Science role models for adolescent girls

As teachers interested in helping girls to realize more opportunities in scientific careers, we can celebrate the fact that girls' achievement has improved in the last 20 years, opening up the doors to those careers (Gilbert and Calvert 2003). However, even though the girls leaving our classrooms are realizing the achievement levels needed, too many of them are turning away from such careers. We must now ask ourselves why they are leaving the scientific pipeline and what we can do to encourage them to pursue scientific careers.

One contributing factor that has been shown to deter girls from entering the sciences is the sex-stereotypical image of scientific careers (Packard and Wong 1999). Scientists are often considered nerdy, male, and white (Mead and Metraux 1957; Eisenhart, Finkel, and Marion 1996), an image that clashes with girls' desired images of themselves (Kahle and Meece 1994; Jackson 2008). In light of this, we, like many other educators, found ourselves seeking science role models for girls (see "Fueling Interest in Science: An After-School Program Model That Works" on page 48 of this issue).

Indeed, research shows that girls are more likely to enter a field when they can identify a role model in that field (Betz 1994; Lent, Brown, and Hackett 1994). But we found that little is known about what it really takes to be a science role model to middle school girls. We knew what we would perceive to be a good science role model, but were also very aware of the fact that middle school girls may find different qualities important in selecting a role model. So, we turned to the experts—eighth-grade girls.

Listening to girls

Through a partnership between a local school district and a research university, full-time graduate student scientists worked with all eighth graders in a school for approximately 10 hours each week. The graduate students facilitated science experiences for students, such as having students research famous scientists and view videos of diverse scientists at work. They also planned presentations for students by diverse scientists from the local community. Over the course of one academic year, we had several conversations with 13 eighth-grade girls taking part in the partnership program. They were presented with many different scientists (e.g., community members, university scientists) for different lengths of time (e.g., one visit, weekly visits), providing an excellent opportunity to talk to the girls about potential science role models. We facilitated focus-group interviews with middle school girls from each of the three most prevalent racial groups represented at the school: Caucasian, African American, and Hispanic. Our conversations were guided by questions such as the following: (1) In what ways can a scientist be a role model? (2) What makes a person your role model? (3) What do you want and not want to see in a science role model? and (4) This project you are participating in brings in science role models for students such as yourselves. What suggestions do you have for those of us trying to match you up with a science role model? The girls specified characteristics about what makes a person a role model, in general, and a science role model, specifically.

Girls consider scientists as potential role models

Over the course of the year, we saw changes in the girls' views, ideas, and thoughts about whether or not a scientist could be their role model. In the beginning of the program, we were concerned when the girls' ideas about what made a role model did not match *any* of the scientists we discussed. This was due to the fact that their perceptions of a scientist did not match their views of a role model. The majority of the girls identified family members as their role models, people with whom the girls felt a deep connection. For example, the girls noted role models are someone "you depend on," someone who is "there for you," and someone who "helps us if we are in trouble." Their idea of "role model" did not fit with their idea of "scientist." For them, scientists were "too geeky," mean, or smart to be their role models. Most of the girls described their image of a scientist as male.

However, three months later, during the second interview, we found that through frequent exposure to diverse scientists, only one girl continued to visualize a geeky male scientist, whereas the rest visualized women scientists whom they described as kind, smart, responsible, funny, and cool to talk to. Some of them also described someone who was "a bit like [Yvette]," a black female scientist they interacted with as a part of the science outreach program curriculum unit. By the third interview, six months later, the girls' conception of a scientist had changed from a monolithic, emotionally detached white male to someone with whom they might be able to identify. They described scientists as normal people who know science and who could be men or women of any ethnicity. In interviews, the girls revealed a distinct change over time toward the idea of a scientist being their role model. When asked again whether a scientist could be a role model for them, most of the girls ultimately answered yes.

Science role-model characteristics

Through talking with the girls throughout that academic year, some characteristics of an ideal science role model for adolescent girls emerged. To them, an ideal science role model is someone who has a good personality, expertise in science, and is able to make personal connections. They were specific about what characteristics constitute having a good personality: kindness, intelligence, helpfulness, willingness to work with kids, and a sense of humor. The girls we interviewed would not consider as a science role model someone who

FIGURE 1 **Suggestions for fostering science role-model relationships**

General approach to providing adolescent girls with science role models

- Encourage science role models to share different sides of their personalities and outside interests with the girls.
- Encourage science role models to share with the girls their personal stories about friends and family.
- Allow girls to see the imperfections of their science role models and other women scientists.
- Encourage the science role models to show girls their enthusiasm for science and that they know a lot about science.
- Encourage frequent interactions between the girls and their science role models; ensure that the time is built in for these interactions to occur.

Sample role-model activities

- Plan an activity early in the year for girls to share stories about their role models and their characteristics. Encourage them to use this information to look for a potential role model in the sciences.
- Create the opportunity for the science role models and girls to have lunch together and build personal connections.
- Create a garden club where botanists and girls can work together to create a school yard habitat (example: *www.nwf.org/schoolyard*).
- During science presentations by local scientists, encourage the scientists to also talk about the personal obstacles they have had to overcome to achieve in science and life.
- Provide historical examples of women scientists who have had to overcome obstacles, such as Alice Eastwood, the botanist whose parents died when she was a young girl. Alice had to find a balance between study and working to care for her family, and she was withdrawn a few times from high school to work for her family.
- Plan an event, such as a symposium or fair, for the science role models to showcase their exciting experiences in science. Have them tell the girls why they are proud of these accomplishments and what they mean to them.

was superintelligent, and they would hardly consider as a science role model someone who was really nice but did not really know science well. It was important for the girls to have a personal connection with their science role model, as they believed such a connection would motivate them to learn and make them feel more confident. However, these perceptions came through interactions between the science role models from the university program and the girls; none of the girls mentioned the scientists from videos or books that were included in the diversity units.

