Reaching Out to the Next Generation of Scientists

By Luz Claudio

Excellence in the Academy Awards

New Scholar

"Dr. Claudio?"—the voice didn't sound familiar.

"Yes?…"

"You're a woman!?"

"Yes, I think so." I was annoyed. "Who is this?"

"This is Nikki Schulak. I direct the Wave Hill Summer Camp for Girls. We are calling you to ask if you could…" She went on to ask if I would host 30 12-year old girls on a visit to my lab. Could I talk to them about what it is like to be a scientist?

Visions of disaster immediately flashed through my mind: beakers crashing to the ground, pipettes being used as blow-darts, giggles at the sight of test tubes and centrifuges. A whole day of work gone just trying to keep a pack of seventh graders from touching my PCR machines.

Or worse…

What if I just sat them down in the conference room and gave a lecture (slides and all) on the virtues of science, the advances we've made, the uncharted fields still unconquered?

And what if after an hour of uninterrupted academic discourse I turned-up the lights only to find blank stares, sleepy glances punctuated with yawns or the heavy sounds of snores. Why bother? Kids don't understand the complexities of big-time biomedical **Science**. What if I bored them!?

"Yes, I'll do it"—I surprised myself saying.

"Great!" said the voice on the line. "We'll be there next Thursday. Can you tell me how to get there from the Bronx?"

Wait a minute here. The Bronx? What have I gotten into!?

When Thursday arrived, I

Luz Claudio *came from Puerto Rico to the Bronx ten years ago to study neurology and became a scientist at the Albert Einstein College of Medicine. She is an associate professor of environmental medicine, studying how environmental factors such as pesticides and lead affect the brain and nervous system. She also directs the Community Outreach and Education Program of the Mount Sinai Environmental Health Sciences Center. This program helps people of color address environmental justice issues in their communities.*

This image of Dr. Frankenstein and Dr. Jekyll, the absent-minded professor, the mad scientist, is ubiquitous.

asked Nikki to gather the girls in our conference room. All of the girls were African-Americans and Latinas, all of them lived in the South Bronx, all attended public schools.

It took them a few minutes to settle down. I stood up from among them and, without introducing myself, asked the restless crowd of girls to describe what a scientist looks like.

Unanimously, they described what could be summarized as an "Einstein-look-alike with glasses and a pocket protector." When I asked what a scientist does, they described it as "he looks into a microscope," and used words like "boring," "hard," and "difficult" to describe what it is like to do science. Needless to say, none of the girls wanted to become a scientist.

The common image of "the scientist" is vividly embedded in the collective mind. He looks permanently electrified, hair standing on end. He is always middle-aged, always white, and always, always preoccupied about his experiments, without regard to their consequences on the humanity beyond his messy laboratory.

This image of Dr. Frankenstein and Dr. Jekyll, the absent-minded professor, the mad scientist, is ubiquitous, perpetuated in films and commercials, and, most distressingly, in children's TV programs that are supposed to "make science fun."

As with many other stereotypes, reality reinforces the image. The most celebrated scientist of the last century was the very model for the scientist "look." Albert Einstein loved music, was playful and funny, and cared very much about the effects of his discoveries on humanity. But what is most vivid in the public's mind is his wild white hair and his spiraling, complex mathematical formulas written on a blackboard.

The girls who came to visit my lab that summer were right to bet that the scientist who was going to welcome them that day was going to be an Einstein look-alike. According to a 1992 National Science Foundation study, more than 90 percent of scientists and engineers were white.[1] Of all scientists, only 26 percent were women.

Although underrepresented minorities comprised 18 percent of the total labor force, they were only 5 percent of scientists and engineers. These statistics have not changed much since the study was conducted.

But why should it matter who does science? As long as high-quality science is being performed, as long as outstanding discoveries are being made everyday, as long as we can put people in other planets, genetically enhance the quality of our food, and produce drugs that

For example, African-American infants have a mortality rate twice that of white infants.

keep people healthy until they are centenarian, then who cares what the face looking through the microscope looks like?

Well ... although this is the age of space exploration, genetic engineering, and information technology, this is also the age of another two-word phrase: health disparities.

Health disparity refers to the disproportionate burden of disease seen in disadvantaged populations. In general, people of color and the poor suffer from higher incidences of many diseases and face lower life expectancies than the general population.

