

Tomorrow's Science, Technology, Engineering and Math Workforce Starts with Early Education



"We need to start early—even before kindergarten—to nurture children's natural curiosity. It's a first step in creating the skilled workforce that allows the U.S. to compete globally."

— Rick Stephens, Senior Vice
President of Human Resources
and Administration, Boeing

Astronaut Dr. Mae Jemison, the first African-American woman to orbit the earth, knew she wanted to be a scientist when she was five years old. Fortunately, her teachers nurtured this interest. How many more five-year-olds can we encourage to become tomorrow's scientific leaders?

While it's true that the U.S. needs more scientists now, we also must build the pipeline for the future. And a growing body of research suggests that developing science, technology, engineering and math (STEM) proficiency starts much earlier than high school, middle school or even elementary school.

According to the *Wall Street Journal*, **"Evidence is mounting about the importance of teaching math in preschool and kindergarten...if children don't have good instruction and effective teachers in early grades, they are more likely to struggle later when they face more complicated concepts."** The CEO of DuPont, Ellen Kullman, agrees: "The path to STEM education starts early, before kindergarten, and we need to engage throughout the education process, not just at the college level."

To meet this challenge, businesses should support efforts that build interest in STEM through play-based activities appropriate for young children.

This brief outlines four facts about the importance of early learning to future STEM success:

1. *The math achievement gap starts early, even before kindergarten*
2. *High-quality early education includes real math and science content*
3. *Early math instruction improves later abilities*
4. *Early learning also helps build the behavior traits—perseverance, problem-solving, patience—that STEM employees need*

To enhance the success of America's youngest citizens and build the STEM workforce of the future, businesses should support **quality early childhood education that includes math and science.**

IBM's KidSmart Early Learning Program has donated thousands of kid-sized computer stations to early learning centers around the country. According to IBM's Cathleen Finn, "The focus on STEM in early education is new, but it's part of an effort to keep the focus on engineering so that we graduate more people in engineering."

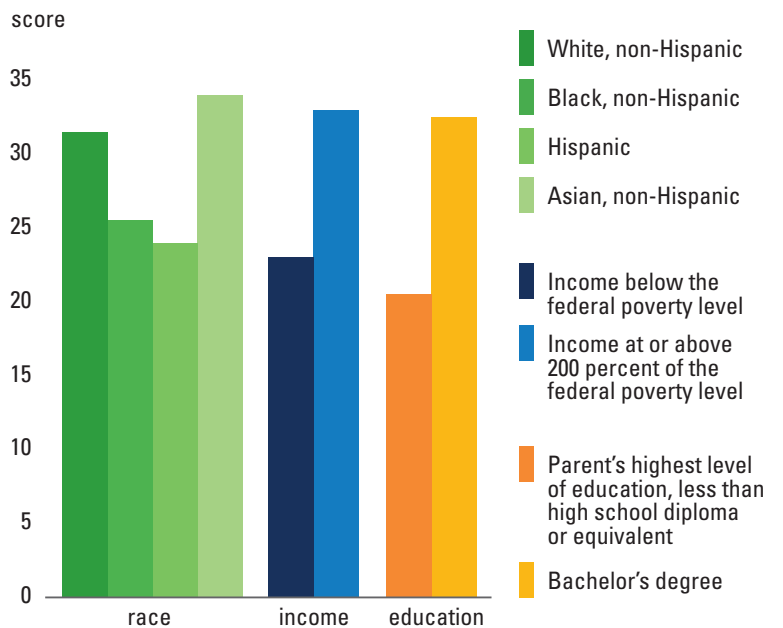
1. The math achievement gap starts early, even before kindergarten

The first three to five years of life are a unique period of growth for a child's brain. Every second, young children's brains develop 700 synapses, the neural connections that support learning and skills. Disadvantaged children can be 18 months behind their peers when they start kindergarten. This gap is as pronounced for math skills as for literacy abilities. U.S. Department of Education data shows that math scores for *kindergarteners* were already higher for children who were white or Asian (than who were African American or Hispanic); whose families had higher incomes; and whose parents were more highly educated (figure 1).

| Preschool Math Topics | Preschool Science Topics |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> • Clocks & calendars • Data & chance • Geometry • Measurement • Money • Numeration • Operations • Patterns | <ul style="list-style-type: none"> • Balancing/scales • Beginning measurement • Earth & environment • Five senses • Insects & spiders • Magnet exploration • Magnification • Sea life • Seasons & weather • Space & science |

Boeing is a founding supporter of Thrive by Five Washington, a public-private partnership that is helping build a comprehensive early learning system in the state. Boeing's funds helped the partnership create and implement an early learning plan that includes numeracy skills for preschoolers, so that "all children enter kindergarten with the mathematics and numeracy skills that will support continuous grade-level mathematical development."

Figure 1: Mathematics scores for children entering kindergarten for the first time in 2010



Source: U.S. Department of Education

2. High-quality early education teaches real math and science

Young children can learn more math and science than we may realize. Good early learning curricula includes a wide range of math and science topics (see box) that are both instructive and fun. Children should experience this content through enjoyable, play-based activities appropriate for their age. The National Association for the Education of Young Children has extensive math and science standards for early learning programs starting in infancy, with topics such as "basic concepts of geometry," and using "the five senses to observe, explore and experiment with scientific phenomena."

