

thought carefully about what we could offer families who were stuck at home and wanting to support their children to learn.”

To bridge the digital divide, they e-mailed activity sheets to teachers to print out and send to children’s homes. Participants then watched videos of experiments and games using cardboard or other recycled objects, including a watering can made from a milk container.

Carrying on in a digital format was also a challenge for the schools-engagement programme of the Kenya Medical Research Institute Wellcome Trust Research Programme (KWTRP), based in Kilifi. Pre-pandemic, the scheme typically engaged with about 4,000 students annually from 50 schools in the East African nation, and organized lab tours, science-career talks and an annual inter-school science quiz. There were also work-experience opportunities for final-year high-school students to gain technical or practical skills at the headquarters of the Kenya Medical Research Institute in Nairobi.

But all of this stopped in 2020. “Since many don’t have access to the Internet [at home], and can only access it through school laptops, online engagement was also not possible while schools were closed,” says Alun Davies, the KWTRP’s schools-engagement lead.

Kenyan schools reopened in January, and the KWTRP piloted online career sessions across ten schools in Kilifi. Davies says that groups of students have been gathering around computers to participate in the sessions, allowing them to engage with researchers in real time, and to view videos about careers related to health research.

To help plug the outreach gap, he says, one colleague developed materials to encourage participating primary schools to establish science clubs. Another colleague helped to produce animations and videos for pupils about COVID-19 vaccine research and contributing to biobanks.

Uneven digital access guided decisions by Fun Lab, a physics programme of the American University in Cairo, around its online outreach offerings. Families without Internet access receive material on CDs, says Mohamed Soliman, science communication officer at the university’s physics department, and a TV channel run by Egypt’s education ministry broadcasts Fun Lab’s science shows, featuring a live audience of 40–50 socially distanced students.

The Francis Crick Institute, a biomedical research centre in London, modified its Primary Science Challenge, run in partnership with UK biomedical funding charity Wellcome and Regent High School, also in London. Primary-school pupils from that part of the city would ordinarily have worked with their teachers in a competition that culminated in giving science presentations at Regent’s theatre. Last

year, pupils took part in ‘Science at Home’ challenges instead. Participants could, for example, enter a competition to design a poster with a public-health message, or complete a science-related challenge set by a teacher, with the Crick awarding prizes to the best entries from each school. “Because of the COVID situation, the theatre event wasn’t possible,” says Clare Davy, education manager at the Crick. “We felt it was important to have a competition that anyone could take part in, so long as they could get a piece of paper. Many children in our schools can’t access the Internet and don’t have a lot of sciencey materials at home.”

For students aged 16–17, the Crick turned to Google Classroom to adapt its work-experience

opportunities, partnering with Centre of the Cell, a science-education centre based at Queen Mary University of London. Some students worked with the Crick’s communications team to produce a video featuring interviews with Crick scientists about the pandemic. The adapted sessions also covered CV writing and interview techniques.

It is crucial, Davy says, to pique pupils’ and students’ interest in the scientific enterprise by engaging them in practical science. “That is such a motivator for science careers. If we can help to fill that gap, it would be great,” she says.

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OUTREACH CAN INSPIRE SCIENCE

Education outreach is rewarding and can inspire the next generation of scientists. **By David Hillier**

It’s April 2020, and I’m on a Zoom call, grinding cabbage leaves and exploring the concept of pH with more than 50 kids from across the United States. It’s a bright spot during a difficult time at the start of the pandemic, and the activity fills me with much-needed joy.

It feels very far from the lab work that I’d focused on for the past 20 years, since graduating with a degree in chemistry from the California Institute of Technology in Pasadena. I’m now a research scientist at Yale School of Medicine in New Haven, Connecticut.

Many scientists find education outreach to be inspiring and rewarding, but it can be hard to find the time and resources to do it alongside research. How can we have good experiences, make a positive impact and still maintain our research?

I went from being too shy to speak in front of a group of students in 2005 to designing and leading an online outreach programme in 2020. I found that the joy of exploring maths and science with kids has rivalled my best days in the laboratory. The work’s impact has been obvious – smiling, curious kids and happy parents – and I enjoyed the intellectual challenge of creating activities for children.

Here’s some advice for others who are interested in doing public-outreach work alongside their science.

Take advantage of opportunities

During my PhD programme, I focused on my own research and rarely considered public

communication – but, after settling into my postdoctoral studies, I became more interested in sharing my love of science and nature with others. My first forays into outreach were built by someone else: I started mentoring students for the New Haven Science Fair, a two-day festival that aimed to help young people start hands-on experiments, in 2016, and I participated in one-day events such as the Julia Robinson Mathematics Festival, which aims to achieve something similar in mathematics.

