

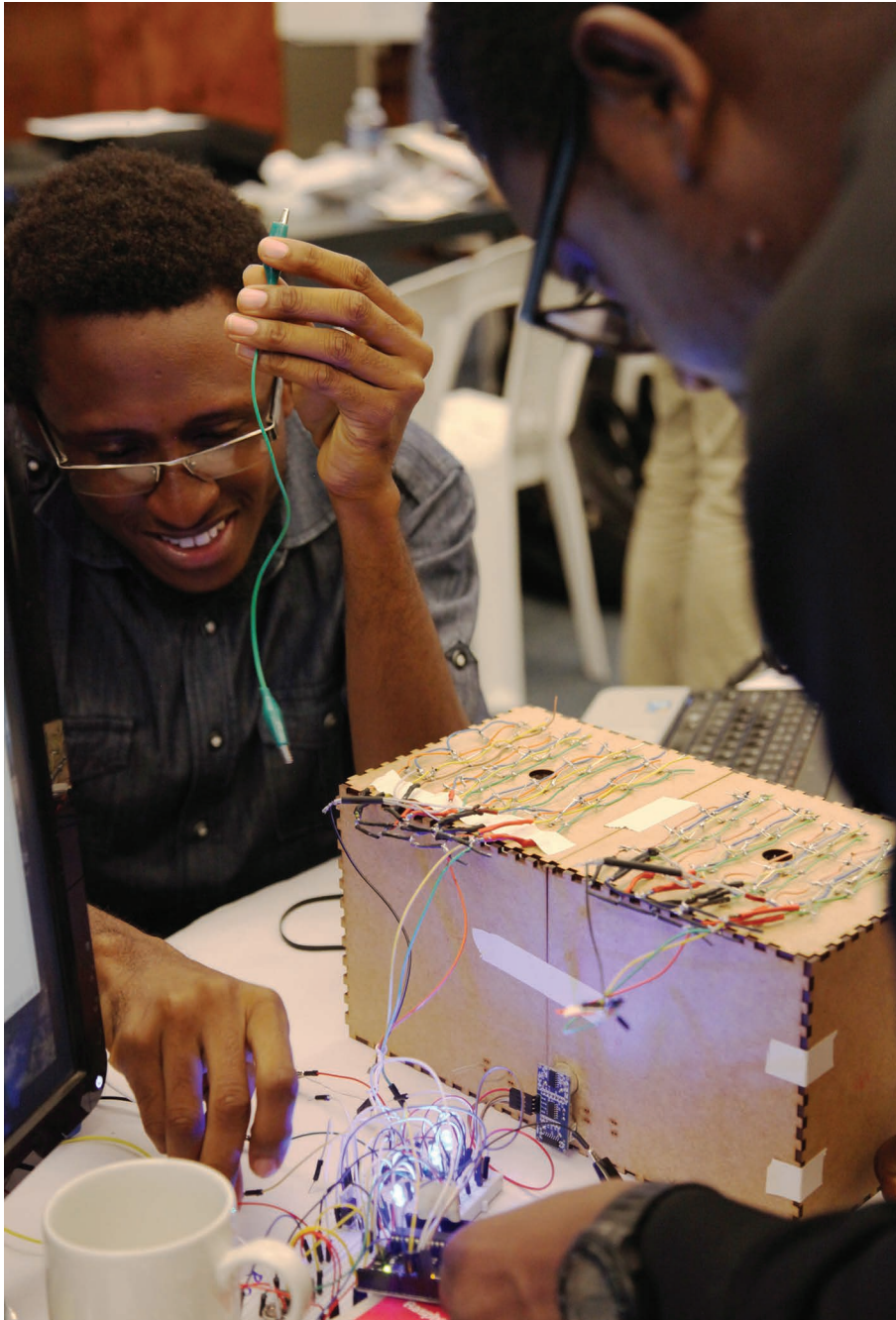
CAREERS

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Oluwaseun Faborode (right) and another scientist enjoy a workshop on how to make low-cost lab gear.

FRUGALITY

Labs on the cheap

How to create a champagne setup on a beer budget.

