

A young girl with brown hair is looking intently at a model of Saturn in a classroom. The model is yellow with a black ring and is mounted on a black stand. In the background, another student is visible, and the room is brightly lit with large windows.

# STRENGTHENING SCIENCE EDUCATION

**THE POWER OF MORE TIME  
TO DEEPEN INQUIRY AND ENGAGEMENT**

NATIONAL CENTER ON  
**TIME & LEARNING**

FALL 2011

“Without fundamentally restructuring the school calendar—particularly at the elementary and middle school levels—to add more learning time, and then prioritizing science during that time, most American students will simply not become either proficient in, or excited about, science.”

*-from Strengthening Science Education*

# STRENGTHENING SCIENCE EDUCATION

THE POWER OF MORE TIME TO DEEPEN INQUIRY AND ENGAGEMENT

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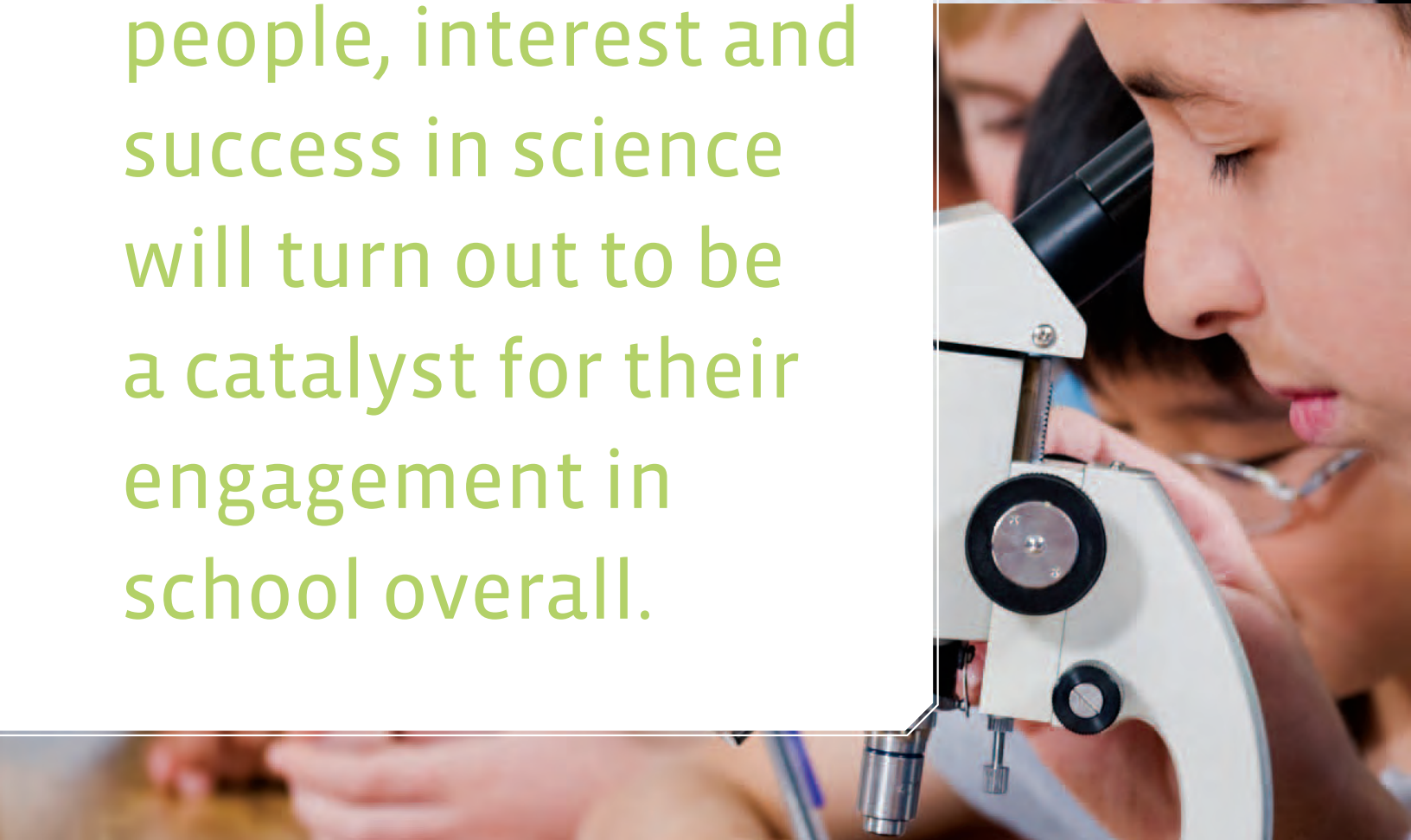
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For many young people, interest and success in science will turn out to be a catalyst for their engagement in school overall.





# SCIENCE EDUCATION AND THE CALL FOR MORE TIME

Children are natural explorers, builders, and inventors. They are curious about how the world works and love to get their hands dirty attempting to find out. Research tells us that science education should build on children's innate curiosity—expanding their scientific knowledge and engagement over time as they examine objects, design and analyze investigations, collect data, and discuss and defend their ideas. For many young people, interest and success in science will turn out to be a catalyst for their engagement in school overall.

There is little doubt, however, that science education in most American public schools is not good enough—either at building science proficiency or engaging children in science. Outcomes on national and international science assessments indicate student proficiency is relatively low and has remained flat for a decade, while college students majoring in science or engineering make up a relatively small proportion of all students.<sup>1</sup> Not surprisingly, the underperformance and lack of interest of U.S. students in science has alarmed educators, policymakers, and civic leaders.

Concerns about the quality of science education dovetail with an overall sense that American public schools are not adequately preparing students—particularly low-income, immigrant, and minority students—to face the challenges of tomorrow. An increasing number of education stakeholders are focusing on the issue of learning time as one key ingredient in the effort to improve student outcomes. They believe that the traditional school calendar of 180 six-hour days per year is too short to enable all students to meet rising expectations for academic performance and also receive a well-rounded education. Education reformers are joining a growing movement in our country to extend the school day—either by adding hours each day or adding days to the school year—with the understanding that more time will bring more opportunities for learning.

The drive to expand learning time holds particular promise for improving science education. In recent years, due to increased accountability for math and reading achievement, the amount of time devoted to science

instruction in public elementary and middle schools has dwindled, making it more difficult to deliver the type of rigorous, inquiry-based teaching and learning that is needed to set our young people on the path to become the next generation of scientists, inventors, engineers, and entrepreneurs.

For this study, the National Center on Time & Learning (NCTL) looked closely at five public elementary and middle schools that have lengthened the school day with a specific goal of improving science instruction. In each of these schools, leaders, teachers, and students are putting the idea of more time for science into practice. All the profiled schools are mainstream district public elementary or middle schools with high-poverty student populations; most also have large numbers of non-native English speakers. Together, these schools offer a glimpse of what is possible when schools and districts make science a priority and when they furnish students and teachers with the time they need to build dynamic science programs.

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## WARNING SIGNS: LAGGING PROFICIENCY AND DECLINING INTEREST IN SCIENCE

The numbers paint a dismal picture: Just 34 percent of fourth graders, 30 percent of eighth graders, and 21 percent of twelfth graders scored proficient on the National Assessment of Educational Progress (NAEP) in 2009, and test scores have shown little improvement during the past decade. In itself, this situation is troubling; when stratified by race and income, the problem appears worse. While 47 percent of White fourth graders, 45 percent of Asian fourth graders, and 48 percent of non-low-income fourth graders scored proficient or higher in 2009, just 11 percent of Black students, 14 percent of Hispanic students, and 15 percent of low-income students reached that mark.<sup>2</sup>

On recent international assessments, U.S. students performed just above the average benchmark in comparison to other countries. Fourth- and eighth-graders' performances on the 2007 Trends in International Mathematics and Science Study (TIMSS) showed no

improvement from 1995.<sup>3</sup> On the 2009 Programme for International Student Assessment (PISA), which tests students' ability to apply what they have learned, U.S. 15-year-olds scored 23rd in science out of 65 countries—slightly behind Slovenia, Poland, and Hungary, and lagging far behind powerhouses China (Shanghai and Hong Kong only), Singapore, Japan, Taiwan, and South Korea.

Lack of science proficiency by high school graduation has consequences along the education pipeline: Only a third of bachelor's degrees earned in the United States are within the science, technology, engineering, or math (STEM) disciplines, compared with 51 percent in Singapore, 53 percent in China, and 63 percent in Japan.<sup>4</sup> Meanwhile, the number of engineering students in India has skyrocketed over the last two decades. This trend likely means this rising Asian nation will exceed the U.S. percentage of STEM majors soon, as well.<sup>5</sup> Yet, the Bureau of Labor Statistics projects that the number of science and engineering jobs will grow by 21.4 percent between 2006 and 2016, nearly double the projected growth rate of 10.4 percent for all occupations during the same time period.<sup>6</sup>

Women and people of color continue to be under-represented in well-paying, secure STEM jobs. Representing about half of the overall U.S. population, women made up just 27 percent of the science and engineering workforce in 2007. African Americans, Latinos, and other under-represented minorities, who together constitute 24 percent of the U.S. population, represent 10 percent of science and engineering professionals with a college degree. During the three decades preceding 2007, the percentage of African Americans and Latinos in non-academic science and engineering jobs inched from three to five percent, and from two to four percent, respectively.<sup>7</sup>

These trends have been noted by everyone from President Obama to America's private sector leadership, from national science organizations to teachers and parents across the country. There is widespread worry that America's declining science proficiency threatens national economic competitiveness and our ability to solve pressing problems in the energy, public health, and environmental sectors. When people do not understand scientific issues, they cannot make well-informed decisions as voters, consumers, or parents. When subjected to inadequate and uninspiring science education, many young people will never discover that science can be the spark that fuels their interest and success in school. Many disadvantaged students will never realize that a career in the sciences is a possibility for them, and such a career means a way out of poverty and a steady path toward a more promising future.

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## DIMINISHING SCIENCE TIME IN SCHOOLS

At just the moment when science education is reaching a crisis, the dedication of public schools to teaching the subject is declining, for the simple reason that science has been edged out as a priority. Since the No Child Left Behind (NCLB) legislation began to hold schools accountable for English and math scores nearly a decade ago, time on science in many American elementary schools has significantly decreased. In one survey, school districts reported that since 2002, they have decreased instructional time for science from an average of 3.76 hours per week to 2.53 hours. The average decrease for science was 75 minutes per week, or a 33 percent drop from the pre-NCLB level.<sup>8</sup>

A recent analysis of 2007-2008 Schools and Staffing Survey (SASS) data found that traditional public elementary schools without extended day schedules spend an average of 2.57 hours per week on science in the third grade.<sup>9</sup>

There is widespread worry that America's declining science proficiency threatens national economic competitiveness and our ability to solve pressing problems in the energy, public health, and environmental sectors.

Some local data sources indicate that some districts are falling far short of providing even two hours of science per week for their elementary-age students. On a 2007 survey of San Francisco Bay Area schools by the Lawrence Hall of Science, 80 percent of K-fifth grade multiple-subject teachers who are responsible for teaching science in their classrooms reported spending 60 minutes or less per week on science, and 16 percent of these teachers reported spending no time at all on science.<sup>10</sup> The Boston Public Schools science director recently told the *Boston Globe*: "We have schools where kids only have the opportunity for science 30 to 60 minutes a week, and we know that's not enough. Unless there's accountability, it's not really going to happen because something else is always going to take priority."<sup>11</sup>



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## NATIONAL LEADERS AND SCIENCE EDUCATORS MOBILIZE FOR CHANGE

At the national level, there are signs of a significant new focus on science education. In November 2009, President Obama announced the *Educate to Innovate* campaign, with the goals of increasing the STEM literacy of all students; moving American students from the middle of the pack to the top in the next decade; and expanding STEM education and career opportunities for under-represented groups, including women and girls. The campaign has announced several high-profile steps, including the creation of the National Lab Network and the White House Science Fair. The administration also has endorsed the formation of Change the Equation, a non-profit organization focused on increasing the impact of business support for better STEM education.

Additionally, the science education community is developing new standards and assessments to reflect recent research on student learning and findings from studies of changing workforce needs. In 2011, the National Research Council (NRC), in collaboration with the American Association for the Advancement of Science, Achieve, Inc., and the National Science Teachers Association, released *Framework for Next Generation Science Standards*, which is more inclusive of technology and engineering than prior standards, and includes a more integrated vision of all four STEM fields. Through a process being managed by Achieve, Inc., an independent, education reform organization that helps states raise academic standards, the states are using this document as the basis for the joint development of a single set of new K-12 science education standards, slated for completion by 2013. While each state will decide whether or not to adopt the new standards, they will provide a solid foundation for the improvement of science education. (Already, 18 states require passing the state's science exam as a requirement for graduation.<sup>22</sup>) The National Assessment Governing Board (NAGB) also has developed new frameworks for the NAEP in science and mathematics, as well as technology and engineering, so that starting in 2014, students will be assessed in all four STEM fields nationwide.

These endeavors, along with related efforts to develop curriculum materials and professional development programs, ground their approach in the seminal science education research published by the NRC in 2007. The NRC report *Taking Science to School: Learning and Teaching Science in Grades K-8* applied knowledge from cognitive science, developmental psychology, education research, the history of science, and other fields to synthesize what is known about how children in grades K-8 engage in science learning.<sup>23</sup> The NRC followed up with a 2008 report *Ready, Set, Science! Putting Research to Work in K-8 Science Classrooms*, which focused on ensuring that

*Taking Science to School* was accessible to science education practitioners.

*Ready, Set, Science!* asserts: “[G]ood science teaching requires (1) extensive teacher knowledge, (2) excellent curricula, (3) effective systems of support and assessment, and (4) more time and attention than are currently devoted to it.”<sup>24</sup> The efforts of the Obama Administration and the science education community detailed above promise to go a long way toward helping American schools fulfill the first three requirements for good science teaching. To meet the fourth requirement—more time—schools may need to expand the confines of the traditional school day and year.



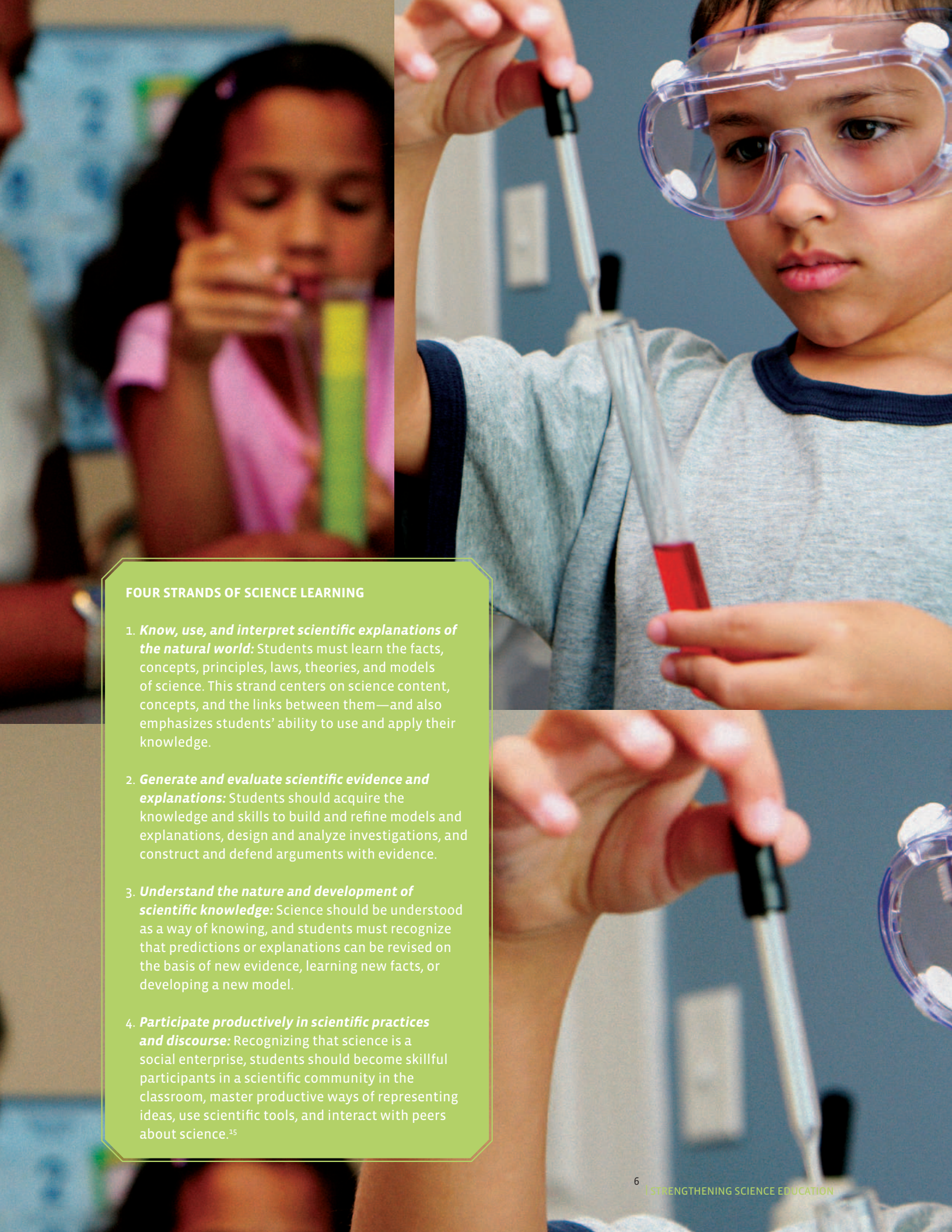
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## WHY BETTER SCIENCE EDUCATION WILL TAKE MORE TIME

According to both NRC reports, the teaching of science should be modeled on how scientists actually conduct scientific inquiry, and this approach will necessitate a shift in the traditional methods employed in science education. No longer should science in classrooms be about merely the delivery of information, but also about analyzing, applying, and reconfiguring that information. Students must learn not just scientific content, but also about scientific process. Further, content and process cannot be divorced from each other, but rather should be treated as an integrated whole, like real scientists do.

As an alternative to the customary approach, the authors of these reports present four interlinked “learning strands that together encompass the knowledge and reasoning skills that students eventually must acquire to be considered proficient in science.” (See box on p. 6.)





#### FOUR STRANDS OF SCIENCE LEARNING

1. **Know, use, and interpret scientific explanations of the natural world:** Students must learn the facts, concepts, principles, laws, theories, and models of science. This strand centers on science content, concepts, and the links between them—and also emphasizes students’ ability to use and apply their knowledge.
2. **Generate and evaluate scientific evidence and explanations:** Students should acquire the knowledge and skills to build and refine models and explanations, design and analyze investigations, and construct and defend arguments with evidence.
3. **Understand the nature and development of scientific knowledge:** Science should be understood as a way of knowing, and students must recognize that predictions or explanations can be revised on the basis of new evidence, learning new facts, or developing a new model.
4. **Participate productively in scientific practices and discourse:** Recognizing that science is a social enterprise, students should become skillful participants in a scientific community in the classroom, master productive ways of representing ideas, use scientific tools, and interact with peers about science.<sup>15</sup>



In the real world of classrooms, however, these four strands are rarely found realized in full. Instead, pressed for time, science teachers often focus on the content facets of *Strand 1*, providing students significant quantities of information on a wide range of topics, but with insufficient attention paid to ensuring students know how to apply their knowledge. As for having students generate their own scientific data and then analyze their meaning—the goals of *Strand 2*—many elementary teachers, in particular, do not have the training, skills, or time to allow students the opportunity to explore phenomena on their own; instead, they confine their *Strand 2* activities to experiments with predetermined steps and results. Teachers' focus on *Strand 3* is similarly inadequate because content tends to be presented in pre-packaged snippets, giving students little chance to categorize and manage those facts on their own. Finally, *Strand 4*, which requires that students work in groups and react to each others' contributions in achieving shared understanding, "is often completely overlooked by educators, yet research indicates it is a critical component of science learning, particularly for students from populations underrepresented in science."<sup>16</sup>

Throughout this paper, we use these learning strands as a lens through which to view and spotlight high-quality approaches to science teaching in the profiled schools. Such a paradigm does not suggest that these schools are overtly designing their methods around the learning strands or that educators there necessarily conceptualize the ideal imagined by the four strands. Instead, the schools have taken advantage of expanded science time to open up more opportunities for a broader approach toward science education and, through this broader approach, they have been able to tap their instincts as educators and integrate aspects of the four strands in their teaching of science.

In part, the more limited approach to the way science education is conventionally practiced in the United States arises from the fact that typical state (and district) learning standards prioritize content knowledge above application of knowledge. Indeed, *Taking Science to School* and *Ready, Set, Science!* propose a fundamental reorganization of K-8 science curricula to center around a defined set of core scientific concepts, creating learning progressions that build students' understanding and knowledge of each concept over time. This reorganization is reflected in the supporting document for the development of the *Framework for Next Generation Science Standards*. Whether or not districts and schools restructure their curricula according to these recommendations, mastering all four strands and raising science proficiency among elementary and middle school students will likely demand (a) more instructional time to teach and learn science and (b) more time to build teachers' capacity to educate their students in accordance with the four strands.