Even though the impact of these activities varied widely, seeing students light up when a scientist joined their classroom had me hooked. I remember walking into my five-year-old son’s last day of preschool, where I’d volunteered to give science demonstrations, and seeing the children’s favourite things from the year posted on the wall. When I saw that one child’s favourite thing was “building rockets with Dr. Dave”, my heart soared.

Many universities have a list of available outreach opportunities through an education department or communications office, or directly in science departments. Science organizations such as the royal academies and the American Association for the Advancement of Science keep databases of programmes, including an increasing number of ‘science cafes’ (where scientists engage with the public in casual settings), and local governments often facilitate science fairs and reading programmes.

These programmes can usually take new volunteers, and you will often be able to start



David Hiller ground cabbage leaves to explore pH with schoolchildren.

with small time commitments. This is a good way to try something new: I am a biochemist, but I loved helping students explore a logic puzzle about a pirate captain and crew (complete with pirate hats) at the Julia Robinson Mathematics Festival. At the same time, if a programme doesn't inspire you, or you don't think you're having an impact, it's okay to move on to something else.

Build events in existing frameworks

After my lab moved to Yale's west campus in 2015, I created an outreach project with two graduate students to provide good opportunities for other graduate students and postdocs.

We started an annual one-day festival to showcase the breadth of science that occurs on the west campus, to show students that science can happen in gardens and art galleries – not just in biochemistry labs – so they could connect it to a field they already loved. And by tailoring our programme to our volunteers and resources, we hoped to maximize the value of our work to students and families in the surrounding school districts.

Early in our planning, we were directed to Yale Pathways to Science, an umbrella organization that facilitates hundreds of outreach activities across campus. We took advantage of the logistical support provided by Pathways, such as help with advertising, registration, food and transportation, as well as their feedback on what content would benefit local students.

This allowed the scientists who we recruited from campus, including biologists, chemists, art preservers and ecologists, to focus on what they did best and enjoyed most – creating engaging scientific experiences.

This was a valuable lesson: like science itself,

the most success in science engagement often comes from building on the progress made by others. Even if no organization exists where you are, collaboration with other groups (especially if you've participated in their programmes before) can keep you from having to reinvent every logistical piece. Also, just like your research, keeping good records of what you did and whether it worked (and storing them in the cloud, so they can be easily shared) will help you to sustain and improve what you create.

Strike out on your own

In 2016, a neighbour asked me whether I was interested in setting up an informal maths programme for our kids and their friends. I was excited to try it, and we started an after-school programme at our local primary school, for children aged five to eight.

We received logistical support from the school, such as classroom space and a way to market the class to students and parents, but we were wholly responsible for designing the programme.

We researched similar maths programmes – including math circles, which are groups that focus on collaborative problem-solving – and built on what we had seen work in other contexts. We decided to create an environment, similar to that of a youth sports team, in which kids could work together to solve problems in different maths fields. We began by exploring logic, graph theory and topology with a group of curious students. In the process, I learnt as much maths as the students did.

The demand for this type of experience was high, and our first programme was oversubscribed. We quickly grew to multiple groups and, eventually, several schools. As the programme grew, we continually solicited feedback from parents about what worked and

what didn't.

My colleagues involved in the programme and I enjoyed creating something that was equally rewarding for us and for students. Although it wasn't a perfectly smooth progression in building my own programme (I was turned down for one grant to expand the programme into lower-income schools), the overall success prompted me to devote more time to developing new activities. Two years after starting, I reduced my research load to give me time to start my own science and maths education business – which is how I found myself grinding those cabbage leaves on that Zoom call in April 2020.

Finding the time

It's important to recognize that support for outreach varies widely depending on your institution and the culture of your department or lab. Fortunately, both universities and funding agencies are placing increased emphasis on communicating science to the public, such as by including a version of 'broader impacts' in the funding criteria: both the US National Science Foundation and Marie Curie grants, delivered by the European Commission, now specifically mention outreach programmes.

Speaking about science to younger audiences also develops your communication skills, which will help the next time you give a talk, contribute to a grant application or write a paper. It might feel less challenging to describe your science to the professors on your dissertation committee after you've figured out how to explain it to a group of nine year olds.

In my case, the support of my principal investigator and university allowed me to pursue my passion for outreach. As I developed new programmes, I created roles that had different commitments and skills to make sure anyone who was interested could find a good fit. Seeking that fit is key to feeling valued and having success in outreach. No one should feel guilty because they couldn't devote enough time to a project. Be clear and direct with yourself and anyone you're working with about the amount of time you're able to devote to outreach.

Outreach can be a meaningful component of your scientific career. Whether you are creating a programme from scratch or volunteering for something with a long history, participation should benefit both you and the public. That has been especially true for me, as the connections I've made have helped me through this past year.

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