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PHOTOGRAPHS IN MEXICO BY

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Through a new nonprofit aimed at enhancing science education in Mexico, Harvard PhD students are going home to become teachers and role models, showing younger students the path to a life in science

When GSAS students from Mexico get together, says Rogelio Hernandez-Lopez, a PhD candidate in chemical physics, the conversation always seems to come around to the same topic. **"We always end up talking about what we can do for Mexico."**

One such conversation happened this July, at the apartment of Adrian Jinich, a systems biology PhD student. When he was a master's candidate at the Center for Mathematical Research in Guanajuato, Jinich had organized informal science outreach programs for local high school students, leading Saturday workshops and inviting professors to give presentations. "I always had really great science teachers," Jinich says, "so I wanted to help give some of that back." The informal talks were soon formalized as the Clubes de Ciencia Mexico, a nonprofit organization that sponsored talks and workshops across the country. Reflecting on the success of this venture, Jinich asked himself whether it might be continued and expanded by tapping into the community of PhD students at Harvard.

Those he approached responded immediately to the idea. Every Mexican PhD candidate at Harvard receives funding from the Fundación México en Harvard, with the understanding that after graduation they will return to contribute to the social, economic, or scientific development of Mexico. "But we didn't want to wait until then," Jinich says of his colleagues. In the Mexico they had grown up in, they agreed, science was not a visible career option. The public education system rarely provides the resources necessary for laboratory work, and teachers often have little science education themselves. There are world-class research institutes, but their agendas are mostly determined by the immediate needs of industry, agriculture, and health.



"Science just doesn't have a place in the culture of Mexico," says Eduardo Martinez, a research fellow in cardiology at Harvard Medical School. "I never met a scientist until I went to college. In the US, you see advertisements for scientific projects on the train and in hospitals. In Mexico, science is something performed by smart people in some faraway place."

Through his Clubes de Ciencia, Jinich had seen firsthand the influence that personal exposure to working scientists could have on promising students. He remembered a student named Manuel Razo, who had stood out from his classmates for his passion and skill. Inspired by his time with the Clubes, Manuel sent an e-mail to Rob Phillips, a professor of biophysics at

In a Clubes de Ciencia project dedicated to plant biology and urban agriculture, PhD student Adrian Jinich helped students design a hydroponic vegetable garden on a rooftop.

the California Institute of Technology. The e-mail led to a Skype conversation, which led to an invitation for Manuel to work with Phillips in the wet lab over winter break and a summer research stint at Cal Tech. Manuel eventually became first author on a paper about the metabolism of lactose in *e. coli*. And after returning to Mexico, Manuel organized a science club of his own.

Wanting to produce more stories like this, Jinich and his team drafted a plan for a pilot program that would bring graduate students and postdocs from American universities to Guanajuato, Mexico, to lead workshops of their own design, drawn from their own graduate work. For five hours a day for a week, students in these work-



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shops would pursue the kind of in-depth research otherwise unavailable to most Mexicans. The project won funding from the Fundación México en Harvard and the David Rockefeller Center for Latin American Studies, as well as a private donation from Juan Enriquez Cabot.

This January, Jinich and six other graduate students and postdocs at Harvard, as well as six more from other American universities, traveled to Mexico for the debut of what they hope will become a recurring program of science education and an enduring exchange between Harvard and Mexico. Sixty percent of participants were college students, and forty percent were in high school. Most students were local, but some traveled to Guanajuato by bus, staying in hotels or with friends for the duration of their workshop.

Topics explored this pilot year ranged widely. One centered on "how a worm thinks"; another was devoted to the analysis of millions of molecules, with the aim of perfecting materials for solar cells. Martinez led his students through the imaging of rodent neurons.

Jose Reyes, a PhD student in systems biology, led a workshop on the microscopy of mammalian cells. Based on recent work completed with Harvard postdoc Ran Kafri and

At top, the Clubes de Ciencia team at Harvard. Below, investigating how cells work by analyzing rodent neurons, led by instructor Eduardo Martinez.



PhD student Miriam Ginzberg, the workshop addressed the question of how cells measure their own size and determine their future growth rate, a difficult problem still the subject of much current research. While the topic might have intimidated graduate students, Reyes found that his undergraduates and high schoolers were unfazed by the challenge.

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"It helped me remember when I was an undergraduate and thought a lot of myself," he says. "As a grad student, you get so immersed in your specialty. Teaching this workshop helped me get back to when I was always addressing broader topics." His students were astonished, he remembers, to learn that the project they were replicating in a week had originally taken academics six years to complete.

