



## STEM Education in North Carolina

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### **The Case for STEM Education**

A globally competitive, knowledge-based economy is a fact of life for North Carolina's high school students—now and for the foreseeable future—and science, technology, engineering and mathematics (STEM) are critical drivers in that economy. To reduce a potentially crippling workforce knowledge gap and to prepare more students—especially those who traditionally have been underrepresented – for STEM careers, North Carolina must make these disciplines accessible and relevant and fundamentally change approaches to teaching.

### **A Vision for STEM Education**

The North Carolina New Schools Project's vision for STEM-focused secondary school innovation calls for schools that provide the tools and space for exploration and invention and that foster a culture of collaborative inquiry among faculty and students. STEM curriculum emphasizes connections within and between the fields of mathematics and science; heavily and meaningfully integrates technology; and introduces and continually engages students in the engineering design process. The arts and humanities further support the STEM focus, and all courses highlight the role of STEM in the global society and economy.

*The Grand Challenges for Engineering in the 21<sup>st</sup> Century*, as identified by the National Academy of Engineering with input from experts from around the world, cut across engineering disciplines; require collaboration among scientists, mathematicians, and technologists; and have social, economic, and political implications. To prepare students to contribute to the global solution of such challenges and to bolster student motivation and understanding, STEM teaching engages students in learning through active solving of real problems. Students regularly engage in deep discourse, marked by discipline-based justifications. Beyond content knowledge, STEM schools value and cultivate creativity and develop the problem solving, communication, and collaboration skills that drive innovation. Extracurricular activities, summer programs, virtual opportunities, and internships provide learning experiences that increase students' awareness of an interest in STEM and its importance in sustaining and improving our lives.

In addition to standard measures of achievement, STEM indicators of success include student excitement about coming to school, enthusiasm for learning, and a passionate interest in the world. Students exhibit confidence and perseverance when faced with a challenge and further demonstrate the ability to gather and analyze relevant information and synthesize knowledge and skills to solve authentic problems in thoughtful and ethical ways.

In order to prepare students to meaningfully contribute within the rapid pace of change in the 21<sup>st</sup> century, there is a need to consider the STEM disciplines in terms of the knowledge, skills, processes, and dispositions to solve pressing problems facing our world. Tackling Grand

Challenges such as “make solar energy economical,” “provide access to clean water,” “engineer better medicines,” or “secure cyber space” requires consideration of the economic, political, and social barriers to solutions and impact of decisions, as well as issues of ethics, sustainability, and equity. The Grand Challenges promote a project-based approach to teaching and learning and provide rich opportunities for cross-disciplinary connections and service learning. This approach serves to attract students traditionally underrepresented in STEM fields and to prepare students to face the Grand Challenges of the 21<sup>st</sup> century.

## Results of STEM Education in North Carolina

In June 2011, hundreds of students become the first graduates of a pioneering group of STEM-focused high schools in North Carolina. Education that emphasizes math and science is not new. After all, North Carolina led the nation in 1980 by opening the N.C. School of Science and Mathematics as a public residential high school for the state’s best and brightest. But 30 years later, the state’s new STEM schools are on the leading edge of a shift in education in North Carolina and nationwide that raises the importance of mastering those skills not just for an elite few, but for all. Our future demands nothing less.

The 10 STEM schools graduating their inaugural class this year were opened on existing high school campuses that a judge had threatened to close because of far-reaching academic failure. Student performance suffered no less in such subjects as science and math. All of the schools offered new opportunity to students with limited means and resources. All of the schools have above average levels of poverty. These schools were designed with the aim to raise student performance and engagement by changing students’ perceptions of science and mathematics as well as their perceived and achieved abilities in these disciplines, while implementing NCNSP’s five core Design Principles for all innovative high schools—to promote college readiness, rigorous and engaging instruction, personalized learning for students, and shared responsibility by educators for the success of all students.

### **Math improvement in Duplin County:**

For the first time, students at Duplin Early College High School achieved 100% proficiency on the Algebra II end-of-course test following math coaching and professional development provided through NCNSP.

The North Carolina New Schools Project provides assistance to innovative schools through an Integrated System of School Support Services. These school support services, aligned with six key Design Principles, include professional development for principals, teachers and counselors, as well as on-site leadership and instructional coaching. In addition, the NCNSP STEM schools that were developed as part of the state’s strategy to turnaround low performing high schools have received focused professional development and materials to implement National Science Foundation-funded mathematics and science curricula, as well as engineering curriculum. Teams from each STEM school participated in the *Secondary Lenses on Learning: Team Leadership for Middle and High School Mathematics* seminar series and have developed research-based, data-driven mathematics program improvement plans.

