

Wolf Trap Foundation for the Performing Arts

*Wolf Trap's Early Childhood STEM Learning Through the Arts
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Feature: Wolf Trap Institute Unites the Arts and STEM in Early Childhood Learning

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*Wolf Trap Teaching Artist Amanda Layton Whiteman leads a preschool class in movement as part of the Early STEM/Arts Program.
(Photo by Scott Suchman, courtesy of the Wolf Trap Foundation for the Performing Arts.)*

When Wolf Trap Teaching Artist Amanda Layton Whiteman arrives at the preschool classroom, all the children are excited that it's time for dance — and for math. The teacher is amazed at how much the children love math, she tells Whiteman. She's astonished that certain children who

once showed little interest in school are absorbed and attentive during the classroom residency sessions. What's happening in this Fairfax, Va., classroom to spark such a change?

Working side by side with the teacher in the classroom twice a week for approximately eight weeks to introduce the children to early math concepts through dance, Whiteman's challenge is to "put math in their bodies." How, she's asked herself, can she use dance to help them make connections to math concepts?

Whiteman leads the young learners in the dance experiences they love to do, knowing they're making important discoveries in the process. When she asks them to make a curvy or angular shape with their arms, they're grasping the earliest concepts of geometry, while also learning to regulate their own bodies. When she asks them to alternate making high shapes and low shapes, they gain the vital math skill of pattern recognition as well as learning to create a dance phrase. *The Early Childhood STEM Learning Through the Arts Program*

This classroom residency is just one of 141 similar 16-session arts-integration STEM (Science, Technology, Engineering, and Mathematics) residencies taking place in Fairfax County Public Schools (FCPS) as part of the [Early Childhood STEM Learning Through the Arts](#) program (Early STEM/Arts) of the Wolf Trap [Institute for Early Learning Through the Arts](#), a program of the [Wolf Trap Foundation for the Performing Arts](#) in Vienna, Va. This initiative is funded through the U.S. Department of Education's [Arts in Education Model Development and Dissemination Program](#), and enters its fourth and final program year in July 2013.

With the \$1.15 million OII grant, Wolf Trap is a pioneer in developing, researching, and disseminating a model early childhood program to support early math teaching and learning through active arts-based experiences for pre-K and kindergarten children, including many classrooms in Title I schools. The program is championed by the FCPS Superintendent, Dr. Jack Dale, and supported by a long-standing partnership with Fairfax County Public Schools. Click [here](#) to see Dr. Dale speaking at a Congressional briefing this past Feb. 26th about the Early STEM/Arts program.

As a national leader in early childhood arts education since 1981, the Wolf Trap Institute coaches teachers in using arts-based strategies to enrich early childhood learning. The Wolf Trap Institute approach used in classrooms throughout the Washington, D.C. region and through partnerships in [16 sites across the country](#) is widely recognized in the field of early childhood education as an effective combination of direct services to children and embedded professional development for teachers. Through the Institute's methods, children literally embody curricular concepts as their imaginations are ignited by music, dance, puppetry, and drama.

Goal: an innovative approach to learning

The Wolf Trap Early Childhood STEM Learning Through the Arts program is pursuing five goals, each of which is strengthened and supported by the others. The program is:

- developing an innovative, research-based arts integration model for early childhood learning in math;
- educating Wolf Trap Teaching Artists in early childhood math skills and concepts to ensure the development of high-quality math/arts content;
- providing professional development to teachers that enables them to apply arts-based strategies in their classrooms;
- improving children’s math and performing arts skills in concert with curriculum standards; and
- documenting and disseminating this model nationally.

Why use the arts to teach STEM in early childhood?

Children learn through discovery. Touching, moving, exploring, questioning — young children are active and eager to learn, using all their senses to absorb information and make sense of the world around them. They are natural artists, drawn to music and stories, delighted by every opportunity to dance or talk to a puppet friend. The U.S. Conference of Mayors, in 2010, drew on research from the [Arts Education Partnership](#) as evidence for their assertion that quality arts learning is vital to young children’s language and social development and their ability and motivation to learn (USCM, 2010). Their report, which called on Congress to appropriate \$53 million for arts education to the Department of Education, also cited a link between arts learning and strong mathematic skills.

Simply put, the arts and STEM are natural partners — both share sequential learning and habits of mind that support creative problem-solving, imaginative thinking, and transference of skills and knowledge to new experiences. Working side by side with the teachers and parents to incorporate the arts into children’s daily experiences, the Wolf Trap Institute’s arts-based teaching method taps into children’s innate desire for active, multisensory learning. Children literally embody concepts by singing and dancing, and they engage their imagination through puppetry, story dramatization, and role play. This approach helps young children to:

- develop skills, language, concepts, and vocabulary in many different subject areas;
- acquire such 21st-century skills as critical thinking, creativity, communication, and collaboration, which are key to their future success; and
- achieve learning outcomes that are aligned with national, state, and local curriculum standards.