Jinich led his students in a hands-on exploration of plant biology and the future of agriculture, highlighted by the construction of a rooftop garden. "We built the garden on top of the house of a student who wanted to teach urban gardening techniques to his aunt and uncle, farmers now too old to work in the field," he said.

While they worked planting corn, onions, radishes, and lettuce, the

students learned about the water crisis and the depletion of the water table by industrial agriculture, a topic especially germane in the farming state of Guanajuato. In fact, a video Jinich showed his students from the Harvard Center for the Environment called out their home by name, noting that the water table in Guanajuato has been falling by an average of two meters a year. “I didn’t know beforehand it would mention Guanajuato,” Jinich says, “but they were amazed to hear it in this talk from Harvard.” After the workshop, his students committed to building a garden on the roof of each of their homes.

Jinich recruited Ian Dunn, a senior in the College who works in his lab, as the only American to lead a workshop this year. A newcomer to Mexico, Dunn was amazed by the beauty of Guanajuato, a city of narrow alleys snaking up hills and brightly-painted houses hundreds of years old. He also enjoyed discovering the local food, especially



a Mennonite cheese famous in the area. Designing a class on the physics of waves, Dunn originally planned to focus on group work and mathematical derivation. “Pretty soon I realized, though, that it would be better to show students examples, things they could measure themselves.” Using only simple household materials, Dunn designed a series of experiments allowing the students to measure the speed of sound and the wavelength of

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light, and to illustrate the behaviors constant across them both. Another turned purple cabbage juice green, to demonstrate principles of quantum chemistry.

Israel Pichardo-Casas, a PhD candidate in cell biology, led a workshop using polymerase chain reactions to identify the genetic heritages of his students. For him, the project was especially rewarding because it was conducted in an area so far from Mexico City, where opportunities for scientific learning are even scarcer than is common in the country. One of his students, a high-schooler named Laura, told him that she would never have been exposed to a subject like PCR reactions at her own school, and that she is now deciding between careers in biology and engineering.

The goal of Clubes de Ciencia is “to engage more students to decide on science as a long-term career,” says Hernandez-Lopez. “People usually think that science is really difficult, and only a career for geniuses — but that’s because there are still inefficiencies in the way we teach science. If we can introduce students to people working in science, we hope they’ll say



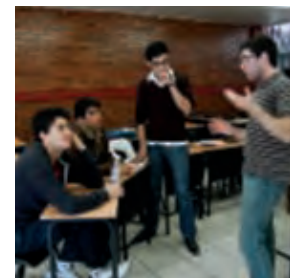
“I want to be where he or she is.”

“You find the best and the worst in Mexico,” adds Jinich. “You have institutes with world-class researchers. But you also have the worst reading and math scores among OECD [Organization for Economic Cooperation and Development] countries.” The burden often falls, Jinich and his colleagues say, on a small list of extracurricular organizations like the Science Olympiads. With Clubes de Ciencia, they hope to add a powerful member to that list.

“The dream is to recruit more tutors from more schools, and expand to other cities in Mexico,” Jinich says, and Hernandez-Lopez agrees: “We want to take advantage of all our friends here in graduate school who are doing interesting research.” Since returning from Guanajuato, they have been discussing the scalability of the project, thinking about expanding it even beyond Mexico. “Any good student can go to another country and improve science literacy there,” says Jinich, pointing to Dunn’s success. They are submitting Clubes de Ciencia to innovation challenges like one recently run by the Graduate School of Education, in which they won third prize.

“Everyone’s excited about MOOCs [massive open online courses],” says Jinich, “and Clubes de Ciencia is like a MOOC with a human interaction component, promoting community.” As they discuss their plans for the future, Jinich and Hernandez-Lopez are looking into using edX’s open source software to add an online component to their project.

“We know we’re privileged to be where we are,” says Hernandez-Lopez, “so we try to figure out ways to share that privilege.” ☞



Top, Ian Dunn leads a course on the physics of waves; left, a student in Ian’s club demonstrating physical waves; bottom, sampling drinking water for a test using polymerase chain reactions to study genes.

Clubes de Ciencia Mexico is currently led by Adrian Jinich, Rogelio Hernandez-Lopez, Roberto Olivares-Amaya (Harvard PhD ’12), Alejandro Quiroz-Zarate (Harvard PhD ’13) and Benjamin Sanchez-Lengeling. Contact ajinich@fas.harvard.edu to get involved.