CAROLINA® CASE STUDY

CAROLINA K–8 CURRICULUM | Smithsonian Science Education Center

FAST FACTS

Participants:
New Haven Public Schools, New Haven, Connecticut

- **Heather Toothaker**, District Science Coach
- **Alexander Kotkin**, Science Teacher, Grades 5 and 6, Benjamin Jepson Multi-Age Interdistrict Magnet School
- **Jessica Farrell**, Science Teacher, Grades 7 and 8, Edgewood Creative Thinking Through STEAM Magnet School

Holly Baldwin, Independent Instructional Support Specialist, Smithsonian Science Education Center, Carolina Biological Supply Company

Challenge: Selecting strong, hands-on science curricula for grades K–8 that address Connecticut science standards

Solution: Implement Smithsonian Science programs

Results: Delivering inquiry-based science that engages students, supports teachers, has a bilingual component, and is proven to raise scores in science, reading, and math

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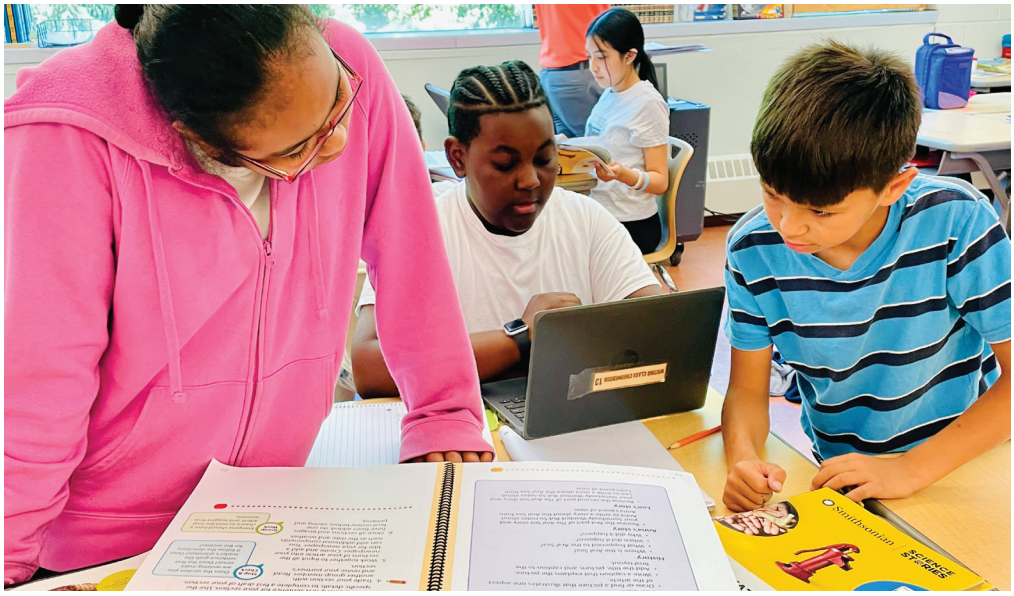
New Haven Public Schools: Finding and Implementing Science Programs for K–8

When the New Haven Public Schools science team began looking for science programs for its grades K–8 schools, they were starting from scratch. Up to that point, they had no formalized science curricula. There was no consistency in science teaching between classrooms within the same grade. Teachers pieced together lessons from kits from a variety of companies. None of the kits were aligned with the Next Generation Science Standards* (NGSS), and some were decades old. Why? Funds had been unavailable.



Grade 5 students use the Smithsonian Science for the Classroom Student Activity Guides and digital resources to obtain, evaluate, and communicate information as they collaborate to design solutions to provide freshwater to those in need.

That all changed with the advent of the Elementary and Secondary School Emergency Relief (ESSER) Fund. Now there was an opportunity to fund three-dimensional science programs, initially for grades K–5 and then a year later for grades 6–8.

"The need had been there for a very long time to have a cohesive program," District Science Coach Heather Toothaker says. "We did our research. We looked to see

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which companies had the best NGSS scores. But for us, it was also who had something that would work for our schools."

To check all the boxes for the New Haven teachers and students, in addition to NGSS alignment, the science program had to:

- Be hands on to physically engage students in investigations of phenomena to answer questions or solve problems
- Support teachers, particularly grades K–5 educators who are uneasy teaching science
- Have a biliteracy component to address the needs of the increasing population of Spanish-speaking students
- Be viable for the long term

"We knew we were not going to be able to spend money on another program for a long time," Toothaker says. "Whatever we chose, we had to get it right the first time."

