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Institute Takes Fear Out of Teaching Elementary School Science

On a warm June day at the Martin Luther King, Jr. Academic Middle School in San Francisco, the science classroom buzzes with activity. Students wearing goggles and white lab coats carefully cut open preserved lamb hearts, probing the cavities with gloved fingers. They “ooh” and “ah” when they see that the walls of the left ventricle are thicker than the right. They find the heartstrings – the tendons that connect the valves to the heart muscle. They use scientific terms: “Mine’s necrotic!” declares one student.

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- Katherine Nielsen

But these students are adults: Elementary school teachers from the San Francisco Unified School District participating in the City Science Summer Institute. The week-long workshop was organized by the University of California, San Francisco’s Science & Health Education Partnership (SEP), an outreach program funded in part by the Howard Hughes Medical Institute. City Science brought together more than 100 teachers from kindergarten through fifth grade for hands-on experience on how to use science kits in their classrooms.

"Many elementary school teachers have little to no science background, and some are even fearful of science," says Katherine Nielsen, co-director of SEP. "The emphasis that No Child Left Behind has placed on reading and math has given many teachers license to avoid teaching science." Indeed, a 2007 study showed that elementary students in the San Francisco Bay Area receive an average of just 60 minutes of science instruction per week, with 16

percent of teachers spending no time at all on science. "It's very easy to say, 'I don't want to teach that,'" Nielsen says.

That's where City Science can make a difference. The program gives teachers in-depth experience with curriculum that has already been approved by the school district—including kits for each grade level developed by the University of California, Berkeley's Lawrence Hall of Science. The kits come filled with materials and detailed guides, but "a lot of teachers find them daunting," says Jennifer Chu, City Science's lead academic coordinator. "This is a way to introduce it to them." More than 200 teachers have been taught how to use the kits and other supplemental lessons, including the lamb heart experiment, since the program began three years ago.

In the summer workshop, the teachers are divided into groups by grade level. Led by a teacher-scientist team, participants work through activities using the science kits—usually an instructional binder plus some of the materials needed for the lessons. But they don't stop there. The teams have worked throughout the school year to develop science lessons not found in the kits—the heart dissection, for example.

Soroya Wood, a fifth-grade teacher at Francis Scott Key Elementary School, and Chris Cain, a fourth-year graduate student in microbiology at UCSF, developed the dissection lesson as a supplement to a fifth-grade science kit about living systems. They first came together during the previous school year, when they planned new lessons and tested them out in Wood's classroom. Then, they shared what they learned with teachers through the summer institute.

Because the supplemental lessons have already been tested in the classroom, the teacher-scientist teams can give advice about practical matters—such as where to buy preserved lamb hearts and how to help kids overcome the "ick" factor. For the heart dissection, Wood described how she led her class in a collective "ewww" at the beginning of the lesson to get it out of their systems.

"The thing teachers really like about City Science is that they get the practical [from other teachers], but they also get the scientific knowledge from the scientist," says Jennifer Howard, a kindergarten teacher at Miraloma Elementary School.

During the 2008-2009 school year, Howard developed new lessons for a kit about wood and paper with Yoko Nozawa, a third-year graduate student in developmental biology at UCSF. "I really wanted to look at this kit to see

how we could make it more investigative and more hands-on for kids,” Howard says. “What can we do for teachers to help get them interested in teaching this kit and get involved with it, so their students will have the same joy that they have?”

The goal of the original wood and paper kit is to get kindergarteners thinking about the properties of wood and paper, how they interact with other things (like water), and how changing the materials—through activities like sanding and sawing—changes how those materials interact.

With conservation in mind, Howard and Nozawa expanded the lessons outlined in the kits to explore bamboo as an alternative to wood. She brought in bamboo samples—not part of the original kit—and had her kids repeat the tests they did on the wood and paper. They also added an experiment with paper towels, asking their students to investigate which towels were stronger or more absorbent and then think about why that might be.

At the workshop, the kindergarten teachers made the most out of learning the new lessons—noisily sawing and sanding their way through pieces of lumber. They tried out several simple experiments with wood and paper and developed their own new investigations with those materials.

The program is popular among elementary teachers—so much so that there were more than twice the number of applications for each available spot at the kindergarten level. So City Science held a second week-long institute just for kindergarten teachers. For kindergarten students, the focus is on encouraging their natural curiosity about the world, Nielsen says, while also trying to teach skills like observation and drawing. For example, one teacher told Nielsen that she had to teach her kids not to draw rainbows in the background when using a science notebook but rather to “try and make an accurate representation.”

SEP sees the City Science program as benefiting the scientists as well. The scientists are usually early in their careers—graduate students or post doctoral researchers—who are taught how to do research but not necessarily how to teach. City Science gives them a chance to learn from master elementary school instructors, Chu says. They work with kids during the year and then with adults during the summer institute.

Cain, the microbiology graduate student, said he gained valuable experience about planning lessons and teaching strategies. “I saw how teaching adults

was very different from teaching kids,” he says. “You have to teach to different levels of learning. Some teachers wanted to be walked through the entire kit, while others just wanted the more hands-on part.” Cain also discovered that although he doesn’t want to be a teacher himself, he can play a role as a scientist to improve science education.

In addition to the training, SEP provides support for teachers through the Daly Ralston Resource Center, a lending library of science teaching materials on the UCSF campus, Nielsen says. The center houses everything from microscopes and DNA extraction kits to skulls and human organs, which the teachers can take back to their classrooms. The City Science teacher-scientist teams can also enter their lessons into SEP’s online database, (<http://seplessons.org>) where teachers can search for activities by grade level and subject.

This summer’s workshop helped many of the teachers gain the confidence to lead a hands-on, inquiry-based lesson in their own classrooms. “Teachers need more support to do it,” says Kay Kirman, who teaches a combined fourth and fifth grade class at Miraloma. “The first time, it’s great to have a scientist leading it.”

During the heart dissection, Kirman marveled at how strong the muscle was and "how difficult it was to cut through even a small heart like this." As both scientists and teachers know, the joy of learning never gets old. "We've had people who have been teaching for 30 years, and they still want to take the course," Chu says.