BY ELIE DOLGIN

Microbiologist Rebecca Shapiro faced a daunting task after starting a tenure-track job at the University of Guelph in Canada: building a laboratory from scratch, on a tight budget.

She inherited some equipment from retiring faculty members but much of it was broken — dangerously so in a few cases. In one instance, she almost burnt herself on a used heating block donated by a colleague, because the whole device became red-hot when she turned it on. “I was like, ‘OK, that’s going in the garbage,’” she recalls.

In June 2018, 6 months into her new job, Shapiro applied to the Canadian and Ontario governments for a Can\$200,000 (US\$152,000) infrastructure grant. The funds would help her to buy most of her equipment, including a Can\$40,000 plate reader, a Can\$40,000 shaking incubator and a Can\$20,000 ultra-low-temperature freezer. But she has also turned to online auction sites such as eBay, BidSpotter and BioSurplus to find deals on functioning heating blocks and other smaller items to get her lab operational.

“My lab thinks I’m weird as I’m constantly on my phone going, ‘Oh no, we’ve been outbid,’” Shapiro says. But the exercise paid off. She estimates that, so far, she’s bought most of her gear — pipettes, vortexes, centrifuges, pH metres, hot plates and more — at a markdown of 60–90% from typical catalogue prices.

Most new principal investigators (PIs) face budget constraints and need to be shrewd about securing lab equipment. They might have start-up packages that, in real terms, are very large sums, but just a few pieces of high-end kit can quickly eat up those funds. Meanwhile, science labs in countries with fewer resources might operate on a shoestring, and new PIs in the developing world often struggle to procure even the most basic supplies.

Fortunately, money-saving deals and inexpensive workarounds abound. Scientists just need to know where to look for them.

It takes extra work to find bargains: some PIs even resort to begging for and borrowing old equipment from other labs, or they work out ways to share things. Yet even the most cash-strapped new lab leaders can usually get their research spaces up and running quickly. They can scour discount online sites, check out businesses such as hardware stores or restaurants that might have similar or identical equipment to sell, and hold off on buying immediately from vendors, who might offer a lower price ▶

► later on if the item has not already been sold. As an added bonus, says Shapiro, fitting out a lab on the cheap can provide a personal sense of accomplishment. “It can actually be really fun,” she says. “I recommend it.”

ECONOMICAL SHARING

One way to save on big-ticket items is to avoid purchasing things that are available already for communal use at core or shared-research laboratories — facilities in which scientists can either book time on state-of-the-art equipment or pay staff to perform technically demanding experiments on their behalf.

At Imperial College London, for example, the department of materials offers a range of top-of-the-line technologies, including electron microscopes and focused-ion-beam instruments — both things that condensed-matter physicist Ben Britton knew he needed for his research into the nature of metals used in the aerospace and energy industries. When Britton was considering whether to take a faculty position in the department, he made sure the job would give him ample time to access these machines affordably.