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## THE POTENTIAL OF PARTNERSHIPS TO INCREASE STUDENT ENGAGEMENT AND COMPETENCE IN SCIENCE

A September 2010 report by the President's Council of Advisors on Science and Technology addressing ways to improve K-12 STEM education pointed out that raising STEM proficiency is only half the battle—inspiring young people to learn STEM and pursue STEM careers is just as important.<sup>17</sup> An oft-cited 2006 study by University of Virginia Associate Professor Robert Tai and colleagues found that interest in science was a more important factor than proficiency for predicting which middle-school students would ultimately earn science degrees in college.<sup>18</sup>

Science learning designed and led by science centers, museums, and community-based organizations—often called "informal science education"—can be particularly effective in increasing students' science knowledge and engagement. In 2009, the National Research Council published *Learning Science in Informal Environments: People, Places and Pursuits*. Declaring that "across all venues—everyday experiences, designed settings, and programs—individuals of all ages learn science," the Committee on *Learning Science in Informal Environments* offered two additional learning strands in science. These strands are particularly relevant to informal science learning, and bookend the four that were defined by their colleagues in *Taking Science to School*. The committee added a first strand focused on experiencing excitement, interest, and motivation to learn about phenomena in the natural and physical world, and a final strand that encourages everyone to think about themselves as science learners and to develop an identity as someone who knows about, uses, and sometimes contributes to science.<sup>19</sup>

Two more recent reports—*Surrounded by Science* (NRC's 2010 follow-up to *Learning Science in Informal Environments*) and *Making Science Matter*, a 2010 report by the Center for the Advancement of Informal Science Education (CAISE)—explore the potential of collaborations among science institutions, community-based organizations, and schools to offer engaging, comprehensive science learning experiences to young people.<sup>20</sup>

Analyzing a set of exemplary collaborations, *Making Science Matter* asserts that “formal-informal” collaborations can be a powerful strategy for making science learning more accessible and compelling to young people by:

- Advancing students’ conceptual understanding in science;
- Improving students’ school achievement and attainment;
- Strengthening students’ positive dispositions towards science;
- Advancing teachers’ conceptual understanding in science; and
- Supporting teachers’ integration of inquiry and new materials in the classroom.

According to the authors, formal-informal collaborations are important because the emerging vision of scientific literacy “involves a rich array of conceptual understanding, ways of thinking, capacities to use scientific knowledge

for personal and social purposes, and an understanding of the meaning and relevance of science to everyday life” that no single sector can provide by itself. Formal-informal collaborations can enrich and connect children’s varied learning experiences across time and settings, particularly for high-poverty schools that tend to be “under-resourced, text-based, and test-driven.”

The report notes that “formal-informal collaborations take significant time and energy, often unacknowledged by sponsors of the work, and are a continuing but valuable process of evolution for individuals and institutions.”<sup>21</sup> Such an approach to science education, which blends the best of classroom and informal learning in school, has the potential to be both rigorous and engaging, build competence and confidence, and involve all young people, regardless of their ability to enroll in additional learning opportunities beyond school. Significantly, for many schools, engaging in these partnerships at the level of depth required to produce the student outcomes desired is not possible within the confines of the regular day.





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## REASONS FOR THIS STUDY: THE NEED FOR ADDITIONAL MODELS

While education leaders and policymakers are making steady progress in establishing new guidelines and frameworks that will promote effective science learning, most school leaders still need more information about the practical ways they can strengthen and expand science education in their own schools.

Such a need is ever greater now that more schools are expanding (or seeking to expand) learning time. The U.S. Department of Education has funded roughly 1,150 schools to increase learning time as part of the School Improvement Grant (SIG) program. In states like Massachusetts and Colorado, and districts from Houston to Pittsburgh to New Orleans, there are initiatives and schools that have built in significantly more time for the express purpose of enhancing teaching and learning. Schools have expanded their schedules in order to expand learning opportunities in core academic classes and provide supplemental academic content, broaden educational offerings through enrichment programming, and strengthen instructional quality by enabling increased teacher collaboration and professional development.

Moreover, there is also considerable support from the Obama Administration and among Congressional education leaders for ensuring that the reauthorization of the Elementary and Secondary Education Act (ESEA) includes resources and a policy framework for increasing learning time in high-poverty, low-performing schools across the country.<sup>22</sup>

Yet, despite this mounting drive to expand time and a deepening understanding of its many benefits, educators are only just beginning to access information about how to best leverage additional time to support student learning. Because the implementation of new standards and accountability through No Child Left Behind has focused on English and math, the field of science education is in particular need of additional research, especially as more states move to enact high standards and accountability in science. This study serves as a first attempt to fill a compelling need for more models of effective expanded-time science programming.

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## STUDY METHODOLOGY

For this report, NCTL chose to study five schools that have expanded their schedules with a goal of improving science instruction. We use case studies of these schools to explore the following questions:

- How did additional time enable school leaders and teachers to change their approach to science instruction? What new opportunities have they found?
- What results are they seeing?
- Has student engagement in science and knowledge about science careers increased along with standardized test scores?
- What unforeseen challenges are the schools encountering, and how are teachers and leaders dealing with them?
- What recommendations do these school leaders and teachers have for other educators currently considering expanding their schedules to devote more time to science?

The expanded-time schools included in this study look very different from one another. There is a mix of urban and rural schools, and they range in size from 204 to 773 students. Three are elementary schools (grades K-5), and two are middle schools (grades 6-8). Despite the range of sizes, locations, and approaches to increasing learning time, all five expanded-time schools have majority high-poverty student populations, and several have significant groups of students whose first language is not English. More importantly, students in all but one of the profiled schools have demonstrated gains in proficiency on science assessments, a key criterion we used for inclusion in the study. (The expanded-time program at the fifth school had been in operation less than one year, and thus, did not yet have state outcomes data; formative assessment data were available.) The schools examined are:

- **Matthew Kuss Middle School** in Fall River, Massachusetts, participating in the state-supported Massachusetts Expanded Learning Time Initiative
- **Thurgood Marshall Academy Lower School**, a New York City elementary school implementing a 2.5-hour extended day available for all students, in partnership with the Abyssinian Development Corporation. The After-School Corporation—in collaboration with New York City Public Schools and the Department of Community and Youth Development—supports the TMALS-Abyssinian partnership as a part of its ExpandED schools initiative
- **Edith Starke Elementary and Pierson Elementary** in Volusia County, Florida—part of a district-led, and Title-I funded, effort to lengthen the school day by one hour in targeted Title I schools
- **Jane Long Middle School** in Houston, Texas, which expanded its school day for sixth graders only, using a mix of school funds, external grants, and resources raised by the school's non-profit partner, Citizen Schools

To produce this report, its lead author and the senior researcher of NCTL engaged in extensive background research, visited each of the schools, interviewed students, teachers, administrators, district personnel, staff, and leadership of external partner organizations, and also conducted follow-up interviews. The research team observed science classes and electives using a modified version of the “2005-2006 Local Systemic Change Classroom Observation Protocol” developed by Horizon Research, Inc.

The following four chapters take a close look at each of these schools and provide many first-hand accounts of the science education goals and day-to-day programming elements at each school. Not surprisingly, many changes—both large and small—have taken place at these schools since the data were collected. The case studies are written with information collected at the time of the site visit. In cases where significant changes have taken place since spring 2011, updated information is appended at the conclusion of the study.

While the schools each use time very differently, the following key successful practices emerged across all five schools:

- 1) Increasing students’ science engagement and proficiency by:
  - integrating more hands-on learning activities and facilitating more scientific discourse within the classroom;
  - implementing specific strategies to counter deficiencies in reading levels, background context, and vocabulary; and
  - enriching the core science content and creating connections to science careers and role models through formal and informal collaborations with outside partners.
- 2) Strengthening teachers’ capacity to implement an enhanced science program by:
  - providing professional development focused on improving content knowledge and pedagogical skill;
  - using student assessment data to drive instructional improvement; and
  - ensuring that core science curricula are uniform across classrooms and mapped to district and state standards and assessments.

In the final chapter of this report, we explore these cross-cutting themes and practices, as well as describe several key success factors and the on-going challenges the schools face, as they work to sustain and strengthen the gains they have made in science education.





# CASE STUDIES





# MATTHEW KUSS MIDDLE SCHOOL

FALL RIVER, MASSACHUSETTS

Poster-sized pictures of students cover the brick walls of the clean, spacious first-floor hallway of Matthew Kuss Middle School in Fall River, Massachusetts. Young faces flash infectious smiles as they accept trophies, perform in a

“In supporting Expanded Learning Time, Kuss parents took a leap of faith. Now there is a consensus that ELT is having a deep, positive impact on the school and our students.”

Nancy Mullen, Principal, Matthew Kuss Middle School  
Fall River, Massachusetts

play, or aim a fierce kick at a soccer ball. One student looks down, reading in studied concentration, while another jots notations in an open notebook as her partner peers into a microscope. The pictures communicate joy, pride, friendship, work, and accomplishment—embodying the culture of the Kuss community.

This community has come a long way since 2004, when, still in its former, rundown building, Kuss was the first school in the state branded “chronically underperforming” by the Massachusetts Department of Elementary and Secondary

Education. Struggling with high truancy, under-enrollment, and unsustainable levels of staff turnover, the school’s condition was symptomatic of Fall River’s decades-long economic decline. An industrial powerhouse in the early part of the 20th century as the center of textile manufacturing in the U.S., Fall River has struggled to regain its former prosperity since the manufacturing companies relocated to the South and eventually overseas. More than 80 percent of the 650 students at Kuss are low-income, compared to 34 percent across the state.

## Why Expanded Learning Time and Why Science?

Nancy Mullen was appointed principal of Kuss in the summer of 2005. Almost immediately after arriving, Mullen led her staff in applying to join the first cohort of Expanded Learning Time (ELT) schools under the new Massachusetts initiative. They planned the school redesign over the course of the 2005-06 school year.

In September 2006, Kuss opened with an eight-hour school day for all students and teachers (about 100 minutes more per day than the pre-ELT schedule). Since then, ELT has proved to be a powerful catalyst to accelerate student academic achievement and create a well-rounded education and enrichment program that increased student engagement and attendance. In 2009, when Kuss moved to

its new building perched on a hilltop overlooking Mount Hope Bay, its academic transformation was already well underway. Kuss has made steady achievement gains, reaching Adequate Yearly Progress (AYP) targets for the past two academic years. The school now has a waiting list and is home to the district’s Gifted and Talented program.

From the beginning of the ELT Initiative, Mullen saw the potential to improve science instruction. Low proficiency levels evidenced the need, and the Kuss had new energy around science instruction created by its designation in 2005 as a NASA Explorer School. The NASA program, which included teacher professional development, student involvement in simulcasts and “e-missions,” and cross-programming within the NASA school network, attracted a cohort of talented science teachers to the Kuss.

Said Mullen, “Massachusetts doesn’t count science for AYP in middle school, but we consider the eighth-grade science test scores to be just as important as English language arts and math scores.” The Kuss approach to improving science proficiency is two-fold: expanding and improving core academic science time and creating a set of hands-on science electives to increase students’ engagement and knowledge. In addition, planning and professional development time supports teachers in using the science time effectively.

### Matthew Kuss Middle School Student Subgroups

2010-2011	
Qualify for free/reduced lunch	82%
First Language Not English	23%
Special Education	18%

#### **MCAS: Massachusetts Comprehensive Assessment System**

*The science MCAS is first administered in fifth grade. The eighth-grade science test, which covers science material taught in sixth through eighth grades, does not impact a school’s AYP or an individual student’s grade promotion. Passing one tenth-grade science MCAS (Biology, Chemistry, Introductory Physics, or Technology/Engineering) is required for high school graduation in Massachusetts.*

### MORE TIME FOR SCIENCE TEACHING AND LEARNING

#### **Core Science Class**

In response to the state’s intervention in 2004, Kuss redesigned its schedule to include a 90-minute daily block of math, science, and English language arts for all students beginning in the 2005-06 school year. With 300 additional hours of learning time beginning in fall 2006, Kuss implemented an innovative modular schedule so that each of the 650 students now has an individualized schedule that includes a customized balance of academics and enrichment.

Said science teacher and 18-year Kuss veteran Cindy Wrobel, “Having the extra time is valuable. We reinforce key concepts, and we have the opportunity to present them in different ways to meet the diverse needs of students.” Continued Wrobel, “Our students lack role models, and generally lack opportunity and exposure to new experiences and different places. ELT gives us the opportunity to provide the guidance and nurturing our students need.”

Over the past six years, the science faculty has aligned the curricula to the state science standards, which Math/ Science Department Chair Ken Ward only half-jokingly referred to as “the bible.” The faculty team is now working with the other Fall River middle schools and the elementary schools on vertically aligning the K-12 curricula, developing uniform interim assessments across the district, and completing an analysis of any gaps between the curricula and the standards.

Ward, who has been teaching at Kuss for more than 30 years, described the impact of additional time on science instruction: “The expanded time has allowed us to integrate more rigor into teaching and learning. We can go more in-depth and ask more complex questions of the students. We have the time to require not just the answer but the why behind the answer—we teach students how to present their evidence, and we help them to make better connections among scientific concepts. We can take the time now to make sure everything is resonating.”

In 2008, Kuss educators identified improved writing skills as an academic priority across grades and subjects. Students demonstrated a distinct weakness in achieving proficiency in “open response” questions (multi-paragraph essays on state standardized tests). Now, every class in the school, including science, integrates writing into the curriculum and displays exemplary student open responses with parsed explanations of how the author would have received a four: the highest open response score on state exams. Science teacher Sarah Chapin gave details: “Kids are writing and editing their work as a group, with their peers. They are constantly going through the process of writing, editing, and revision as part of the science class. We devote additional time to this priority.”

## THE MASSACHUSETTS EXPANDED LEARNING TIME (ELT) INITIATIVE

Massachusetts is the only state that has implemented a publicly-funded, statewide Expanded Learning Time (ELT) Initiative. Following a planning year, an original cohort of ten schools (including Matthew Kuss Middle School in Fall River) opened as ELT schools in fall 2006. The program has expanded to 19 public schools serving a total of 10,500 students in nine districts. The schools receive \$1,300 per student from the state Department of Elementary and Secondary Education (DESE) to expand instructional time by a minimum of 300 hours per year. Encouraged by DESE to completely redesign their school day from the ground up, these schools are required to add time for core academics, enrichment courses, and teacher planning along with professional development.

The Massachusetts ELT Initiative is based on these guiding principles:

- **Significantly More Hours of Learning for Every Student**—Each participating school adds 300 hours over the course of the school year. This time can be added in the form of longer school days or additional days in the school year, but every student must participate.
- **Complete School Redesign**—Each participating school aims to completely redesign its educational program tied to student needs, student goals, and a clear, school-wide academic focus.
- **Balanced Use of Additional Time**—Additional time must be distributed in three key areas: (1) core academics, (2) enrichment opportunities, and (3) teacher planning and professional development.
- **Competition for State Funding**—Applying districts and a subset of their schools must: (1) have completed a rigorous planning process, (2) developed a high-quality ELT proposal, and (3) be able to prove that they have the capacity for successful implementation.
- **Flexibility and Innovation**—Participating schools and districts have the flexibility to create their own redesign approach, including goals, staffing plans, labor agreements, compensation, and schedules. This flexibility is intended to spur innovation and has resulted in a wide range of approaches to the complex challenges of adding time.
- **Inclusive Planning Process Prior to Implementation**—Schools are encouraged to include diverse stakeholders, especially teachers and parents, in a comprehensive planning and redesign process over the course of a full year so they can develop higher quality proposals and have greater success when implementing the expanded-time schedule.
- **External Partnerships to Enhance School Redesign**—Preference is afforded to schools that include partnerships in various aspects of the educational program, because external partners can contribute expertise and resources that schools may not have when working alone. Partners can include universities, community-based organizations, health centers, businesses, artists, and many others.
- **Accountability for Results**—Each ELT school has developed a three-year performance agreement with the state, setting achievement goals across a number of areas. In addition, the U.S. Department of Education is funding a six-year evaluation of the Initiative.





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## INITIATIVE RESULTS

After four years, Massachusetts ELT schools are demonstrating the impact more time can have. An evaluation showed in 2010 that, compared to other high-poverty schools and to a set of matched comparison schools, ELT schools are more likely to be high-growth schools. (High-growth schools are those where high-poverty students are learning far faster than expected.) There is a fair degree of variation in both implementation and outcomes among the 19 schools, but there are some standout performers, especially for those that have been in the program the longest.<sup>23</sup> Fourth-year schools significantly outperform their matched comparison schools in fifth-grade science, the tested subject where ELT schools provide significantly more time than the matched schools.

**Fourth-year schools significantly outperform their matched comparison schools in fifth-grade science, the tested subject where ELT schools provide significantly more time than the matched schools.**

As for outcomes not related to test results, a statistically significant higher proportion of teachers in ELT schools reported that they are satisfied with the amount of time available for instruction in English language arts, math, and especially science and social studies than those in the matched comparison. Students in ELT schools also reported that they were able to choose activities not previously available.

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## ABOUT MASSACHUSETTS 2020

*(State Affiliate of National Center on Time & Learning)*

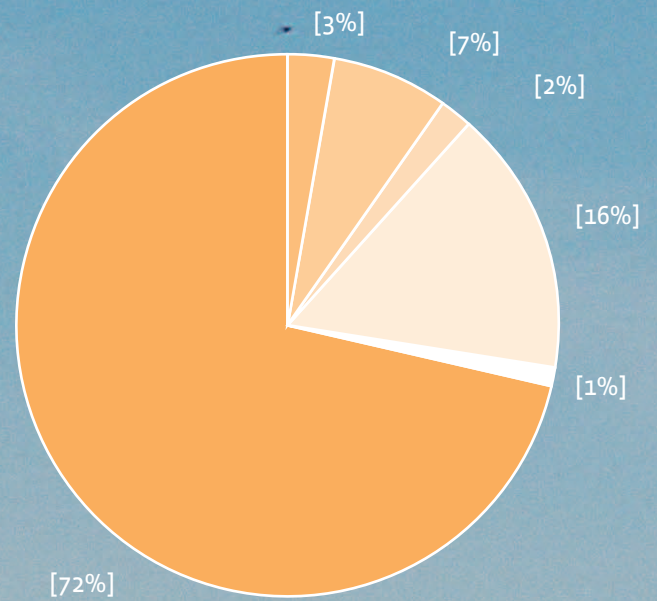
Since 2006, Massachusetts 2020 has provided technical assistance to support the planning, implementation, and continuous improvement of the Expanded Learning Time Initiative at participating schools across the state. This assistance includes:

- Developing and leading bi-monthly convenings where ELT school and district leadership teams receive in-depth, targeted assistance on topics related to effective ELT implementation;
- Providing monthly school-level coaching and assistance to a subset of ELT schools, in partnership with Focus on Results, a national organization that provides in-depth technical assistance to schools aimed at improving student outcomes;
- Coordinating periodic school visits for ELT schools to see effective expanded-time practices in action;
- Facilitating networking and cross-school sharing opportunities for current ELT schools and those interested in learning more about expanded time models;
- Advocating at the state and national levels for funding and to build support for ELT;
- Providing research and analytical support, particularly around identifying effective practices and emerging models; and
- Facilitating and supporting ELT schools in creating partnerships with external organizations to enhance teaching and learning in multiple ways, including providing enrichment programming, teacher professional development, or in-depth academic content. In 2008, Massachusetts 2020 created the ELT School-Community Grant Program to provide additional support to exemplary school-community partnerships.

### Matthew J. Kuss Middle School 2010-2011

Number of Students:	650
Grades:	6 – 8
Students Participating in the Expanded Day:	100%
Former Schedule:	7:40 AM – 2:30 PM
Expanded Day Schedule:	7:13 AM – 3:35 PM
Time on Science per Week (pre 2005 redesign):	Core Science: 260 minutes
Expanded Day Time on Science per Week:	Core Science: 450 minutes
Elective Science per week:	90 minutes

### Matthew Kuss Student Demographics | 2010-2011





Through a partnership with the Urban Ecology Institute (UEI), Kuss faculty members also have used the expanded science time to integrate field studies into the core curricula for every student. In 2009, Massachusetts 2020 brokered this connection between Kuss and UEI, a Boston-based nonprofit dedicated to increasing youth interest in science and environmental stewardship through hands-on, inquiry-based urban ecological studies. At the time the Kuss partnership began, UEI had developed curricula and training focused on winter ecology and the harbor and watershed ecosystems for high school teachers, and UEI also was partnering with 21st Century Community Learning Centers and other after-school programs, but had not worked directly in middle school classrooms. Lindsey Cotter-Hayes, UEI's Director of Education Programs, explained, "The very first year we started working with Kuss, they wove our field studies right into the core academic science program."

Last year, UEI was awarded a grant from the Dominion Foundation to develop field studies units for Kuss focused on the nearby Taunton River. UEI is providing professional development to Kuss science faculty on running an outdoor classroom; conducting field studies with groups of students; and teaching the students to use equipment including hand-held GPS units and digital cameras. The studies focus on the health of the Taunton River and its immediate environment and cover topics such as water and soil quality and the impact of invasive species. As part of the chemistry unit, students analyze the pH, salinity, coliform, phosphates, and nitrates in water from the Taunton River and the ocean at high and low tide. The units are linked to the state standards at grade level. One teacher reported: "Students in my class asked, without prompting, about how the Brayton Street power plant affects the river. They were concerned about the temperature of the river encouraging growth of coliform bacteria, as they didn't want the river to stink. There were also numerous comments of 'I feel like a real scientist' and a general improvement in behavior and lab skills as they stepped up to the task of using 'real science stuff' and figuring out difficult directions."

Because Kuss is incorporating these units into the core science curriculum, every student in the school participated in field studies this year, for a period of between one and four weeks. Cotter-Hayes of UEI reveled in seeing the entire Kuss science faculty embrace field studies. One teacher reported, "Our eighth-grade class has been using the [UEI] curriculum throughout the year, incorporating activities such as nitrogen cycling and food webs. These activities help to supplement our existing curriculum and address previously missing standards. Students really enjoyed the nitrogen cycle unit. They could

see how nitrogen moved through plants and atmosphere and animals, sometimes getting stuck in one particular loop. This provided them with a more accurate picture than the text, which makes it seem as if molecules cycle everywhere at all times."

