Project Exploration's Sisters4Science

Involving Urban Girls of Color in Science Out of School

by Gabrielle Lyon and Jameela Jafri

Project Exploration's Sisters4Science (S4S) is an after-school program for middle and high school urban girls of color. Designed to *get* girls interested in science, *keep* girls interested in science, and *equip* girls with skills and experiences that enable them to pursue science, S4S creates a science-rich learning environment that puts girls at the center.

This paper sketches the context for participation in science by girls from historically underrepresented populations and offers a detailed description of S4S and its personalized, girl-centered pedagogy. The S4S example suggests a need to complement current out-of-school science programs with lessons from girl-centered practice and research.

S4S in Context

Participants in Sisters4Science represent the young people least likely to participate or achieve in science. Sisters are primarily African-American and Latina girls

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Sisters4Science

Special
Intelligent
Satisfied
Terrific
Envy us
Real
Scientifically smart

4ever and always

Social
Caring
Indifferent [to social norms]
Elegant
Nice
Courageous
Emotional

—*Jasmine*

(Jafri, 2007, p. 1)

who attend schools where the majority of students (upwards of 80 percent) come from low socioeconomic backgrounds. Furthermore, many of our girls join S4S at a time when they are struggling academically.

Populations historically underrepresented in science are discouraged from participating in out-of-school science experiences by multiple factors including lack of transportation, money for pay program fees, a sense of "welcome" at the program, and accessibility to students with disabilities. Intermittent or non-existent programming acutely affects participation by students from historically underrepresented populations; most high-caliber science programs are restricted to academic high achievers or to students from families with the means to pay for programs (Campbell, Denes, & Morrison, 2000; Jolly, Campbell, & Perlman, 2004; Lynch, 2000; Lyon, 2009; Scharf & Woodlief, 2000). A lack of personal connection to science can give students the feeling that what is taught is not relevant to them (Bouillon & Gomez, 2001), particularly when they come from communities traditionally marginalized in science, including minorities, new immigrants, low-income students, and students who do not perform well in school.

Urban minority girls also face social and cultural stereotypes that can steer them away from science, engineering, and math—both in and out of school. The middle school years have emerged as a critical period for engaging and sustaining girls' interest in science. Extensive research suggests that a lack of self-efficacy, not mental ability, hinders girls' participation in science as they move from elementary to middle and high school (Halpern, et al., 2007; Simpkins & Davis-Kean, 2005).

Design Issues

Encouraging minority youth—particularly girls—to pursue science has been on the national education policy agenda for nearly three decades. Gender-specific programming has been a focal point for encouraging girls' engagement in science (U.S. Department of Education, 2007).

The late 1990s and the 2000s saw a growth in case studies describing programs that effectively engage girls and minority youth in science. Introducing girls to role models, such as female scientists, has been identified as one way to encourage girls to envision a career in science (Basu & Barton, 2007; Cachaper, et al., 2008; Fancsali, 2003; Ferreira, 2001; Zacharia & Barton, 2004). Other strategies have focused on fostering girls' sense of ability and self-efficacy in science and technology (Denner, Bean, & Martinez, 2009). These recommendations emerge from studies showing that girls tend to underestimate their abilities in science and math, even when they perform well in these subjects (Halpern, et al., 2007).

Decades of focused attention and development of specific programs that engage girls in science have not led to the anticipated increases in participation at the college, graduate school, or professional levels. Recent reports suggest that women make up only 25 percent of the over 5 million scientists in the United States, and women of color make up just 2 percent of that group (Girls Coalition of Greater Boston, 2009).

Engagement, Capacity and Continuity: A Trilogy for Student Success (Jolly, et al., 2004) explores why successes in individual programs are not translating into more progress at the systemic level. In summary:

> Stand-alone efforts that try to improve student academic performance or increase student interest in certain careers will only have limited success. It is the combination of "engagement, capacity, and continuity" that's essential to real progress. We've often said to children, "You can be whatever you want, as long as you work hard enough." But children need

access and support in order for that to happen. The ECC [engagement, capacity, continuity] Trilogy focuses on not just the child's will, but on the structures that are needed to support that will, to ensure that all children do get to become whatever they want. (Jolly, et al., 2004, p. iii)

We propose an additional observation: Case studies examining science programs designed to target girls fail to incorporate lessons learned from local and national studies of "best practices" for (non-science) girls' programming. By and large, these studies indicate single-sex youth development programs for girls are of the highest quality when grounded in a philosophy that recognizes that girls have unique needs. That is, effective, high-quality girls' programs are characterized not simply by the absence of boys, but rather by the presence of specific youth development strategies that are gender-sensitive (Mead & Boston Women's Fund, 2000; Roychoudhury, Tippins, & Nichols, 1995).

