

STATEMENT OF GRANT PURPOSE

Heena Mutha, India, Education

Studying Innovation in Education

In 2002, Dr. S.P. Gupta of the national government's India Vision 2020 group identified the current educational system as a fundamental weakness in the nation's prospects for continued economic and socio-political success. Accessibility and relevance remain primary shortcomings in technical education. However, local organizations are currently working to meet these needs at all levels of schooling. The Agastya International Foundation in Bangalore has begun bringing hands-on science education to rural students in Karnataka and Andhra Pradesh at the primary and secondary education levels. The leaders of the newly founded Indian Institute of Technology at Rajasthan are using this pivotal time to reexamine engineering education and focus the curriculum on design. During my Fulbright, I will spend seven months working with Agastya supported by Dr. N. Nandini at Bangalore University and Mr. Ajith Basu, Agastya's chief program executive. I will then spend 2 months working at IIT-Rajasthan with the director, Dr. Prem Kalra. My experiences in developing curriculum, researching active-learning in classrooms, and studying at immersive, project-based technical institutions make me well-suited to contribute meaningfully within both organizations. As a Fulbright ambassador, I will gain firsthand experience in leading educational reform on a regional scale. This will be an important step toward my lifelong ambition of starting my own educational non-profit.

The Agastya International Foundation, established in 1999 to revitalize primary and secondary education, is invested in inspiring creativity and curiosity in young minds. They disseminate knowledge to rural communities through many programs supported by the Global Children's Fund, including mobile labs, science fairs, and the Young Instructor Leader program. Rural students are selected to participate in the Young Instructor Leader Program, where Agastya staff train them to conduct and present science experiments to their peers and younger students at Agastya science fairs and back home in the village community. The peer-to-peer model promotes a discussion-based learning environment. This program allows science to penetrate the farther reaches of the rural environment.

While at Bangalore University and Agastya, I will work with the Young Instructor program. As part of the Young Instructors Program, I will work with the current staff to train young students on teaching methods. My experiences in student-teaching-student programs are well matched for this position. Over two years ago, I started an Olin education outreach program, Engineering Discovery, where I trained my peers on how to present science concepts. While developing one of our first modules, a bottle rocket design workshop, I discovered that the undergraduate team had not clearly explained how fin placement affects the stability. I pushed the team to rethink whether lecture was an appropriate medium to present the concept, and we developed an experiment for students to conduct that would show why fins are placed at the base. Over the past 5-6 years, I have been training and teaching my peers how to work with younger students. To develop a greater understanding of pedagogy's underlying principles, I also conducted an independent research project on active learning in classrooms while studying abroad in Scotland. While at Agastya, I hope to study their teaching model and use my experience to provide support for the program through assisting staff in leading training sessions and providing the young instructors feedback.

Agastya develops many science demonstrations and short activities for its science fairs and learning labs. Dr. N. Nandini at Bangalore University is developing activities integrating, biodiversity, sustainability, and renewable energy. Under her mentorship, I intend to design

several short thematically linked activities. I am well-positioned to do this work using my background in mechanical engineering, design, and curriculum development. By June 2010, I will have completed the Wellesley College teaching certification program, having spent 200-300 hours writing lessons and teaching high school physics. To complete this coursework, I wrote a 10 day module for my 9th grade students exploring thermodynamics and mechanics of renewable energy systems. For the activities at Agastya, I envision the children learning about sustainable design and the environment, and using this as a foundation for building a renewable energy system. To emphasize the engineering component, the students will move through an entire design process, from considering material choices and cost, to sketching ideas in computer-aided drafting software and building a prototype. They will present their work at a science fair.

In addition to developing curriculum at the primary and secondary level, I have been invited by IIT-Rajasthan's director to assist in redesigning engineering education. While the IITs are certainly world class institutions, this new campus aspires to redefine engineering as innovation that considers human needs and creativity, and foster education where students can take ownership of their learning. My undergraduate institution, Olin College, shares this mission. Olin emphasizes team- and project-based learning, with a mission to design for the needs of society. Where most engineering programs start at a problem and then build solutions, we learn how to identify problems. In one of my required courses, User-Oriented Collaborative Design, I spent two months observing and interacting with fire fighters, discovering authentic unmet needs before proposing solutions for them. IIT-Rajasthan aspires to implement this design philosophy in its curriculum. My insider experiences in Olin's design-centered curriculum allow me to offer valuable perspectives for IIT's proposed innovations. Additionally, although I have spent my life in the U.S. my entire family is Rajasthani. I can use my U.S. academic background and my Rajasthani heritage to move between two cultures and find ways to adapt Olin's ideas to the Indian context. From IIT, I look forward to learning about the challenges and possibilities of establishing an engineering school like Olin in a setting different than the United States.