Principals and teachers from each of the STEM schools have visited other STEM schools across the country to garner best practices to take back to their schools. Teachers and students from the STEM schools share their projects at an annual Project-based Learning Conference and Student STEM Symposium, and students have created Youth Technology Corps clubs, FIRST Robotics teams, and Junior Engineering Technical Society clubs. STEM schools have the opportunity receive feedback from students through an annual Youth Truth survey with a STEM-focused addendum.

After nearly four years of experience, these schools are demonstrating that changing the way teachers teach and students learn translates into significant gains in performance and student engagement. As a group, students in STEM schools last year achieved twice the statewide pass-rate gains on end-of-course exams in Algebra II, Biology, English and all year-end exams combined. And while STEM schools trailed the state by 18 points in 2009 on that “composite” passing rate, they narrowed that gap to less than 8 points in 2010. At the same time, students in the STEM schools have been more likely to be promoted from 9th grade—a key indicator of eventual graduation—and less likely to drop out. Eight STEM schools had 9th grade promotion rates of at least 92 percent and dropout data from the state showed STEM schools with a combined dropout rate of 1.5 percent—less than half the state's rate of 3.75 percent. The differences are even starker when the schools are compared against the high schools from which they were created in 2007.

The schools remain a work in progress; their performance still has plenty of room for improvement. But their gains are significant. Because of these schools, the students they will graduate this spring will have more and better options from which to choose.

### **The Work Ahead: Scaling STEM Education Statewide**

North Carolina is poised to be a leader in STEM education. Under the state’s \$400 million federal Race to the Top grant, the North Carolina New Schools Project, in cooperation with the N.C. Department of Public Instruction, higher education and the private sector, is developing statewide networks of STEM schools oriented to four fields that are consistent with North Carolina’s economic and workforce development requirements: health and life sciences; energy and sustainability; biotechnology and agriscience; and aerospace and advanced manufacturing. Those schools will serve every region in the state as a critical investment for our state's economic development, and as a doorway to promising futures for students whose options too often have been limited by geography and poverty.

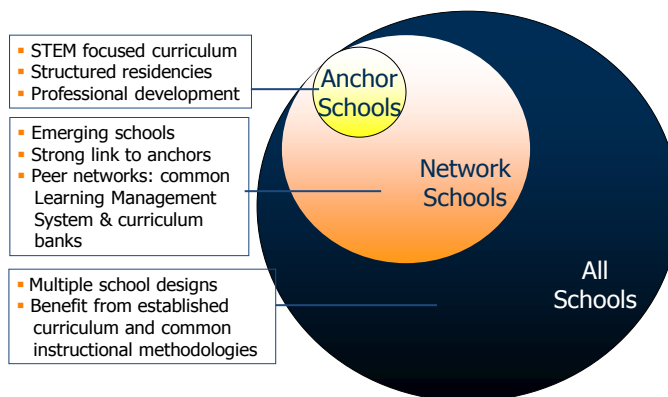
Each network will be served by an anchor school which will accelerate development of a fully articulated and coherent curriculum, instruction, assessment, and professional development model consistent with the vision for STEM education set forth above.

These networks of STEM schools will benefit from stronger ties to North Carolina's changing economy through Industry Innovation Councils that will help support and advise the schools. The councils, representing each of the four Affinity Networks, are intended to tap into the expertise and innovation in the state's industries as a way to strengthen both education and economic development in North Carolina. Members of the councils will learn about effective

models and practices and advocate for the schools at the local and state level. Key goals of the councils further include broadening learning opportunities for students and teachers and helping to strengthen support for improvements to the network.

Affinity networks of schools will also be supported through the development of virtual communities in which faculty and administrators are engaged in e-learning and social networking. These virtual communities will incorporate online professional development, curricular resources, as well as social networking to build true communities of practice. Each virtual community will include links to private sector applications of the STEM theme, as well as connections to higher education partners engaged in supporting the network. The intent is to create a social learning community within each network so that professional development is integrated with user-contributed content, networking, and problem solving.

### STEM School Theory of Change



As North Carolina moves forward in STEM education, the growing networks of NCNSP STEM schools will serve as models for the development of additional schools, as well as for scaling STEM education in all schools across the state. Quality STEM education prepares all students to compete in the 21<sup>st</sup> century economy, not just future scientists or engineers. Increasingly, graduates require more flexible and adaptable understanding and competence in math, science and technology, no matter the future paths they choose. They will be called upon to engineer solutions to problems throughout their personal and professional lives. A rigorous and relevant STEM education provides the foundation for college, work and life in the 21<sup>st</sup> century that is the mission of all North Carolina schools.