First: Getting It Right

New Haven Public School District comprises 44 schools, 31 of which are grades K–8 elementary/middle schools. Of its 19,150 students, approximately 12,500 students are in grades K–8. Twenty schools are Title I schools. The district boasts the highest suburban enrollment in magnet schools in Connecticut, with nearly 3,000 of the more than 7,300 students in the 20 magnet schools commuting from suburban towns (NHPS 2024).

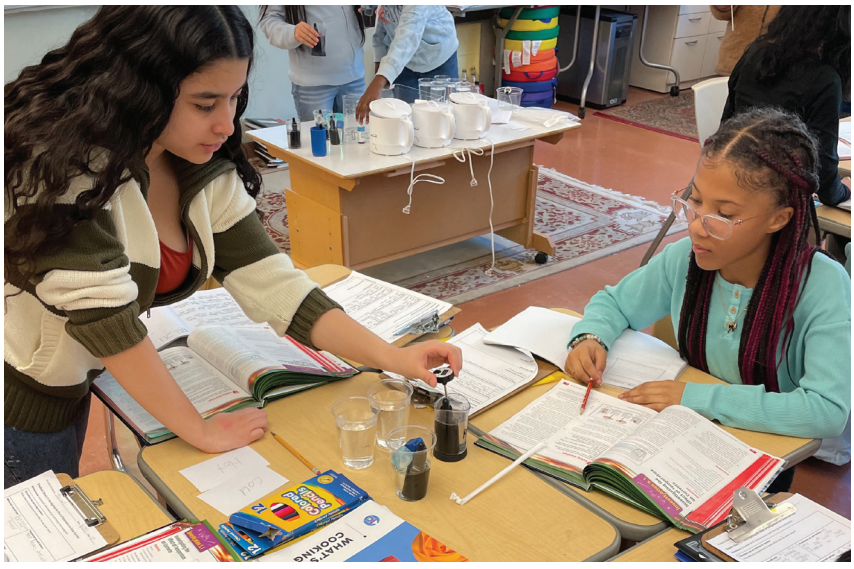
In its search for a science curriculum for grades K–5, Toothaker and previous Science Department Supervisor Richard Therrien homed in on three programs. Each program was piloted across grades K–5 in both community and magnet schools that encompassed New Haven's diverse populations, including students with special needs, biliteracy, and varying achievement. Nine teachers piloted the programs across those factors.

The teachers tested the lessons in their classrooms independent of one another and then presented their findings—rating charts, student work samples, and student experiences—to a panel that included coaches for special ed, literacy, math, and science and a curriculum specialist. Once approved, the panel's findings were brought before the superintendent and Board of Education for final approval.

"There were two clear choices almost from the get-go based on our own criteria," Toothaker says. But after piloting the programs, the final decision came down two considerations:

- One program focused more on hands-on investigations; the other had a high level of computer use. While digital assets have a place in learning, the panel wanted the bulk of student work to be hands on.
- One program excelled by providing impeccable customer service.

The grades K–5 program that won the support of the teachers, panel, and board is **Smithsonian Science for the Classroom™**. A year later, a science team comprising Toothaker, District STEM Coach Dr. Andrea Gomez, and Science Department Supervisor Robert McCain followed the same process to select a grades 6–8 science



With STCMS, grade 6 students investigate the effect of temperature on water currents.

> "It's not a canned investigation where you know what the outcome is, and that is an incredibly different approach for teachers who have not taught [three-dimensional, inquiry-based] science."
>
> **—Heather Toothaker**

program. The clear choice: the **Smithsonian Science and Technology Concepts for Middle School™** (STCMS™).

Second: Professional Development

The Connecticut State Board of Education adopted standards that embrace the NGSS in 2015 to provide all students with "a rich and challenging science curriculum that will promote scientific literacy, while inspiring and supporting advanced study and science-related careers" (CT.GOV 2024). In preparing to implement the Smithsonian Science programs, the science team faced a significant challenge: most of the teachers had not been trained in the NGSS.

"It's a huge mental shift for a lot of teachers," Toothaker says. "We were teaching them how to teach vocabulary properly, how not to frontload, what is inquiry truly. … It's not a canned investigation where you know what the outcome is, and that is an incredibly different approach for teachers who have not taught [three-dimensional, inquiry-based] science.

Toothaker, Gomez, and McCain kicked off professional development (PD) for the Smithsonian Science for the Classroom program in August 2022, prior to the start of the 2022–23 school year. Holly Baldwin, an independent instructional specialist, was part of the group of educational experts from Carolina Biological Supply Company and the Smithsonian Science Education Center who provided a broad overview of how the program would help teachers achieve Connecticut's science standards and introduced the first module. The district scheduled a second full day of PD in September, followed by after-school opportunities throughout the year. The team introduced grades 6–8 teachers to STCMS a year later following the same professional development protocol. Baldwin continues to be onsite to provide support for a week each month through June 2025.

