



MRS fuels a Pan-India materials science education program led by early career scientists

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In 2016, a group of graduate students and research professionals based around the globe had an idea for a project to assess the needs of students in various rural and urban settings in India and to introduce them to the world of scientific research. They named the outreach initiative Vision India: GenY Applied Science Network (VIGYANshaala), which translates to “a school of science.” What they accomplished in less than two months is amazing.

Team VIGYANshaala traveled close to 10,000 miles, reaching out to more than 100 schools, involving more than 250 teachers and volunteers each, and teaching more than 5000 students (between 13

and 18 years of age, mostly high school students) about science, technology, engineering, and math (STEM) disciplines. Members of the team include Aditya Sadhanala (University of Cambridge, UK), Darshana Joshi (University of Cambridge, UK), Shruti Sharma (Stony Brook University, The State University of New York, USA), and Vijay Venugopalan (Politecnico di Milano, Italy). They received a grassroots grant from the Materials Research Society (MRS) Foundation that aided with the mission to create a multi-tier peer networking platform for research professionals, scientists, academicians, and postgraduate students

who will inspire and actively mentor the next generation (GenY) of learners.

Although India has a high average scientific literacy due to compulsory science courses up until high school and plenty of engineering colleges, the overall retention in STEM careers is low in quantity and quality. VIGYANshaala has a twofold aim to address these issues:

1. To expose youth to the fun in science and its impact on daily lives by bringing together “hands-on” sessions with mentors and educators from a wide variety of STEM fields with a focus on materials science.
2. To create a mentor network of students, working professionals, and academicians committed to the cause of inspiring GenY learners in STEM fields.

This effort includes several interesting hands-on experimental activities, presentations, and one-on-one interactions through the combination of interactive demonstrations for exhibiting the latest scientific research, such as flexible electronics, and providing opportunities to perform scientific experiments, such as DNA extraction and advanced optics tests. All backgrounds of students were included—those from different cultures and regions of India, including several of the remotest areas, such as the India-Nepal border areas, the Himalayan state of Uttarakhand, and remote parts of the southern state of Tamil Nadu.

The workshops catered to different aspects of STEM fields, with a focus on materials science, and each employing varied approaches to excite young students. One of the highlights of the workshop was extraction of DNA from a banana using a simple procedure involving common household ingredients. The session, led by Sadhanala, gave insights into the latest developments in printed electronics and demonstrations of energy-based devices, such as flexible solar cells and solar-cell-powered toys. Joshi gave an



Top: Students extracting DNA from bananas and tomatoes. Bottom: One of the parallel sessions, with multiple sessions in the background.

introduction to the world of polymers and gels, from plastics to proteins, captivating the students with demonstrations of different types of Silly Putty, making slime, superabsorbent polymers (fake snow, which has the capability of absorbing water ~500 times its size), super hydrophobic coatings, cooking an egg without a stove, and demonstrating protein folding and denaturation. Sharma gave an introduction to graphene and led the sessions on DNA extraction. Venugopalan conducted a hands-on optics session, where students were engaged in advanced optics experiments where they were able to observe and experience the concepts of total internal reflection, interference and diffraction of light, and the spectrum of different light sources, which they otherwise study only theoretically in books.

The success of this effort has encouraged the planning of additional activities. The team is enlisting the help of various Indian institutions that have offered to partner with the team for future endeavors. These include Vigyan Prasar (an organization under the Department of Science and Technology in the Government of India), The Institute of Mathematical Sciences (IMSc), the Indian Institutes of Technology, Chennai, and the Tamil-Nadu Science Forum.

Team VIGYANshaala is committed to inspiring and training fellow postgraduate and PhD counterparts in India for communicating science research. This, in turn, will help them hone their transferrable skills while sharing their passion for science with younger generations. Shivani Semwal, Joshi's mentee for the last five years, is one of their success stories. She conducted a session on "Fun Science," demonstrating the basic concepts of physics and chemistry with day-to-day products, such as milk, soap, and candles. She will be starting her PhD program at Memorial University, Canada, in September.

The team received support from various host institutes, senior professors, early career scientists, teachers, and doctoral and master's students, who also volunteered and interacted with the students and assisted in conducting the sessions. Himadri Barman, a postdoctoral fellow at the IMSc, Chennai, conducted a

session on green energies and energy storage (batteries) at workshops in four locations. Varnuni Prabhakar, outreach officer at IMSc, facilitated all of the workshops in Southern India.

The members of VIGYANshaala who have been conducting these workshops all across the country acknowledge the support of their volunteers, host organizations, and the MRS grassroots grant for facilitating and making these workshops a success. Reaching out to students requires active involvement of local schools, and the response has been immensely encouraging for these workshops.

The fact that students stayed beyond their normal school hours, despite that in several cases they had to walk/travel approximately one hour to get to their homes, to enthusiastically participate in the activities is a big indicator of the success of the program, which motivates the team to push the boundaries further.

In order to make this program sustainable, all interested early career scientists and graduate students keep in constant touch with VIGYANshaala for future workshops. VIGYANshaala is now working on making an online database of the network of scientists who are willing to join this movement. At the same time, they plan to establish "Innovation Labs" across the country that will serve as repositories for these



Shivani Semwal conducting a chemistry session.

workshops' supplies and modules, with one being actively developed in Delhi. The goal is to work with the education community to communicate scientific research that encourages dialogue and mentoring, while seeking answers to some of the most wonderful puzzles of nature. Anyone interested in more information is encouraged to contact the team at VIGYANshaala@gmail.com.

The Materials Research Society Foundation supports grassroots grants to allow initiatives that broaden the impact within and outside of the materials community.