There were different perceptions among the three ethnic groups about the importance of gender-matched or race-matched role models. The Caucasian and Hispanic girls believed that race-matched role models were not important. They typically answered, "Race doesn't matter at all," to a question of whether or not they wanted to have science role models from the same ethnic group as themselves. Some did indicate the need for diverse role models by saying, "They shouldn't all be Caucasian." In contrast, the majority of African American girls expressed a strong opinion that science role models should be persons of color. The girls differed widely on the issue of gender in relation to science role models. There were girls within all three groups who explicitly stated that gender "does matter." Others noted that gender mattered for the boys. In discussing how they would feel if only women scientists were invited into the schools, some participants believed that boys should have male role models, indicating they did believe that gender of the role model mattered for boys. Other girls verbalized that gender did not matter in a role model.

Promoting effective relationships with science role models

It was clear from interviewing these girls that, while it is important to them that their science role model have expertise in science, it is even more important that the person be able to make a personal connection and demonstrate care for them. The girls in this study articulated that a science role model needs to have a good personality, expertise in science, and the ability to make personal connections.

These characteristics conflicted with *our* initial perceptions of a science role model. We perceived a science role model as a person who serves as an example to strive for, has good study habits, and models good characteristics. We unintentionally supported the girls' initial beliefs that scientists could not be their role models because they were "too good" or "too smart." We also believed that a science role model was a person who has a love and enthusiasm strongly focused on science, which conflicted with the girls' idea that a role model needs to be someone who cares for them personally. By the end of the third interview, however, we broadened our scope beyond focusing on science and also recognized the importance of science role models having personal relationships with students.

The girls with whom we talked sought a personal connection. To them, a role model was someone who cared about them and shared common interests/experiences. The stereotypical image of a scientist caused the girls to believe that a scientist was someone with whom they could not/would not have a relationship. It is the image of a scientist who only cares about science and not people that prevents girls from having a relationship with a scientist. The presence of caring teachers and lack of caring scientists in their lives may explain why more girls pursue teaching. If the image used to attract girls to science is too perfect, this may have the opposite impact from what was intended.

Ultimately, the characteristics of science role models arose from giving the girls a voice. Through asking and listening to them, it was possible to understand what characteristics of science role models are important to them.

Conclusion

As we continue seeking ways to encourage girls to pursue careers in science, we can be guided by *their* words and ideas in providing opportunities for science role-model relationships to develop. By asking questions about science role models, we saw changes in the girls' ideas of what makes a good science role model. In the beginning, girls identified family members, with connectedness and caring as central characteristics, as their role models. Over time and through experiences with females pursuing STEM careers, they described scientists as cool-to-talk-to, normal, smart people who know a lot about science. Most said a scientist could be their role model.

What the girls revealed is also very helpful in talking to scientists interested in being role models for girls. Science role models could be encouraged to share different aspects of their life to reveal their complex personalities to the girls, and we can expose girls to life stories of female scientists in history in our science classes. Another possibility is to plan an event where science role models showcase their exciting experiences in science, so that the girls may see their enthusiasm and expertise in science in a social setting. Some possible ways to encourage personal connections between the science role models and the girls include setting up lunch buddy

systems and encouraging participation in and formation of groups that are both social and involve science, such as a gardening club (see Figure 1 for more suggestions). Using the girls' ideas and thoughts can help us foster effective science role-model relationships and move toward increased female participation in science.

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A student-centered project focused on obtaining clean drinking water for the community

As teachers of upper-elementary and middle school science, we understand that it is often difficult to motivate our students to learn. We have stood on our heads, dropped things out windows, and performed countless other committable actions in the name of science. But, when we successfully engage our students, it is all worth it! This project-based science unit, focused on a local environmental issue, created a great deal of interest and learning and drew in the support of the community. We designed and implemented the project in a fifth- and sixth-grade classroom when we were Peace Corps volunteers in Central America. Although this project was carried out in Central America, the teaching approach is transferrable to schools in urban and rural contexts in the United States. Local environmental concerns are prevalent worldwide. Allowing students the autonomy to investigate a local issue they find significant and supporting them in their investigation can lead to enhanced student engagement and motivation.

The project

The project developed from a multi-week service-oriented unit that addressed a community problem and introduced teachers to alternative instructional strategies. In order to promote student engagement, we wanted students to choose the topic of the investigation. As instructors, we served as advisors to help students: identify the problem, research the problem, collect and compile data, and present their findings. These steps paralleled the process of scientific inquiry as defined by the National Science Education Standards (NRC 1996) and were similar to approaches to inquiry described by Crawford (2000) and Chin and Chia (2004).

Identification of the problem (day 1)

We introduced the project by asking students to brainstorm the most urgent environmental issues facing their community. As a group, students generated a long list of concerns. We wrote students' ideas on the board and discussed each of the issues as a class. After much discussion, students decided to research the lack of potable drinking water because they felt it was the most pressing environmental issue for the community.