Cotter-Hayes noted that teachers saw many examples of students with prior behavior and engagement issues excelling in the field studies units. UEI has contracted with Lesley University in Cambridge, Massachusetts to formally evaluate its initiative, and is exploring the potential of expanding its partnership to other Fall River schools.

### **Science Electives**

In addition to five 90-minute core academic science periods, all Kuss students take a 90-minute block of elective science per week. Science electives are designed with two main goals: 1) targeting gaps in the standard curricula or concepts that students are having difficulty grasping and 2) awakening students' passion for science by having teachers design and teach electives focused on their own science interests. Science electives—along with enrichments in performing arts, sports, martial arts, and other areas—are designed sequentially to build student mastery over time. Teachers are given planning time to design their electives, which are mapped to the state science standards.

### **Kuss Science Electives 2010-2011**

Design Lab

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Duct -Tape Engineering

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Weather Watchers

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Field Studies (in partnership with the Urban Ecology Institute)

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Project Go-Green!

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Astronomy I, II, and III (in partnership with The Harvard-Smithsonian Center for Astrophysics)

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Forensics

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Marine Ecology

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Science of the Titanic

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Mosaic of Science

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Chapin teaches the Field Studies elective, which delves deeper into the UEI curricula. “The opportunity to teach science electives was a big reason I came here. I want to teach the science I am passionate about—hands-on ecology.” The electives focus on active, project-based learning. Science teacher Jamie Guile pointed out, “In science, knowledge comes from mistakes, from participation, and from teamwork. Electives allow this and the kids are into it.” All the electives are designed around the science standards, and cover concepts and principles that are taught in the core science classes.

Said Guile, “In seventh-grade science, we cover universal design and the students build a bridge in one of the hands-on activities. The Design Lab elective gives them the orientation, the foundational knowledge for this.” The teachers also noted the confidence and pride displayed by those students who have built prior knowledge of a scientific concept through an elective. “It’s great when they have confidence in their own knowledge of science,” said Guile.

Students in Michelle Burgess’s Project GO Green! class make recycled paper and study environmental stewardship. Burgess said, “One of the benefits of electives is that students get to choose them. Sometimes they choose something because a friend did, and they don’t realize how much they will be interested and learn and be engaged.”

In addition to the collaboration with UEI, Kuss has built collaborations with Project Oceanology and the Harvard Smithsonian Center for Astrophysics around science electives.

**Project Oceanology:** Last year Burgess and Guile participated in Building New England Connections, a two-day professional development institute offered by Project Oceanology in Groton, Connecticut, focused on using the watersheds and coastal environments of New England as a context for learning science. The institute, funded through the National Oceanic and Atmospheric Administration’s Bay-Watershed Education and Training Program, provided Burgess with content and lesson plans for her Marine Ecology elective. Guile and Burgess subsequently led the sixth grade on an overnight trip to Project Oceanology where they participated in a research project of coastal and watershed environments which included taking an oceanographic research cruise, working in a laboratory, and completing field studies. Bristol Community College underwrote the cost of the sixth-grade trip.

**Science MCAS Review:** In the second half of the academic year, eighth graders take a 20-week course which reviews content on the Science & Technology MCAS (the state standardized assessment, which tests mastery of the state’s science standards for grades six through eight). The Kuss science faculty members jointly teach the course, with the teacher of each grade level focusing on the science content taught during that grade. “It helps to have different teachers lead the course—especially teachers the eighth-graders have not had in a while. It jogs their memory for sixth-grade science when the sixth-grade teacher is the one reviewing it. And it makes sense—those are the teachers currently teaching that content,” said Guile.

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### MORE SUPPORT FOR USING SCIENCE TIME EFFECTIVELY

Kuss science teachers meet weekly in their grade-level group, and monthly as an entire faculty. They share strategies for organizing the classroom, facilitating student conversation, and designing activities, and they observe their colleagues at work. Chapin noted, “We really want to be in each other’s classrooms more. We want to experiment with different teaching approaches and observe how it works, to create ways to continuously improve.”

Said department chair Ward, “The additional time has enabled teachers to meet more frequently and more effectively. Teachers are looking at data, sharpening their skills on data analysis, and sharing data with each other.” As an ELT school, Kuss receives free training, through Massachusetts 2020 and Focus on Results, in how to use data to drive instructional improvement. Principal Nancy Mullen noted, “One big ah-ha moment for us was when Focus on Results and Massachusetts 2020 urged us to display the data prominently, share it with kids, set mutual goals, and have the kids and families sign MCAS contracts. This created shared accountability—we are all responsible for the success of our kids.”

Kuss science teachers also participate in science-focused professional development led by Chapin, who is a trainer for the FOSS (Full Option Science System) curriculum used in the core science classes, and through science partner organizations.

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## ELECTIVE SPOTLIGHT: ASTRONOMY IN-DEPTH

Through its membership in the NASA Explorer Schools network, Kuss Middle School was introduced to the Harvard-Smithsonian Center for Astrophysics (CfA) and its Science Education Department (SED). Kuss students were then invited to join a project SED was leading for the National Science Foundation (NSF), called Innovative Technology Enabled Astronomy for Middle Schools, or ITEAMS. Part of NSF's ITEST (Innovative Technology Experiences for Students and Teachers) program, the goal of the ITEAMS project is to inspire participants to pursue STEM careers and increase their mastery of foundational STEM subjects.

Using the SED's robotic telescopes in an online MicroObservatory, Kuss students involved in ITEAMS engage in real-life research. Thanks to a secure website, students can even use the telescopes while sitting in front of their computers at school.

Said CfA's Science Education Specialist Jaimie Miller, "The students are engaged in the same kind of research as our astrophysicists." The partnership is in its third year and is preparing for scale-up. There are a total of 70 Kuss students participating, split between first, second, and third year of participation.

The project's learning progression begins with first-year students learning how to use the robotic telescopes by examining deep space objects and investigating questions of distance, size, and scale. Second-year students are engaged in individual research projects on subjects of their choice—for example, phases of the moon or specific space objects. Said Miller, "In the same way scientists do, they

take pictures with the telescopes, download and process the images, and use them in their research." The third-year cohort completes a capstone project contributing to the SED's real-time study of exoplanets. This cohort works as a group to take pictures and analyze data.

The project is led by Kuss science teachers Sarah Chapin and Sandy Sullivan, who teach the Astronomy elective and participate in the SED's professional development three to four times per year. The SED also provides access to the robotic telescopes, other tools, and activity plans for the teachers. Explicit connections to science careers are made on field trips, where students travel to Harvard to visit the science laboratories and to the New England Aquarium for a behind-the-scenes tour to meet the Aquarium's marine scientists.

Miller said, "What I love most about [the Kuss students] is that they all ask questions. That's the beginning of any kind of academic learning—the ability to ask questions. They are asking the same questions that scientists are investigating right now. They have a really keen insight and curiosity that is impressive." Miller noted that the classroom environment created by Chapin and Sullivan encourages participation and inquiry: "The teachers create an environment where questioning is okay—it's expected—and the students are treated equitably, by each other and the teachers. The kids are really smiling from the inside when they get the answers right."

The project is evaluating its impact through subject matter tests and a student survey assessing self-identity (identifying as a "science person"), efficacy (feeling capable of becoming a scientist) and career intention.

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## IMPACT

The additional time for science and the deep formal-informal collaborations built by the Kuss through ELT enable students to become more engaged in their own science learning in ways that are aligned with the National Research Council findings on teaching and learning science. For example, through the Urban Ecology Institute curricula, students apply science concepts to environmental concerns in their home environment, which is an example of *Strand 1* from *Taking Science to School*—to know, use, and interpret scientific explanations of the natural world. Students who collect data through UEI and the Harvard-Smithsonian Center for Astrophysics Astronomy project, along with receiving explicit instruction on how to present evidence, are exposed to *Strand 2* skills and knowledge—generating and evaluating scientific evidence and explanations. As the third-year students contribute to the center’s real-time study of exoplanets, they learn about the nature of science (*Strand 3*) and foster their own identities as science learners and people who know about, use, and contribute to science, reflecting a learning strand introduced in the NRC’s *Surrounded by Science*. Encouraging students to ask scientific questions and discuss ideas respectfully with peers exemplifies *Strand 4*—participating productively in a scientific community.

The focus on science in the expanded-time curriculum has positively impacted Kuss student performance on the state standardized science test. From 2007 to 2010, the percentage of eighth graders scoring proficient or advanced on the science MCAS nearly doubled from 15 percent to 27 percent, outpacing overall district gains and besting the district average of 22 percent proficient in 2010. Kuss staff members are clearly not satisfied with a 27 percent proficiency rate, but they know the scores are headed in the right direction. Department Chair Ward surmised that students’ science proficiency is increasing as a result of a combination of strategies, catalyzed by the availability of more time. “We have changed a lot of things in the last few years: We instituted the workshop model

and learned how to better use data. We increased peer observations, and redesigned the curricula.” The continuing focus is on improving students’ writing and reading comprehension skills while simultaneously introducing and reinforcing key scientific concepts.

Principal Mullen believes the ELT electives have also increased students’ passion, as well as their ability in science, as evidenced by the increasing number of Kuss students choosing to enroll in science honors and/or advanced placement classes in high school.

Beyond science, ELT has had additional positive impact on Matthew Kuss Middle School.

**Increased ELA and Math proficiency:** Between 2006-2010, Kuss increased the percentage of students scoring proficient or advanced on MCAS by 34 points in math and by 16 points in ELA, as compared to the other three middle schools in Fall River, which have seen gains of 18 points in math and 10 points in ELA during the same time period. The Kuss math gains have been particularly impressive. Over the course of five years, Kuss eighth graders have all but eliminated a 28-point achievement gap with the state.<sup>24</sup>

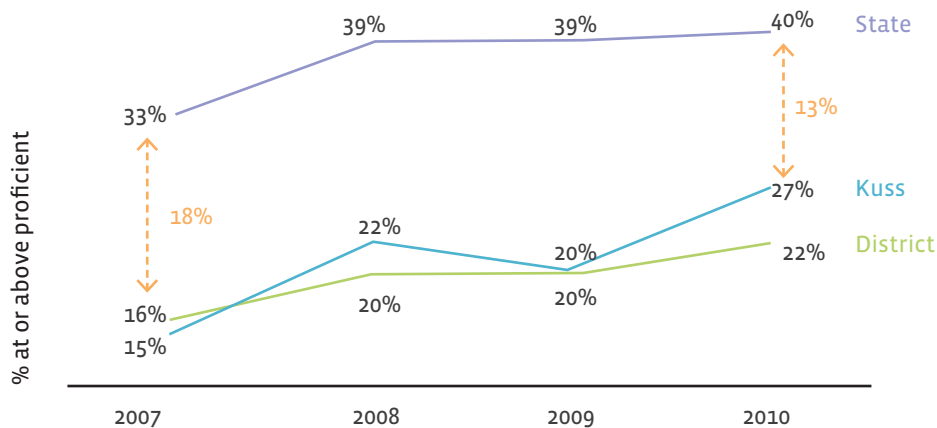
**Increased enrollment and attendance:** Enrollment at Kuss has ranged from a low of 480 before ELT to 650 for the 2010-2011 school year, making it the largest of Fall River’s four middle schools. In addition to the rise in enrollment, daily attendance rates have increased to 94 percent, and suspension rates have decreased 10 percent since the 2008-09 school year.

**High rates of teacher satisfaction:** In 2009, 90 percent of Kuss teachers participating in a survey project agreed that their school “sets high standards for academic performance” and 96 percent agreed that teachers in their school “are a professional community of learners focused on being good teachers.”<sup>25</sup>



ELT electives have increased students' passion, as well as their ability in science, as evidenced by the increasing number of Kuss students choosing to enroll in science honors and/or advanced placement classes in high school.

**Narrowing of Science Gap with State**  
8th Grade Science MCAS Test



Massachusetts Department of Education: Matthew J. Kuss Middle School





# THURGOOD MARSHALL ACADEMY LOWER SCHOOL

NEW YORK, NEW YORK

**Adults and children of the Thurgood Marshall Academy Lower School (TMALS) in Harlem share a friendly, open manner that belies an intense focus on the task at hand.** High expectations for children’s success are communicated not just in the way teachers query children on the subject matter, but also in the ubiquitous portraits of African-American icons past and present and the exemplars of student academic work and art projects carefully chosen for the walls of the hallways and classrooms.

“Focusing on science through expanded time has opened the door for us to be a better school.”

Sean Davenport, Principal (2004 – 2011)  
Thurgood Marshall Academy Lower School, New York, New York

TMALS was founded in 2005 by the Abyssinian Development Corporation (ADC) in partnership with the New York City Public Schools and New Visions for Public Schools. The elementary school is part of the preK-12th grade education pipeline shepherded by ADC in Central Harlem. The pipeline begins with Head Start and culminates with the Thurgood Marshall Academy for Learning and Social Change (TMALSC), a middle/high school created by ADC, New Visions, and the

New York City Public Schools in 1993. TMALSC now enrolls 550 students in grades 6-12 in a state-of-the-art building completed by ADC and its partners in 2004 as the first high school built in Harlem in more than 50 years. The high school boasted an 88 percent cohort graduation rate for the class of 2009, versus a 63 percent cohort graduation rate in New York City overall.

Since 1989, ADC has been a driving force for the revitalization of Central Harlem, leveraging \$600 million in resources to support its housing, economic revitalization, civic engagement, social services, and education initiatives. Under the leadership of founder Dr. Calvin O. Butts III, pastor of the historic Abyssinian Baptist Church, ADC’s community development strategy is driven by the conviction that education is the central element in long-term community revitalization.

Both the middle/high school and TMALS share the motto “it takes a village to raise a child,” and although the phrase is almost cliché, a visit to TMALS is a lesson in how powerful this notion can be when it is lived and breathed every day. TMALS is led by Principal Sean Davenport, whose confident, distributive leadership style aligns well with the school’s partnership model. His goal is to ensure that every teacher is equipped with the confidence and skills to teach each

subject well. He spends a lot of time in the classrooms, observing the teachers and asking the students to explain what they are learning. His style is reflected in the way faculty members readily collaborate with one another and with the on-site ADC staff. Said Josh Livingston, Manager of School-Based Programs for ADC, “TMALS is a very special community that’s becoming a model for our education work.” Davenport works closely with Livingston and Lucile Middleton, a TMALS teacher and ADC Educational Liaison, to create additional opportunities and supports for TMALS students. Under New York City’s principal empowerment model, Davenport has wide latitude to make budget and staffing decisions that support his vision.<sup>26</sup>

### Thurgood Marshall Academy Lower School (TMALS)

#### 2010-2011

Number of Students:	204
Grades:	K – 5
Former Schedule:	8:30 AM – 2:45 PM
Expanded Day Schedule:	8:30 AM – 5:30 PM
Former Time on Science per Week:	135 minutes
Expanded Day Time on Science per Week:	180 minutes

One of the major resources ADC and TMALS manage together is the placement of nine AmeriCorps Fellows who assist teachers during the core classroom time and lead afternoon activities from 1:00 PM to 5:30 PM each day. With a total teaching staff of 15, an additional nine AmeriCorps members add significantly to the school’s capacity to provide one-on-one attention to its students.

#### Why Expanded Learning Time and Why Science?

When Davenport and Livingston heard about The After-School Corporation’s Expanded Learning Time pilot in 2007 (see box, p. 25), they immediately decided to apply, knowing how they struggled to schedule adequate instructional time in core subjects within the six-hour-and-twenty-minute New York City school day. The desire to improve and expand science instruction was a driving factor in their decision to apply for the initiative. Principal Davenport explained, “Initially we were looking for exposure and engagement. There is not enough conversation about science in the African-American community. We want our kids to understand that this is a subject they can conquer.”

The TMALS team redesigned the school day to incorporate expanded time and began the program in 2008. Livingston of ADC said, “We looked at the day as a blank canvas. We have the children from 8:30 to 5:30: Who do we want our students to be? What do we want them to learn and know how to do? How do we create a day that will support our children to meet these goals?” The planning team created Academic Days (two afternoons a week) and Enrichment Days (two afternoons a week), with Fridays reserved for community service projects led by the AmeriCorps team. This programming for students on Friday also enables teachers to participate in weekly meetings and professional development. The team created a schedule which grouped grades K-2 and 3-5, alternating the Academic and Enrichment Days for each group.

For the Enrichment Days programming, ADC organizes yoga, art, dance, and capoeira (a Brazilian art form that combines elements of martial arts, sports, and music), among a rich assortment of resources. Livingston said, “We understand how mood and social/emotional and physical health impact a child’s love of learning. The enrichments are designed to support the total healthy development of every child.” Academic Days include an additional science instruction block taught by TMALS teachers. Although not required to work the expanded day, 12 of the 15 teachers opt to teach in the afternoons.

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#### MORE TIME FOR SCIENCE TEACHING AND LEARNING

In a February 2006 *Education Week* article, The After-School Corporation (TASC) President and CEO Lucy Friedman, along with co-author Jane Quinn of the Children’s Aid Society, discussed the potential of after-school programs to support science education:

“After-school programs offer an ideal setting for nurturing the potential scientist in every student, as well as for reinforcing the science taught during school hours. Compared to the school day, these programs’ smaller groups, longer time slots, and less-formal settings provide opportunities for young people to visit museums, study neighborhood environments, cultivate gardens, perform laboratory experiments, and have their love of discovery awakened in countless other ways.”<sup>27</sup>

Principal Davenport’s goal was to bring the unique benefits of after-school science learning into TMALS classrooms during the expanded day, while at the same time build his faculty’s comfort level and confidence in teaching science. Davenport also wanted to strengthen the integration of literacy and math activities into science



learning. He said, “We wanted to take a different approach for the afternoons —less formal, more hands-on and engaging. The children understand it is still school. They are still in uniform. But there are no grades; it’s a friendly environment for students to take risks and make mistakes. Learning science is all about learning from mistakes.”

### TMALS Student Subgroups

2010-2011

Qualify for free/reduced lunch	72%
Limited English Proficient	0%
Special Education	9%

Source: New York City Public Schools

Davenport looked to TASC’s Frontiers in Urban Science Initiative (FUSE) to help find the appropriate science curricula for the TMALS expanded time and also provide hands-on training for the teachers (see box, p. 27). The FUSE initiative has evaluated several different curricula and selected those that:

- are inquiry-based and hands-on;
- involve youth in developing higher-order thinking skills such as decision-making, planning, problem-solving, and reflecting;
- include opportunities for parental involvement;
- provide opportunities for youth to learn about role models;
- encourage youth to see themselves as learners;
- use techniques appropriate for a variety of learning styles, with attention to the needs of under-represented populations;
- use affordable materials that are easy to find;
- be easy to implement by staff who have no science background;
- address national STEM standards;
- include a training component; and
- provide appropriate content for an urban, diverse audience.<sup>28</sup>

For the 2010-2011 school year, TASC offered the following curricula:

- After-School Science Plus (Grades K-8)
- After-School Conservation Club (Grades 3-6)
- 4-H Wonderwise (Grades 3-7)
- BirdSleuth: After-School Investigators (Grades 3-6)
- Mixing in Math (Grades K-5)
- NASA—The Planetary Neighborhood (Grades 3-5)
- Afterschool Universe (Grades 6-8)

TMALS chose Science Plus for the first grade, the Afterschool Conservation Club for the second grade, 4H Wonderwise for the third grade, and science curricula designed by teachers in the fourth and fifth grades. The 2010-2011 school year was TMALS’s second year with Afterschool Science Plus, and their first year piloting the other programs.

The teachers are enthusiastic about After-School Science Plus, created by the Academy for Educational Development’s Educational Equity Center. TMALS sent a team of teachers to the TASC-sponsored After-School Science Plus training, where they conducted experiments they would subsequently teach the students. Debra Turner, a third-grade teacher, noted, “Science Plus emphasizes constructing things, figuring it out, and getting excited about science. Since the experiments use everyday materials, the children often repeat them at home. When they share what they learned in school, they are leaders and build confidence, and then the families are also engaged.”

Principal Davenport added, “Some of our teachers struggle with science and math. The Science Plus curricula is accessible and welcoming, for them and the students.”

Teacher Lucile Middleton commented on the impact of Science Plus on TMALS: “One of our teachers had a very traditional approach to science: worksheets, reading chapters in book, memorization, testing, and on to the next chapter. Science Plus training has been transformative for this teacher. Now that classroom has centers and experiments throughout the school day.” Another teacher added, “Science Plus has helped give teachers the confidence to teach science, and it’s changing the way we teach.”

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## EXPANDED LEARNING TIME AND THE AFTER-SCHOOL CORPORATION (TASC)

In New York, The After-School Corporation (TASC) leads and supports a city-wide network of 17 public elementary and middle schools that are expanding the school day by at least 35 percent—more than 60 additional days of school—each year. TASC ExpandedED Schools (an initiative launched in 2007 as Expanded Learning Time schools) is managed in partnership with the New York City Department of Education and the Department of Youth and Community Development.

Most of the ExpandedED Schools began their expanded schedules as voluntary programs that served anywhere from 29 percent to 100 percent of the students. Over the course of the three-year pilot, the expanded day has remained voluntary for students, but at four schools nearly all the students now participate in the ExpandedED Schools program. For example, at Thurgood Marshall Academy Lower School, 91 percent of the 204 students attend the expanded day.

During these additional hours, each school partners with a community-based organization to provide enrichment programming. The expanded school day is designed by a cross-sector team, including the principal, teachers, community partners, parents, and a school staff member who is the educational liaison between the school and community-based organization staff. TASC advises schools to spend at least 40 percent of added time on academic support; at least 30 percent on arts, sports, community service, and leadership activities; and also to add a third daily meal and recreational activities to the schedule.

