business for the North American region. Under his leadership, Covestro became the title sponsor of the Science Center's Covestro Pittsburgh Regional Science & Engineering Fair, brought Greenlight for Girls Day to Carnegie Science Center, and named the Science Center's Covestro Gallery, which houses the H2O! exhibit.

What is Covestro's mission?

I can sum up our mission in two words: innovation and sustainability. Every day, in labs around the world and right here in Pittsburgh, our scientists are discovering new ways to address today's challenges through our materials, and more efficient and sustainable processes for producing them.

Why is a STEM-prepared workforce important to Covestro?

Innovation at Covestro wouldn't be possible without a world-class STEM workforce, which is why we need to ensure the next generation is up to the challenge. In fostering a STEM-literate society, we are simultaneously building a diverse talent pipeline to feed our – and the country's – growing need for STEM professionals.

In what ways has Covestro supported the Science Center?

We've enjoyed a long and mutually beneficial relationship with the Science Center that stretches back to our days as part of the Bayer Group. Since becoming Covestro, we renewed that commitment with a \$1.85 million sponsorship that will help fund museum programming to further STEM education. Visitors can now explore the science of water in the newly named Covestro Gallery. We're also the proud sponsors of the annual Covestro Pittsburgh Regional Science & Engineering Fair, which we kicked off this year.

Why does Covestro see as value its support of Carnegie Science Center?

Carnegie Science Center supports us as much as we support them. We are natural partners for each other because we have a shared mission to advance STEM education, and this isn't something either of us could accomplish alone.

Do you have any personal favorite exhibits/activities at the Science Center?

Each exhibit is fascinating in its own way. If I had to choose, the one exhibit that always grabs me is roboworld™. I am mesmerized by Hoops, the robot that can sink a basketball from anywhere on the court. I also have a special fondness for the H2O! exhibit, which happens to be in the Covestro Gallery.

Congressional Briefing Puts Early Childhood Education on National Radar



At the Congressional Briefing, Congressman Mike Honda; Rudo Kashiri of NASA; Russell Shilling, Executive Director of STEM at the U.S. Department of Education; Carrie Lynne Draper of Readiness Learning; David Lowenstein of PBS Kids Digital, and Wendy Brenneman of Carnegie Science Center.

Carnegie Science Center's Manager for Early Childhood STEM Initiatives **Wendy Brenneman** spoke at a Congressional Briefing, *Education through the Lens: Early Learning STEM* in June about the importance of informal STEM for young children. The briefing, organized by Congressman **Mike Honda**, and Congresswoman **Sheila Jackson Lee**, was held in the Congressional Auditorium, Capitol Visitor Center in Washington, D.C. Moderated by **Russell Shilling**, Executive Director of STEM at the U.S. Department of Education, the panel included **Carrie Lynne Draper** of Readiness Learning, **Rudo Kashiri**

of NASA, and **David Lowenstein** of PBS Kids Digital.

Wendy also co-presented a featured session, *A Connected City: How Collaboration, not Competition, Strengthens a Community of Learners* at the National Association for the Education of Young Children's Professional Development Institute in Baltimore. In that session, Wendy and a team of Pittsburgh-based partners guided attendees in developing a plan for early childhood collaboration in their cities, based on Pittsburgh's successful model. ■

Science Center Summer Camps Stop the Summer Slide



Kids learn digital design and coding at Videogame Arcade summer camp.

Deep in concentration with headphones on their ears and fingers on their keyboards, a roomful of 10–12-year-olds in Fab Lab Carnegie Science Center build their very own video games.

They're participating in Videogame Arcade, a new Science Center summer camp. It's just one of the dozens of Science Center summer camps designed to delight children in their out-of-school time while also providing the spark of scientific inspiration. Reaching more than 2,200 children this summer, STEM-related camps are a key element in stopping the summer slide and sending students back to school primed and ready to learn.

Science Center summer camps have been a Pittsburgh tradition for decades. Camps offer a full week of themed activities infused with science-filled fun. Campers can investigate science careers, experiment with roller coasters, build a bridge, and design their own video games.

At Videogame Arcade, campers learn about game development and get creative with their own games. Using Scratch programming language and the "MaKey MaKey" boards, campers design video games and hand-held controllers.

In another Fab Lab workshop, campers experiment with the science behind quadcopter flight to assemble and build

their own mini indoor quadcopters. Using the Fab Lab's 3D printer and laser cutter, campers design and test their device's chassis. On the last day of camp, the quadcopters race one another through an indoor obstacle course challenge.

Camps for early learners, ages 4–5, focus on topics such as trains, insects, and the wonders of weather. New this year was camp Peg + Cat, developed in partnership with The Fred Rogers Company. Campers solve big problems using measurement, estimation, sorting, and creativity.

For older campers, ages 12 and up, the Introduction to Laboratory Science camp teaches about molecular biology and microbiology and the techniques scientists use in the laboratory. Students have the opportunity to spend two days in the Citizen Science Lab with real scientists and state-of-the-art equipment as they carry out hands-on experiments with DNA and bacteria.

No matter the age group or the camp's theme, the common thread is STEM education and a way to keep brains in gear even when school is out. Summer camps are hands-on, minds-on, and so much fun that campers don't even realize all the content they're learning. ■

International Science Center Group Lauds Carnegie STEM Excellence Pathway



Carnegie Science Center staff proudly pose with their "Edgie Award" at the Association of Science-Technology Centers conference in Montreal.