Video: Akua Kouyate, Wolf Trap’s senior director of education, Wolf Trap teaching artists, and Fairfax County early childhood educators discuss the [Early STEM/Arts](#) approach to arts integration.

Wolf Trap Institute staff first noticed the connection between arts-based learning and math fluency while reviewing the results of a 2006 evaluation research study that compared children’s assessment scores for Wolf Trap residency classrooms to children’s scores in control classrooms. The independent evaluator initially set out to compare literacy skills of the two groups, knowing how vital early reading proficiency is to a child’s lifelong learning. The [evaluation](#) revealed that the children who received Wolf Trap residencies not only excelled in language and literacy, but they also tested significantly higher than children in the comparison group in other areas, including logic and mathematics. The research showed that Wolf Trap’s method made the difference. [Click here](#) to see comparison data based on the [Child Observational Record](#) administered by the Office for Children of the Fairfax County schools in early childhood settings. Children in the two groups were assessed before and after implementation of Wolf Trap’s Fairfax Pages program and the results showed statistically significant differences in mean gain scores in all six measured domains between Wolf Tap residency classrooms and the control classrooms in the study.

Improved STEM learning, pre-K through high school, is an important national goal. However, international comparisons indicate that American students are being outperformed in math and science by students in other nations (OECD, 2010). President Obama and Secretary of Education Arne Duncan have outlined [national priorities](#) that include increasing STEM literacy for all students, improving the quality of math and science instruction in schools, and expanding STEM education and career opportunities for underrepresented groups, including women and minorities.

Starting early — with the arts — matters

A student’s math skills upon entering kindergarten are “the strongest predictor of later school achievement,” according to a 2007 study by Northwestern University researchers (Duncan et al., 2007). Early education in math-focused curricula can make a great difference and, in particular, can narrow the later achievement gap between children from affluent communities and children living in poverty (Clements & Sarama, 2007, 2008; Griffin, 2004; PCERC, 2008; Starkey et al., 2004).

In “Effective Practices in Early Childhood Education” (Bredekamp, 2010), early childhood expert Sue Bredekamp draws on key studies (Denton & West, 2002; Klein & Knitzer, 2007) to identify this “mathematics achievement gap” and to draw a connection between economic advantage and math skills level. Other studies have observed that low-income children may not be given access to opportunities that allow them to learn and practice the “language of mathematics” so necessary for their future success in school (Ginsburg, 2006; Ginsburg & Pappas, 2004).

Wolf Trap’s Early STEM/Arts model helps bridge that gap and gives children a crucial foundation for later academic achievement. Using the arts to teach STEM concepts not only builds those vital math skills but also can inspire a life-long interest in STEM subjects. Young children who develop a love and appreciation of math or science, through creative, arts-based instruction, become innovative adults who can thrive in — and contribute to — the 21st-century economy.

Rick Stephens, senior vice president of human resources and administration at Boeing and the chairman of the Aerospace Industries Association Career and Workforce Steering Committee, states, “Children whose imaginations are sparked by someone who reveals the possibilities of math or science tend to gravitate towards STEM-related interests. When this happens, that person is typically an inspiring teacher.” Wolf Trap is committed to supporting teachers to identify creative ways that inspire the very youngest children and provide them with the tools they need to succeed — in school and in life.

A model teacher/artist partnership

Teachers who learn arts integration techniques in a Wolf Trap classroom residency continue to use those strategies in successive years in their classrooms. What’s more, the residency services are customized to each classroom and each teacher — whether it’s a classroom of children with special needs or a teacher who feels inhibited by creative expression.

Video: *Fairfax County preschool teachers describe the [classroom residency model](#) that Wolf Trap teaching artists employ in the Early STEM/Arts program.*

Studies show that when professional development for teachers fails, two common reasons are a lack of intensity (less than 30 hours) or a lack of follow-up. In these cases, according to the research, there is a limited effect on teacher practice and no effect on student achievement (Garet et al., 2001; Yoon et al., 2007).

To address this, Wolf Trap Early STEM/Arts takes a dual approach to working with teachers. First, Wolf Trap provides a five-day professional development institute for groups of teachers from each participating school that allows time for small group work, sharing, and reflection. Then, over the course of two school years, the teachers experience two separate residencies with Wolf Trap Teaching Artists in two different performing arts disciplines. Together, the teaching artists and teachers plan and deliver lessons with the goal of sustaining and extending the teachers’ ability to teach math through the arts. Click [here](#) to view a sample Early STEM/Arts lesson plan. All combined, the program provides teachers with up to 108 hours of professional development accompanied by the feedback and support of their teaching artists, school administrators, and the Wolf Trap Institute staff.

