

[Menu](#)[PURDUE](#) / [ENGINEERING](#) / [GEP](#) / [NEWS](#) / [2023](#)

## Nine engineering students explore water scarcity challenges in rural India during Engineering's first Winter Flex study abroad course

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The well opening was rusted shut and clogged with debris. A group of researchers— nine Purdue undergraduate engineering students and Venkatesh Merwade, professor of civil engineering at Purdue University and Allen Bradley, professor of civil and environmental engineering at the University of Iowa— looked around the rural landscape for a tool to clear the well. They had only the equipment in their backpacks, including water test kits and a few specialized water quality sensors. Unfortunately, a crowbar wasn't included. If they couldn't clear the well, they'd be unable to sample the water quality and report back to the [Sehgal Foundation](#), a rural development NGO based in Haryana, India, that manages thousands of water management and community-led development projects across rural northern India. If Bradley hadn't been part of the group that designed the well some years ago, this vital water source might have gone entirely unnoticed alongside the dirt road.



The group is the first cohort to participate in Engineering's first inaugural Winter Flex study abroad program, a project-based learning opportunity for students between the fall and spring semesters. Students arrived in India only days before. Still, they quickly became masters of their equipment, prepared to measure chemicals like nitrate and total dissolved solids (TDS), indicating levels of organic matter in the water. Information like this is critical to communities in rural India struggling with the overuse of already scarce water resources, poor water quality, and the impacts of climate

change.

To the rural communities in India, the students' water samples aren't just data. That knowledge is vital to life. Water is inherently connected to every aspect of life in rural India, like agriculture, school enrollment, hygiene, and health— just one of the many perspectives the students gained during their transformational week-long Winter Flex study abroad program in northern India.

### Winter Flex term provides new study abroad and academic opportunities for students

Last spring, the University Senate [approved](#) the inaugural three-week "Winter Flex" session for the 2022-2023 academic year. The new term is voluntary for undergraduate and graduate students and provides study abroad and other academic opportunities which might not otherwise work into students' regular semester coursework. The opportunity is beneficial for engineering undergraduates who may have a demanding curriculum. "Short-term study abroad project-based courses are something that really anybody can fit into their schedule," Merwade said.

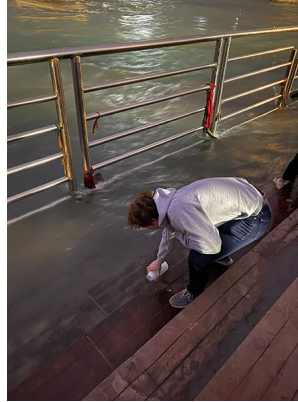
Marian Muste, 2022 Curtis professor in civil engineering at Purdue and adjunct professor in mechanical engineering and geographical and sustainability sciences at the University of Iowa, has led international study abroad programs at the University of Iowa since 2001. When he was awarded the Edward. M. Curtis visiting professorship, Muste said it was an ideal opportunity to bring a similar program to Purdue students during the

Winter Flex session. In collaboration with Merwade, the pair designed a study abroad water conservation course, "International Perspectives in Water Sciences and Management," during which students participate in the Sehgal Foundation's water conservation projects and learn how culture, economics, and environment impact access to water resources in rural northern India.

## Global perspectives on water poverty

According to the Sehgal Foundation, India has 18% of the world's total population but only 4% of the world's water resources. In the more than 1,000 rural villages of northern India where the foundation works, access to water underlies every aspect of their lives. "If you're in a rural area, and you don't have access to clean, safe water, that's a paramount problem," said Bradley.

During the study abroad course, nine engineering students experienced the challenges of water access in quality first-hand— that's where they found themselves as they pulled and yanked at the rusted opening of a well alongside a rural Indian road. It was a lesson in creativity and ingenuity required for engineers in the field, said Muste. Though he couldn't attend the trip this year, Muste explained that resourcefulness is always part of the experience of engineering abroad. "It's not like you have a van with tools, and you just get what you need. It's basically what is in the backpack— that's what we have," he explained. "It requires innovation and creativity to do jobs."



As the group pondered their problem, a motorbike throttled by. As it came closer to the group, it stopped. A group of Americans standing alongside a rural Indian road was a curiosity for locals; the group was used to drawing attention. Upon noticing the group's well debacle, the riders promptly rode away. A few minutes later, they returned with a tool to help pry the well open. "I forget what they got for us," Bradley said. But he remembers they were eager to help clear blockages in the well. "We're providing information that the community is eager to learn about," Bradley said.