The Carnegie STEM Excellence Pathway continues to grow, and it's now helping more than 7,000 schools in 17 states improve their STEM education practices for 3.9 million students. In recognition of the Pathway, the Association of Science-Technology Centers (ASTC) awarded Carnegie Science Center the Roy L. Shafer Leading Edge Award for Business Practice. Staff accepted the award at the annual ASTC Conference in Montreal.

It's a rare feat for a science center to win this award even once, yet this is Carnegie Science Center's third Leading Edge award in the last six years. The 2015 award lauded the Carnegie STEM Excellence Pathway for its ability to meet community needs. The Pathway provides an iterative STEM improvement process for schools aimed at helping all schools strengthen their STEM efforts. ■



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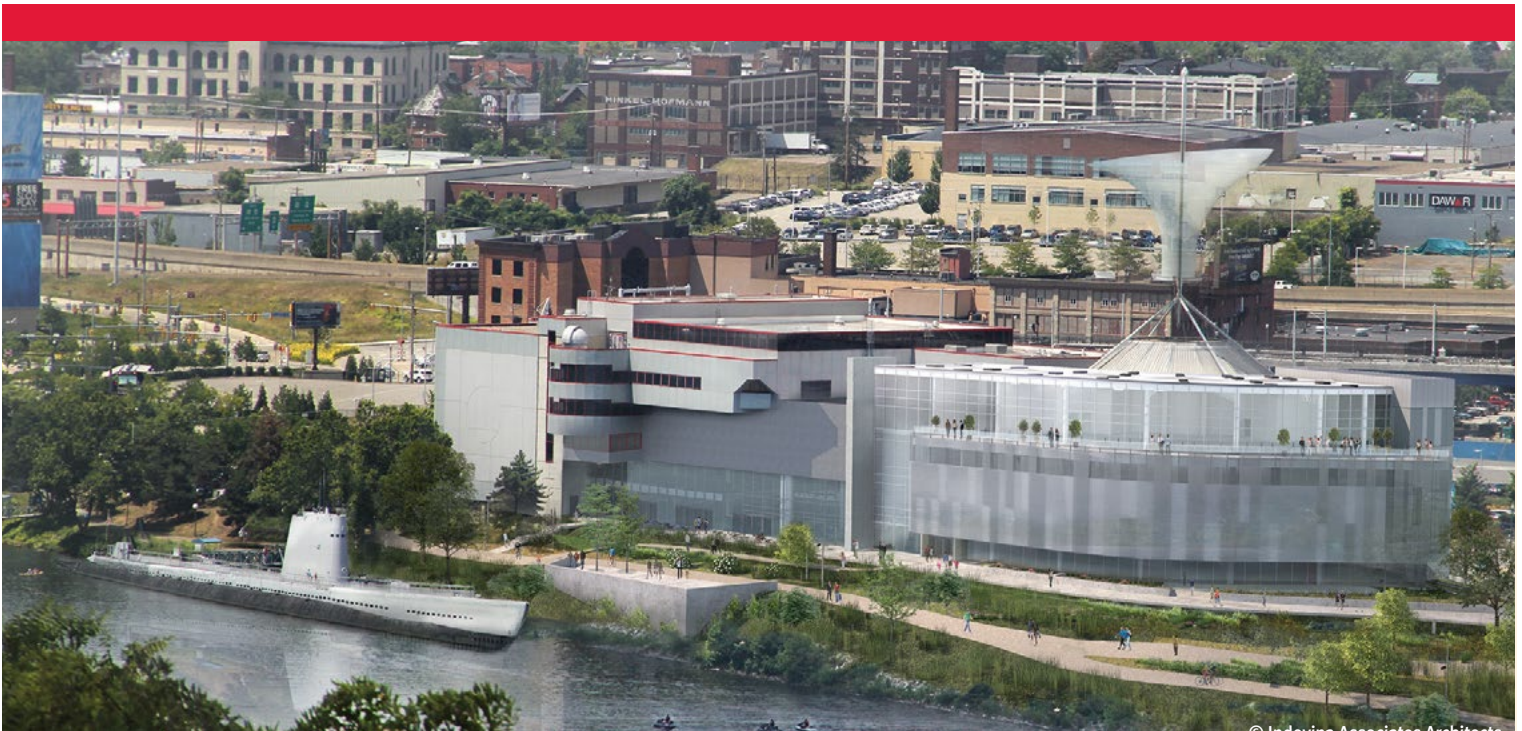
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The addition of a Science Pavilion, as shown in this rendering, will significantly increase educational programming.

Science Center to Double Educational Space, Expand STEM Programming

Twenty-five years after opening on Pittsburgh's North Shore, Carnegie Science Center is planning to expand with a new Science Pavilion offering to Pittsburgh STEM learning labs and a gallery to host blockbuster exhibitions. The Science Center's new Science Pavilion, to be built eastward along the Ohio River facing The Point, will house 6,000 square feet of STEM (science, technology, engineering, and math) Learning Labs that will offer expanded STEM-related programming and competitions and also serve as a regional hub for teacher professional development

activities. Above the STEM labs, a new 14,000 square-foot Special Exhibitions Gallery will allow the Science Center to bring world-class traveling exhibits to Pittsburgh, expanding its annual attendance by as much as 50 percent. The Science Pavilion is a part of **SPARK! A Campaign for Carnegie Science Center**, publicly announced in April. FedEx has pledged \$5 million in support of *The SPARK! Campaign*. The gift, which is the largest corporate gift to *The Campaign*, will fund the FedEx STEM Learning Labs, part of the Science Center's new Science Pavilion. ■