During her visits, Baldwin offers a variety of approaches for PD that include full-day classroom walkthroughs and visitation with school administrators, answering teachers' questions, and modeling lessons in classrooms for teachers to observe.

Initially, many grades K–5 teachers found inquiry-based science challenging. "Science was not in their daily lesson plan, and then NGSS is completely different for them," Baldwin explains. "By New Haven providing teachers with opportunities to share successful strategies and showcase student work, they're facilitating a culture of collaboration and knowledge-sharing that can lead to further innovation and effectiveness in the classroom."

To further support educators, Baldwin developed a Google classroom platform that enables teachers to communicate across the different schools and provides additional digital resources specific to the district. For grades 6–8, because there is consistently a dedicated time for science, teachers dig deeper into NGSS strategies to understand how STCMS supports them.

"One of the things we've stressed with teachers is it's not about content, it's about process," Toothaker explains. "Content is important, but we can never discover new content on our own if we don't understand how scientists think and work to discover what is happening."

Third: In the Classroom

For Alexander Kotkin—an educator with 12 years of experience at Benjamin Jepson Multi-Age Interdistrict Magnet School—it was "quite the stress test" learning how to teach inquiry-based science in two new curricula in the 2023–24 school year. Kotkin uses the Smithsonian Science for the Classroom program for two grade 5 classes and the STCMS program for two grade 6 classes every day.

In previous years, he had 45 minutes each week to teach science using kits that were rotated from one school to another and "were more activities than real learning."

For Jessica Farrell—an educator with 10 years of teaching under her belt but just finishing her second year at Edgewood Creative Thinking Through STEAM Magnet School—having the STCMS program for the 2023–24 school year "was a great sense of relief." Familiar with the NGSS, she received pushback at a previous school when using three-dimensional science teaching strategies. Farrell now has support to embrace those strategies using the STCMS program in two grade 7 and two grade 8 classes every day.

Both Kotkin and Farrell were nearing the end of their first year in teaching the Smithsonian programs.

Initial Experiences

Kotkin was eager to have the opportunity to do something meaningful with science and enhance his then limited knowledge of the NGSS. But for him, the amount of information provided during the initial PD session—what he needed to know about NGSS, how to access different parts of the curriculum—was overwhelming.

The first three weeks of the school year, Kotkin arrived early and stayed late as he delved into the curricula and learned how it meshed with his teaching style. "It gave me the opportunity through practice to eventually become comfortable," he says. "Both the representatives from the Smithsonian and Carolina started to make a habit of saying, 'Relax. It's your first year.' But this idea that I was always behind the eight ball, that there was always something that I wasn't doing that I should be doing, I hadn't felt that since my first couple of years teaching."

That all changed about two months into the school year. "Now that I understand the program, now that I understand how things are organized and where to find everything both physical and digital, I have no bad things to say," he explains. "I love the way it's organized. I feel that I can go and find what I need, and if I have a question, I know where to ask it. For the most part, all the materials are provided to me, and I don't have to go out and find things. Now I feel I'm getting what I need and getting it readily, in not only in the communications by email but also with the district trainings that we have on a regular basis, either with the Smithsonian trainers themselves or via proxies within my district."

Farrell says her introduction to STCMS through PD was "literally amazing." Past professional learning was based on English language arts (ELA) or math, which had to be manipulated to fit science. Now science is the star that propels ELA and math forward. "I feel for the first time, PD is relevant to me," she explains. "It's exactly what I need. … It's just a sense of relief because whenever I feel like I have an issue, I'm able to rely on someone who knows the curriculum. It's people who understand the NGSS." Farrell was ready to jump into action.

The Smithsonian programs call out the science and engineering practices, crosscutting concepts, and disciplinary core ideas in each lesson to reassure teachers that they are providing three-dimensional learning, which Farrell finds helpful. But for her, the lesson-planning support in the Teacher Edition is what sets the curriculum apart.

"The teacher guides, they are highly effective," she says. "They show you what you need, where you can find it, what it looks like, where in the unit it pertains to. It's self-explanatory. The fact that things are separated so I can

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—Alexander Kotkin

prepare myself, I do think that now I can use my summers more wisely. I can essentially come into my school and start setting up units, because I see how certain things are laid out. I really like that that thinking piece is done for me."

Initially, Farrell's biggest challenge in teaching the STCMS program in her first year was in timing. "We either overestimate the amount of time it takes to set something up or drastically underestimate it," she says. Additionally, she sought and received help in pacing large units to reflect the time available in the school schedule.