Much of this research is grounded in an approach that asks girls what matters from their perspectives. For example, in *Integrating Vision and Reality: Possibilities for Urban Girls Programs*, Molly Mead and the Young Sisters for Justice—a program of the Boston Women's Fund—undertook a research project to understand what makes an ideal girls program (2000). They conducted case studies of three programs in urban communities that worked with girls of color, the majority of whom came from low-income families. Based on their case studies, the researchers summarized key benefits of single-sex programs for girls:

- Programs are designed with girls' experiences and strengths in mind.
- Programs for girls are run by adult women, who simultaneously serve as role models.
- Programs help girls recognize the inequities they face in the world and help them develop strategies to overcome those inequities.
- Girls learn to respect themselves and one another.
- Girls learn the importance of connecting with other girls and focusing on issues of joint concern.
- Girls learn to develop positive relationships with their female relatives and with other adult women and young women.
- Girls learn about the different roles women can play in families, in communities, and the workplace.
- In terms of girls' development, programs take on a role that other institutions such as schools, communities, and families do not. (Mead & Boston Women's Fund, 2000)

The experience of Project Exploration's Sisters4Science suggests that science programs that want to recruit and retain urban girls of color need to tap into this base of practice and research.

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Nuts and Bolts of S4S

Project Exploration (see www.projectexploration.org) is a Chicago-based nonprofit science education organization whose mission is to make science accessible to the public—especially minority youth and girls—through personalized experiences with science and scientists. In 1999, Project Exploration launched an afterschool program for middle and high school African-American and Latina girls to connect girls' lives and experiences to science and the natural world. Sisters4Science is intended to:

- Help girls develop self-esteem about their thoughts, feelings, experiences, and decisions
- Encourage girls to explore natural science in a safe environment
- Expose participants to the wide variety of roles played by women in science
- Improve girls' overall school performance by developing goal-setting, decision-making, and communication skills
- Combine science learning with leadership development

Drawing on philosophy and pedagogy inherent in girl-only youth programs (Fullwood, Davis, & Debold, 2000; Mead & Boston Women's Fund, 2000; Ms. Foundation for Women, 2001; Phillips, 2007), S4S puts girls at the center of its endeavors. S4S facilitators are responsible for creating experiences that speak to girls' interests and experiences. S4S is run after school between October and May at five sites. In 2007, 73 girls participated in the program; 93 percent were African American

S4S Portrait in Practice

"Girls, welcome, welcome! Do you remember where we're going this weekend? That's right! Ingleside, Illinois!"

Jameela, the Project Exploration program facilitator, is ushering in a dozen middle school girls. At the front of the room, the visiting scientist, Lisa, is unpacking supplies for the day's activity with the help of two girls. On the wall is a poster with a photo of each Sister and her handwritten name.

"Dr. Shakaya, come on, grab your snack, we're just starting. Girls, if you haven't signed the thank-you notes to the scientists who were with us last week, do that while you're getting snack." Jameela calls the girls "doctor" and hugs them as they arrive.

The girls are familiar with the routine: grab a snack, sign thank-you cards, find their journals, take a seat. The energy of the classroom is lighthearted and comfortable.

"Jameela! At Ingleside will we still get to eat all we want at the meals?" This weekend, S4S will travel to a nature center for a leadership retreat.

"That's a good question. I remember when we went to Lake Geneva, it was a buffet. I don't know if it will be the same set-up. I will check and let you know."

As the girls get settled, the room quiets. The girls stop shuffling their things, put away lip gloss, and turn to the front of the room.

"OK," Jameela says, shifting gears, "journal time. What do we write?"

"Date, time, place." The girls have their journals open and are flipping to a new page.

"Are we 'a.m.' or 'p.m.'?"

"p.m.!"

"Right, p.m. We're scientists—we love using our units! Today I have a special prompt because we're starting a new exploration. Do you remember how a few weeks ago we were wondering during snack time, 'What the heck is in what I am eating?' Well, that's what we're going to get into today."

And so the session begins. In the next hour and forty-five minutes, the girls will introduce themselves to Lisa by playing a name game in which they identify their favorite ice cream, will disaggregate fat from milk and observe the rates of diffusion of food coloring in different fat-quantity milks, and will make their own ice cream.

As Lisa, a food scientist, takes students through a lab protocol that mimics one she's working on in her state health department lab, Jameela connects the dots and keeps the activities from becoming abstract: "What is the cup like that we're pouring into? Our stomachs, right. What is the vinegar like? The acid in our stomachs." (Jameela had prepped the girls the previous week about food processing in the human body.)

