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CASE STUDY

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Smithsonian
Science Education Center

FAST FACTS

Participants:
Dr. Maureen Ruby, Assistant Superintendent of Brookfield Public Schools in Brookfield, Connecticut

Rachel Cohen, Teacher Leader for Middle School Science, 5–8 for Brookfield Public Schools

Debbie Farias, K–12 Director of Instruction for Brookfield Public Schools

Elisa Larson, Kindergarten Teacher at Brookfield Public Schools

Dr. Carol O'Donnell, Director of the Smithsonian Science Education Center, Washington, DC

Dr. Brian Mandell, Director of Curriculum and Communications, Smithsonian Science Education Center

Challenge: Connecticut schools need to acclimate K–8 teachers and students to their new state science standards and help students prepare for the Connecticut Next Generation Science Assessment.

Solution: NGSS-aligned Smithsonian Programs introduce and foster student-driven, 3-dimensional learning—helping students use science and engineering practices to demonstrate an understanding of disciplinary core ideas and crosscutting concepts.

Results: Teachers gain the confidence needed to teach student-driven, 3-dimensional science lessons, and students build the critical-thinking and problem-solving skills needed for academic success.

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Smithsonian Science for the Classroom™: 3-Dimensional Approach Leads to Teacher and Student Success

"How can I learn to use the Next Generation Science Standards* (NGSS) approach in my classroom?" Many teachers have asked this question since the NGSS were finalized in 2013.

The State of Connecticut is one of 44 states that have adopted NGSS-based standards.[1] As such, the Connecticut Next Generation Science Assessment is aligned to the NGSS and, according to an interview with the chief performance officer at the State Department of Education, is unlike previous science assessments.[2] Old assessments may have asked students to regurgitate content taught in a lecture-style setting. The new assessment evaluates whether the student is able to use science and engineering practices to demonstrate understanding of core ideas and crosscutting concepts.[3]

The Smithsonian Programs allow students to engage with content through inquiry and hands-on, minds-on experimentation.

Dr. Maureen Ruby is the Assistant Superintendent of Brookfield Public Schools in Brookfield, Connecticut. She knows how important it is for both teachers and students to successfully embrace the problem-based, student-driven approach that is at the heart of the NGSS. Dr. Ruby began looking for ways to help her district move forward with NGSS, and she discovered the Smithsonian Programs for grades K–8.[4]

"After evaluating every K–6 science program in the market, we chose to go with Smithsonian Science for the Classroom," says Dr. Ruby. "The program is designed in such a way that elementary teachers, who are not accustomed to teaching engineering and science, can integrate the lessons into the school year; and the modules are bundled in such a way that the students have the opportunity to meet all the standards."

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Students drive more of the instruction than they realize in 3-dimensional lessons.

Intuitive Professional Development

Dr. Ruby realized that the teachers themselves must first learn how to instruct and guide their students using the NGSS approach. She and her teachers found themselves benefitting from the Smithsonian Programs even before they began using them in the classroom. "The professional development is second to none and cognitively engages the teachers," Dr. Ruby explains. "When you're cognitively engaged, you're focused and exhausted but reinvigorated by the end! The trainers are also available to support teachers after the training."

Debbie Farias is Brookfield's Director of Instruction for grades K–12. She explains, "We do training with our K–8 teachers prior to implementation of the Smithsonian Programs. As teachers navigate through the materials, it really does develop them professionally by teaching them to think differently about the way they instruct." The teachers come out of the training with a better understanding of the importance of allowing time to instructionally engage with their students as they "do" science, versus just learning content from the teacher.

During the teacher training, Farias pulled a few sample questions from the state assessment for the teachers to try. "These were third- and fourth-grade questions, and they were challenging!" she says. "You really need to synthesize information and use problem-solving skills to answer the questions." Using sample test questions in the training was a real eye-opener for the teachers. It was evident that the design of the Smithsonian Programs provided students with multiple opportunities to not only learn science content, but importantly, engage with the content through inquiry and hands-on, minds-on experimentation. The structure of the lessons iteratively nurtures students' individual and collective critical thinking and problem-solving skills. Through the interactive, collaborative design, students' intellectual interdependence and communication are naturally supported.

Rachel Cohen is the 5–8 science coach and a teacher at Brookfield. She has seen firsthand how using the Smithsonian Programs in professional development is helping her be an NGSS-thinking teacher. She describes how, "a lot of times students will ask me, 'Mrs. Cohen, is this correct?' And I'll say, 'I'm not sure, is that correct? Let's go through the process.' The Smithsonian Programs are changing the mindsets of both me and my students."

"When you're cognitively engaged, you're focused and exhausted but reinvigorated by the end!"