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Students' Perceptions

For both Kotkin and Farrell, their students had to adjust to the changes in inquiry-based teaching styles and learning expectations.

"I'm presenting an inquiry and not worrying that the kids don't have a complete answer by the end of a given lesson or the end of a class, trusting the process," Kotkin explains. "Walking around the classroom, I'm asking questions and not necessarily answering the students' questions if the situation doesn't call for it. So being in a science classroom—a legitimate, inquiry-based science classroom where they were expected to not only run experiments but also to make connections to help them arrive at the pieces of learning that they needed to have—was new to them as well."

Kotkin guided students in the modality of thinking and encouraged them to see the benefits of the new learning style. "Now they love everything we do in here, and they show up ready and eager to participate" he explains. "But they had to get used to it."

Smithsonian Science encourages students to deepen understanding of phenomena used in investigations by making real-world connections. As a student-centered curriculum, it recognizes that students' everyday experiences—in and out of the classroom—serve as robust resources for making sense of phenomena and solving problems. Farrell's students were not accustomed to thinking about science outside of the classroom. Much to their chagrin, Farrell assigns homework on Mondays, to be due on Thursdays. "For me, that's an accountability piece," she says. "I want to make sure they get used to doing something [pertaining to science] at home, that they're consciously thinking about something they're learning in class."

The Smithsonian programs use coherent storylines that build to students answering a question or solving a problem and deepen understanding through a lesson-by-lesson progression. As an educator who is teaching both the Smithsonian Science for the Classroom and STCMS programs, Kotkin notes that there are obvious step-ups between grades 5 and 6. "But the program itself is streamlined enough where, one, I can learn it one way and be able to adapt that learning to understand how to prepare and present both curriculums and, two, that the programs are similar enough where my fifth graders who will become my sixth graders of next year will be comfortable walking into the science classroom and not immediately wondering what the heck is going on."

Results

Into the spring of his first year in teaching the programs, Kotkin has seen definitive improvements among students who have embraced the inquiry-based learning supported by Smithsonian Science curricula. "You can see the learning that is going on," he says. "It's much more noticeable among the students in the middle to upper levels of their education. For those students who are a little bit on the lower end, they struggle with assessments, not only with their understanding of them but with their ability to take what they've learned and utilize it in a continuing manner."

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>
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Farrell's students, still in their first year of inquiry-based learning, also find written assessments difficult. STCMS assessments are on grade level, but many of Farrell's students are reading at a significantly lower level. To help build their confidence, she restates assessment questions for them and taps into resources from lower grade units that build to the grades 7 and 8 investigations. But she recognizes that text on statewide science exams is on grade level and is "working on the foundational skills that they are missing, like, yesterday."

Smithsonian programs are designed to support students in meeting ELA, math, and science standards as well as support teachers as they build understanding of how to use science and engineering practices to demonstrate students' learning progression.

"New Haven is working toward improving literacy outcomes for their students in the science classroom," Baldwin explains. "By utilizing the Carolina Science Online® platform and its text-to-speech feature, they're addressing the needs of students who require additional support with reading proficiency." Additionally, the Smithsonian Science Stories series for grades K–5 is provided at and below grade levels as well as in Spanish. Vocabulary for all grades is reinforced by multiple, repeated, hands-on experiences, providing a rich context for learning words and definitions. As students behave as scientists and engineers, they keep their own STEM notebooks, helping them become more structured and coherent in their writing. Studies have shown that the Smithsonian's research-based instructional methods lead to higher scores in science, reading, and math.

In working with New Haven staff, Baldwin notes that the district is deeply committed to inclusivity and accessibility in education, ensuring that all students have the resources they need to fully engage with the curriculum. The Smithsonian's incorporation of point-of-use English Learner (EL) strategies in its Teacher Edition supports teachers in facilitating more effective discourse among students with varying levels of English proficiency, fostering an inclusive classroom environment where every student feels valued and understood.

Takeaways

Kotkin is looking forward to his second year of teaching the curricula. "Now that I feel comfortable, now I can take the next step and go even deeper. I can focus a little less on the procedural stuff and just getting through the lessons and focus more on that expansion of knowledge and really building in more of those extension activities," he says.

Farrell offers advice to anyone new to the programs: "Take the time to go through the Teacher Edition, like really go through every single thing. Read through the resources, make your own notes, and dissect it. … I add Post-It notes: 'You will need blank, blank, blank.' 'This is important.' … And if you have an issue, there is always a place to find an answer."

References

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New Haven Public Schools. 2024. "Our Schools." Accessed April 26, 2024: https://www.nhps.net/domain/115.

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