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Experts Urge Earlier Start to Teaching Science



Kailyn Frank, 4, center, framed by tubing held up by a student, uses a turkey baster to draw water from a plastic bin during a "Water Exploration" exercise at the Southampton Head Start facility in Riverhead, N.Y., on Jan. 12.

—Emile Wamsteker for Education Week

Play-based approaches also develop language skills.

By [Debra Viadero](#)

The sand-and-water table in Barry Hoff's classroom in the Southampton Head Start program on New York's Long Island, used to be filled with sand on two sides.

But water was restored to the table last month as 16 preschoolers stood around it, dipping and pouring water through tubes and funnels, squeezing it through turkey basters, and learning, in the process, something of what it's like to think like scientists.

The change in Mr. Hoff's room, and in a handful of other classrooms like it around the country, stems from growing interest among academic experts and educators in teaching science to preschoolers.

"I think a lot of preschool teachers aren't aware of the fact that preschoolers can figure out things like they do, or make predictions as they do," said Mr. Hoff, who's been teaching preschool for four years. "But some of the things we're doing now are things that children find a lot of wonder with."

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Three years ago, when a task force of the congressionally chartered National Research Council issued influential recommendations for improving K-8 science education, it also made a pitch for introducing scientific study even before the start of formal schooling, with children as young as 4.

“The commonly held view that young children are concrete and simplistic thinkers,” the report said, “is outmoded.” It is refuted, some experts added, by decades of research in cognitive science and developmental psychology.

Concerns about American students’ performance on international science tests and the supply of students pursuing careers in science, technology, engineering, and mathematics, or STEM, fields, combined with the expansion of federal testing requirements to include science, have served in recent years only to heighten that call.

Shells and Magnets

Yet, as University of Miami researcher Daryl B. Greenfield found in a [Florida study](#) testing the school-readiness skills of more than 5,000 Head Start graduates, science is one of the areas in which children show the least learning growth during their preschool years.

“Most teachers will have a science area in their classroom, ... and if you look on plans, you would see something listed as science but, in reality, there would be some shells, some magnets, and maybe a pumpkin, or a book about animals in winter,” said Nancy Clark-Chiarelli, a principal research scientist at the Education Development Center, a research group based in Newton, Mass. “But those items are not conceptually related, and they don’t promote children’s independent exploration of them.”

If preschool teachers had water tables in their classrooms, Ms. Clark-Chiarelli and her EDC research partners found in their work, they were often turned into bathing areas for plastic dolls rather than used as science-teaching tools.

Ms. Clark-Chiarelli and her colleagues sought to improve preschool science teaching by crafting a “Young Scientist” curriculum series with support from the National Science Foundation. The guides focus on teaching children about the natural world and developing their knowledge of physical science through building structures and water play.

Because preschool teachers are often uneasy about teaching scientific concepts, the research team also developed an accredited professional-development program for them, and assessments to determine whether teachers and their pupils were benefiting from the added instruction.

The EDC researchers field-tested the program with 50 Massachusetts teachers working in Head Start, the federal preschool program for disadvantaged children, and found “dramatic” learning gains for teachers, coupled with “promising” improvements for their young students in two of the three science content areas on which the guides focus.

Beyond ‘Amazing’

Now, with funding from the U.S. Department of Education’s Institute of Education Sciences, the researchers are engaged in a larger study testing the curriculum’s efficacy in Mr. Hoff’s class and dozens of other New York Head Start classrooms in Westchester County and on Long Island. Halfway into the six-month training program, Mr. Hoff



Jerson Juarez, 4, pours water down a funnel during a water exploration exercise this month.
—Emile Wamsteker for Education Week

said the knowledge he has gained is already transforming his teaching.

"I do consider myself scientifically minded, but before it was more or less 'Let's see this,' or 'This is amazing,' and I'd kind of explain what was occurring and move on," he said in an interview. "This is something to guide [students] on to exploring, and it seems to have more lasting impact on their learning."

When his students play with the water, for instance, he makes notes of what they're doing and uses the notes later on, during discussion time, to coax children to share their discoveries. What did you do with the funnel, he might ask, or how did you get the water in the tubes? Did you notice any bubbles?

"Because kids can parrot back what they hear, teachers think they know more than they do," said Cindy Hoisington, who is working with Ms. Clark-Chiarelli as a lead instructor and teacher mentor on the project. "Kids don't know bubbles are full of air, and teachers are kind of shocked because they thought their kids knew that."

'Guided Play'

New efforts to teach more science in preschool come at a time when early-childhood educators worry that a growing emphasis on academics during those years is crowding out the playtime that children need for healthy development.

Kathy Hirsh-Pacek, a psychology professor at Temple University, in Philadelphia, counts herself as one of those advocates. But she says efforts to expand preschool science teaching need not necessarily conflict with young children's need for playtime. Science can be taught in the context of play.

"The people who are pure play people suggest that you need to have free play for young children, and I think the evidence is pretty clear on that," Ms. Hirsh-Pacek said. "But I also think the evidence is pretty clear that you don't just need to have free play for children. There's free play, and there's guided play."

"You just have to be careful," she added, "because sometimes adults can become too intrusive and the play just stops."

The EDC researchers say their efforts also go hand in hand with the growing emphasis in preschool programs on developing children's language skills.

"We believe in order to have good discussions, you have to have something to talk about," Ms. Clark-Chiarelli said.

Research-and-development efforts aimed at improving preschool science instruction are also under way at the Center for Math and Science Education at the University of Texas and the University of Miami, where Mr. Greenfield is developing an assessment of preschoolers' science readiness, as well as at other locations.

In September, meanwhile, a team of researchers led by Rochel Gelman, a cognitive psychologist from Rutgers University's Busch campus in Piscataway, N.J., published a book on the subject called *Preschool Pathways to Science: Facilitating Scientific Ways of Thinking, Talking, Doing, and Understanding*.



Teacher Lisa Tharpe divides sand to show how a river might cut through land over time during a science lesson at the Southampton Head Start facility in Riverhead, N.Y.

—Emile Wamsteker for Education Week

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“In preschool, you find that kids are natural scientists, whether it’s life science, earth science, or physics,” said Mr. Greenfield. “Young kids are interested in changes in the weather or whether something is hard or soft. They have a natural curiosity about the world.”

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