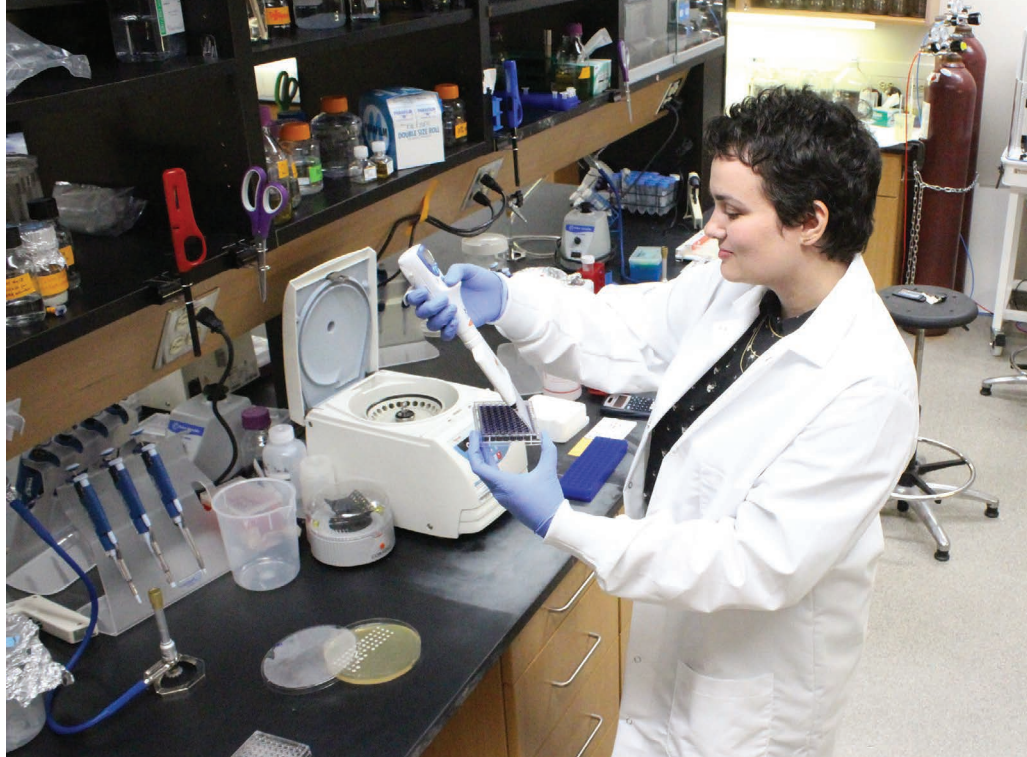
Before accepting the post, he negotiated unlimited free access to the equipment until he secured external funding. Britton estimates that the arrangement saved him an extra £20,000 (US\$26,500) annually in his first few years as an independent leader, a sum he used instead for computing equipment.

Thinking beyond core research facilities, chemist Paul Bracher recommends setting up less-formal arrangements with nearby labs. This can save researchers from having to buy equipment that’s integral for their work, but that doesn’t get used every day. Bracher, who started a lab five years ago at Saint Louis University in Missouri, studies the origin of life. His research involves some chemical synthesis — but not a lot. So he managed to avoid buying a \$5,000 rotary evaporator, a device that removes solvents from samples, by arranging to borrow one when necessary from a colleague.

For Bracher, each dollar saved was another dollar available to buy something else for his lab. To work out what he needed, he created a spreadsheet and sought advice from other junior faculty members who had been in a similar position, and from equipment vendors who had worked with other new PIs.

Among the spreadsheet entries were everyday lab items such as hammers and paraffin film — things that typically include huge markups when bought from lab supplies companies. Instead, Bracher popped down to his local hardware store and shopped online. A \$70 hammer was available at one-tenth of the price. On Amazon, a \$100 roll of paraffin film sells for around \$25.

But it’s not just household goods that are sold by alternative vendors. Sometimes it’s worth thinking across industries. Bracher’s research, for example, often involves setting



Microbiologist Rebecca Shapiro says fitting out your own lab on the cheap “can actually be really fun”.

up reactions in humidity-controlled chambers that are designed to mimic the conditions in primordial times. A good-sized chamber can run into the tens of thousands of dollars — much more than Bracher had budgeted for. Restaurants and catering businesses, however, use practically the same item — known as a ‘holding cabinet’ — for keeping cooked food hot and ready to eat.

Those run for about \$5,000 apiece. Bracher picked up three of them. And although the food-grade cabinets might not be quite as precisely fine-tuned as the lab-grade ones, they’re more than adequate for his research purposes.

Bracher also used crafty negotiating tactics for items he could get only from specialized lab suppliers. For instance, he knew he wanted an expensive type of mass spectrometer for analysing trace metals, but he didn’t need it right away. So he put in a few low offers and waited for vendors to meet his price. Months later, a sales representative called. He was trying to meet a manager’s quota, he explained, because it was the end of a fiscal quarter, and he could now offer the instrument for almost as low a price as Bracher had initially offered. “It often helps to wait,” he says.