Jameela checks on the girls' observations as they work in pairs at desks around the room, "How much vinegar did you stir in? How much liquid do you have now? How much did you start with? You can always make notes, don't forget—your journal is your friend."

Jameela builds real-life connections between Lisa and the Sisters. She has worked with Lisa in advance to ensure the activity will be authentic: something that taps into what Lisa is working on and wondering about as a scientist and that connects directly with the girls' questions.

"Just 20 minutes left, and we need to make ice cream."

The ingredients have been pre-measured to save time. The girls pour salt and ice into large sealable plastic bags, add bags with ice-cream ingredients, wrap the package with newspaper, and shake. They toss the taped bundles for five minutes, and it's ready to eat. Already their rides are waiting; parents are calling girls' cell phones.

"8:45 a.m. sharp on Saturday for the retreat! Don't be late!" Jameela's voice trickles after them.

and 5 percent Latina. Seventh-graders made up 47 percent of participants, eighth-graders 44 percent, ninth-graders 8 percent, and sixth-graders 1 percent (Jafri, 2007).

S4S anchors Project Exploration's Services for Girls programs, which enable staff to foster long-term relationships with girls and give them ongoing opportunities to develop the skills and experience they need to consider pursuing science in, and beyond, college. The All Girls Expedition is an intensive two-week immersion experience that allows a dozen high school girls to learn practical geology, biology, evaluation, and field science. Girls' Health and Science Day is an annual conference designed by S4S to provide information on girls' health issues. Each spring 120 girls in grades 7–10, including but not limited to S4S girls, participate in a day-long conference that includes workshops on self-defense, puberty, sexually transmitted diseases, teen dating, and violence. Finally, Project Exploration's Women in Science supports female scientists to lead science activities across these programs.

Research into out-of-school time science programs lacks detailed descriptions of programs that are effective at recruiting and retaining girls and minority youth to science (Lee & Luykx, 2006; McClure, Rodriguez, Cummings, Falkenberg, & McComb, 2007). The following description of the program structure and curriculum of Sisters4Science may help fill the gap.

Program Structure

School Partnership

Project Exploration establishes written contracts with partner schools outlining roles and responsibilities. Project Exploration agrees, for example, to provide a given number of sessions, to develop and document the S4S curriculum, and to provide materials and supplies. We also recruit and train the scientists who work with the girls and facilitate a year-end event for the school community. The school, in turn, provides a meeting room with secure storage, contributes financially to help cover a portion of the program cost, and designates a contact teacher who ensures that the room is open and ready and that the girls are reminded about sessions.

Recruitment

Project Exploration works with each contact teacher to recruit 12–15 girls who are willing to experience something new and are curious about science. They need not be academically successful or excel at science. Recruitment typically consists of posting flyers and announcements and sending information home with all the girls in a school. Project Exploration staff and S4S alumna visit classes and run hands-on activities or set up a booth at a back-to-school open house. We work closely with the contact teacher to ensure that girls who sign up are informed about weekly sessions and are supported to participate. S4S maintains an open-door policy: Any girl in the school can come to any session; however, to be eligible for field trips, girls need to attend three sessions in a row.

Working with Scientists

Introducing youth to scientists is built into the mission of Project Exploration. The U.S. Department of Education (2007) says that exposing girls to female role models who are successful in math and science can counteract "stereotype threat"—negative stereotypes that girls may develop about themselves. Our own anecdotal experience in S4S reveals that students often do not know what their possible future selves and careers could be. Since Project Exploration began ten years ago, we have been working with scientists who are dedicated to public outreach. Since then, Project Exploration has developed a cadre of approximately 50 professional women scientists and graduate students who are part of a formal Project Exploration Women in Science program. Recruitment happens through word-of-mouth as well as through established partnerships with universities, corporations, local informal science institutions, and museums. An annual training for Women in Science members orients them to Project Exploration's personalized approach to science as well as to constructivist and youth development strategies for teaching science.

Identity as a Foundation

At the heart of the narrative of S4S is an effort to enable girls to feel special and to be trailblazers. For example, the "S4S True/False Quiz: A Statistical Glimpse of Girls and Women in Science and in Life" explores careers, school, and self-image. Sample questions include:

- 98% of secretaries are women. (True.)
- 40% of computer scientists are women. (False. Only 4% are women.)
- 34% of high school girls are advised by teachers not to take senior math. (True.)

Girls document their collective responses. As the group reviews answers and graphs data, participants talk about what surprised them and why. A discussion about data and statistics also begins to foster a sense of identity: Sisters are working to change the face of science.