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## RESULTS

As part of an interim evaluation of a three-year pilot of TASC's expanded-time model, teachers were asked whether it improved their students' learning. Eighty-five percent of teachers in ExpandedED Schools reported improved learning for participants. The evaluation also revealed that student attendance rates at ExpandedED Schools were about four percentage points higher than students in matched comparison schools.<sup>29</sup>

**About TASC:** Founded in 1998 with a challenge grant from the Open Society Institute, TASC's vision is that "kids from all backgrounds will have access to the range of high-quality activities beyond the school day that every family wants for their children: experiences that support their intellectual, creative, and healthy development and help them to be their best, in and out of school."<sup>30</sup> TASC has supported more than 150 community organizations to operate daily after-school and expanded learning programs in 325 New York City public schools, serving 300,000 students. TASC also has been a key leader in developing infrastructure to support after-school programs, including staff training and education, curricula development and dissemination, expanded funding models, and policy and advocacy at the city, state, and national levels.

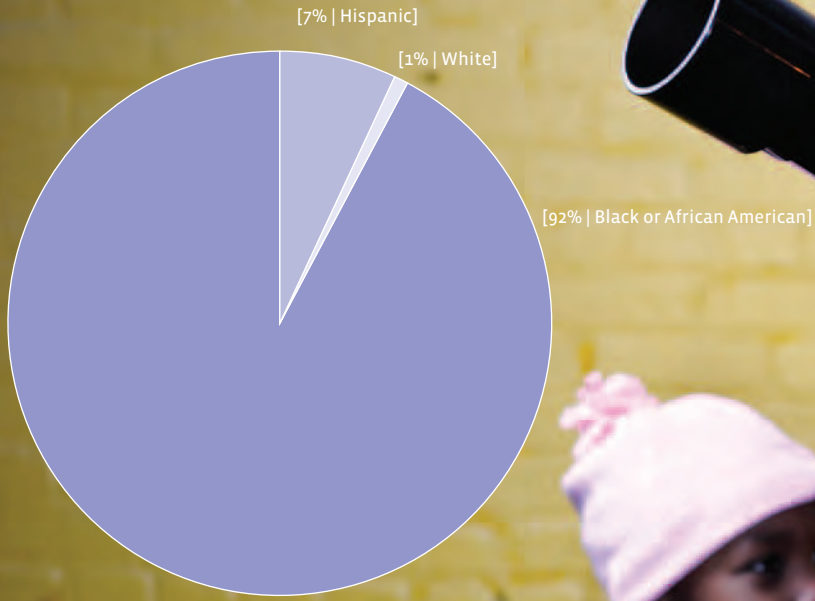
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## FRONTIERS IN URBAN SCIENCE EDUCATION (FUSE)

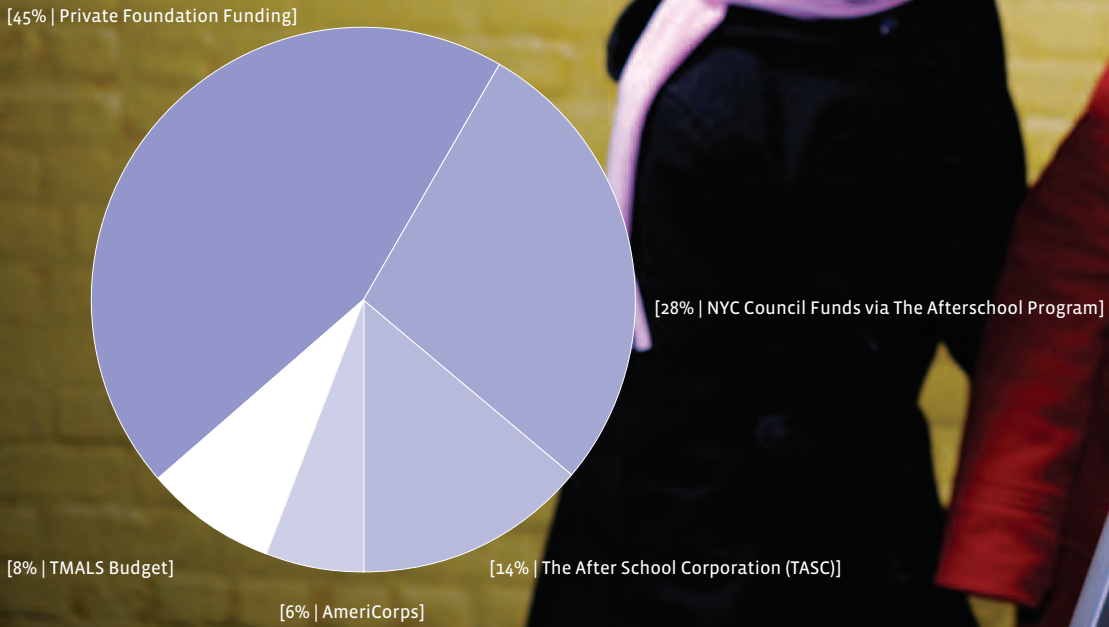
TASC launched the Frontiers in Urban Science Education (FUSE) initiative in 2007 to increase young people's interest and engagement in STEM learning in school, after school, and over the summer. FUSE's goal is to catalyze a culture shift among after-school leaders and staff in support of high-quality informal science education (ISE) within after-school programs. FUSE employs a two-fold approach to bring about this culture shift and to shape practice. First, a "grass-tops" strategy engages leaders and staff of schools and after-school programs, government officials, science organizations, policymakers, and funders in awareness-raising activities that will build enthusiasm and capacity for inquiry-based STEM learning after school. Second, a "grass-roots" strategy provides frontline after-school staff and supervisors with the content knowledge and instructional skills to deliver high-quality ISE.

With support from the Noyce Foundation, TASC developed the FUSE model, then with further support, joined with the Collaborative for Building After-School Systems to launch FUSE in multiple cities around the country. In 2011, TASC joined with the New York State Afterschool Network (NYSAN) to launch FUSE throughout New York State.

# TMALS Student Demographics 2010-2011



# Funding the Expanded Day at TMALS





## MORE SUPPORT FOR USING SCIENCE TIME EFFECTIVELY

ADC's STEM Director Evelyn Roman supports the TMALS faculty in honing their pedagogy and helping to integrate the science curricula across the full day and across the disciplines of literacy and mathematics. Roman assists teachers and administrators with planning, instruction, and implementation, and leads professional development for the K-2 and 3-5 teacher teams. She also provides individual coaching and technical support on a weekly basis to the TMALS teachers.

Said Roman, "Sometimes teachers will come from a workshop very excited, but then hit a roadblock when they try to implement what they have learned. My role is to deepen their knowledge of the content and the curriculum and help them make connections among the various approaches, whether it is After-School Science Plus, the FOSS [Full Option Science System] kits, or other resources."

Her emphasis is on helping teachers integrate literacy, hands-on science, and math. "There is so much emphasis on literacy and math in New York, as in other places," Roman explained. "So the teachers are more prone to incorporate the science when you can make those explicit connections. They know they are enhancing the math and literacy skills, too."

Roman is passionate about the potential of integrating literacy, math, and science to address the vocabulary and reading skills gaps that hinder the efforts of many low-income children to reach proficiency in math, science, and other areas. "There is an important crossroad between science and English language arts. We can bring out the science in a book, and at the same time very intentionally teach children literacy strategies—how to dissect the figurative language, how to discern the author's intent, how to look at the roots of words and infer their meaning by connecting it to what they already know. *The Evolution of Calpurnia Tate*, by Jacqueline Kelly, is a great example."

The book is a coming-of-age story of a young girl in early 20th century Tennessee, struggling with societal and family pressures and discovering her joy in accompanying her naturalist grandfather on his wildlife investigations. "We need to increase kids' exposure to high-quality books and support those lessons with hands-on science activities. The more they experience hands-on learning, the knowledge is internalized, and the vocabulary increases," said Roman.

### TMALS Expanded-Day Schedule (Typical Third-Grade Schedule)

	Monday	Tuesday	Wednesday	Thursday	Friday
8:00-8:30	Breakfast	Breakfast	Breakfast	Breakfast	Breakfast
8:45-9:30	Journal Writing (Math for those below grade level)	Journal Writing (Math for those below grade level)	Journal Writing (Math for those below grade level)	Journal Writing (Math for those below grade level)	Journal Writing (Math for those below grade level)
9:35-10:20	Math	Choice: Visual Arts, Character Building, Literacy through Arts	Math	Choice: Visual Arts, Character Building, Literacy through Arts	Math
10:23-11:10	Gym	Math	Gym	Math	Gym
11:15-12:05	Reading/Writing	Social Studies	Reading/Writing	Social Studies	Reading/Writing
12:10-1:00	Lunch/Recess	Lunch/Recess	Lunch/Recess	Lunch/Recess	Lunch/Recess
1:05-1:50	Math	Math	Math	Math	Math
1:55-2:40	Science	Science	Science	Science	Science
2:50-3:27	Small Group Instruction: Reading Help, Math Help, Advanced Math, Music, Museum Club	Small Group Instruction: Reading Help, Math Help, Advanced Math, Music, Museum Club	Small Group Instruction: Reading Help, Math Help, Advanced Math, Music, Museum Club	Small Group Instruction: Reading Help, Math Help, Advanced Math, Music, Museum Club	Small Group Instruction: Reading Help, Math Help, Advanced Math, Music, Museum Club
3:30-4:15 4:25-5:00	Meal and Science	Meal and Choice: Martial Arts, Photography, African Dance, Step Team, Chorus	Meal and Science	Meal and Choice: Martial Arts, Photography, African Dance, Step Team, Chorus	Meal and Science
5:00-5:30	Homework	Homework	Homework	Homework	Homework

### CLASSROOM SPOTLIGHT: INTEGRATING SCIENCE, MATH, AND LITERACY THROUGH *MOUSE COUNT*

Evelyn Roman, ADC's STEM Director, and the teachers describe how TMALS integrates literacy, math, and science in a multi-day first-grade lesson based on the book *Mouse Count*, by Ellen Stoll Walsh. The book tells the story of a meadow snake counting up ten mice he catches for a later meal, and then counting down as each one escapes.

The lesson begins with a read-aloud, to build the children's counting and prediction skills, and then moves to a hands-on activity that builds number sense as the children use counters to generate different combinations of the number ten.

The lesson proceeds into science, as the class discusses what living things need to survive and how a meadow functions as a habitat. The children create their own meadows in another hands-on activity. Then the class discusses how many mice snakes need to eat to survive, testing out estimating skills and generating hypotheses.

The teacher brings in a snake skeleton or a live snake, so the children can see how the spine is constructed and enables it to slither—reinforcing new vocabulary throughout. The children compare the snake's spine to their own spines, discuss different kinds of snakes, and are introduced to how snakes are classified.

Finally, the students write their own *Mouse Count*-inspired book. "Many of these children have never seen a meadow, so it is important to emphasize and re-emphasize the vocabulary throughout. This deeply extended lesson is possible at TMALS because they can stretch it over several days and afternoons," said Roman.

Teacher Danica Ward added, "The expanded time enables us to teach skills in different ways. We can alternate among textbooks, labs, and hands-on centers. We introduce the concepts during the first part of the day and then go back in the afternoon to extend the lesson. I use that extra time to build it up, and make sure students get what they need. It isn't always something new. Repetition is useful sometimes for children who take longer to get it, especially if the group is smaller."

Siobhan Gordon, a first-grade teacher, agreed, "Children have different learning styles and the expanded time provides more time to meet their needs. Especially in science, the opportunity for children to be hands-on, and touch things, is important. Before expanded time, we may have gone back to reinforce a lesson the next day, but we only had time to mention it. Now we can extend, expand, and deepen."

“One of our teachers had a very traditional approach to science: worksheets, reading chapters in book, memorization, testing, and on to the next chapter. Science Plus training has been transformative for this teacher. Now that classroom has centers and experiments throughout the school day.”

Lucile Middleton, teacher, TMALS

## IMPACT

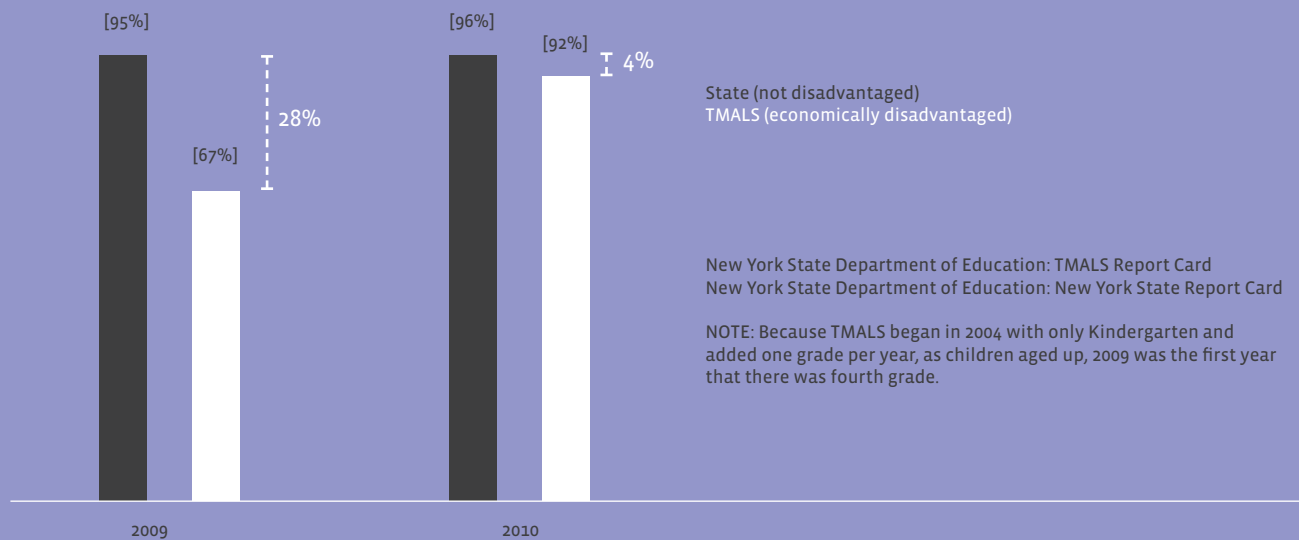
Lessons like *Mouse Count* have meaningful impact on TMALS students' proficiency in science. When the students can actually see how a snake's skeleton is constructed and compare it to their own spines they are applying new concepts (*Strand 1*). When the children create their own meadows and learn about the interactions between snakes and mice, they are gathering evidence and reasoning from the evidence about what snakes need to survive (*Strand 2*). When they return to the same lesson later in the day, the students are encouraged to reflect on their earlier experiences (*Strand 3*). And when they have a chance to talk with one another about their ideas, they are participating productively in a community of fellow scientists (*Strand 4*).

On the 2010 New York state standardized science test, nearly 92 percent of TMALS fourth graders scored proficient or above (56.8 percent proficient; 35.1 percent

advanced) compared to 83 percent proficient or above in New York City. For TMALS, these results represent a significant gain from the year before, when 71 percent of fourth graders scored proficient or above.

TMALS does not rely on test scores alone to evaluate the impact of the school's focus on science. Principal Sean Davenport engages in frequent classroom observations, and often asks students to explain to him what they are learning. He, Evelyn Roman, and the school staff are aware that sustained gains will take a multi-year effort. Roman added, "It is important to do constant assessments that are creative. We're not just relying on having the children write something, but instead being intentional about having the teacher ask direct questions and learning how to differentiate the progress and understanding of individual children working within a group or playing a game."

## Narrowing of Science Achievement Gap: TMALS vs. State







“The expanded time enables us to teach skills in different ways. We can alternate among textbooks, labs, and hands-on centers. We introduce the concepts during the first part of the day and then go back in the afternoon to extend the lesson.”

Danica Ward, fourth-grade teacher, TMALS

#### POSTSCRIPT

In summer 2011, Sean Davenport left TMALS to lead the Thurgood Marshall Academy for Learning and Social Change (TMALSC), the middle/high school counterpart to TMALS. Art teacher Dawn Brooks Decosta was appointed principal of TMALS. Decosta intends to continue the expanded-learning-time program and its emphasis on hands-on, engaging science activities, citing After-School Science Plus as a key driver of science proficiency among TMALS students.

Decosta and her faculty are also analyzing the full curricula against the new Common Core standards and identifying gaps and areas for sharper focus. “The new standards really emphasize non-fiction reading and writing skills—and we are focusing on this as a lever to deepen our approach to integrating science and literacy throughout the grades,” said Decosta.





# EDITH I. STARKE AND PIERSON ELEMENTARY SCHOOLS

VOLUSIA COUNTY, FLORIDA

**In 2006, Deputy Superintendent Chris Colwell began to focus deeply on the inadequacy of science instruction in Volusia County Public Schools.** “We have three big problems in science instruction: time, training, and rigor,” he explained. Colwell then detailed the background on each of these three challenges.

“My hardest year teaching here was the one year we did not have the extra hour. I could not take a breath. There was no time to do the hands-on inquiry approach. Student learning suffered.”

Jennifer Robinson, fifth-grade teacher, Pierson Elementary School

**Time:** Florida state law requires a 90-minute reading block and 60-minute math block daily in elementary school. Said Colwell, “As a result, we had to face the harsh reality that we did not have explicit science instruction going on in our elementary schools. In some places, we have

allocated 15-20 minutes three times a week, and even this is not happening.”

**Training:** Acknowledged Colwell, “Many of our teacher preparation institutions focus their pre-service education on reading first, math second, and science not at all. There is inadequate science content knowledge and science pedagogical skill. Particularly in the upper elementary grades, many teachers are not comfortable with science content.”

**Rigor:** Florida adopted the Next Generation Sunshine State Science Standards in 2008. The state science assessments are changing in 2012 to reflect the new standards. These new standards do not “spiral” or revisit content with increasing complexity across the grades. Each unit is taught fully in one grade only. In addition, districts are preparing for 2016, when passage of biology, and either chemistry or physics, will be required to graduate high school. In Colwell’s view, the district needs to increase academic rigor throughout the science curriculum to ensure students are prepared for the new requirements.



## VOLUSIA COUNTY PUBLIC SCHOOLS

### Plus One

The Plus One Initiative of Florida's Volusia County Public Schools began in January 2003, when the teachers and principal of one elementary school began a pilot program expanding the six-hour school day by one hour. Participating teachers were paid for their extra time out of the school's Title I allocation. Recognizing the early success and popularity of the pilot, and seizing on the additional time as a key strategy to assist under-performing schools in improving student academic outcomes, the district has expanded the program to nine elementary schools. These nine Title I schools enroll approximately 4,800 students, 82 percent of whom are low-income. The one additional hour per day at each school boosts learning time by the equivalent of an extra 30 days each year.

Funded entirely by Title I and overseen by the district's Title I administrator and deputy superintendent, Plus One has been level-funded by the district over the last two years, despite declining Title I allocations from the federal government. The additional funding supports teachers and paraprofessionals to work the additional hour at their contracted rate. Plus One began as voluntary for teachers to participate and then, by 2007, became mandatory for the whole faculty at each participating school, as long as 80 percent of the school's teachers vote to participate.

All Plus One time is devoted to additional academic instruction, and each Plus One school has flexibility in designing its schedule and choosing the academic priorities for its additional time. Across the district, time for science had been scaled back in elementary schools to accommodate more time in English language arts and math classes. Consequently, most of the Plus One schools use at least part of the additional instructional time for science. In addition, the district has been supporting a strategy whereby schools offer small-group academic support classes, built into the day, to address student learning deficits in targeted ways. The Volusia Plus One schools have implemented this model more fully than the non-Plus One schools because they are able to dedicate approximately 30 minutes daily to these classes.

**Results:** All Plus One schools have seen marked growth in the percentage of students achieving proficiency in writing. Science scores have risen fairly consistently in most of the participating schools over the last four years.<sup>31</sup>

### District and School Details

Located about 50 miles northeast of Orlando, Volusia County is an area roughly the size of Rhode Island. Home to half a million people, Volusia incorporates a stretch of beaches along the coast—including Daytona Beach—and extends west to the farming, residential, and retirement communities near St. John's River.

Volusia County Public Schools enroll nearly 63,000 students in 45 elementary schools, 13 middle schools, 10 high schools, and several alternative programs. Students come from 158 countries and speak 78 different languages. Although the county has economically prosperous areas, it also has towns marked by significant poverty levels. Just over half of the district's students are eligible for free and reduced-priced meals and 68 schools receive Title I funds. Volusia County also contends with the state's second highest rate of homeless children (behind Miami-Dade).

The case studies presented here focus on two schools implementing the district's Plus One program: Pierson and Edith I. Starke elementary schools.

Pierson Elementary School is the only elementary school in the agricultural town of Pierson, about 30 miles west of the Atlantic Ocean. Known as "The Fern Capital of the World," Pierson has a population of 2,596 according to the 2000 census. Ferns grown on Pierson's sprawling farms are exported worldwide for use in floral arrangements and other decorations. According to the 2000 census, the per capita income for the town was \$12,450. Pierson began to partially implement the Plus One initiative in the 2007-2008 school year, with school-wide implementation beginning in fall 2008.

Edith I. Starke Elementary School is one of six public elementary schools located in the county seat of Deland. With a population of about 25,000 according to the 2000 Census, Deland is known for its historic architecture and is home to Stetson University, the first private college in the state. The per capita income for the city in 2000 was \$15,936. Starke has been a Plus One school since the 2006-2007 school year.



### Why Expanded Learning Time and Why Science?

Pierson and Starke Elementary Schools are using Plus One—an extra hour of instruction available for some Volusia elementary schools—to increase the time, training and rigor of their science instruction.