JD Chesloff, executive director of the Massachusetts Business Roundtable, points out: "**Young children are natural-born scientists and engineers. Like STEM, investment in early childhood education is a workforce-pipeline issue...And the best way to shore up that pipeline is to start investing in it early.**" The Massachusetts Governor's STEM Advisory Council's plan has a component focused on pre-k, which is now a national model.

3. Early math affects later abilities

While it is a long road from pre-k to Ph.D., a growing body of research shows that early exposure to math is linked to later abilities in that and other subjects:

- A 2010 Canadian study found that “[K]indergarten skills in math significantly predicted second grade math, reading, and general achievement.”
- According to Prof. Greg Duncan of the University of California, Irvine, “Early math concepts, such as knowledge of numbers and ordinality [sequences like 1, 2, 3], were the most powerful predictors of later learning,” and “school-entry reading and math skills are almost always statistically significant predictors of later reading and math achievement... [and] rudimentary math skills appear to matter the most.”
- Children with “persistent” problems in math at ages 6, 8 and 10 were 13 percent less likely to graduate high school and 29 percent less likely to attend college.
- An article in *Science* concludes, **“Preschool children’s knowledge of mathematics predicts their later school success into elementary and even high school. Further, it predicts later reading achievement even better than early reading skills.”**

4. Early learning builds the behavioral traits that STEM employees need

The development of children’s brain synapses not only supports cognitive abilities but also social and emotional skills such as focusing, persevering and working well with others. These are important for all employees, including those in the STEM field.

According to Prof. James Heckman, the 2000 Nobel Laureate in economics, “more than smarts is required for success in life...the empirical literature shows high economic returns for remedial investments in young dis-advantaged children...[that affect] a range of cognitive and non-cognitive skills, schooling achievement, job performance, and social behaviors, long after the interventions ended.”

“One often overlooked benefit of early childhood STEM programs is that they can counteract the destructive and persistent belief that math is for boys. Boys and girls alike internalize this belief as early as second grade, long before any actual gender differences in performance. We need to nip those attitudes in the bud, especially since math is the language of STEM.”

—Linda Rosen, CEO of Change the Equation

These effects are apparent to people on the front lines —according to the 2004 Fight Crime Invest in Kids National Kindergarten Teacher Survey, 88 percent of kindergarten teachers said that children who attended a high-quality pre-kindergarten program were more or much more likely to get along with other children and pay attention, and 86 percent of teachers said these children were more or much more likely to have problem solving skills. These behavioral qualities are critical early foundations for success both in school and the workplace.

International energy giant National Grid has partnered with the Boston Children’s Museum to create and distribute STEM teaching kits for child care facilities, pre-schools, Head Start centers, and public school kindergartens. The kits will include lessons and activities that focus on building science, technology, and engineering skills both for the children and their teachers. According to Marcy Reed, president of National Grid Massachusetts, “There is a projected shortfall of engineers, and working with programs that reinforce those basic skills ties in so well with our ‘Engineering Our Future’ initiative, which is designed to inspire youth to pursue science, technology, engineering and math skills.”

In support of PNC Grow Up Great, the PNC Foundation has partnered with Sesame Street™ to tour “One World, One Sky: Big Bird’s Adventure,” a planetarium show that travels via a mobile dome to early learning centers to provide preschoolers with lessons on math, astronomy, and science.

What can the business community do?

Business leaders can take a variety of steps to help children access quality early education that includes science and math. Visit www.ReadyNation.org or contact us to learn more.

1. Support access to quality early education in your community and state
2. Use “P-12” instead of “K-12” to emphasize that education starts earlier than kindergarten, and include pre-kindergarten in any STEM initiatives
3. Support programs to train pre-k and early elementary grade teachers in math and science
4. Offer employees information on engaging their young children in fun math and science activities
5. Provide expertise, volunteers and resources to local preschools to help develop play-based, hands-on science and math programs

Conclusion

Finding skilled workers will be a constant challenge for American businesses as they compete in the global marketplace. To keep our STEM workforce competitive, we need to develop the young learners who will start the innovative companies and make the scientific breakthroughs that our country needs.

ReadyNation, a project of America’s Promise Alliance, is a business partnership for early childhood and economic success. Our mission is to amplify the voice of business leaders in support of early childhood policies and programs that strengthen our economy and workforce. ReadyNation is a key component of the Grad Nation, a large and growing movement of individuals, organizations, and communities working together and with America’s Promise to end the dropout crisis.



How can ReadyNation help you?

- Use ReadyNation’s free materials to engage business leaders as champions for early learning
- Sign up for our monthly e-newsletter to learn about evidence, business networking events and new champions
- Contact ReadyNation for help in spreading this crucial message—to find speakers in your state and to receive sample speeches, op-eds and other communications materials
- Sign the ReadyNation Pledge to be part of the national movement
- Attend a ReadyNation-sponsored conference or event to connect with the national network of business leader advocates

Add your voice.

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