For example, African-American infants have a mortality rate twice that of white infants.[2] Cancer survival rates for minorities and low-income populations, according to the American Cancer Society, are 10 to 15 percent lower than those of more affluent white Americans.[3] The same appears to be true for an array of other diseases and adverse health conditions, including diabetes, asthma, low birth weight.

The Office of the President, the Surgeon General, Department of Health and Human Services, and the National Institutes of Health all have issued major statements and allocated funds for the study of causes and solutions to health disparities. Included in all these agendas are provisions for the training of underrepresented minorities in science and medicine.

This recognition by the federal government that people of color suffer disproportionately from the burdens of disease underlines the need to increase the numbers of minorities in the health sciences. Why? In the early 1980s, the Robert Wood Johnson Foundation showed that minority physicians were more likely than their Caucasian colleagues to practice in underserved minority communities. This appears also to be the case for minority scientists, who may tend to do research on diseases that particularly affect minority populations.

"This shouldn't mean that only women do breast cancer research, or only Blacks do studies of sickle cell anemia,"says George Friedman-Jiménez, director of the Occupational & Environmental Medicine Clinic at Bellevue Hospital in New York.

But personal experience and cultural background may motivate a person to pursue a particular area of research. Native Americans, for example, are more likely than Caucasians to become environmental scientists. The National Science Foundation found that 47 percent of Native American scientists were environmental and life scientists

The mistrust of science prevalent in African-American communities follows from past mistakes by scientists.

while 23 percent of white scientists pursued those areas of research.[4]

"The best qualified researchers should be doing the best research, regardless of their ethnicity," says Friedman-Jiménez. And sometimes, the "best qualified researchers" are those who come from the same communities that are under study. This is because there is a general mistrust about science and about scientists coming to town to "study" people who are in distress.

In the mid 1980s, for example, the United Church of Christ's Commission on Racial Justice published a study that found a disproportionate number of polluting industries were located in minority neighborhoods.[5] The commission found that people of color were 47 percent more likely than whites to live in zip codes that contain one or more hazardous waste facilities.

These and other studies fueled the environmental justice movement, which has resulted in legislative actions and socio-political activism in many communities throughout the United States.[6]

One of the pioneering government officials to seriously tackle the environmental justice issue was Kenneth Olden, director of the National Institute of Environmental Health Sciences. He helped implement community outreach programs in which scientists were required to be directly responsive to community needs.

In pursuing these programs, he established an atmosphere in the environmental health research sector designed to end the practice of treating community residents merely as subjects in epidemiological studies. Instead, environmental health scientists engaged in close collaborations with neighborhood residents in order to better understand disease causation and implement solutions.

Besides being an accomplished scientist in the area of molecular oncology, Dr. Olden also happens to be an African-American. Perhaps this made him especially attuned to the need for changes in the way community-based research science is being conducted today.

This need for research scientists to come out of their labs and establish links with communities also has brought about an increased need for scientists of color who can better gain access to the communities often most affected.

The mistrust of science prevalent in many communities, especially in African-American communities, comes from past mistakes such as the Tuskegee syphilis study, when African-American patients were deceived and denied medical care. These and other

By the time students are in college, most already have ruled out science as a viable career choice.

episodes of insensitivity and sometimes negligence left a sense of vulnerability and fear about science in many communities.

Research scientists, including those in government agencies, now recognize the need to be sensitive to issues of culture, language, and traditions, not only in conducting population studies, but also in treating individual patients.

As the demand for this kind of sensitivity increases, so does the need to reach more minority students and interest them in a career in science. But most efforts to bring the excitement of science to all students have not challenged the images of who a scientist is.

Changing stereotypes is not an easy task. Think of the many racial, cultural, and gender stereotypes that are so much a part of our society. By the time students are in college, most already have ruled out science as a viable career choice, and thus the applicant pool continues to be reduced. To address these issues, higher education needs to reach out to students ever earlier in order to meaningfully affect their visions of themselves, their world, and their career choices.

One approach to reach students at an earlier age entails having students of various abilities, including high school students, perform tasks appropriate to their level of training within a research team. All the students are valuable for the team, whether they have limited formal training in biomedical sciences or are advanced postdoctoral fellows. This approach motivates advanced students to serve as mentors and promotes a collaborative atmosphere among participants.

I have used this multitiered mentoring in my laboratory as a way to incorporate students at different levels of the educational tree into my research programs.

For example, in a study of the environmental health effects of lead, high school students carefully introduced varying amounts of lead into different types of plants. Younger students conducted measurements of the growth of the plants and maintained these records.