Starke and Pierson redesigned the entire school day to take advantage of the Plus One hour. Both schools also have instituted core reforms that position them well to maximize the use of additional instructional time, including establishing teacher professional learning communities to analyze data and improve instructional practice. The schools also have implemented the Response to Intervention model to boost literacy and math proficiency. Given the opportunity to add an extra hour, each school chose science as a key priority. Both these schools are also supported by additional science professional development and curricular resources from the district.

#### Starke Elementary School 2010-2011

Number of Students	429
Grades	K – 5
Percent of Students Participating in ELT	100
Former Schedule	7:55 AM – 2:05 PM
ELT Schedule	7:55 AM – 3:05 PM: M, T, Th F 7:55 AM – 2:05 PM: W
Former Time on Science per Week	K-5: 40-60 minutes
ELT Time on Science per Week	K-3: 150 minutes 4-5: 275 minutes

#### Pierson Elementary School 2010-2011

Number of Students	540
Grades	K – 5
Percent of Students Participating in ELT	100
Former Schedule	8:10 AM – 2:20 PM
ELT Schedule	8:10 AM – 3:20 PM
Former Time on Science per Week	60 minutes
ELT Time on Science per Week	300 minutes

### MORE TIME FOR SCIENCE TEACHING AND LEARNING

Before Plus One, the schools averaged 20 minutes of science instruction two to three days per week across K-5. Now, Starke and Pierson fourth and fifth graders participate in about 60 minutes of science each day. Students in primary grades have 30 minutes per day of science. Students at both schools are actively engaged in science learning. Teachers use a mix of pedagogical approaches, including teacher-led discussions, peer-to-peer questioning, and hands-on experiments and investigations. The classroom pace overall is relaxed, and the teachers often stop to reinforce a particular concept or check to see if the lesson is resonating with the group.

Teachers at both schools consider the additional science time critical to their approach. Said Jason Knox, a Pierson fifth-grade teacher: “Now we have a chance to go back and spend the extra time to make sure students really understand it—especially my ESE (special education) students. Sometimes it takes them longer to read the material, understand the instructions, and ask questions. With the extra time, they can do it.”

For example, Laura Bechard’s blended fourth- and fifth-grade class at Pierson is divided into teams that rotate among experimental stations demonstrating the effects of water erosion. One group is creating small and large waves by moving the water back and forth and observing the impact on the sand in plastic bins, while another group observes the different impacts of simulated rain on planters filled with clover and those packed with just dirt. In their science notebooks, the children share observations and make drawings of their results.

Said Bechard, “You have to do science; you cannot just read about it. We do experiments three times a week, on average. But to have value, it needs to be explicitly connected to the real world, and students need to engage in discussion and analysis around the experiment. We need that extra time for debriefing to reinforce the vocabulary or scientific concepts illustrated during the experiment. Otherwise it’s just a fun experiment.

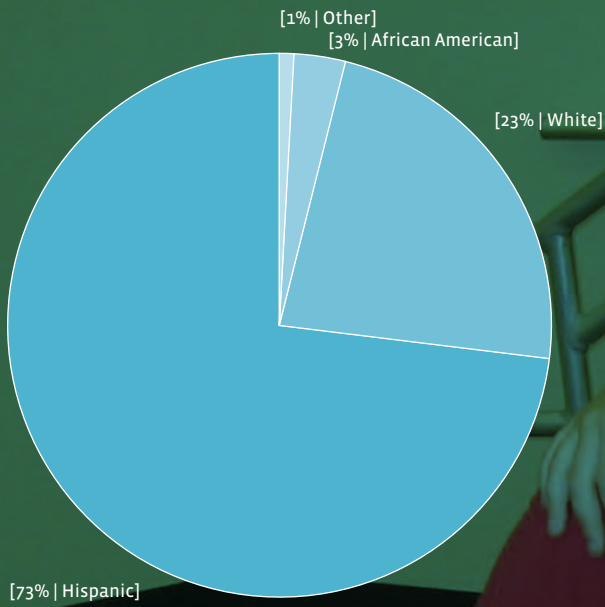
“Engaging in that debriefing in the deep way these students need takes a lot of time,” Bechard continued. “Students must show me in lots of different, creative ways that they understand what the science is. For example, they can go online to create a comic strip that illustrates the difference between erosion and weathering. They can create posters or movies using online tools.”

The school staff members talk about the impact of poverty and language barriers on student learning and how they adjust their pedagogy to fill gaps in students’ contextual knowledge. Richard T. Myers, the principal at Pierson, said,



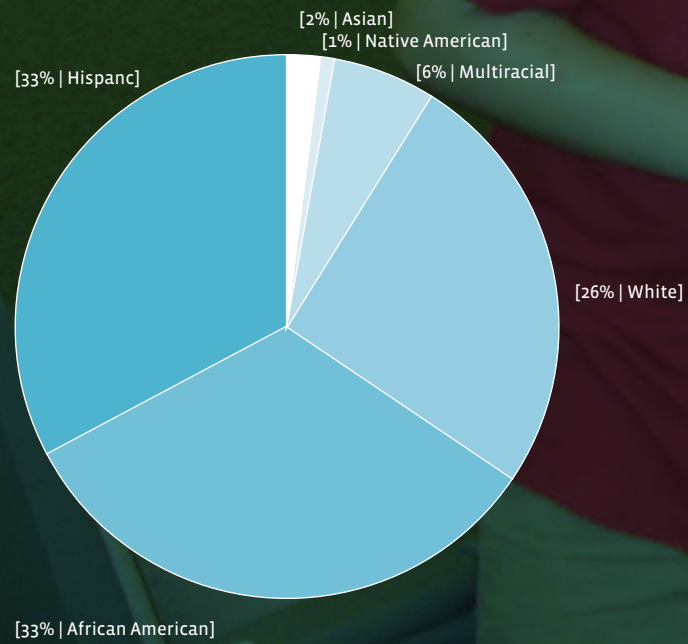
## Pierson Elementary Student Demographics

2010 - 2011



## Starke Elementary Student Demographics

2010 - 2011



“Our students are struggling with the basic vocabulary, understanding the general concepts. We have a high-poverty population. Families are struggling to make ends meet. Many parents are simply not able to provide content knowledge and consistent help to ensure their children’s academic success. Children and families on the whole have very limited exposure to the world outside of the town.” Said Bechard, “Our students struggle with how the science we teach connects to the real world. We need to make it explicit and reinforce those connections constantly. This, again, takes time.”

According to the teachers, these contextual gaps impact standardized test scores. “Often, test scores don’t reflect the science knowledge. The way the tests are built, the assumed frames of reference are missing for our students, and they get tripped up by a strange word or unfamiliar setting, even if they do understand the scientific concept,” said Principal Myers.

#### **Beyond the Expanded Day**

Both Pierson and Starke schools have implemented additional supports, beyond the Plus One initiative, to bolster student achievement and support families.

Starke has a 21st Century Community Learning Center after-school program on site until 5:30PM every day. The program enrolls 65 children from grades three through five who have each been identified by the staff as needing extra

support. Sharon Lloyd mentors the Starke fifth graders’ science fair projects during the after-school program, filling an important gap because many of these children do not have the support readily available at home for helping with these labor-intensive projects. According to Starke Principal Barbara Head, children in the program have made academic gains when measured against children who are not in the program.

Pierson Principal Myers was determined to bring the Science Olympiad to Pierson after seeing its potential for catalyzing science engagement among middle schoolers. Begun in the 2010-2011, the 22-member team is the only elementary-level Science Olympiad team in the district. The team trains after school under the supervision of a Pierson teacher and is preparing to travel to Orlando for the Science Olympiad competition. For many of the team members, this will be their first trip to Orlando, 30 miles to the west. Pierson teachers also started a Saturday session to provide support and materials for students working on their science fair projects.

Both schools run well-attended, school-based Family Science Nights in partnership with Orlando Science Center and the Museum of Arts and Sciences. The events feature hands-on learning labs staffed by teachers and volunteers (and at the Starke, by Stetson University education students).

“Our students struggle with how the science we teach connects to the real world. We need to make it explicit and reinforce those connections constantly. This, again, takes time.”

Laura Bechard, fourth-grade science teacher, Pierson Elementary School

## Pierson Elementary Expanded-Day Schedule (Typical Fifth-Grade Schedule)

	Monday	Tuesday	Wednesday	Thursday	Friday
8:15-9:15	Math	Math	Math	Math	Math
9:15-9:45	Intervention	Intervention	Intervention	Intervention	Intervention
9:45-10:45	Science	Science	Science	Science	Science
10:50-11:35	Specials	Specials	Specials	Specials	Specials
11:40-12:30	Lunch	Lunch	Lunch	Lunch	Lunch
12:35-1:10	ELA	ELA	ELA	ELA	ELA
1:10-1:40	Social Studies	Extra PE	Social Studies	Extra PE	Social Studies
1:45-2:15	WG Reading	WG Reading	WG Reading	WG Reading	WG Reading
2:15-3:15	SG Reading	SG Reading	SG Reading	SG Reading	SG Reading

### CLASSROOM SPOTLIGHT: WHAT ARE SHADOWS?

Sharon Lloyd’s kindergartners at Starke Elementary are sharing what they know about shadows. They offer the following observations, which Lloyd writes on the whiteboard at the front of the room while the children sit cross-legged in a semi-circle around her.

- Shadows follow you
- Our hands make shadows
- Shadows can be big or little
- The sun makes shadows

Lloyd turns to the picture book *Bear’s Shadow* by Frank Asch and begins to read. She stops frequently to ask her students to predict what might happen next. At the point where Bear has greeted his shadow and settled down for a nap, Lloyd asks the children to predict what will happen to his shadow as he sleeps. She directs the children to discuss their ideas in pairs, and then take turns sharing with the group. They predict that the shadow will not stay the same. “The clouds might come!” offers one intently focused girl.

After bringing the entire class outside into the courtyard, Lloyd lays out a large piece of paper depicting a pond scribbled in with blue marker. She has a few magnetic fishing poles and some toy fish. Each child gets a chance to catch the fish, while Lloyd points out that where they choose to stand either hides or exposes their shadow to the fish. “Keep your shadow behind you so it doesn’t scare the fish!” she calls.

Back inside, the children take out their science journals. Each is marked with the title “Scientist” preceding his or her name and is filled with drawings and writing from the

year’s science lessons. Lloyd asks the children to draw themselves fishing and include the pond, their own body, and their shadow. She keeps asking questions as she circles the room. Stopping next to one child, she exclaims, “I am so proud of you that you thought to include the sun in your picture!”

Lloyd is a 20-year veteran of Starke. She is recognized by Principal Barbara Head and her peers as the school’s resident expert on science. For several years, Lloyd was the science lab intervention teacher. She has spent the last two years teaching kindergarten. She explains the full context of the day’s lesson. “The shadow lesson is part of a four-week unit on Objects in the Day and Night Sky, within our Earth in Space and Time curriculum. During the unit, we record how the position of the sun changes during the school day. Yesterday we discussed what we knew about shadows. We incorporate literature into the lesson whenever we can. We always try to have an interactive activity—today it was fishing. Then we have the children explain what they learned in their science notebook. Tomorrow we will trace our shadows outside periodically over the course of the day.

“We construct the lesson to focus on literacy and reading strategies and delve into scientific concepts, building on what the children already know. We would not be able to accomplish all these goals without the extra hour of instructional time,” Lloyd said.

Principal Head commented, “Integrating literacy is critical. Children under-perform on the district third-grade science assessment because they struggle with reading. Yes, kids need hands-on science. But the biggest factor determining success is ‘Can they read the text?’”



**Starke Student Subgroups 2010-2011**

Qualify for free/reduced lunch	92%
English Language Learners	27.7%
Special Education	19.1%

**Pierson Student Subgroups 2010-2011**

Qualify for free/reduced lunch	88%
English Language Learners	47%
Special Education	11%





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## MORE SUPPORT FOR USING SCIENCE TIME EFFECTIVELY

In Volusia County, the district plays a key role in supporting science instruction. The district science team, consisting of a science specialist and a teacher-on-loan, organizes professional development opportunities, provides guidance in developing curricula maps and pacing guides, and designs the interim science assessments. The district also supports four science coaches, funded through federal American Recovery and Reinvestment Act (ARRA) resources. The science coaches are school-based, and they also provide professional development and training for elementary science teachers throughout the district. At each school, one person is the science contact and receives a stipend to participate in two days of training and periodic meetings called by the district science staff.

The district staff admit that this professional development and coaching arrangement is less than ideal but that it tries to leverage the resources that are available in the fairest way possible. “We know we do not have enough resources to offer all the content, assessment, and data analysis training needed,” said Jennifer Taylor, District Science Specialist K-12. “Our goal is to ensure equity across the system in access to science materials, supplies, labs, resource materials, and textbooks.”

The district also places a great deal of emphasis on having quality curriculum and materials. Volusia science experts produce the science curricula map keyed to the state standards for each grade. The map provides pacing guidance and suggestions for activities but does not provide day-to-day lesson plans. At each school, the teachers review the map and plan their daily lessons. The district science team provides support and guidance to the teachers as they complete this process.

Teachers at both Volusia expanded-time schools had high praise for the district’s efforts. Having just completed a district-sponsored teacher workshop that showcased a hands-on rocks and minerals unit, Pierson fourth-grade teachers were eager to teach the lesson to their students.

The district requires teachers to give eight science assessments per year in grades three through five. “We work hard to make sure the assessments are at the right level of difficulty,” said Laura Herrera, who is a science teacher-on-loan to the district science department. She continued, “Students are required to apply, synthesize, and problem-solve with their knowledge, not just demonstrate memorization of facts.”

The teachers analyze the results of the interim assessments within their professional learning communities (PLCs). The science team provides the PLCs with guidance documents and data analysis sheets to help increase the efficiency and impact of their efforts. Said Carolyn Gardinier, Volusia County Public Schools Title I Director, “We have helped the PLCs move from admiring all this data to actually using it to make instructional decisions.”

Starke School has brokered an additional resource for teacher professional development through its relationship with nearby Stetson University. Stetson professors provide in-service teacher professional development and ongoing guidance to Starke’s PLCs and Principal Barbara Head in a range of areas—including core curricula, classroom management, behavioral interventions, and staff recruitment and retention. Starke, in turn, provides practica placements for pre-service Stetson education students. Deputy Superintendent Colwell explained, “The Stetson model is to go deep. They are consistent, long-term partners that are deeply impacting a small number of schools, including Starke.”

Stetson pre-service teachers are urged to take extra steps to get to know students and families during their practica, through volunteering in the after-school program and staffing family nights. Said Douglas MacIsaac, Stetson University professor, “Some students study the impact of parent involvement on children’s school performance, but our pre-service teachers understand it first-hand.”

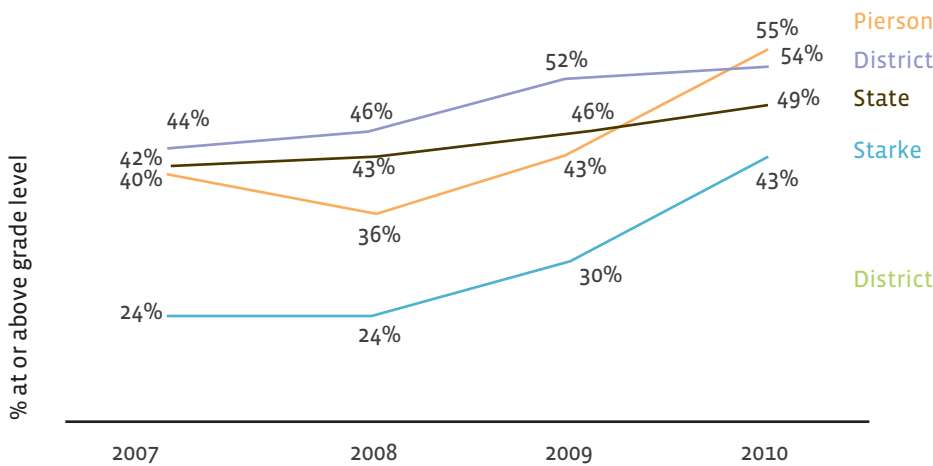
**IMPACT**

The additional hour of time enables teachers at Starke and Pierson Elementary Schools to integrate a range of teaching and learning strategies aligned with the *Taking Science to School* strands. For example, an important aspect of *Strand 3* is not just for the students to be aware of what professional scientists do, but engage in reflection on the ways that their own thinking and learning is progressing. Requiring students to write and draw in their journals after they engage in science activities encourages them to reflect on their own thinking and learning, even as early as kindergarten age. Starke and Pierson teachers are also aware of the importance of *Strand 4*—participating productively in scientific practices and discourse. These teachers recognize that students need to engage in discussion and analysis around the experiments—not just to better understand the vocabulary and scientific concepts, but also to gain practice articulating their ideas and listening thoughtfully, critically, and respectfully to one another. As one of the teachers remarked, without an opportunity for the students to discuss their ideas together, “it’s just a fun experiment.”

Students in both schools—despite higher poverty rates and greater language barriers than students in the district and state overall—are catching up with, and sometimes outscoring, their peers on the fifth-grade science test. In 2010, the percentage of Starke students that scored proficient on the test was within six points of the state average (43 percent vs. 49 percent), and Pierson students’ proficiency rates bested the state (55 percent). Perhaps more importantly, over the last four years, each school has experienced growth in proficiency of at least 15 percentage points, suggesting that over time the schools are increasing the effectiveness of their science teaching.

**Student Performance on 5th Grade FCAT Science Test**

Starke and Pierson vs. State



FCAT: Florida’s Comprehensive Assessment Test

Florida Department of Education: School Science Reports

Cost per student for Plus One (2009 - 2010 school year) is approximately \$700. (Funded through Title I dollars.)





# JANE LONG MIDDLE SCHOOL

HOUSTON, TEXAS

**Jane Long Middle School has been under construction in more ways than one. Amidst a major renovation to the physical plant, students and staff endure the inconvenience of noise, dust and taped-off walkways, understanding their patience will eventually be rewarded with a better facility.** The simultaneous construction project—building an educational program that results in increased opportunities and academic success for Jane Long students—is significantly more challenging, but

**“Staying here keeps me occupied and helps my brain develop more so I can get to high school and succeed in life.”**

Carmen, sixth grader, Jane Long Middle School

promises to have even more transformative and lasting impact for the school’s students and their families.

Ninety-six percent of Jane Long students are low-income, and 85 percent are Latino, reflecting the demographics of Gulfton, the school’s surrounding neighborhood. Gulfton is best known for its 90-plus apartment complexes, built to house oil industry professionals in the 1960s and 1970s. After the oil bust of the 1980s, the neighborhood

transitioned to become a low-income community of immigrants from Mexico, Central America, and dozens of other countries and regions. By 2000, Gulfton was Houston’s most densely populated community, with an estimated 45,000 people living in a three square-mile area. Local experts estimate the actual population of Gulfton is closer to 70,000, accounting for a significant number of people who are reluctant to participate in the Census because of immigration status.<sup>32</sup> Houston

Independent School District (HISD) schools in the neighborhood have struggled with overcrowding and low academic performance.

### **Why Expanded Learning Time and Why Science?**

Over the past four years, KIPP, YES, and Harmony charter schools have opened in Gulfton, offering extended school days and promising better academic results for neighborhood children. Hundreds of families have opted out of HISD in favor of the charters, driving Jane Long’s enrollment down from 1,337 students in 2007 to 773 in 2010.

As Jane Long has lost students to the nearby charters, its budget decreased, forcing the school to cut enrichments such as band and theatre arts, spurring increased student

## Jane Long Middle School 2010-2011

Number of Students:	773
Grades:	6 – 8
Students Participating in Expanded Day:	Required for all 240 sixth graders 60 seventh/eighth graders voluntarily participate
Former Schedule:	7:45 AM – 3:00 PM
Expanded Day Schedule:	7:45 AM – 5:30 PM
Former Time on Science per Week:	180 minutes
Expanded Day Time on Science per Week:	450 minutes of core science classes for sixth and eighth graders; additional average of 90 minutes per week of STEM apprenticeships through Citizen Schools for all sixth graders and 60 seventh/eighth graders

attrition. Leaders and staff of the school, acutely aware of the competitive environment, knew they needed to break out of the crippling cycle.

Diana De La Rosa was the principal of Jane Long from 2003 until mid-March 2011, when she was tapped to lead the turnaround of another Houston middle school. She explained, “When I started, we were really struggling to meet academic performance goals. The majority of students were failing. It was clear to me that we did not have enough time to counter the students’ language and knowledge gaps. We needed a way to increase instructional time—especially in science.” De La Rosa and her team started by redesigning the schedule to create 90-minute instructional blocks. Students received a 90-minute block of science every other day.

Aware that the competing charters all had extended schedules, De La Rosa and her staff also sought to provide learning opportunities beyond the school day for Jane Long students. “We had a few after-school programs at the time, but they were led by teachers who were frankly worn out by the end of the day. There was no energy to try anything different and the programs had little impact on students,” said De La Rosa. “Then Citizen Schools came along. They were ready to take on the afternoon.”

Founded as an after-school program in Boston in 1995, Citizen Schools runs expanded day and after-school programs for 4,400 middle school students at 37 sites in seven states. The Citizen Schools model features project-based “apprenticeships”—ten-week, hands-on courses taught by “Citizen Teachers” from the local community, including journalists, lawyers, stockbrokers, scientists, and others. In addition to participating in apprenticeships,

students receive academic support, go on field trips, and engage in service opportunities and college and career explorations.