Research and dissemination to extend the work

As important as the instruction and learning is by itself, Wolf Trap views research that rigorously evaluates the methods and outcomes of its work as a vital part of this program. In addition to educational gaps in early childhood STEM, there is also a research gap. The Committee on Early Childhood Mathematics, in its 2009 report, “Mathematics Learning in Early Childhood: Paths Toward Excellence and Equity,” found that little research has been done on how best to prepare early childhood educators to teach math, or on the link between in-service preparation of teachers and student achievement in math (NRC, 2009).

Wolf Trap’s independent evaluation partner team from [American Institutes for Research](#) (AIR) hypothesizes that “students who benefit from two years with teachers from the same school participating in the Early STEM/Arts program will do better each year and better over two years, compared with the students in control schools, because their teachers will continue to have support as they make progress in teaching math with the support of the performing arts.” In support of this project, AIR conducted and published a [literature review](#), specifically looking at constructs related to teacher practice and student outcomes.

Video: *Dr. Mengli Song, principal education researcher for the American Institutes for Research, describes the [strategies for evaluating Early STEM/Arts](#) and plans for release of the evaluation report.*

The project plan includes sharing the evaluation results and the Early STEM/Arts model nationally. In January of this year, Wolf Trap began the process of disseminating the Early STEM/Arts model to the [16 Wolf Trap Regional Programs](#) across the country. They will be ready to implement the model within their communities by 2013-2014 school year. Beyond that, strategies and research findings will be shared both online and through direct interaction in communities throughout the country. The goal is to foster a nationwide community-of-practice network for early childhood educators sharing effective Early STEM/Arts practices. Even now, Institute staff and Wolf Trap Teaching Artists deliver presentations nationwide at conferences and online to share the program overview and the research that shows the impact of the arts on STEM learning. Recordings of these presentations, such as a Telos Corporation podcast interview with Wolf Trap Senior Director of Education Akua Kouyate, are made available to the public via Wolf Trap’s website. Click [here](#) to access the podcast.

The next chapter in Early STEM/Arts

Using the model developed for early math learning through the arts, Wolf Trap has already begun to explore the connections between scientific inquiry and the arts, as well as between engineering principles and the arts. Wolf Trap Teaching Artists in the D.C., Maryland, and Virginia region are receiving intensive, multi-day professional development with science and engineering professionals and early childhood education specialists. These artists have begun to develop and present [classroom strategies](#), such as “Artful Engineering: Exploring Simple
Wolf Trap Foundation for the Performing Arts | *Early Childhood STEM Learning Through the Arts* 6
Article available at: <http://www.ed.gov/oii-news/feature-wolf-trap-institute-unites-arts-and-stem-early-childhood-learning>

Machines Through Drama, Movement, and Music” and “Early Learners Use Engineering’s Six Steps to Succeed,” that teach scientific inquiry or that dramatize the problem-solving techniques of the engineer.

Video: *Preschool students enact the popular story of “The Three Little Pigs” while learning [the six steps of engineering](#).*

Reaching every child

A breakthrough moment happens in the classroom when Wolf Trap Teaching Artist Amanda Layton Whiteman sees a child point out a color pattern in the room without prompting. “He is thrilled to discover that the math/dance lesson applies to the world around him,” according to Whiteman. For a child that young, this is a major “a-ha!” moment.

Teachers in Early STEM/Arts residencies have “a-ha!” moments, too. One teacher summed it up this way: “When I found out it was going to be math, I was saying, oh jeez, this is going to be hard. But as I got involved with the artist, I realized that math is everywhere. And to be able to incorporate the arts into everyday lessons helps you reach every child.”

Rebecca Proch, Sarah Greenbaum, and Jennifer Cooper of the Wolf Trap Foundation authored this feature article.

The Wolf Trap Institute for Early Learning Through the Arts is a program of the Wolf Trap Foundation for the Performing Arts. Wolf Trap was founded in 1966 to act as the private partner of the National Park Service in the management of Wolf Trap, America’s only National Park for the Performing Arts. The mission of the Wolf Trap Foundation is to present and create excellent and innovative performing arts programs for the enrichment, education, and enjoyment of diverse audiences and participants. Wolf Trap is recognized as a national leader in presenting the finest in classical and contemporary performing artists, supporting the development of America’s most promising young artists, investing in the creation and production of innovative new works, and piloting groundbreaking programs in arts and education.

Opinions expressed in this article do not necessarily reflect the positions or policies of the Department of Education. The article is being made available on our home page to promote continuing discussion of educational innovation and improvement. No endorsement of any educational product, service, curriculum, or pedagogy is implied.

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