The high school students conducted library research to find out how different plants may absorb lead from the soil, serving as environmental purifiers. College students involved in the project supervised the high school students in the exposure and collection of specimens that were then analyzed in the laboratory by a doctoral student who, together with me, conducted the statistical assessment and prepared a scientific paper. A

Educational strategies can be targeted that directly impact preventable disease in communities at risk.

laboratory technician oversaw all safety and quality control procedures.

In addition to the students, several community residents got involved in the project by preparing informational leaflets explaining lead toxicity and sources of pollution to their neighbors. This project illustrates how it can be possible to bring young students and neighborhood residents into the conduct of real science that is relevant to the community.

Community residents participate in the research process alongside students and faculty members. As a result of this type of collaborative interaction between residents of communities, students, and academic faculty, I have found that all are empowered and have the opportunity to understand the inside scoop of the scientific endeavor.

Even when they do not pursue science as a career, participants become more vocal in issues regarding science, health, and governmental regulatory processes because they can understand scientific concepts and have gained access to information that may have previously been incomprehensible. In addition, this interaction fosters the ability of scientists to gain access to the community in order to design studies that can have a positive impact on real community problems.

Educating children in the biomedical and health sciences can also have a great impact in enabling children to take control of their health. Direct education of children can reduce exposure to risk factors.[7]

For instance, the Open Airways for Schools asthma management curriculum designed by the American Lung Association is specifically geared toward helping children manage their asthma symptoms.[8]

This educational program teaches asthma management strategies in a child-friendly manner, demystifying the illness by allowing children to understand the disease process, identify asthma triggers, and take some control of their own symptoms. It has been shown quite clearly that patient education improves compliance and is an important part of the control and treatment of asthma.[9]

Another effective strategy to increase student interest in science is parent involvement. Parent education level is a stronger predictor than family income, single parenthood, or family size for ensuring the health of children.

Nearly 25 percent of children in the United States are born to a mother who is not a high school graduate.[10] But regardless of level

Scientific information may not be an immediate priority in an otherwise disadvantaged community.

of formal education, many parents are intensely interested in their children's education, particularly if that education can be related in some way to the health of their children and of their community. Educational strategies can be targeted that directly impact preventable disease in communities at risk, and these may be relevant to parents and students alike.

Various approaches have been used to educate parents, ranging from direct counseling to providing information via recorded telephone messages.[11]

The Centers for Disease Control and Prevention, for example, has recommended that parents be educated about sources of lead during well-child visits. Yet only 12 percent of parents of children found to have elevated blood lead levels had received preventive counseling prior to detection.[12] Clearly, more needs to be done to implement such parent education strategies.

Community outreach and education strategies have to cope with a general lack of scientific knowledge. The complexity of scientific data and disagreements among scientists make the communication of scientific findings difficult.

Another obstacle: Scientific information may not be an immediate priority in an otherwise disadvantaged community.[13] Many communities affected by health disparities are also plagued by economic and social distress that may be more acute or more visible.

But, even with these obstacles, communities generally welcome outreach efforts and are interested in learning about their health and the health of their families.[14] For this reason, it is important that attempts to address environmental health issues give a community and its children a real sense of empowerment.[15] This can be done by emphasizing that communities and individuals can do something to improve their health.

The goals of community activities and increased student involvement in the biomedical field may include increased community participation in research protocols, organization of forums and community-based symposia for the dissemination of study results, and community participation in public hearings and policy meetings with regulatory officials.

In turn, academic scientists must learn to respect and value the knowledge and expertise that community residents bring to the design and implementation of solutions to community health problems. These opportunities for increased interaction between scientists, community residents, parents and students also helps to

They saw that I was a real person, just like any they encounter on the streets of their neighborhood.

demystify science and build a sense of collaboration.

Many institutions have recognized the need to address the lack of science education in minorities. The National Institutes of Health, for example, has spent in excess of $1.5 billion to increase the numbers of minority scientists over the last two decades. But the numbers have barely improved since the 1970s when minorities made up 2 percent of the scientists in the United States.

Reasons why these governmental programs often fail include inconsistency of funding, unrealistic goals, low expectations, failure to reach students early enough to have an impact in their careers, and a lack of follow-up on the progress of the programs.

Until individual scientists acknowledge the importance of reaching out to the younger students and are supported by their institutions in doing so, little progress can be expected. The breaking down of stereotypes about science and the interaction of real role models and youngsters are key to making headway in increasing the number of students (of any race) aspiring to become scientists.