In the first year of Citizen Schools at Jane Long, 38 students participated for the full year, averaging 93 percent attendance in the program. According to rubrics developed by Citizen Schools to track student outcomes, 79 percent of students in the program that first year improved their oral communication skills and 72 percent improved their leadership skills. Over the same period, 71 percent maintained a passing grade or improved a lower grade in English language arts and 74 percent did so in math. Satisfaction was also high: On a scale from 1 to 5, the average rating of program quality by students, families, volunteers, teachers, and Citizen Schools staff members was 4.3 out of 5.

De La Rosa was impressed. “Then we thought, let’s assign them the really tough kids!” she said. The same year Citizen Schools came to Jane Long, De La Rosa had targeted intensive attention on the “bridge group”—22 sixth graders who were over-age for grade level and struggling academically. De La Rosa herself led the group in the homeroom period and encouraged teachers to provide the group with additional help before and after school. Despite the extra effort, the end of the year brought disappointing results: Only 10 bridge group students were promoted to seventh grade.

The next year, De La Rosa enrolled 15 bridge group students in the Citizen Schools program. She was overwhelmed by the result. “They did not lose one of those kids! They even had a few in honors classes by the end of the year. The Citizen Schools staff struggled less, persisted

more, and did better than we did. We were able to accelerate the progress of these students through middle school so that by the end of eighth grade they caught up with their peer group.”

That experience convinced De La Rosa that Citizen Schools could have a similar impact on the entire sixth grade. A year of intensive planning, including focus groups with parents, principals, and teachers of elementary feeder schools, resulted in Jane Long teachers voting 36-1 to expand the school day by requiring all sixth graders to enroll in the Citizen Schools program. With permission from HISD, in Fall 2010 Jane Long began requiring all sixth graders to attend school from 7:45 AM to 5:30 PM, with the last 2.5 hours devoted to the Citizen Schools program.

The expanded schedule was funded by a combination of Title I, AmeriCorps, state and local education funds, and private resources raised by Citizen Schools. To help finance the program, Jane Long eliminated an assistant principal position and funding for field trips and other activities. Additional resources from a 21st Century Community Learning Center grant support the voluntary participation of seventh and eighth graders in the Citizen Schools program.

De La Rosa would have liked to extend the school day for the entire school, but began with the sixth grade given budget constraints. “We strategically focused on the sixth grade to establish a baseline of educational culture and behavior in middle school. We want these kids to achieve success, to build their confidence right from the start.”

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## MORE TIME FOR SCIENCE TEACHING AND LEARNING

### Core Science Class

Once they were sure that the entire sixth grade would enroll in Citizen Schools, Jane Long school leaders redesigned the school day to leverage additional time for science. Since Citizen Schools provided electives via their apprenticeship program, school leaders eliminated one of the sixth-grade elective blocks and doubled science instructional time to 90 minutes daily for sixth graders. At the same time, administrators eliminated an eighth-grade elective to double eighth-grade science time to 90 minutes every day. Eighth grade is the testing year for science in Texas.

De La Rosa saw the impact on the faculty right away. “They are less stressed about covering all the topics, and they have better classroom management because they see the students every single day,” she said.

Assistant Principal Kendall Bailey said, “The majority of our students are not native English speakers. Like any other students, they need time to understand the scientific concepts, but they need even more time because they really struggle with the both the scientific language and limited vocabulary overall.”

Of the 240 entering sixth graders in Fall 2010, 87 were reading at third-grade level or below, and another 75 were reading below the fifth-grade level. The teachers identified students’ low reading levels and inadequate grasp of vocabulary as important priorities for additional attention. They used some of the extra time to emphasize the vocabulary—calling it out, using it in sentences, and highlighting it in the interactive science notebooks.

Jill Bailer, a 28-year veteran teacher at Jane Long and the science department head, said, “My students recently got tripped up by the word ‘reflect’ in a lesson explaining the source of moonlight. They understand that the moon’s light comes from the sun, but they didn’t know that word. Compounding the problem, they lack inference skills. Throughout their education, they have not been challenged enough to problem solve. We need to build their skills and motivation to find the answers they don’t know. With more time, we can create good projects that consistently extend the learning, give the kids a chance to demonstrate what they know, challenge them, and build their confidence over time. We have the chance to be intentional about that now with the sixth grade.”

Bailer offered an example of a project on the lunar cycle as a way she uses the expanded time to build higher-order skills. “We gave the students two days to work on their lunar cycle models. They worked in teams; they were creative about organizing resources; and their understanding of the concepts deepened.” Science teacher Ella Meisner commented, “Sometimes it is during a project that I can see where students do not really understand the scientific concept—even if they did okay on their written assessment, they have misconceptions that are revealed through doing the project, and I can correct them.”

Another impact of the increased science time is the opportunity to increase engagement in science, by building closer teacher/student relationships, and more broadly diversifying the teaching methods. Said Meisner, “I really like seeing the eighth graders every day—I am making deeper connections with them.”



**Jane Long Expanded-Day Schedule**

	Monday	Tuesday	Wednesday	Thursday	Friday
7:45 – 8:30	Elective / Advisory	Elective / Advisory	Elective / Advisory	Elective / Advisory	Elective / Advisory
8:30 – 10:00	Science	Science	Science	Science	Science
10:00 – 11:30	Math	Math	Math	Math	Math
11:30 – 12:00	Lunch	Lunch	Lunch	Lunch	Lunch
12:00 – 1:30	Social Studies	Social Studies	Social Studies	Social Studies	Social Studies
1:30 – 2:45	ELA	ELA	ELA	ELA	ELA
2:45 – 3:00	Snack	Snack	Snack	Snack	Snack
3:00 – 4:00	Academic Support – Math Academic League	Academic Support – DEAR, journaling, differentiated support by team	Academic Support – Math Academic League	Academic Support – DEAR, journaling, differentiated support by team	Explore – Choice Activities
4:00-4:30		Apprenticeships		Apprenticeships	
4:30-5:30	College and Career Connections		Explore – Choice Activities		

**CLASSROOM SPOTLIGHT: STORE DESIGN AS A FOUNDATION FOR SPECIES CLASSIFICATION**

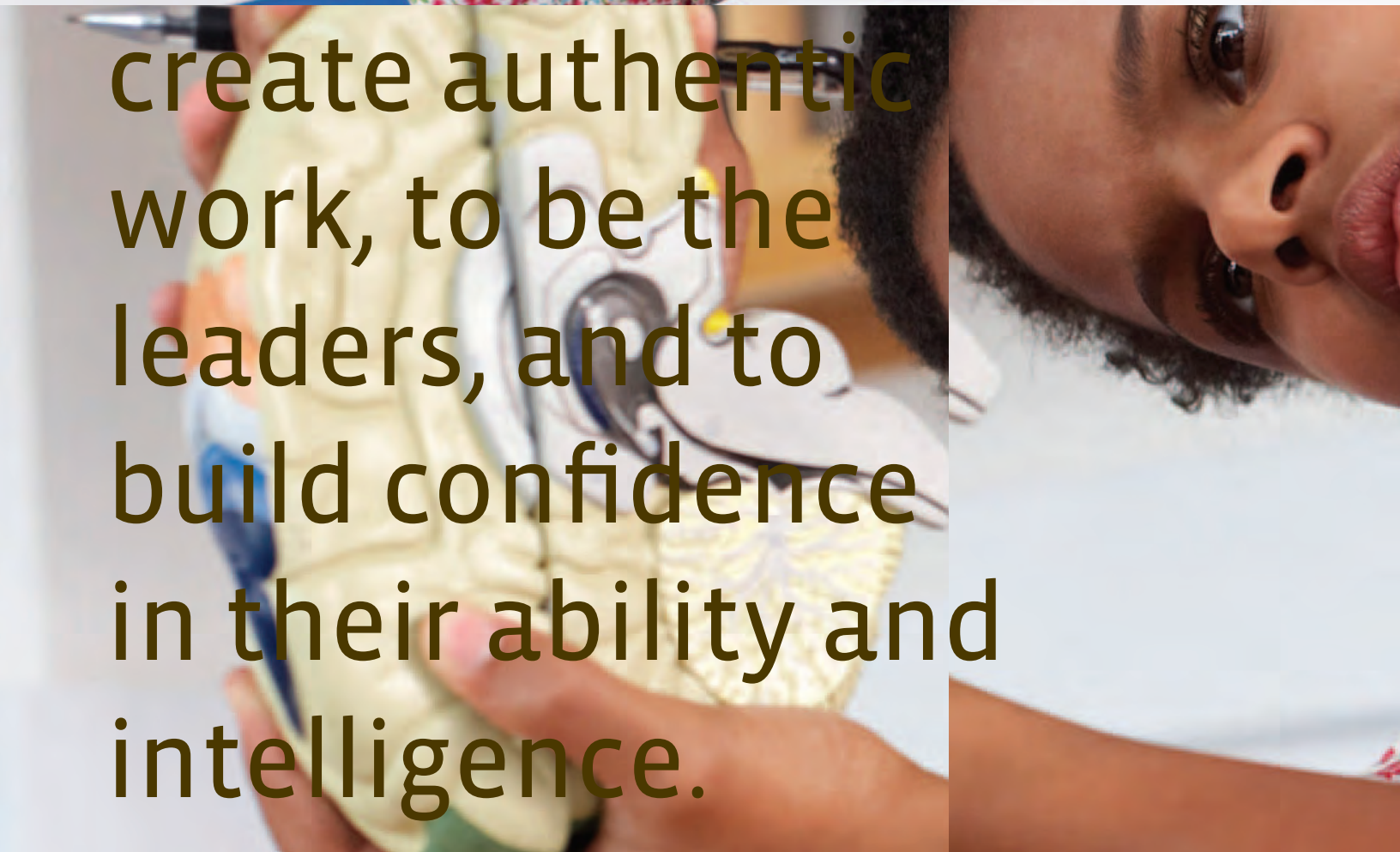
Sixth-grade science teacher Diann Valentine uses some of the expanded science time to test out a new project with her students. She has created an interdisciplinary unit on store design, with the goal of building foundational knowledge for subsequent lessons on species classification. Valentine divides her students into teams and assigns a different type of store to each team. Then she provides the teams with lists of typical items that would be found in their stores. She asks the teams to categorize the products, justify their choices, and diagram their store’s layout. She has designed the exercise so the students are required to create hierarchical classification systems—like the systems that biologists use to classify species—but using familiar objects. Valentine extends the lesson into math, requiring students to price the products and create financial projections. Throughout, she emphasizes the vocabulary of commerce. Introducing the project to the students, Valentine explains that she wants them to prosper in their careers and that this project is intended to teach them both about the real issues businesspeople face every day and about the knowledge and follow-through on tasks required to be successful.

Valentine assigns specific roles to each team member. “I asked the young people who usually have the most trouble focusing to lead their teams,” she said. The project is designed to last seven 90-minute class periods and to culminate with the teams presenting their stores to the class. The class is then ready to move directly into a unit on species classification. “My students don’t have the background knowledge within which to situate explanations of scientific concepts. This unit is designed to create that. But we would never have done this if we had not doubled the science time,” said Valentine.

Students are excited as they embarked on the project. Said Luis, a sixth-grade student, “We are grouping things different ways so we know where to find them. We are making diagrams. We have to figure out the aisles and the prices. We are doing math. I am the financial manager of the store!” Alex, another sixth grader, added, “I’m the team manager of my store. I have to take care of the whole project and make sure it does not get messed up.”



Apprenticeships  
give young people  
the opportunity to



create authentic  
work, to be the  
leaders, and to  
build confidence  
in their ability and  
intelligence.

## APPRENTICESHIP SPOTLIGHT: VISION AND THE BRAIN

Play-Doh and pipe cleaners are the supplies needed for the “Vision and the Brain” Citizen Schools apprenticeship session late on a Tuesday afternoon. Citizen Teacher Saumil Patel chose these simple supplies to help his students grasp some complicated scientific content. They are building brain models using Play-Doh, delineating the different lobes of the brain by color. Natasha Parekh, a Citizen Schools teaching fellow, circles the room, answering questions and making sure everyone is on track. “Who remembers the function of the occipital lobe?” Patel queries the class. Frank, an eighth grader, calls out “Vision!” and then turns to his companion to note, “Isn’t it weird that the vision lobe is at the back of the head?”

Asked about his experience in Citizen Schools, Frank offered, “Citizen Schools helps me in science class. I like it because I learn new things and my friends are here. It is fun. They also help me with my homework. It’s not like my

mother doesn’t help—she does! But Citizen Schools helps me too.”

With their brain models completed, the 15 students turn their attention to Patel, who is a research assistant professor in the Department of Neurobiology and Anatomy at the University of Texas Medical School. Patel manages the group easily with his calm, friendly demeanor and clear expectation that the students will master the material. He describes a diagram of a nerve cell, pronouncing the scientific name and functions of each part, and asks the students to build a basic cell structure using pipe cleaners. He circles the room to check on their progress, asking one student where the nucleus of his cell is and another to explain the difference between dendrites and axons and where each is on her model. “These are beautiful. I knew you would be able to do this!” Patel says to the group.

### Citizen Schools Science Apprenticeships

Jane Long’s program with Citizen Schools has grown from 70 students in 2009-2010 to 300 students in 2010-2011. Fourteen full-time teaching fellows and eight part-time team leaders staff the program. The program’s major components:

- Monday–Thursday academic support sessions, or “Academic Leagues,” focus on math at the request of Jane Long school leaders;
- career and college experiences, field trips, and explorations designed to help students develop future college and career goals; and
- twice-weekly apprenticeships.

The teaching fellows and team leaders support the volunteer “Citizen Teachers” in leading apprenticeships. To keep group size small (15 vs. 28 during the core academic classes), Citizen Schools operates 36 apprenticeships per week at Jane Long. Citizen Schools designed more than half of the apprenticeships to draw upon science, technology, engineering, or math content and contexts. Development of the computing-focused apprenticeships is supported in part by a 2010 three-year National Science Foundation grant to Citizen Schools.

For the vast majority of Jane Long students, participating in Citizen Schools is the first opportunity they have ever had to meet science professionals and engage in active learning connected to the STEM disciplines. Said Kathryn

Nash, Director of Civic Engagement for Citizen Schools Texas, “They don’t know any scientists and they don’t know what scientists do. Now they are meeting scientists and engaging in real work. This opens their eyes to possibilities that they have never considered before.”

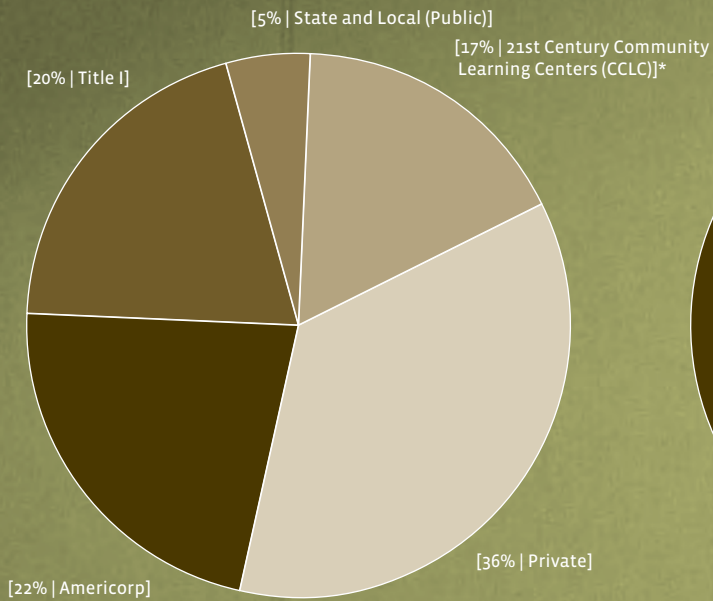
The apprenticeship is the centerpiece of the Citizen Schools model. According to Nash, apprenticeships give young people the opportunity to create authentic work, to be the leaders, and to build confidence in their ability and intelligence. Citizen Schools requires each apprenticeship to include the following components: 1) interactive, hands on teaching; 2) explicit career connections; 3) a focus on at least two of the following 21st century skills—oral presentation, teamwork, leadership, data analysis, advanced literacy, or technology; and 4) a high-quality WOW!—the end product students present in a showcase attended by their teachers and families. The WOW! showcase is the culminating event of the 10-week apprenticeship. Students are in the lead roles—presenting their work to their families and school-day teachers. Citizen Schools presents a special showcase for teachers at 3:00 PM and then another for families in the evening.

“We are very intentional about guiding the content of the apprenticeships—the lesson plans are structured and very detailed, and we help the Citizen Teachers weave in the hands-on activities throughout,” said Nash of Citizen Schools. Mandy Hauser-Gandin, Citizen Schools Program Director, explained, “We carefully choose Citizen Teachers. We need people who enjoy middle school-age kids and can be dynamic in front of them. We especially look for people



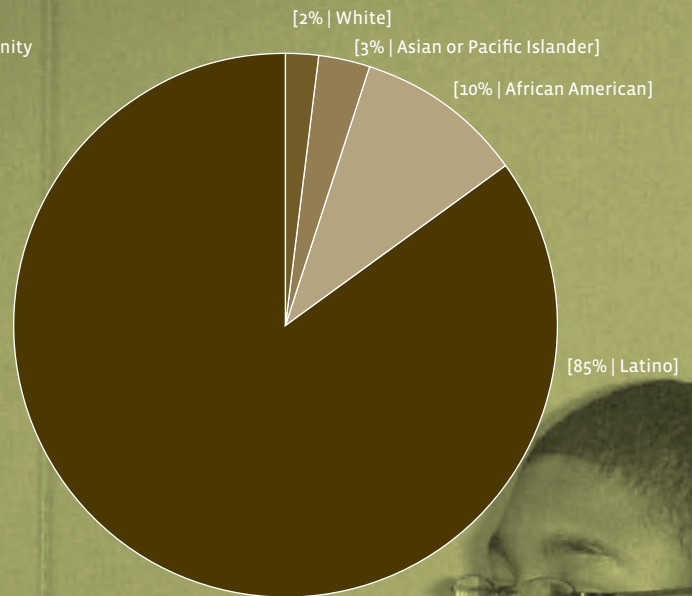
### Funding the Expanded Day at Jane Long

2010 – 2011



### Jane Long Student Demographics

2010 – 2011



\*21st CCLC funds support the voluntary participation of seventh and eighth graders in Citizens Schools at Jane Long. Cost per student for the expanded-day schedule: \$2,155.



who are learners themselves—open to hearing feedback about their teaching. We try for college graduates—because we think our kids should go to college and we want to be role models.”

Citizen Teacher Katrina R. DeNosaquo, a geophysicist from Conoco Phillips, recently led a team of engineers and geophysicists in developing and teaching an apprenticeship on natural disasters. Each week, DeNosaquo works with students to explore a different type of phenomenon. One week, students built volcanoes and looked at land formations. Another week, students made their own structures and tested their integrity using a leaf blower to simulate hurricane-force winds. Later, students traveled to Galveston to examine damage from the 2008 Hurricane Ike and meet with Texas A&M professors who engage in hurricane research. DeNosaquo said: “We focused on teaching the kids about analyzing data. We did some basic earth science so they understood about plate tectonics, but we really minimized our ‘talking at them’ time. We built a model of the earth’s plates using wood, sandpaper, and a bungee cord so the kids could simulate plate movement; we built volcanoes; and we had them interpret earthquake data.

“The challenge in teaching this age is that they don’t always offer feedback very well. You have to take the time to really know each young person and ask in a lot of ways to make sure they are getting it. Sometimes the lesson is not targeted right—too complicated, or too easy, and you need to readjust. Also, it’s late in the afternoon—they can be tired. It’s very hard, very frustrating, and very rewarding. You really get a sense of accomplishment working with them. I am so proud of what they can accomplish.”

Said Principal De La Rosa, “The central focus is what the kids are doing. They are working together—they are dissecting sheep hearts and building solar cars. They are learning about careers and possibilities.”

Cassandra Jones, Citizen Schools Campus Director for Jane Long, added, “Our goal is to expose kids to all kinds of STEM content and careers and spark their engagement in science. One thing we realized was how important exposure is. These kids have not had the opportunity before to see if that spark of interest is there. So when they feel it, they are excited.”

### Jane Long Student Subgroups 2010-2011

Eligible for Free/Reduced Price Lunch	96%
Limited English Proficient	52%
Enrolled in Special Education	12%

### MORE SUPPORT FOR USING SCIENCE TIME EFFECTIVELY

The Jane Long science teachers collaborate closely with one another. “We have very structured science curricula and we are all covering the same units at roughly the same time. So we know as seventh- and eighth-grade teachers, what all the sixth graders did in science and we can build on that. We have had common curricula for about six years,” said science teacher Diann Valentine. “It helps us that the science teachers are a team; we have a positive culture working together. We recreate that positive culture in our classrooms,” said science teacher Gina Rodriguez. The teachers receive support from the school administration and also from the district science team.

However, the science teachers point out the gaps in consistency between the district’s planning guide—called the HAP-G—and the district-mandated interim assessments, which must be administered every two to three weeks. In addition to the inconsistency in content between the assessments and what is expected to be taught, the assessments are perceived by the teachers to focus primarily on lower-order thinking and content. Additionally, the HAP-G does not yet reflect the changing Texas science standards and the statewide standardized test. Science Department Head Jill Bailer also noted, “The breadth of content is onerous for our kids, especially because they have few resources to assist them at home.”

One of the most significant challenges for Jane Long moving forward is increasing connections between Citizen Schools staff and the science faculty to ensure that all science time is used most effectively. Beyond the occasional apprenticeship led by a science teacher, or teachers choosing to attend the twice-yearly WOW! showcases, there is very little interaction between the two groups of educators. Kendall Bailey, Jane Long Assistant Principal, said, “Our faculty and the Citizen Schools staff could learn a lot from each other. The Citizen Schools teachers have more freedom over what they teach [in the apprenticeships], and their careers are not hinging on how well the students do on the standardized tests. They could show our teachers how to make their classes more engaging, more meaningful for the students. On the flip side, the Citizen Schools staff plans great things for the kids to do, and sometimes they struggle with execution. Our faculty could help with content knowledge, pedagogical strategies, and classroom management.”