Girls at the Center

Putting girls at the center means enabling girls to shape what is most worth knowing and experiencing by co-creating curriculum. S4S exemplifies this co-creation with two launch activities that shape the year's learning environment and curriculum: a code of conduct and an interest survey.

At the beginning of the year, each group of girls creates a code of conduct that reflects what they think is necessary to create a safe space where they can explore science and leadership together. From this activity, one group of girls developed the mantra "One Diva, One Mic" as a way to express the importance of allowing a girl to speak without interruption from her peers. The saying was subsequently adopted across program sites (Jafri, 2007).

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The interest survey serves as a needs assessment at the beginning of the program. It surfaces scientific topics of interest as well as the girls' social and cultural interests—how they like to spend their time, their hopes and expectations for the year, and so on. The results of the survey materialize as the year's program units.

Program Overview

A typical 90-minute S4S session begins with girls signing in, taking a healthy snack, and picking up their journals. Warm-ups or brainteasers create a positive group dynamic and get the girls energized and focused. Most sessions center around an activity presented by a visiting scientist during which girls learn about the scientist's personal career path and explore a specific scientific topic in depth. Each session includes journaling and personal reflection.

The first unit of the year at each site is dedicated to understanding the nature of science. Girls work through ideas about how science works: data and data collection, differences between evidence and opinion, science as something observable, and so on. They build on these ideas throughout the year as they explore two or three additional units, each lasting two or three sessions, based on their interests. In 2007, units ranged from engineering to evolutionary biology, chemistry, and forensics.

Personalized Curriculum

Project Exploration has developed a personalized curriculum model designed to foster access and equity in out-of-school science programming. S4S employs this approach across activities.

Long-term Relationships

Project Exploration fosters and supports long-term relationships with participants in all our programs. Students who participate in a Project Exploration program are invited to science explorations, special events, and leadership opportunities throughout middle and high school. Project Exploration offers a minimum of four programs each year; S4S participants are invited to extend their connections to science and scientists with students from other Project Exploration programs. Practically, this means that girls who are no longer in S4S because they have completed middle school continue to have opportunities to interact meaningfully with Project Exploration staff and students. This emphasis on developing long-term relationships is encapsulated in a saying repeated by both staff and students: "Once a Project Exploration student, always a Project Exploration student!"

Personalized Experiences with Science and Scientists

One of the goals of S4S is to introduce girls to professional women scientists whose presence can help girls envision careers in science. Working with Women in Science exposes Sisters to the roles played by women in the scientific world and challenges perceptions about what women can and cannot do. Girls have opportunities to ask scientists questions about their lives, educational and career paths, and families and home lives.

Journaling

Writing and discussion create "safe spaces" in which girls can explore personal experiences as well as scientific ideas. S4S journaling sessions are conducted within the framework of the code of conduct created by the girls. Journaling enables girls to document their learning, thoughts, and ideas as well as to practice communication skills. Sharing entries with one another reinforces the development of girls' identities as Sisters and can help facilitators to personalize otherwise abstract concepts.

Students' Lived Experiences as Entry Points

Finding ways to make abstract scientific ideas accessible is at the heart of Project Exploration's approach. All of our programs help students to make choices and to develop projects based on their interests and curiosity.

For example, one topic girls often express interest in learning about is "life through time." Conceptualizing

4.5 billion years of evolution is challenging for students and teachers alike. How to render ancient periods, eras, and epochs relevant?

We begin with a journal prompt: "Write about a moment in your life when something changed and you were different afterward." The girls construct a timeline of these moments using paper, glue, glitter, and markers; then they share their work. In a subsequent session we broach the history of life on earth and the geologic timeline in terms of moments of change and difference, using our personal timelines as an access point. This exploration includes a field trip to a lab or a museum collection, or sometimes a rock-hounding trip alongside an evolutionary biologist or geologist.

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Culminating Event

Project Exploration's personalized curriculum calls for opportunities to publicly and visibly celebrate students' growth. S4S concludes with a Reflection of Knowledge, a culminating event in which girls showcase their leadership skills and scientific knowledge to parents, teachers, scientists, and peers. For the facilitator, the Reflection of Knowledge serves as a performance assessment of core concepts and content knowledge. Each Reflection concludes with a certificate ceremony during which each girl is recognized and celebrated for her contributions. Acknowledging girls' work and interest in science publicly reinforces the narrative of Sisters as trailblazers, emphasizing that their interests are valuable to a diverse community.

How Are We Doing?

