From Pumpkin Pie to CSI

Dr. Meenakshi Rao Challenges Students to Find Chemistry in the World Around Them

When members of the chemistry department asked Meenakshi Rao if she’d develop a new introductory seminar course on a subject close to her heart for the fall 2013 semester, she jumped at the chance. Rao, Barnard’s senior lecturer in chemistry and director of the organic chemistry labs, has taught at the College for 22 years and knew exactly how to draw new students to the field: a course on forensics and chemistry in everyday life.

One of her inspirations for the course, “From Pumpkin Pie to CSI,” the latter referring to the popular television show, came from a trip Rao took with a group of students recently to the “CSI: The Experience” exhibition at the Discovery Times Square museum. The students solved hypothetical crimes by examining blood types and matching DNA samples to potential suspects. They were fascinated by the experience, and the memory of their enthusiasm has stayed with Rao ever since. She still keeps pictures from the trip on a bulletin board outside her office. “The excitement in their expressions was incredible,” she says.

It doesn’t hurt that Rao is also a fan of Sherlock Holmes. Her appetite for mysteries fuels her own passion for studying forensics. “Sherlock Holmes, CSI, The Mentalist—I can’t get enough of it,” she admits with a laugh, noting that it’s the way that crime stories hinge on the science—the analysis of a hair fiber or a tooth filling—that captivates her. She’s not alone: Today’s students have grown up watching images of scientists working in labs, using chemistry to solve crimes in ubiquitous crime procedurals such as CSI. New technology in forensics has also brought increased media attention to the field as investigators have solved cold cases and reversed past

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and fundraising, in addition to car design and testing, says the club's faculty advisor and a professor in Columbia's mechanical engineering department. He describes Pasha as "the glue that binds the team together. She is very well-organized and a force of personality." His selection as president provides inspiration to other women. "The need to encourage female students to get involved in a hardcore engineering project like this one is very important," he adds.

About a quarter of the club's members are women. Pasha's leadership has changed the atmosphere, pushing members "to open themselves up to people who don't know as much about cars" but have other valuable organizational and business skills as well as a desire to learn, Pasha says.

Pasha is thinking about a career in engineering management, a field she hadn't previously considered. Leading Knickernose, she "troubleshooted" her ability to manage a group of people, she says. "I wasn't aware that I had the skills to do so."

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program since 2010.

"Any time you can find outside support for programming that has already been defined as a high priority for the College, there are good and practical reasons to do so," says Feder-Kane. "The college was already planning to move forward with the program, and the outside funding ensures that we can make it even better."

"Part of the money will go toward developing materials to get the message out about healthy and unhealthy relationships," notes Murphy. "We have been brainstorming about some of the tools that will help us do this. We want to use this money to reach as many groups as possible. The rape crisis center has already done education and intervention models for the athletic teams at Columbia, but we want to reach people from a wide variety of backgrounds."

The goal is to unveil the bystander-intervention program in the fall. "Right now we are working on the curriculum," says Singleton. "We are looking at what has been done on other campuses and deciding if we want to take ideas from these programs and create our own, or if we would rather adopt one in place at another institution."

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convictions with new DNA evidence. "When I was growing up, I wasn't exposed to these topics," Rao says. "You didn't see science in the mainstream media." Her own undergraduate and master's education at India's Bangalore University rarely covered how chemistry could be found in the outside world.

Forensics and a Calendar of Chemistry

That won't be the case for Rao's students. In the weeks the course is devoted to forensics, students will learn crimes scene chemistry and evidence-analysis techniques. For example, they'll learn how they can use atomic absorption spectroscopy, a way to detect trace amounts of elements in a sample, to identify the additional metals in a gold tooth filling found at a crime scene. Knowing the filling's makeup can lead investigators back to a specific dentist who used a particular filling mixture—and to identify patients who could be potential suspects.

Studies who continue in chemistry will encounter atomic absorption spectroscopy in the course "Quantitative and Instrumental Techniques," where the method is used to determine how trace elements found in certain foods match the foods' dietary information. An early understanding of how scientists use these techniques in fields such as forensics gives students a broader sense of how hard science is applied outside the classroom or lab.

The changing seasons and holidays also inspired Rao to design "Calendar of Chemistry." As the leaves change, she will teach the chemistry of color and invite her students to her family's home on Long Island. The trip, which also includes a hike through the fall foliage, has become an annual tradition for Rao and the students in her fall courses. Rao will then teach the chemistry of fear to coincide with Halloween, exploring how our bodies produce chemicals that induce this flight or flight response after a sudden fright.