One challenge is identifying the time for the team to work together. In the original design, students were to be dismissed early every Friday to enable joint planning and professional development among teachers and Citizen Schools staff. This plan had to be scrapped due to grant requirements that the extended program had to run every day. Nevertheless, Citizen Schools Campus Director Cassandra Jones is moving forward. “We are already getting more intentional by emphasizing scientific discourse and process across all of our science-focused apprenticeships,” she said.

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## IMPACT

The expanded school day and the redesign of the schedule to provide more core science time has given Jane Long teachers and Citizen Schools staff and volunteers time to engage students in all four of the important strands of science identified in *Taking Science to School* and the two additional strands emphasized in *Surrounded by Science*. For example, the store item classification project, which is designed to help students understand the rationale behind the ways that biologists classify living things, provides an opportunity for students to participate in *Strand 3*—understand the nature and development of scientific knowledge. Citizen Schools STEM apprenticeships offer strong examples of all four *Surrounded by Science* learning strands: creating excitement, interest, and motivation to learn about phenomena in the natural and physical world and developing a sense of identity in young people as science learners.

At the close of its first year, the expanded schedule for Jane Long sixth graders had impacted the school in several ways:

- No state assessment in science is administered to sixth grade students, but the math and reading scores of the Jane Long sixth-grade showed considerable improvement over past years. The percentage of sixth graders passing the Texas Assessment of Knowledge and Skills (TAKS) in math in spring 2011 rose from 70 to 77 percent and the percent passing with a “commended performance” increased 13 to 30 percent. According to the Texas Education Agency, commended performance is considerably above the state passing standard and shows thorough understanding of the knowledge and skills at the grade level tested.<sup>33</sup> Prior to this year, the sixth-grade math passage rate was increasing only about a percentage point a year for the last four years. Strikingly, the percentage of sixth graders scoring in the commended performance range had been decreasing nearly 2 percentage points per year over the prior three years before increasing 17 points in 2011. Reading achievement also climbed, with sixth-grade passing rates on the 2011 reading TAKS improving from 63 to 73 percent and the commended performance rate increasing from 16 to 26 percent.
- The 2010-11 academic year was the first in nine years that the school exceeded its enrollment projections for the sixth grade. On the first day of school in September 2010, 200 students were expected, and 240 showed up.
- Parent satisfaction was high. According to a parent survey administered by Citizen Schools, 89 percent of respondents agreed that expanded time helped their child do better in school; 92 percent agreed that since expanded time was implemented, their child has tried harder to do well in school; and 76 percent of parents said the main reason they want their child attending an expanded-time school is for exposure to skills and opportunities needed for his or her future. One parent noted in written survey feedback: “My child has a great attitude, stands tall, speaks out, has great confidence, honesty, and openness” as a result of participating in Citizen Schools.
- Attendance improved. Sixth graders posted a 96 percent attendance rate in 2010-2011 (representing a 20 percent reduction in absenteeism). Students noted in written survey feedback, “I have fun and do stuff I’d never done in my life” and “What I like about Citizen Schools is they praise me a lot when I do good.”

Jane Long faculty members mentioned the difference they saw in students’ social development, communications skills, use of vocabulary, and ability to explain and speak confidently. “The exposure to people, places, ideas, outside of their immediate neighborhood is so valuable. It is so important how Citizen Schools teaches the kids to think about their futures and the possibilities outside this five-block area—which for many constitutes their entire world,” said teacher Gina Rodriguez.

Carlos, a sixth grader, declared, “I have nothing to do at home. I want to be here doing something.” His friend David said quietly, “Citizen Schools is a part of me, like a family, a home. My friends are here. I am comfortable. I like the teachers. The classes are smaller. We have more one-on-one time. I am comfortable saying I don’t understand, and they help me.”



“The exposure to people, places, ideas, outside of their immediate neighborhood is so valuable. It is so important how Citizen Schools teaches the kids to think about their futures and the possibilities outside this five-block area—which for many constitutes their entire world.”

Gina Rodriguez, science teacher, Jane Long Middle School

#### POSTSCRIPT

In March of 2011, Principal Diana De La Rosa was transferred by HISD to a new position as principal of an underperforming school, Patrick Henry Middle School, and a new administrative team took over management of Jane Long. The switch in administrators is part of a larger plan to convert Jane Long to a magnet school serving grades 6 – 12 with a focus on health sciences. As part of that transition—which is set to offer grade 9 beginning in Fall 2012—the current Jane Long administration opted to eliminate the expanded-time program for sixth grade and return to a traditional schedule. The future plans include offering health science-related internships for older students.

In her new role at Patrick Henry, Principal De La Rosa has continued the partnership with Citizen Schools


and applied for a grant to support it. Because the grant (a federal Title I Priority Grant) was awarded for only one year instead of the expected three, however, Patrick Henry is not able to move to an expanded day for all sixth graders at this time. De La Rosa hopes to find sources to support expanded time in future years and is actively seeking public and private grants to support the schedule expansion for all sixth graders. For now, the school offers optional after-school enrichment with Citizen Schools and approximately 200 students participate (including about one third of the sixth grade class). In addition, Patrick Henry will focus attention on developing the science curriculum, including running a STEM fair with parents and a STEM summer camp for seventh graders.

A young woman with dark curly hair, wearing a blue lab coat and clear safety goggles, is focused on a chemistry experiment. She is pouring a vibrant blue liquid from a 250 mL beaker into a glass flask that is held in a metal clamp on a stand. The background is dark with faint, glowing green and yellow lines, suggesting a laboratory or educational setting.

# KEY FINDINGS

“What doesn’t work is tacking on a few more minutes to the day and asking teachers to do more of what they have been doing. That’s simply because there has to be a more complete change in the structure and content of schooling. We need to find ways to deepen student engagement, to give kids a greater sense of ownership over their learning, and to really tap into student motivation. ELT opens up those possibilities, and when it is done well, you are seeing kids gaining a sense of mastery and competence.”

– Pedro Noguera, Executive Director of the Metropolitan Center for Urban Education, New York University

A smaller, inset version of the same young woman in the blue lab coat and safety goggles, performing the same chemistry experiment of pouring blue liquid from a beaker into a flask on a stand.

Pedro Noguera, Peter L. Agnew Professor of Education at New York University, was not specifically addressing science education in his interview with The After-School Corporation last fall, but it is striking how much the key themes emerging from research on science education intersect with the major tenets of student-centered pedagogy. Each school visited for this report is attempting to use the expanded time for two basic purposes:

**Increasing students' active engagement in and proficiency with science learning**

**Strengthening teachers' capacity to implement an enhanced science program**

These two broad approaches, each entailing three distinct facets, are explored in detail below. The findings are drawn from the insights and information provided by the staff from the case study schools as well as observations of scholars and the study authors.



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## MORE TIME FOR SCIENCE TEACHING AND LEARNING

The initial drive for building in additional time in class has been to make available more “time on task” for students. Beyond this objective, however, schools have found three specific benefits of having more time both within core science classes and in extra science-themed activities to advance their overall science education program.

# 1.

## Aligned with the National Research Council's reports on how students learn science, expanded-time schools are integrating more hands-on learning activities and facilitating more scientific discourse within the classroom.

“Hands-on learning” has become a ubiquitous phrase in science education, and as such, it means different things to different people. Karen Worth, chair of the Teaching Standards Committee of the National Science Education Standards Project, defines hands-on learning as follows: “Hands-on learning is not simply manipulating things. It is engaging in in-depth investigations with objects, materials, phenomena, and ideas, and drawing meaning and understanding from those experiences.”<sup>34</sup>

Many teachers in expanded-time schools are integrating hands-on learning into the longer instructional blocks in ways that meet this higher standard of scientific investigation. The activities include experiments, such as using water and sand to create erosion; and projects, such as building scale-models of the solar system, creating diagrams of the structure of a cell, or creating replications of the meadow habitat. Although these projects take time to implement correctly, the impact on students' learning can be significant. For example, across the country, fourth-grade students who reported participating in hands-on science activities every day, or almost every day, scored an average of 16 points higher on the 2009 Science National Assessment of Educational Progress (NAEP) than those who reported never doing hands-on activities.<sup>35</sup>



Although integration of hands-on approaches in science class is necessary, it is not enough. *Ready, Set, Science!* asserts, “Many teachers have their students do experiments or make observations with the hope that scientific understanding will miraculously emerge from the data. Being exposed to new information, however, is not the same as understanding or integrating that information into what one already knows. Real conceptual change requires that deeper reorganizations of knowledge occur.”<sup>36</sup>

Many teachers interviewed for this report recognized this difference between information exposure and integration, and they reiterated that the additional time was particularly important for them to ensure that hands-on activities are surrounded by reflection on science content, attention to language, and opportunities for students to build and demonstrate understanding through discussion and argument.

Said Jennifer Taylor, Volusia County District Public Schools Science Specialist K-12, “These discussions are key; otherwise it’s what I call ‘birthday party science’—fun and exciting but students don’t necessarily retain the science knowledge.” Debra Turner, a third-grade teacher at TMALS in New York City explained, “Sometimes the students get caught up in the experiment and lose sight of the point. We need the extra time to keep them on track and keep the focus on the science goals.”

Providing opportunities for students to develop and communicate their ideas through group discussion and debate is an important way skilled science teachers create classrooms that emulate how scientists work. In an April 2010 *Science* review, Stanford University School of Education Professor Jonathan Osborne noted that to ensure student discourse effectively contributes to learning, teachers must teach the norms of social interaction, model exemplary arguments, define specific outcomes of the discussion, help students ask the appropriate questions, and identify relevant and irrelevant evidence.<sup>37</sup> The *Ready, Set, Science!* authors point out that teachers can use scientific argument and other

discourse strategies to build the capacity of linguistically diverse learners by “allowing time for complex ideas to be expressed, listened to, repeated, re-voiced, and responded to at length.”<sup>38</sup>

School leaders and teachers at the profiled schools spoke about how the expanded time has enabled them to create an environment that allows students to make mistakes and examine what they have learned as a result, rather than rushing through the material. Several teachers across different schools pointed out that creating an environment in which mistakes are welcomed as opportunities to learn emulates how scientists engage with their own material. As Sharon Lloyd, a teacher at Starke Elementary in Volusia County, expressed, “We must be willing to allow the students to make mistakes and to make mistakes ourselves. There is valuable learning in making a mistake. Science is not a perfect thing.”

These teachers also are guiding their students to work in a scientific community of their peers. Starke Elementary teacher Cindy McNairy said, “In addition to the science content, one of my goals is to teach students to work as cooperative partners, so they are familiar with the scientific process. Working this way is the same as how scientists approach their work.” Travis Bacon, a Pierson fifth-grade teacher, said, “My students need to work on respecting each other and treating each other as members of a community. They need life and social skills. We need the extra time for this. We need to slow everything down and bring students together to talk and engage in self-reflection. That’s a great way for us to find out: Have they internalized the learning?”

Therefore, through hands-on learning students can deepen their mastery of science content and the scientific process by engaging in investigations and discovery; gathering and presenting evidence; defending and explaining their ideas in classroom discussions; and working productively with their peers. In other words, students in expanded-time schools are engaging in science learning that blends the National Research Council’s four science learning strands.

## 2.

**Teachers in expanded-time schools are using the extra time to implement specific strategies to counter deficiencies in reading levels, background context, and vocabulary, which often are pronounced among high-poverty, English-language-learner student populations.**

Many teachers and administrators pointed to gaps in reading skill, background context, and knowledge of both scientific discourse and general vocabulary as significant challenges for students. Said Siobhan Gordon, a first-grade teacher at Thurgood Marshall Academy Lower School (TMALS) in New York City, “We need to build their vocabulary and expose them to new experiences so they have opportunities to broaden their language and perspective. We need to build their knowledge so when they are reading they have a broader context to approach the material.” She provided an example: “Many don’t know what a fireplace is; when a question on the test refers to a fireplace, they don’t know what to do.”

The need to boost reading proficiency has driven school leaders across the country to expand instructional time in English language arts, sometimes at the expense of science time. Some researchers question that dichotomy, pointing out that literacy skills are best acquired and understood as learning tools that support acquisition of knowledge across disciplines. These researchers cite examples of efforts to integrate literacy and science instruction, with the results benefitting student competencies in both areas.<sup>39</sup>

At Matthew Kuss Middle School in Fall River, Massachusetts, the focus is on writing practice across all academic areas and expanding the students’ knowledge of vocabulary broadly. Said Sarah Chapin, a Kuss science teacher, “We have found that sometimes key words in

the test question are unfamiliar, for example: tradeoffs, congestion, interchangeable. In each instance, students did not know the word and couldn’t understand the question, even though we are confident they did understand the scientific concept. So we are working on vocabulary and inference skills.”

At TMALS in New York and at Pierson and Starke in Volusia County, the science lessons include guided reading and building students’ decoding and inference strategies. At Jane Long in Houston, the “science language goals” of each lesson are emphasized, repeated, and reinforced multiple times. Jane Long’s teachers also recognize the impact of increasing project-based learning on the ability of English language learners to grasp the material. Diann Valentine, a science teacher at Jane Long, said, “My sixth graders recently completed models of the solar system. They examined the sun and prominences, asteroids, meteorites, and comets. After this project, my English language learners gave a much better, more detailed explanation of this on English proficiency assessments than I have ever seen in the past.”

The schools also are making efforts to connect classroom material to the “real world.” *Ready, Set, Science!* identifies connecting “students’ everyday thinking, knowledge, and resources to practicing scientists” as a key strategy for promoting equality in classroom discourse with multi-cultural populations.<sup>40</sup> In doing this, teachers also are linking new ideas to prior knowledge and experiences. Forging such a link is one instructional and curricular feature that can support students in developing literacy in the context of science, according to researchers. “Eliciting prior knowledge becomes especially important when concepts are abstract, when scientific principles seem distant from students’ everyday lives, and when students’ experiences lead them to develop inaccurate ideas,” assert Joseph Krajcik and LeeAnn Sutherland of the University of Michigan in an April 2010 *Science* review article.<sup>41</sup> Said fifth-grade Pierson Elementary teacher Travis Bacon, “Tomorrow we will be outside with the garden hose in the dirt to see how erosion occurs. Our students struggle with applying science to life, so we try to make the examples concrete.”

### 3.

**In both expanded-time middle schools included in this study, students were choosing from a set of science electives aimed at increasing engagement, enriching the core science content, and creating connections to science careers and role models (relating directly to National Research Council reports on both formal and informal science learning). These two middle schools have created formal-informal collaborations to deliver this broad range of science-based electives.**

Both middle schools studied—Kuss and Jane Long—designed electives to replicate the mixed-age, active, hands-on learning environments found in high-quality out-of-school time programs. Their primary goal is fostering engagement in science, and research shows that eighth graders who demonstrate interest in STEM are three times more likely to later pursue degrees in STEM fields.<sup>42</sup> The President’s Council of Advisors on Science and Technology asserted in their September 2010 report on improving K-12 STEM education, “Students need opportunities to establish deeper engagement with and to learn science and

mathematics in non-standard, personal, and team-oriented ways that extend beyond the curriculum and the classroom. This is especially vital for identifying and nurturing high achievers and future STEM innovators.”<sup>43</sup>

At Jane Long, the electives—in the form of “apprenticeships”—are delivered by local volunteer professionals through Citizen Schools. At Kuss Middle School, science faculty members teach the electives on subjects of their own choosing. Kuss faculty have partnered with external organizations, including Urban Ecology, the Harvard-Smithsonian Center for Astrophysics, and Project Oceanology, to provide curricular materials and professional development supporting specific electives.

Career connections are an important component of the electives and apprenticeships. The scientists teaching apprenticeships through Citizen Schools can become role models for Jane Long students. Most of these students are meeting a working scientist for the first time, and the fact that many of the scientists reflect the students’ own racial and ethnic heritage makes it all the more possible for students to envision such potential career pathways for themselves. Bringing STEM professionals into the classroom—not just for a one-time visit, but in active teaching roles over time—can be a powerful strategy to counter the lack of social capital that prevents low-income and minority young people from considering STEM careers.<sup>44</sup> At Kuss Middle School as well, teachers make a point to emphasize the career possibilities. Kuss science teacher Jennifer Berube, who teaches the Forensics elective, noted, “I make sure students understand the career potential in forensics. Otherwise, they never assume this is a possibility for them.”





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## MORE SUPPORT FOR USING SCIENCE TIME EFFECTIVELY

Some of the schools examined in this report have built time in their expanded schedules to increase their support for teachers to help them make the most effective use of science time. Other schools profiled here reserve the expanded time exclusively for instruction, yet administrators look for ways to implement increased support for teachers within existing “teacher time.” As described below, such supports include access to: (a) professional development tools and training to help teachers use student assessment data to drive instructional decisions and (b) curricula that are uniform across the district and mapped to state standards and assessments.

### 1.

**Supported by external partners, school districts, and/or school leaders, teachers in expanded-time schools are participating in professional development focused on improving content knowledge and pedagogical skill.**

Most teachers in the profiled schools wanted access to better and more targeted science professional development, and school leaders agreed, citing barriers of money, time, and lack of good quality options. In many places, teachers filled the gaps by creating peer support groups, which are often led by the veteran science teachers and center on peer learning exchanges and observations.

Outward-looking, partnership-oriented perspectives on the part of school leaders and/or veteran teachers enabled access to many free or low-cost external professional development resources—including After-School Science Plus and assistance from the Abyssinian Development Corporation’s STEM Director for TMALS in New York; the Urban Ecology Institute, Harvard-Smithsonian Center for Astrophysics, and Project Oceanology for Kuss in Massachusetts; and Stetson University professors for Starke Elementary in Florida. The Volusia County school district science specialists also play an active role in offering professional development opportunities that are directly aligned with the district’s science curricula and well-regarded by teachers. This district’s goal, in the near

future, is to streamline and focus training opportunities, in science and across the curriculum.

According to TMALS staff, enrolling a team of teachers in professional development that was actually designed for after-school educators worked well, because it enabled the teachers to build their skills and confidence in facilitating inquiry-based lessons in a more accessible and lower-stakes environment than formal K-12 professional development would have offered. Having a school leader that recognized this and welcomed the “after-school” curricula into the school was an important factor in creating success at TMALS.

### 2.

**Either as part of an expanded-time initiative, or as part of parallel reform efforts, teachers in expanded-time schools are using student assessment data to drive instructional improvement.**

Kuss Middle School has anchored its overall school redesign in increasing teachers’ ability to analyze formative assessment data to drive instructional improvement. For this reason, Kuss allocates part of its expanded time for teachers to participate in data analysis teams. “Using data to improve our practice is like breathing now,” said Cindy Wrobel, a Kuss science teacher. Through the Massachusetts Expanded Learning Time Initiative, Kuss accesses free training, drawing from the resources of Massachusetts 2020 and Focus on Results (organizations that work directly with schools to facilitate improvement) to build teacher and administrator skills in this area. Now, Kuss science teachers are leading the development of interim science assessments that will be used across the district.

Volusia County reserves the “Plus One” hour for instruction, rather than time specifically for teachers to analyze data and apply findings to their instruction (although the 16 teacher professional development days over the course of the year are extended by one hour each in Plus One schools). However, the district has deeply engaged school leaders and teachers in using data to understand what students are learning. The science team requires third-, fourth-, and fifth-grade teachers to administer eight interim assessments over the course of the year and has provided the teachers with

guidance documents and data analysis sheets to help them analyze the data during their collaborative planning time.

Launching the Performance Matters system to analyze student data is the next major step for Volusia County. This system will track state assessments and district interim assessments in English language arts, math, and science. In this way, the new software will free teachers from completing data analysis by hand and enable them to spend more time planning and evaluating instructional responses to the data. Performance Matters also will provide a major tool for customizing professional development for each teacher—not just in science, but overall—as student assessments are analyzed to understand individual teacher needs.

### 3.

**Teachers in expanded-time schools are working in teams to ensure that core science curricula are uniform across their classrooms and mapped to district and state standards and assessments.**

All the schools profiled in this report have created uniform science curricula over the past several years. They have moved toward increasing the consistency of what and how science is taught across their classrooms and, in some cases, across their schools as well. Kuss teachers are now working with elementary and high school teachers to vertically align the science curricula K-12 and complete an analysis of any gaps between the curricula and the Massachusetts state science standards. The Volusia County district produces a science curricula map keyed to the Florida state standards for each grade. Jane Long teachers plan their pacing together so they are all covering the same units on roughly the same days. And the teachers of Thurgood Marshall in New York City work with Evelyn Roman, the Abyssinian Development Corporation STEM director, to align the science curricula in core academic classes with afternoon science enrichments.

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#### ESSENTIAL FACTORS FOR SUCCESS

The authors of this report observed the following four key characteristics that contribute to each of the schools' success in leveraging the expanded time for improved science instruction.