Beyond spending time at Agastya and IIT-Rajasthan, I cannot wait to integrate into my host communities through food and religion. I hope to take cooking classes, potentially at Manju's Cooking School in Bangalore. I look forward to tightening my technique and discovering new purposes for the boxfuls of dals and spices I always keep near me. During my time in Rajasthan, I also hope to study many Jain temples firsthand including Mount Abu, Ranakpur, and Nakoda. As an American Jain, these places are historically compelling and serve as the basis for my personal vegetarian lifestyle.

As a Fulbright recipient in India, I would have the opportunity to work closely with education reform initiatives, allowing me to share my experiences within the US system and take lessons from India's well-established organizations back to my own projects in the US. While in India, I plan to present what I have found at Bangalore University and IIT-Rajasthan. Following my return to the US, I will share what I have learned with Olin College faculty and student leaders. I also hope to share my experiences with pedagogically innovative groups such as the Harvard Change Leadership Group and publish a narrative within the IEEE *Spectrum* magazine or the *Journal of Science and Technology Education*. I intend to further my education through graduate school in mechanical engineering. I hope to integrate my Fulbright experience in India and advanced degree work to start my own science education non-profit. Working with Agastya and IIT-Rajasthan will be an essential first-step toward achieving my lifelong goal of improving accessibility, quality, and relevance at all levels of technical education.

PERSONAL STATEMENT

Heena Mutha, India, Education

I was supposed to be a boy. Horoscopes had forecasted I would be a cute Indian male named Saagar, but I like to defy the odds. I came into this world a little girl named Heena. My formative years were spent sporting a stylish bowl cut, dressed in loose T-shirts and jeans, riding around on my black bicycle. There were only boys in my neighborhood, so my sisters and I passed the time playing hockey, baseball, and basketball in the streets with them. My parents encouraged me to learn technical skills. My father bought circuits kits for me and my sisters, and my mother taught me long division before I went to kindergarten. When I was four and a half, I decided that I could still do the things I liked while dressing like a girl. First, I told my father I wanted to grow out my hair. Then, I swapped out my clothing with my older sister's hand-me-down dresses and traded my black roadster bicycle for a pink and periwinkle one, but I still continued to play with the boys in the streets and study math and science.

As I grew older, my neighborhood schools ran out of subjects in math and science for me to take. At age 14, I did what would have been unfathomable for my mother's generation: I packed my bags and left home for the Illinois Mathematics and Science Academy (IMSA), a school that would support my growth in technical fields. Here I discovered the power of innovative and creative classrooms. Rather than listen to lectures from my teachers, I was handed a lab notebook and papers published in the *Journal of Biochemistry* and instructed to design and execute my own research project. In math class, through discussions on Euler's theories with my peers, I developed material for inclusion in my self-written textbook. I realized that I was single-handedly creating my own solutions and understanding. To share my newfound passion in science and math, I began writing curricula and hosting summer science camps for IMSA's educational outreach program, Kids Institute. I taught fifth graders how to extract their DNA from cheek cells, design cars driven by balloons, and study fish under a microscope.

During my college search, I learned quickly that there were few institutions pedagogically not reliant upon lecture and contrived problem sets. Then I stumbled upon Olin College, a four-year old school that taught engineering focused on designing for the needs of society. Olin is devoted to an interdisciplinary, project-based education that works to develop new and effective teaching and learning methods. I chose Olin because I belong at a new school that seeks to reform and reinvent engineering education. At Olin, I developed a liquid crystal display (LCD) to study materials science, designed a toy that can climb walls, and analyzed power plants via simulation. To share my enthusiasm with young students, I founded Engineering Discovery, a group that develops hands-on curricula to teach science and engineering to local preteen children.

During the holidays, I eagerly travel back home to my family. My parents tell me how proud they are of my academic accomplishments, yet I often overhear my mother (the very person who trained me in long division at an early age) praising my mundane *rotis* (flatbreads) to my extended family rather than acknowledging the laudable LCD I have brought home to show off. It is puzzling, and, at times, frustrating, to be caught among these mixed expectations. I realize that I am not alone in experiencing this confusion and I cannot pretend to know how to resolve them. But, for me, opening educational opportunities for others may provide one step toward settling the conflict.