The students' study abroad course began with an introduction to the Sehgal Foundation's work in the region. They were trained on the equipment needed to sample water and air quality at project sites. Each student was tasked with a specific responsibility and prepped their instruments for their first site visit the next day. Within a few days, Muste said, the students are masters in their roles. "It's a miracle to me even now, after so many visits, that in two to three days, they own their project, and they just move," he said. "It's a sense of ownership."

The rusted well was only one of more than a dozen project sites or water sources the young engineers encountered during their trip. The first project site students visited was Untka Public School, where a recharge injected harvested rainwater into the saline groundwater. This process creates a freshwater pocket for the school and its students. Since the project was installed, student dropout rates have significantly decreased. Similarly, in another public school, enrollment increased from 287 students to 489 after rainwater harvesting and a borewell for drinking water were installed. Traveling abroad and investigating different approaches to water scarcity challenges was illuminating for students. "It's a great opportunity to get a better global perspective on problems we may be familiar with," said one student. "The way we treat an issue in the States could be and is very different to how it is addressed in India, and seeing some of the reasons and effects of those differences was really impactful."

At other project sites like Alwar Check Dam, locals explained that watering with fresh, clean water from the dam improved the taste of their vegetables. The group visited step wells— some more than 800 years old— where locals descend dozens of steps to access stored water. Experience in the social context of engineering solutions is a powerful supplement to classroom work, said Merwade. Purdue offers courses on water treatment, and students are technically trained to understand which equations and software to use to solve water scarcity issues. However, he explained that they might not have enough information on how things look on the ground or what happens in communities if that water doesn't get treated. "What impact does [clean water] have on a community? How will their life change if they have access to clean water? They don't get to experience that in a 16-week course," Merwade said. "However, a one-week [study abroad] program can change their whole perspective of what they have learned, how useful it is, and how they can use what they have learned to solve a problem or help a community."

The group also traveled to other important water conservation and engineering sites, including the 180-year-old Ganga Canal System and the sprawling Ganges River. They took a train from Delhi to Roorkee to visit the National Institute of Hydrology (NIH) Roorkee to learn about its aquifer and groundwater projects. The sites

are stunning feats of engineering and nature, and Anna Perez, A student from Purdue's Polytechnic Institute, said the experience developed skills she knows are essential for her future engineering career. "It's an amazing way to develop your out-of-the-box thinking skills and multicultural communications as an engineer," she said.

## An unforgettable experience for engineering undergraduate students

Professors were mindful of weaving in visits to architectural wonders like the Taj Mahal, Agra Fort, and Bahai Temple, and natural and cultural wonders like Lodhi Garden and Bapu Market into the trip. Perez said the cultural excursions were an irreplaceable experience. "While at face value, it can seem daunting to go to a place like India, I am thoroughly glad that I went because of the small group size, the ability to be involved in many communities, and the exposure to so many different cultural experiences and locations," she said.



Students enjoyed meals of butter chicken and naan, sipped chai or masala tea at tea time, and even won a group dance award for "Best Dancer" during an international New Year's event at a hotel in Agra. "We won the award for our enthusiasm and dancing to songs that apparently had sad lyrics in Hindi, but none of us knew the words," Griffin Laihinen, Environmental and Ecological Engineering remembers.

Though students were overwhelmingly pleased with their experience, it wasn't without its challenges, Merwade said. Seeing locals live with dirty water and waste in the environment was visually unpleasant for some. "I was telling the students that many of the things we recycle in the US end up here. Many things are connected globally. I think it is important for them to see this global context," Merwade said. It was also the first time many students experienced being a minority in another culture. "I had the best time learning about Indian culture and learning an appreciation for all the things I took for granted in America," said one student. It also gave me the chance to experience what it is like to be a minority."

To help students process the complex experience, Merwade hosted reflection periods at the end of the day. "I thought that was really valuable," said Bradley. "Students showing how they were feeling and reacting, I think that was probably meaningful to them so that they could sort of mark how this experience was affecting them."

This first group of Winter Flex participants will always share the memories of this meaningful experience. "India is a beautiful and completely different country from the U.S., so it really pushed me as a traveler in all the best ways," said another engineering student. "Thank you for doing it at Purdue; it is an experience I will never forget." Muste, Bradley, and Merwade hope to offer the study abroad course again and with the University of Iowa students.

View the group's [story map](#) here to learn more about the sites and activities the group experienced during the trip.

Updates on Winter Flex study abroad and course offerings will be available on Purdue's [Global Engineering Programs and Partnerships website](#). Professors interested in leading a study abroad program are encouraged to contact Jill Churchill at [churchil@purdue.edu](mailto:churchil@purdue.edu).

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