But haggling to the point of annoyance can backfire, warns Kevin Ryan, who until he retired in April co-owned and operated W. Nuhsbaum, a microscope dealership headquartered in McHenry, Illinois. Purchasing an expensive microscope or some other costly piece of lab gear might seem a bit like buying a car, he says. But whereas any mechanic can change a car’s oil and rotate its tyres, the sales representative who sells a large lab instrument to a PI will be the researcher’s point of contact for servicing and upgrades for years to come.

“It’s a fine line with discounting,” Ryan says. “You don’t want to be too hard on the salesperson because you want to build a long-lasting relationship.”

Besides, there’s often no need for aggressive negotiation tactics; most suppliers will accommodate reasonable requests to secure the business of a newly hired faculty member, notes Lisa Witte, president of Fisher Scientific, a lab-supply company in Pittsburgh, Pennsylvania. That’s because early-career investigators have decades of purchasing ahead of them, and vendors want to build brand loyalty early on. As Witte points out: “We want to earn that repeat business.”

That’s why Fisher Scientific created its New Lab Start-Up Program, and why other suppliers — including MilliporeSigma in Burlington, Massachusetts, and VWR in Radnor, Pennsylvania — offer something similar. Fisher Scientific’s scheme works like a coupon book for lab supplies, with 100 money-saving offers across a broad range of products for new PIs. “We really try to help the PI stretch those precious research dollars as far as they can,” Witte says. The more a PI spends, the more they can save, she adds, “because if it’s one big bulk order, we’re generally able to give additional discounts”.

MONEY PROBLEMS

Even with heavy discounting, however, some researchers still can’t afford even the most basic labware. Plant biologist Muvuri Tjiurutue completed a PhD at the University of Massachusetts Amherst before taking a job in 2016 at the University of Namibia in Windhoek. There, she had no shakers or stirrers, let alone any of the more sophisticated analytical instruments that she had come to rely on in graduate school. “I haven’t actually been able to do my research because of lack of equipment,” Tjiurutue says. “It is very frustrating.”

Seeding Labs, a non-profit organization in Boston, Massachusetts, came to her rescue. It collects millions of dollars worth of surplus equipment from Western universities,

JEHOASHA SHARMA

companies and government agencies. It then offers this inventory to institutions in low- and middle-income countries that show potential to advance cutting-edge research — if only they had the gear.

Tjiurutue applied to Seeding last July, asking for equipment that she estimates was worth more than 5 million Namibian dollars (US\$365,000). A shipment full of chromatographers and basic lab staples is now due to arrive before the year's end. Tjiurutue's department only had to pay N\$33,500 to defray some of the costs of obtaining, handling and shipping the equipment.

Rupika Delgoda, a chemist at the University of the West Indies in Mona, Jamaica, received her own delivery of lab goods from Seeding Labs in October 2017, but not before struggling for years to launch the university's Natural Products Institute. "We had to build counter-tops and start from scratch," says Delgoda, who heads the institute.

Her strategy was to ask former colleagues for unused equipment. Her ex-lab mates from the universities of Oxford and Leicester, UK, where Delgoda had trained, came through with boxes of free gear. "They were happy to know they found a good home," Delgoda says.

Others also find ways to get by without buying anything. Evolutionary geneticist Santiago Castillo Ramírez returned from a postdoc in the United Kingdom to start a lab at the Center for Genomic Sciences in Cuernavaca, part of the National Autonomous University of Mexico. Because he had a minimal start-up package that barely covered the cost of a couple of computers, he decided to form collaborations.

Initially, he partnered with teams in Germany and the United States, working with genomic data sets they'd previously amassed on sexually transmitted infections and tick-borne pathogens. Then he joined forces with Miguel Cevallos, an experimental microbiologist also working at the Center for Genomic Sciences. Together, they established a research programme studying the rise of new kinds of drug-resistant bacteria in Mexican hospitals.

Cevallos does the lab work and Castillo Ramírez sticks to the genomic analysis. "It was a win-win situation for both of us," Castillo Ramírez says.

MAKE DO

Scientists with access to a 3D printer and a bit of engineering know-how now also have the opportunity to make their own lab equipment — with detailed assembly instructions and open-source software available through online repositories. "It's a very efficient way

of getting things done quickly to a fairly high standard," says Tom Baden, a neuroscientist at the University of Sussex in Brighton, UK.