—Dr. Maureen Ruby, Assistant Superintendent of Brookfield Public Schools in Brookfield, Connecticut

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Unleashing the Power of Student Curiosity

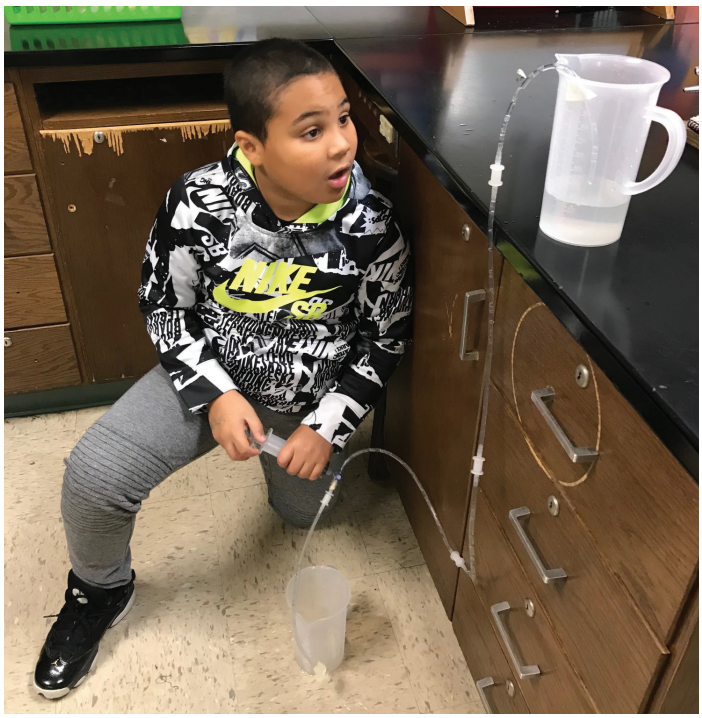
The phenomenon-based Smithsonian Programs encourage students to follow their natural curiosity and drive their own learning process. Each module begins with a real-life problem and a central driving question. These driving questions serve to motivate students and tie together the concepts found within the PE bundle. The students then construct scientific explanations for natural phenomena and design solutions to problems that all feed into the larger driving question. The student-led investigations are hands-on, collaborative, and build over time, and conclude with a culminating challenge—a science challenge or design challenge, depending on the module. As Ms. Farias describes, "The Smithsonian pedagogy of inquiry and starting with a focused question really gets the kids thinking and then spending collaborative time to discuss and explore." The students engage in all three dimensions of learning through this process, for example:

- They use the Scientific and Engineering Practices dimension when they plan and carry out investigations, analyze and interpret their data, and engage in argument based on their evidence.
- They use the Disciplinary Core Ideas dimension as they engage with life science, Earth science, and physical science content, such as when they research and learn about the topic they are investigating, ask and find answers to their questions, and participate in collaborative discussions.
- They use the Crosscutting Concepts dimension as they identify patterns in their data, evaluate possible cause and effect relationships, and develop and evaluate system models.

In a sample 3-dimensional lesson, first graders might examine their shadow over time and consider the question, "Why is my shadow shorter sometimes and longer other times?" Students share their initial ideas about the question, make and record observations of shadows, develop and use a model to figure out the Sun's apparent daily pattern of motion in the sky, and check the accuracy of their model by observing photographs of the Sun. At the end, students explain why their shadow is shorter sometimes and longer other times. As Ms. Cohen says, "In reality, they are driving more of the instruction than they realize."

Dr. Ruby and the Brookfield teachers also find the inquiry approach helps students strengthen their critical-thinking skills. By consistently leading students back to their own investigations, teachers are encouraging students to use the data they generate to solve the problem and find answers to their own questions. Continuous focus on and support of problem-solving abilities not only prepare students for the state assessment, but also help them build skills for college and the workforce.

Dr. Ruby expresses her appreciation for the NGSS approach: "The standards are designed so that we teach



With the Smithsonian's 3-dimensional programs, students are having fun and falling in love with science.

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children how to think and problem solve in the context of science disciplines and disciplinary literacy. When students are thinking like scientists, talking like scientists, and reading the materials through the lens of scientists, then they can perform like scientists. This way of learning levels the playing field for all different types of learners. Students start thinking of themselves as being capable and feeling like real scientists."

Positive Outcomes

The Brookfield Public Schools is committed to providing students with a world-class education that prepares students for college and career and positions them to "create their tomorrow." In doing so, they are able to demonstrate their competencies in a variety of ways, including achievement on assessments. Ms. Cohen considers 3-dimensional teaching and learning to be essential to preparing her students to tackle a variety of academic challenges, including advanced science courses beyond middle school and the Connecticut science assessment for grade 8. "The assessment questions can be very challenging," she explains. "They are usually based on a simulation or scenario with imbedded information on the topic, but the main question requires the student to solve a problem related to the topic. So, the student has to figure out how to logically think about and solve the problem. The Smithsonian Programs help students learn to think this way," says Ms. Cohen, "because the questions included in the Smithsonian modules are very well written and help our students learn to think critically."