- 1. Leaders who prioritize science and find resources to support it:** With the focus over the last decade on ELA and math assessments, too few schools have prioritized science. Yet, in each of these schools under study, the principals, asserting that science proficiency is equally important to children's learning, have shifted financial and staff resources to improving science instruction. For example, at Jane Long Middle School in Houston, then-principal Diana De La Rosa gave up an assistant principal position to fund the Citizen Schools expanded day program. Meanwhile, Florida's Volusia County devotes 20 percent of its Title I resources to the nine Plus One schools (out of 68 Title I schools), and has increased its spending on science instruction, despite a district curriculum budget decrease from \$7 million in 2007 to \$2 million in 2010.
- 2. School teams with intensity of purpose and a willingness to take risks:** Teachers, school leaders, and external partners at the expanded-time schools have an intensity of purpose as they wrestle with the complex challenge of increasing student achievement in science and other academic areas. In each school, expanding the schedule represented a major disruption of the status quo and required an enormous investment of time, talent, and resources. Still, everyone who participated in this study—school leaders, teachers, students, and external partners—talked approvingly of the benefits of having more time.
- 3. Commitment to improving teaching:** Expanded learning time is proving to be a powerful draw for strong science teachers. In some schools, they have the chance to design and teach electives beyond their core academic classes and participate in partnerships and professional development focused on science topics of their own choice. In all schools, teachers have the time to delve deeply into scientific content and process in their core academic science classes. Veteran science teachers are creating partnerships with external science organizations, mentoring novice teachers, developing innovative lesson plans, leading discussions of student assessment data, and engaging in expanded peer observations.

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## CONTINUING CHALLENGES

**4. Formal-informal collaborations that enrich science teaching and learning:** Some schools have leveraged expanded learning time to create or deepen formal-informal collaborations that have transformed their approach to science instruction and enriched their science course offerings. These partnerships are aimed at sparking student engagement in science through active learning connected to real-world situations and broadening student perspective about science careers by having them work with, and learn from, scientists. Because the collaborations happen during the school day, all students have access to, and benefit from, these experiences, not just those who might have chosen to enroll in after-school programming or in the informal science programming offered by one of the partner organizations. School leaders also have been savvy about choosing their partners, tapping into the resources and expertise of organizations that have embraced the mission of improving science engagement and proficiency among under-represented populations, and the leaders have garnered national and local public and private resources to implement their ideas. These partner organizations include Citizen Schools, The After-School Corporation, Abyssinian Development Corporation, the Harvard-Smithsonian Center for Astrophysics, and the Urban Ecology Institute. In some cases, these organizations have brought not only resources and expertise; they also have introduced their school partners to new strategies for assessing student outcomes that go beyond standardized tests or grades to measure engagement in science and students' sense of themselves as capable of pursuing science careers.

As a result of these core elements and the ways in which they have led school leaders to manage learning time, four out of the five schools in this study have shown increased science proficiency levels, as measured by state standardized tests. (Jane Long Middle School in Houston experienced the expanded time schedule for only one year, thus it will be difficult to assess the impact of the initiative on eighth-grade science test scores.) As detailed in the case studies, additional impacts of lengthening the school day have included increased enrollment, attendance, positive behavior, parental involvement, and student engagement in science.

Even with these successes, the profiled schools are facing similar challenges in their efforts to create better outcomes for students—both in science achievement and engagement and in overall academic and personal success. These four challenges are:

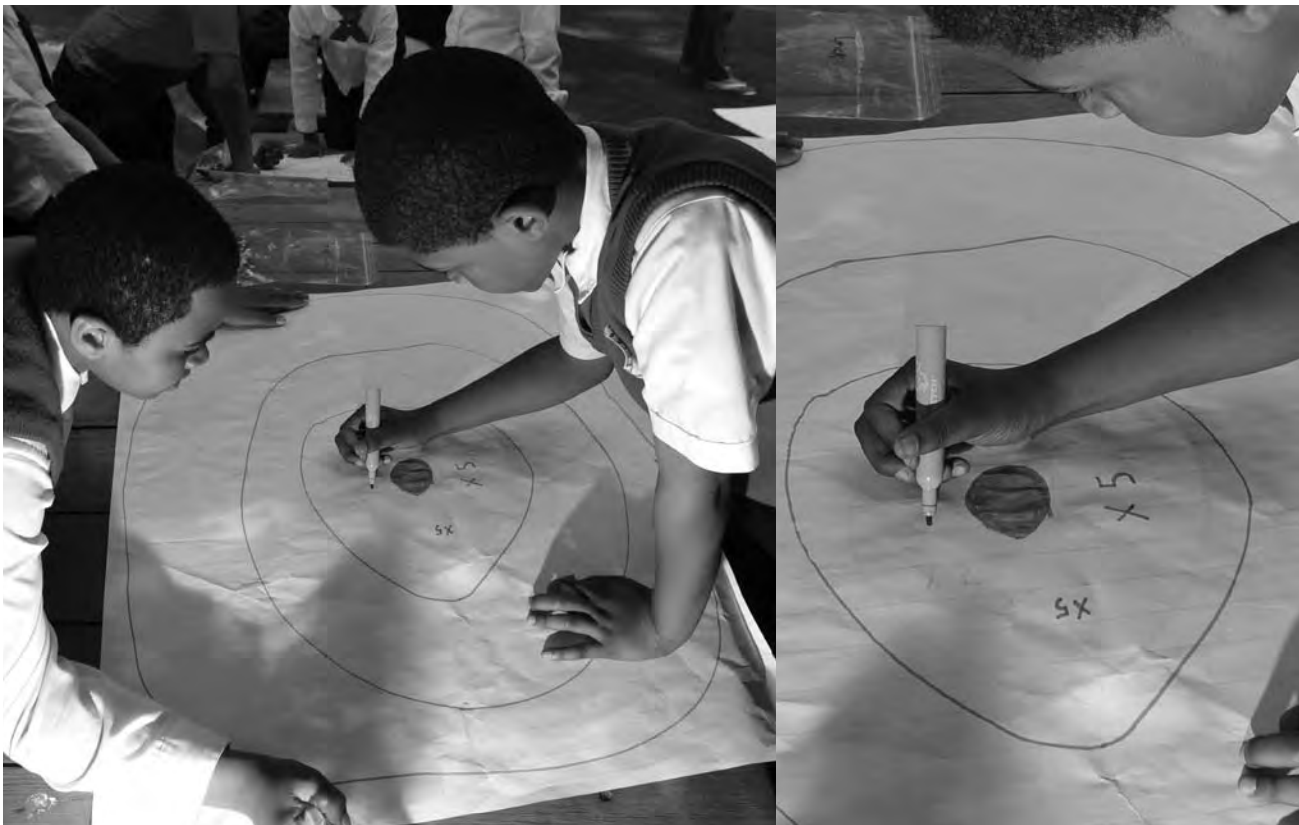
**1. Improving the quality of science teaching:** Transforming science classrooms so they more closely emulate how scientists go about their work—as articulated in the National Research Council's Science Learning Strands—is a complex endeavor. Changing system-level factors, such as standards and assessments, to more closely align with a higher-order, comprehensive vision of science proficiency will ensure that teachers are not forced to emphasize content over scientific process. In addition, good professional development is needed across the board. The most effective teachers in the group of schools studied have had strong support from district science teams, or from external science partners, to build their scientific knowledge and improve their pedagogical approaches over time.

**2. Overcoming high-poverty and English-language-learner students' deficiencies in reading skill, background context, and understanding both the scientific discourse and more general vocabulary:** Teachers in every school have used extra time to integrate specific strategies aimed at issues facing English language learners. Nearly all teachers interviewed for this report considered such issues their major obstacle to success and were searching for more effective approaches. For a special section in *Science* magazine in 2010, researchers explored the topics of science, language, and literacy, and offered arguments in support of a range of practices, such as teaching in the students' native language in the early grades; redesigning science texts; and implementing a number of specific approaches shown to have positive impact.<sup>45</sup> Broader dissemination of this emerging knowledge is needed, so that teachers, district science specialists, and school leaders have the chance to put into practice what researchers in science and literacy education are learning. In addition, more research must be conducted to explore how learning opportunities should be designed to build a stronger and broader background context for low-income children, so they can better scaffold knowledge and skills in science and in other academic areas.



**3. Align science electives with core content:** In some cases, the schools that offer science electives have not yet made strong connections between these electives and their core science curricula. Exploring how to make those connections is an ongoing challenge, both for schools with electives delivered by external partners (Jane Long), and those where the electives are taught by teachers (Kuss). Additionally, understanding how to assess the impact of the electives is an area that needs more attention. Although the electives are not strictly informal or after-school programs, their design and delivery has many similar attributes, including the fact that students in electives are not tested or graded in the same ways as they are in core science classes. Recent work by the National Research Council, the National Academies of Science, and the Program in Education, After-school and Resiliency (PEAR) at Harvard University and McLean Hospital has provided ideas on how to assess not only cognitive outcomes, but also attitudinal, behavioral, and social outcomes from informal science experiences.<sup>46</sup> The schools and their partners could potentially adapt these lessons to their expanded-time electives in an effort to better understand whether the electives are delivering on their promise to enhance science engagement and competency.

**4. Achieving financial stability:** The schools in this study have been creative in leveraging resources to expand learning time. With an unstable budget outlook, however, it will likely be more difficult to sustain and expand the number of students served. Volusia County has seen their Title I funding reduced in recent years, as their numbers of children in poverty have declined, and further Title I decreases could impact the future of the Plus One program. In Massachusetts, the Kuss Middle School relies on annual legislative appropriation for ELT funding. Thus far, state leaders have remained committed to the program, but increasing budget pressures could impact the Kuss ELT program. TMALS in New York City has funded its expanded time through multiple public and private sources and must contend with the ongoing threat of severe budget cuts and the difficulty of sustaining private philanthropic investment over the long-term. The short tenure of expanded time at Jane Long in Houston is an example of how a program championed mainly by a single school leader is extremely vulnerable when that leader moves on. No school in this study has yet accessed a way to fund the expanded schedule that is completely integrated with the core per-pupil budget and thus more insulated from annual variations in funding.



# THE PROMISE OF MORE TIME FOR SCIENCE

Policymakers, education reformers, and science educators are working hard to change the way science is taught in America. Increased public and parental awareness about the importance of science; strengthening science standards, assessments, and curricula; and opportunities that involve students in informal and out-of-school time science all promise to help produce more knowledgeable, engaged graduates who will become the inventors and innovators of tomorrow.

However, as long as time for science instruction continues to be squeezed, even these strategies will likely fall short of moving the needle on the science engagement and proficiency of American students across the board. Without fundamentally restructuring the school calendar—particularly at the elementary and middle school levels—to add more learning time and then prioritizing science during that time, most American students will simply not become either proficient in, or excited about, science.

Using a range of strategies, the expanded-time schools examined in this report have demonstrated that additional time can bring about marked change in students' science experiences and proficiency. The schools also are offering teachers more support to use science time effectively—through meaningful professional development, solid instructional leadership, innovative partnerships, high-quality assessments, and curricula that meet individual students' needs.

This significant work must be strengthened, sustained, and scaled to continue to offer useful lessons to science education reformers. Additional analysis and solutions that address common challenges also will benefit the increasing number of schools and districts currently considering expanding their school day and year. Many more implementation models are needed to guide the efforts of schools and districts to add time in ways that will produce positive outcomes for students, in science along with other disciplines. Policymakers should prioritize funding that supports expanded time, so that schools can effectively implement those models that will have the greatest impact on students.

The potential impact of expanded science time is reflected in the comments of Amira, a sixth grader: “I wasn’t that good at science before, but now I see that different ways of teaching are more interesting and help me learn. I like the fun, hands-on experiments that help to explain things.” She continued, “It also helps me when teachers take the time to make connections to my real life, tell me about my career, and help me think about the future.”



“I wasn’t that good at science before, but now.... I like the fun, hands-on experiments that help to explain things. It also helps me when teachers take the time to make connections to my real life, tell me about my career, and help me think about the future.”

– Amira, a sixth grader



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## ENDNOTES

- <sup>1</sup> National Center for Education Statistics (2011). *The Nation's Report Card: Science 2009* (NCES 2011–451). Institute of Education Sciences, U.S. Department of Education, Washington, DC; National Science Foundation, National Center for Science and Engineering Statistics (2010). *Science and Engineering Indicators 2010, Chapter 2. International S&E Higher Education*. Arlington, VA (NSB 10-01).
- <sup>2</sup> *Nation's Report Card*, p. 9 and p. 12.
- <sup>3</sup> National Center for Education Statistics. *The 2007 Trends in International Mathematics and Science Study*. Washington, DC: Author.
- <sup>4</sup> *Science and Engineering Indicators*, 2010.
- <sup>5</sup> Banerjee, R. and Muley, V.P. (2007). *Engineering Education in India* Mumbai, India: ITT Bombay.
- <sup>6</sup> *Science and Engineering Indicators*, Chapter 3. Science & Engineering Labor Force. Sidebar: *Projected Growth of Employment in S&E Occupations*.
- <sup>7</sup> *Ibid. International S&E Higher Education*.
- <sup>8</sup> McMurrer, J. (2008). *NCLB Year 5: Instructional Time in Elementary Schools: A Closer Look at Changes for Specific Subjects*. Washington, DC: Center for Education Policy.
- <sup>9</sup> Kolbe, T., Partridge, P. and O'Reilly, F. (2011). *Time and Learning in Schools: A National Profile*. National Center on Time & Learning and the Center for Education Policy Analysis, University of Connecticut.
- <sup>10</sup> Dorph, R., Goldstein, D., Lee, S., Lepori, K., Schneider, and S., Venkatesan, S. (2007). *The Status of Science Education in the Bay Area: Research Brief*. Berkeley, CA: Lawrence Hall of Science, University of California.
- <sup>11</sup> Johnson, A. "Making science elementary: Schools work hard to fit lessons into busy day." *The Boston Globe*, March 4, 2011.
- <sup>12</sup> Center on Education Policy. (2010). *State High School Tests: Exit Exams and Other Assessments* Washington, DC: Author.
- <sup>13</sup> National Research Council. (2007). *Taking Science to School: Learning and Teaching Science in Grades K-8*. Committee on Science Learning, Kindergarten through Eighth Grade. Richard A. Duschl, Heidi A. Schweingruber, and Andrew W. Shouse, Editors. Board on Science Education, Center for Education. Division of Behavioral and Social Sciences and Education. Washington, DC: The National Academies Press.
- <sup>14</sup> Michaels, S., Shouse A.W. and Schweingruber, H.A. (2008). *Ready, Set, Science! Putting Research to Work in K-8 Classrooms*. Board on Science Education, Center for Education, Division of Behavioral and Social Sciences and Education. Washington, DC: The National Academies Press, p. 57.
- <sup>15</sup> *Taking Science to School*, p. 37.
- <sup>16</sup> *Ibid.* p. 21.
- <sup>17</sup> President's Council of Advisors on Science and Technology (2010). *Report to the President: Prepare and Inspire: K-12 Education in Science, Technology, Engineering, and Math (STEM) for America's Future*, p.12.
- <sup>18</sup> Tai, R. H., Liu, C.Q., Maltese, A.V. & Fan, X. (2006). "Planning early for careers in science," *Science* 26 May 2006. Vol 312, no. 5777, pp. 1143-1144.
- <sup>19</sup> Bell, P., Lewenstein, B., Shouse A. and Feder, M., Editors. (2009). *Learning Science in Informal Environments: People, Places and Pursuits*. Committee on Learning Science in Informal Environments, Board on Science Education, Center for Education, Division of Behavioral and Social Sciences and Education. Washington, DC: The National Academies Press, p. 2 and 4.
- <sup>20</sup> Fenichel, M., and Schweingruber, H.A. (2010). *Surrounded by Science: Learning Science in Informal Environments*. Board on Science Education, Center for Education, Division of Behavioral and Social Sciences and Education. Washington, DC: The National Academies Press.
- <sup>21</sup> Bevan, B. with Dillon, J., Hein, G.E., Macdonald, M., Michalchik, V., Miller, D., Root, D., Rudder, L., Xanthoudaki, M., & Yoon, S. (2010). *Making Science Matter: Collaborations Between Informal Science Education Organizations and Schools*. A CAISE Inquiry Group Report. Washington, DC: Center for Advancement of Informal Science Education (CAISE).
- <sup>22</sup> See National Center on Time & Learning (2011), *Learning Time in America: Trends to Reform the American School Calendar* Boston, MA: Author.
- <sup>23</sup> Checkoway, A., et al. (2011). *Evaluation of the Expanded Learning Time Initiative Year Four Integrated Report: 2009-10* Cambridge, MA: Abt Associates.
- <sup>24</sup> Weighted for school size and rounded up to the nearest whole number.
- <sup>25</sup> The Tripod Project administers student, teacher and parent surveys and analyzes the data to help schools measure the impact of effective teaching and student engagement.

- <sup>26</sup> For more information on New York City's principal empowerment model, see <http://schools.nyc.gov/offices/empowerment/default.htm>
- <sup>27</sup> Friedman, L. and Quinn, J. "How After-School Programs Can Nurture Young Scientists and Boost the Country's Scientific Literacy." *Education Week*, February 22, 2006.
- <sup>28</sup> Donner, J. and Morgan, E. (2010). Collaborative for Building After-School Systems Frontiers in Urban Science Exploration Resource Guide. p.8. <http://www.afterschoolsystems.org/content/document/detail/3040/>, retrieved April 2011. The criteria were also informed by the work of Great Science for Girls, a National Science Foundation-funded project of the Educational Equity Center at the Academy for Educational Development.
- <sup>29</sup> Interview with Saskia Traill, The After-School Corporation, April 2011; The After-School Corporation. (2010). *Unlocking the Power of Expanded Learning Time: Year Two Report*. New York: Author.
- <sup>30</sup> <http://www.tascorp.org/section/aboutus/mission>, retrieved May 2011.
- <sup>31</sup> See Farbman, D. (2011). *Harnessing the Power of Expanded Time to Improve Schools*. Boston, MA: National Center on Time & Learning. Available at: <http://www.timeandlearning.org/?q=node/99>.
- <sup>32</sup> Rogers, S. (2005). "Superneighborhood 27: A Brief History of Change." *Places*, 17(2). College of Environmental Design, University of California, Berkeley, CA.
- <sup>33</sup> *Texas Assessment of Knowledge and Skills: Understanding the Confidential Student Report, A Guide for Parents*, 2011. <http://www.tea.state.tx.us/student.assessment/taks/csr/>, retrieved June 2011.
- <sup>34</sup> Haury, D. and Rillero, P. (1994). "Perspectives of Hands-On Science Teaching." The ERIC Clearinghouse for Science, Mathematics and Environmental Education. Posted to the North Central Regional Laboratory's Pathways to School Improvement internet server. <http://www.ncrel.org/sdrs/areas/issues/content/cntareas/science/eric/eric-1.htm>, retrieved March 2011.
- <sup>35</sup> The National Assessment of Educational Progress Data Explorer: <http://nces.ed.gov/nationsreportcard/naepdata/report.aspx>, retrieved May 2011.
- <sup>36</sup> *Ready, Set, Science!*, p. 41.
- <sup>37</sup> Osborne, J. (2010). "Arguing to Learn in Science: The Role of Collaborative, Critical Discourse." *Science*, 328(5977), 463-466.
- <sup>38</sup> *Ready, Set, Science!*, p. 101-102.
- <sup>39</sup> Pearson, P. D., Moje, E., & Greenleaf, C. (2010). "Literacy and science: Each in the service of the other." *Science*, 328(5977), 459-463.
- <sup>40</sup> *Ready, Set, Science!*, p. 101.
- <sup>41</sup> Krajcik, J. and Sutherland, L. (2010). "Supporting Students in Developing Literacy in Science." *Science*, 328(5977), 456-459.
- <sup>42</sup> A. V. Maltese and Tai, R.H. (2010). "Eyeballs in the Fridge: Sources of Early Interest in Science." *International Journal of Science Education*, 32:669-685.
- <sup>43</sup> President's Council of Advisors on Science and Technology (2010). *Report to the President: Prepare and Inspire: K-12 Education in Science, Technology, Engineering, and Math (STEM) for America's Future*. p.96.
- <sup>44</sup> National Science Foundation Final Workshop Report (2005). *Pathway to STEM Careers: Preparing the STEM Workforce of the 21st Century, Broadening Participation Through a Comprehensive, Integrated System*. [http://www.seas.gwu.edu/~stem/STEMreport\\_March05.pdf](http://www.seas.gwu.edu/~stem/STEMreport_March05.pdf), retrieved May 2011.
- <sup>45</sup> Pearson, P. D., Moje, E., & Greenleaf, C. Among the approaches cited were: Concept-Oriented Reading Instruction (CORI), In-depth Expanded Applications of Science (Science IDEAS), Guided Inquiry supporting Multiple Literacies (GisML), Seeds of Science—Roots of Reading and Reading Apprenticeship. An article in the same issue of *Science* by Catherine Snow (p. 450-452) also referenced Word Generation, <http://www.wordgeneration.org>, a program for middle school students developed by the Strategic Education Research Partnership that embeds all-purpose academic words in interesting topics and provides activities for use in math, science and social studies as well as English language arts classes.
- <sup>46</sup> Hussar, K., Schwartz, S., Boiselle, E. and Noam, G. (2008). *Toward a Systematic Evidence-Base for Science in Out-of-School Time: The Role of Assessment*. The Program in Education, After-school and Resiliency (PEAR) at Harvard University and McLean Hospital; and Friedman, A. (Ed.). (2008). *Framework for Evaluating Impacts of Informal Science Education Projects*. [http://insci.org/resources/Eval\\_Framework.pdf](http://insci.org/resources/Eval_Framework.pdf), retrieved May 2011 and *Assessment Tools in Informal Science: Ratings and Reviews*: <http://www.pearweb.org/atis>.

# NATIONAL CENTER ON TIME & LEARNING

The National Center on Time & Learning (NCTL) is dedicated to expanding learning time to improve student achievement and enable a well-rounded education. Through research, public policy, and technical assistance, we support national, state, and local initiatives that add significantly more school time to help children meet the demands of the 21st century.

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***Strengthening Science Education: The Power of More Time To Deepen Inquiry and Engagement***


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