Baden's lab uses an Ultimaker 2, a compact desktop machine that costs around £1,800 new, but alternatives exist for a few hundred pounds. And although it takes a little longer to build this kind of gear in-house, he notes, the material and electronics that go into 3D-printed labware typically cost a fraction of what commercial platforms would charge.

Last year, for example, Baden detailed the design blueprint for making a pressure ejection system for precisely delivering minute volumes of liquid using off-the-shelf components and 3D-printed parts (C. J. Forman *et al. Sci. Rep.* 7, 2188; 2017). It cost him around £400 in materials, he says; commercial models are at least five times as much. His group has also developed and produced other custom-built gear. "Anything mechanical that doesn't need to be micrometre-precise tends to be 3D-printed in our lab," Baden says.

Through a non-profit organization that he co-founded, called TReND in Africa, Baden now runs workshops in Ethiopia, Uganda, South Africa and elsewhere to train scientists in this kind of do-it-yourself approach to low-cost labware. Oluwaseun Faborode, a neurophysiologist at the University of Ibadan, Nigeria, attended one of those courses and quickly put his newfound skills to use, programming a microcontroller to aid him in studying rodent models of depression. "It's just a basic timing indicator," he says — but it helps to reduce the chance of human error and investigator interference in the experiments. By building his own equipment, Faborode says, "I'm upping my game."

But relying on homemade gear or second-hand lab supplies has its downsides. There's a chance of something being faulty, and there's no money-back guarantee from the manufacturer. On the other hand, "you don't have an unlimited pot of money," notes Bracher, so one must be strategic about where to cut corners and when to pay full price.

Shapiro draws the line at her plate readers, instruments she uses to measure simultaneously the growth of dozens or hundreds of yeast strains to probe drug resistance. "You're running some risk of the equipment not working very well, and it's not under warranty," she says. "I'm not willing to run that risk on some \$40,000 sensitive piece of analytical equipment, but I am willing to run that risk on a basic centrifuge or vortex."

One scale that she bought on Bidspotter came without its charging cord. And the electronic multichannel pipette from eBay needed to be recalibrated. But Shapiro got both items working eventually.

And the added hassle? "It's easily worth it," she says. ■

Elie Dolgin is a freelance writer in Somerville, Massachusetts.

TRAINING

Broaden careers advice

A consortium of European research universities is calling for its members to support junior scientists' efforts to pursue non-academic careers. The League of European Research Universities (LERU), which represents 23 institutions, says in a June publication that universities, supervisors and principal investigators (PIs) overemphasize an academic career path, even though more than 60% of all European research jobs lie outside academia (see go.nature.com/leru). The report cites a "critical need" for training and support programmes to help graduate students and postdoctoral researchers prepare for a wide possibility of career paths. It also points out that some universities have already launched such initiatives. Several, for example, have programmes aimed at helping PhD students and postdocs to launch their own businesses. LERU recommends that PIs and supervisors counter the common perception that any job outside academia counts as a failure. To further help young researchers gain experience and independence, LERU calls on the European Commission and other funding bodies to support research in which postdocs serve as project leaders.

EQUALITY

Call for standards

US universities should make their hiring and pay practices fairer for women from ethnic minorities who are faculty members, administrators or other academic professionals, says an association of human-resources executives working in higher education. In a report published in May (see go.nature.com/cupa_hr), the College and University Professional Association for Human Resources (CUPA-HR) in Knoxville, Tennessee, finds that women from ethnic minorities in faculty and administrative positions earn less than 87% of their white male counterparts' salaries, and that their numbers are disproportionately low in those positions. The association advises institutions to evaluate recruitment and pay practices for all job categories, and to compare their salary data with those of peer institutions to establish fair market rates for employees in minority groups. CUPA-HR also encourages universities to consider suggestions for improving promotion potential for female employees from ethnic minorities. The report is based on surveys carried out in 2016–17 of nearly 560,000 employees at more than 1,100 public and private institutions.