An emphasis on evaluation and feedback has helped S4S evolve over time. The program uses a variety of tools to assess program delivery and impact:

- **Participation tracking.** We track how many different girls attend as well as which girls come consistently.
- **Pre- and post-participation assessment.** We gauge girls' evolving comfort with science and familiarity with science concepts.
- **Year-end performance assessment.** Tied to our culminating Reflection of Knowledge, this assessment is grounded in the girls' actual work and presentations.

Each year girls evaluate the program in terms of three S4S themes: what it means to be a leader, science skills, and the growth of scientific content knowledge drawn from personal experience. Girls respond to questions such as, "What specific skills in science do you feel you have gained? Based on your experiences, what are the characteristics of a leader?" Year-end evaluations from 2007 suggest that girls demonstrated growth in leadership and decision-making skills as well as positive shifts in attitudes towards science, including an increased ability to do science (Jafri, 2007).

When asked "What is the best part of being in S4S?" Sisters responded:

- *We get to learn new things that wouldn't come to you every day.*
- *I feel that I am more interested in science because of S4S.*
- *It's just girls and we can do things cooperatively together.*
- *Having time away from my family and learning about science.*
- *We get to answer questions and ask questions and we really learn stuff we didn't even know.* (Jafri, 2007)

While S4S is not the only experience in a program year that helps girls to think of themselves as capable leaders, participants regularly tell staff they overcome personal obstacles, including peer pressure and lack of parental support, to choose S4S over other afterschool opportunities.

Project Exploration is working to better understand what motivates girls to return to S4S every year as well as what hinders or encourages their participation in science activities both in and out of S4S. Girls make up more than 70 percent of all Project Exploration program participants, and S4S participants make up approximately 30 percent of our more than 250 students. We know anecdotally that many S4S girls participate in other Project Exploration programs beyond middle school, through high school and into college. We anticipate undertaking a longitudinal study that disaggregates S4S data from cu-

MAKING ROOM

Our "timeline" prompt has regularly elicited highly personal stories from our writers. Girls have written about when they changed schools or had an accident such as falling down the stairs, but they also write about deaths in their family or the trauma of losing family members to prison or violence. During a journaling session like this one, facilitators work to ensure that girls have time to share and discuss whatever emerges. Sometimes whatever else we might have had planned for the day is put on hold.

mulative Project Exploration data. Until then, we track a selection of indicators for all Project Exploration students including retention, high school graduation, and college majors. This aggregated data shows that 43 percent of all girls who graduate from high school as Project Exploration field alumnae have gone on to major in science.

Consistent participation and demonstrated growth in science skills and motivation by girls in S4S suggests that girls who have traditionally not been encouraged to pursue science—particularly girls of color who may not be academically successful—are interested in science, can do science, and will stick with science when given personalized opportunities to explore it.

Drawing Girls into Science

Decades of national policies calling for the recruitment and retention of minority youth and girls to science have had little impact on participation by women of color in most fields of science. Obstacles such as fees, tuitions, and academic prerequisites continue to keep students in historically underrepresented populations from participating or achieving in science programs. Most research into urban minority girls' participation in out-of-school science offers anecdotal evidence in the form of descriptions of individual programs while providing little in the way of curricular framework that could be applied in other settings. The framework of engagement, capacity, and continuity, as suggested by Jolly and colleagues (2004), is a starting point for changing the status quo, but it is not sufficient.

Running an effective girls-only science program requires more than simply not inviting boys.

Project Exploration's personalized curriculum—which focuses on fostering and supporting long-term relationships, knowing students for what they are interested in as well as what they can do, and bringing young people from historically underserved communities together with scientists—is inherent in Sisters4Science. Project Exploration's orientation to making science accessible to urban girls of color is grounded in a girl-centered research base (Fullwood, Davis, & Debold, 2000; Mead & Boston Women's Fund, 2000; Ms. Foundation for Women, 2001; Roychoudhury et al. 1995). Running an effective girls-only science program requires more than simply not inviting boys. In S4S, putting girls at the center of science includes:

- Allowing girls to co-create curriculum based on their interests and strengths
- Enabling girls to engage in high-caliber, hands-on, authentic science explorations tied to personal experiences
- Enabling girls to work directly with women scientists, who serve as teachers and role models
- Using leadership development to equip girls with skills and experiences critical for advancement in science
- Creating a culminating public event that enables girls to reflect on individual and group growth and to share reflections with a diverse community

Practitioners and researchers need to draw on what we know matters for girls when creating girls-only science learning environments. This approach, as we're learning from Sister4Science, may offer a new blueprint for involving girls from historically underrepresented populations in science out of school.

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