Minority programs found to be particularly effective in attracting and retaining students in science should be opened to non-minority students as well, because all students face barriers, such as peer pressure, lack of preparation, preference for more lucrative careers, and a general negative view of science.

But a reality check confirms that there is also a need to change the academic culture. In today's academy, faculty must devote less and less time to teaching, as obtaining research grants becomes more and more competitive.

Research and writing papers and grants consume most faculty members' time. Time for mentoring individual students and teaching is limited.

To encourage faculty to pursue teaching and mentoring, academic institutions should establish a reward system that acknowledges these efforts. All scientists, regardless of race or ethnic background, who conduct quality research should be encouraged to become effective mentors.

Yet, sometimes the interaction needed to make an indelible impression on a youngster does not require one-to-one mentoring or even the investment of huge amounts of time.

Going back to the original story, I want to tell you what happened in my visit from the girls from the Bronx. I told them not only about my work in the lab and the discoveries I've made. I also told them about my family in Puerto Rico, my passion for salsa dancing, and my early struggles with the English language. They saw that I was a real person, just like any they encounter on the streets of their neighborhood–just like them.

Then, I had them wear disposable surgical gowns, complete with gloves and masks, and they visited my laboratory in small groups. They lined up to look into the microscopes at brain cells living in Petri dishes.

No beakers fell on the floor and no one yawned in boredom. They were all excited and talkative, asking good questions about science and about me, like how come my white robe was rolled up at the sleeves. Answer: It was not the proper size for a five-foot-one girl scientist like me.

I must report that weeks after the presentation to the summer campers, I received a letter from them letting me know that coming to the lab had made them "really feel like doctors." Dressing up like a "doctor" made a huge impression on them and changed their image about themselves and what they could become.

Their journal entries for that day read: "Today was an exciting day, we went to meet a woman scientist who studies the brain." Another girl wrote: "Now I know Hispanic women can do anything." Yet another said: "The scientist had nice shoes." I don't know if any of them will become scientists, but at least now they know they have that option and can still be who they are. ■

Works Cited

[1]National Science Foundation (1994) *Women, Minorities and Persons with Disabilities in Science and Engineering*.

[2]Williams DR, Collins C. "US socioeconomic and racial differences in health: patterns and explanations." *Annu Rev Sociol.* 1995; 21:349-386.

[3]NIEHS/AACR "Task Force on the Advancement of Minorities in Science (1996) Vision for a Model Program." *Cancer Res* 56: 3380-3386.

[4]National Science Foundation (1994) *Women, Minorities and Persons with Disabilities in Science and Engineering.*

[5]Goldman BA, Fitton L. "Toxic Wastes and Race Revisited: An update of the 1987 report on the racial and socioeconomic characteristics of communities with hazardous waste sites." *United Church of Christ Commission for Racial Justice*, Center for Policy Alternatives, Washington D.C., 1994; 1-27.

[6]Brown P, Masterson-Allen S. "The Toxic Waste Movement: A New Type of Activism." In *Proceedings of the American Sociological Association Annual Meeting,* Washington D.C., August 14, 1990.

[7]Gorman KS, Pollitt E. "Does schooling buffer the effects of early risk?" *Child Dev* 67: 314-326 (1996).

[8]O'Neill MS. *Helping schoolchildren with asthma breathe easier: partnerships in community-based environmental health education*. Environ Health Perspect 104: 464-466 (1996).

[9]Bone RC. "Goals of asthma management. A step-care approach." *Chest* 109: 1056-1065 (1996).

[10]Zill N. "Parental schooling and children's health." *Public Health Rep* 111: 34-43 (1996).

[11]Alemi F, Stephens RC, Muise K, Dyches H, Mosavel M, Butts J. "Educating patients at home." *Community Health Rap. Med Care* 34 Suppl 10: 21-31 (1996).

[12]Chaisson CE, Glotzer DE. "Counseling to prevent childhood lead poisoning." *J Natl Med Assoc* 88: 489-492 (1996).

[13]Jensen RA. "Outreach by the Hanford Tribal Service Program to Indian communities around the Hanford Nuclear Reservation." *Cancer* 78 Suppl 7: 1607-1611 (1996).

[14] Rowan F. "The high stakes of risk communication." *Prev Med* 25: 26-29 (1996).

[15]Claudio L. "New efforts to address childhood asthma in the Bronx. Environmental Health." *Perspectives* 104: 1028-1029 (1996).