Popular cooking shows have also introduced food chemistry to a mainstream audience; before Thanksgiving break, Rao will delve into that topic. Students will learn how one small structural difference in the otherwise identical molecular formulas of nutmeg and cloves—common pumpkin pie ingredients—makes these two spices dramatically different in aroma and taste. She will delve the final class of the chemistry of ice as students depart for winter break. Rao will also have her students explore chemistry in art restoration, forgery detection, cosmetics, even the chemistry of love.

Putting Science in Context

Rao designed the new course to provide a passion for chemistry in first-year students, many take "General Chemistry." Telling the stories behind the science captures their attention, she explains. "Then they're awake for the chemistry.

Her passion for chemistry and novel approaches to teaching it helped earn Rao Barnard's Emily Gregory Award for excellence in teaching and for devotion and service last year. Her methods have adapted to changes in students. Over the past decade, she has observed that students are less likely to apply their chemistry studies to careers outside the traditional pursuits of medicine, research, or academia, so Rao sees more of her former students going into such fields as art restoration and forensics.

The students respond so well to stories and real-world examples of science that she discusses chemistry-related news articles in class. The more she uses this approach, her first-year students to the ways science fits into life, the more likely they'll find inspiration in the field. "If high-school students were exposed to these stories, as many would see the need to major in chemistry in college," she believes. Rao expects a full classroom this fall, and hopes to add a lab in coming years to accommodate the need.

"I want to meet them in person. And now I get to do that every day, for this book that nobody wanted to publish for so long! It's really a miracle." "People who know me on campus—other faculty and staff—are coming up to me saying they want to give us a copy of this book," Rao says, laughing. "I think the title—Pumpkin Pie to CSI—has really clicked with people."

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Never explained that her work as a dancer and actor was a different way. She's tried to transform and change people's mentality. And filmmaker Luis, who had grown up in a more privileged background than the other two panelists, urged the audience to "get started, sometimes to take risks. Don't try to be perfect. Don't try to know everything. Learn along the way."

The "Women in Science" panel, moderated by Brazilian journalist and television host Monica Werneck, featured Duilia de Mello, a NASA astronomer and professor of astrophysics at The Catholic University of America, and Mayana Zatz, professor of human and medical genetics at the University of Sao Paulo. Their primary issue was countering stereotypes that keep women from pursuing the sciences. Said de Mello, "We can't have girls think that science is for men." Similarly, Zatz pointed out that her field of genetics was nearly unknown when she began her career. "School has to be restructured to teach young people how to think.

The afternoon panel, "Conversations on Leadership," was moderated by Spar, who said, "One of the ideas behind the global symposium is to learn from other countries and to bring back that learning to our students. [Here] we see mothers playing a big role in telling their daughters what they could do. We're not hearing complaining. What has Brazil done right? What can we learn?"

Maria Cristina Farias, columnist for Folha de Sao Paulo, and Adriana Machado, CEO of GE Brazil, highlighted some of the ways that Brazil's policies and culture work for women. "Gender has not been an issue in my career," said Farias, adding that 40 percent of the editors at her paper are women. "There's a culture of meritocracy. For Machado, a key element is Brazil's policy of granting six months of maternity leave as a result, women aren't afraid of losing their jobs after they have children. Machado, mother of a 14-year-old and a 7-year-old, said, "I got promoted after the birth of my second boy. I have a structure at home where I know my kids are taken care of."

This, again, middle- and upper-class women in Brazil can afford to hire household help, which enables them to work outside the home with less stress than their American counterparts. "Ultimately," said Machado, "women shouldn't be shamed of desiring power. You have to teach women and girls that there's nothing wrong with having power."

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"Peta and I shut four hours of sleep," she says. "I danced in the streets of Rio, as we were exploring ways in which woman measure themselves, their experience, and their life. Police stopped us twice because we were in the middle of the street or on some forbidden property. It was amazing to be so focused on any impulse that might immediately become the seed for movement."

María Rivera Manzuchi, assistant professor of education, expanded her understanding of education in her elementary-science education in Brazil. (Previous research was done in the United States and Argentina.) She developed methods to understand new perspectives on science education. In collaboration with Prof. Félicia Moore Mensah from Teachers College, she visited local schools and spoke with teachers, parents, administrators, and students. Manzuchi says, "I gained a much deeper appreciation for the Brazilian education system. There are similar challenges, and unique challenges, around issues of equity, especially with access for secondary students to quality education." She adds, "Both Argentina and Brazil have female presidents. They've broken that glass ceiling. I wonder what impact that has on young girls, and where we go from here, considered a non-traditional field."

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