The 2018–2019 school year was the first year that Brookfield students completed the NGSS-based state assessment. Students in grades 5 and 8 completed the assessment, and Dr. Ruby and her staff were very encouraged by the results: 75% of Brookfield students in 5th grade and in 8th grade met or exceeded state standards (which represents the total % of students performing at and above "3"). They all look at this as a great start to their school-wide transition to NGSS-based science teaching and learning.

	Level 3: Met Standard		Level 4: Exceeded Standard	
Grade	Brookfield District	All Districts	Brookfield District	All Districts
5	60.2%	40.4%	15.3%	13.3%
8	64.2%	43.3%	11.3%	8.9%

Standardized test achievement is only one measure of student success. Beyond test performance, Brookfield's teachers appreciate several generalizable and impactful benefits that they have observed since implementing the Smithsonian science modules. The student-to-student interaction that occurs during the lessons is another priceless, naturally occurring aspect of the Smithsonian Programs that Ms. Farias has observed. "I was in a 4th grade classroom when they were doing the unit on how motion energy changes. Watching the kids go through the different stations and hearing the rich student-to-student discourse was amazing. Previously there was a lot of teacher talk, but the Smithsonian Programs really help

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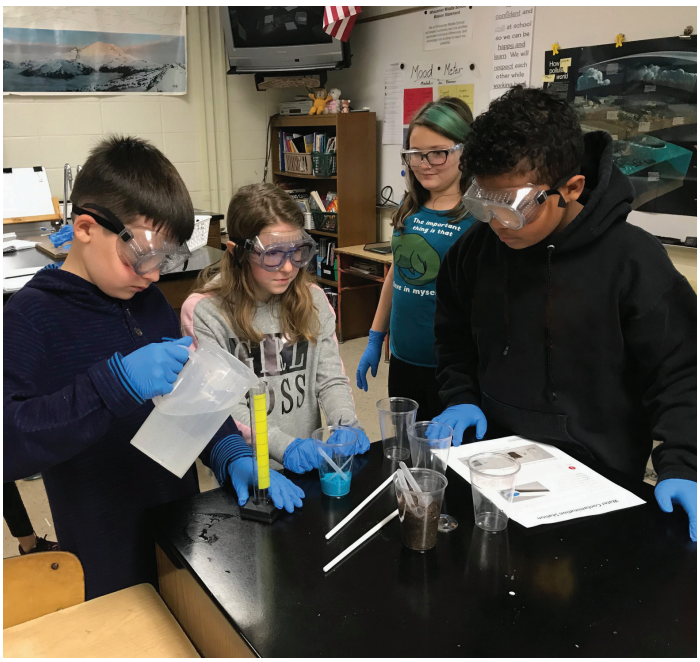
students build on their learning through collaboration with others, which is real life."

According to Dr. Ruby: "Successfully interacting with peers, engaging in collaborative problem-solving, conducting purposeful discourse, and developing persistence, resilience, and a passion for learning are our desired outcomes for our students. Respectable test scores are a byproduct of good instruction with a quality curricular resource, not our reason for teaching."

While Brookfield students are benefitting in these diverse ways using the Smithsonian's 3-dimensional programs, they are also having fun and falling in love with science. "The kids love science so much, and the cool thing is that what they are finding to be fun is also meaningful, purposeful, and tied to standards," explains Ms. Farias. "So, the fun for us is in the fact that it's engaging while also being a relevant, meaningful learning experience for them."



Brookfield students build on their learning through collaboration and problem-solving.

Ms. Farias and Ms. Cohen report the parent community shares anecdotes of their students "chatting up a storm" about their science classes and describe students as "smiling from ear-to-ear" as they describe what happens when they "do science." Elisa Larson's kindergarten students love their science activities as well, demonstrating the universal appeal of "doing" science.

"When all these aspects come together it is pretty awesome," says Dr. Ruby. "I think when a student says they love science, it translates to 'I'm learning something, I'm engaged,' because you don't love something unless you know it and you have positive emotions. So, this also ties into social emotional learning. When kids are engaged and happy, then their barriers are down, and they are more positive and open to learning."

Dr. Ruby looks forward to continuing to implement Smithsonian Programs in Brookfield classrooms and seeing many more smiling faces thanks to science!

References:

1. National Science Teaching Association. https://ngss.nsta.org/about.aspx
2. Megan, Kathleen. 2019. "About half of CT students reach grade level or better on new science test." The CT Mirror, December 18. https://ctmirror.org/2019/12/18/about-half-of-ct-students-reach-grade-level-or-better-on-new-science-test/
3. Connecticut State Department of Education. https://portal.ct.gov/-/media/SDE/Student-Assessment/NGSS-Science/ScienceFAQ20190924.pdf?la=en
4. Smithsonian Science Education Center. https://ssec.si.edu/smithsonian-science-for-the-classroom (K–5) and https://ssec.si.edu/stcms (middle school)

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