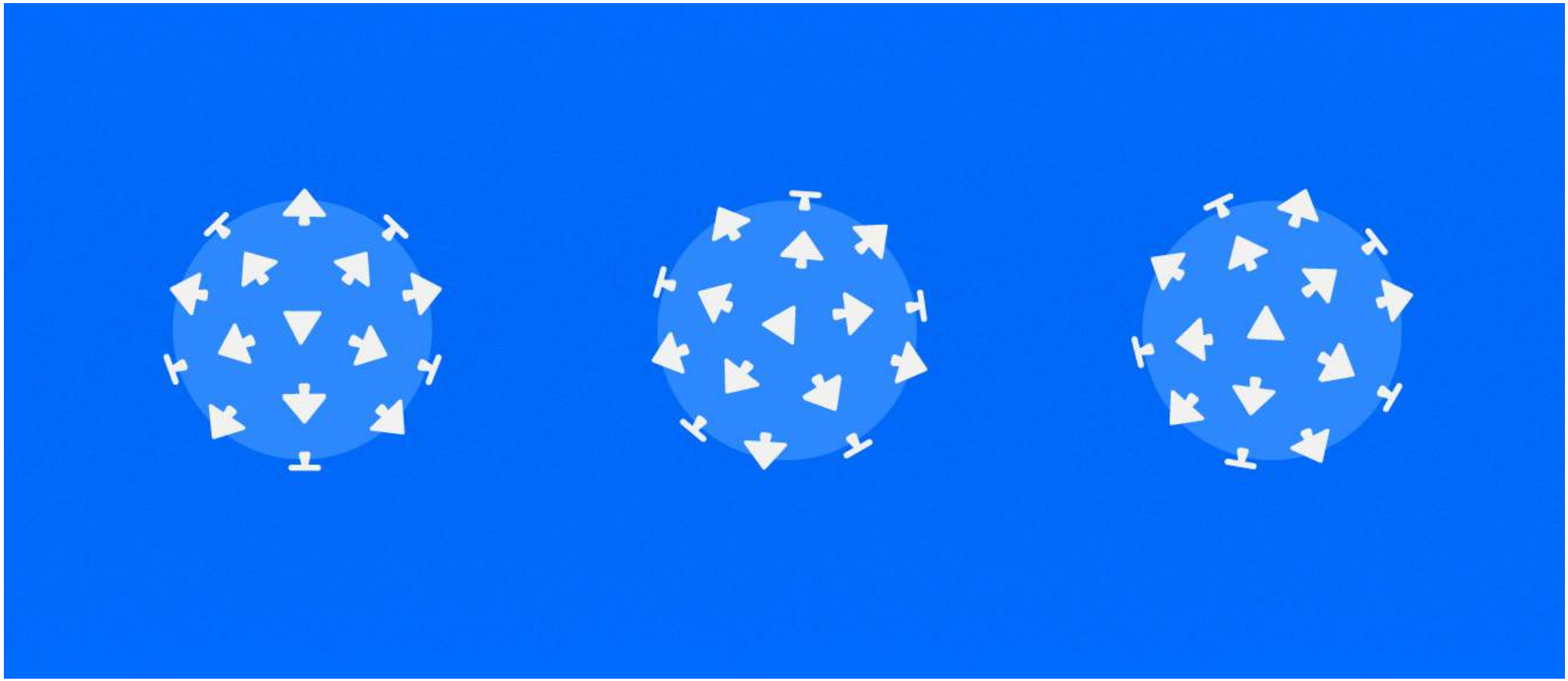
How COVID-19 Changed Life Sciences Forever

opentrons

And How You Can Future-Proof Your Lab With Next-Gen Laboratory Robots

Written by
Opentrons



INTRODUCTION

Table of Contents

CONTENT

CHAPTER 1

Introduction

For months on end in 2020, news reports featured long snaking lines of people waiting hours to get tested for SARS-CoV-2, the new coronavirus that causes COVID-19. Millions of people wanted to know if they had contracted the virus, but tests were hard to come by, leaving many people out of luck. And those who were able to get tested often had to wait days or weeks for their results, making the entire process nearly useless in efforts to stop the spread of disease.

The causes of the testing chaos are complex—high demand, scarce supplies, staffing issues—but one major bottleneck was clear: the laboratories that process clinical tests simply could not meet the demand. Most did not have anywhere near the capacity needed to process a huge influx of test samples.

Indeed, the COVID-19 pandemic exposed a major deficiency of traditional labs: most were unable to quickly pivot from their routine operations to meet the rapidly escalating needs of a global health crisis. Their designs and procedures—equipment, supply chains, workflows, and more—were unable to scale to meet the urgent need for diagnostic testing.

But some innovative labs were able to quickly ramp up to meet the demand. By mid-year, the **Pandemic Response Lab** in Manhattan, many hospital clinics in Europe, and scores of others around the world had overhauled their operations to process thousands of test samples each day, in some cases starting from scratch. How? They embraced the newest generation of laboratory automation—the cornerstone of which are liquid handling robots from Opentrons that are user-friendly, open-source, and perhaps most important, affordable.

ROBOTS FOR THE REST OF US

Robots have been used to automate processes in life sciences laboratories for decades. But they typically are not very user-friendly. Most are complicated machines that use proprietary software. They require steep learning curves and lock users into one vendor. They offer no options for scientific collaboration, so protocols and results are rarely shared, delaying scientific progress. And they are expensive.

Opentrons' pipetting robots, conversely, are a true revolution in the life sciences field. Accessible to smaller clinics and research programs, biotech startups, DIY researchers, and many others, they are helping scientists around the world to quickly take on big issues such as coronavirus testing bottlenecks, as well as collaboratively explore other vital issues such as climate change and global food shortages.

"Life science is going to be the most important technology in the 21st century," says Will Canine, co-founder and CPO at Opentrons. "We're building a company that is making life science tools more accessible to everyone."

Imagine what *your* lab could do with a robot.

CHAPTER 2

User-Centered Design: Tools Built for Scientists

Isn't it time you worked with tools that were built for you, not the vendor's technician?

Most bench scientists have experienced the mind-numbing tedium of pipetting hundreds or thousands of liquid samples by hand. The work can take hours, if not days. One slip, one miscalculation, can mean an entire experiment is compromised. Repetitive stress injuries are common.

Standard laboratory automation systems promise to relieve that pain. But they come at a very steep price, in terms of both time and money. Most such systems are complicated and hard to operate. Just ordering one can mean a months-long specification and custom construction process. Then, once delivered and installed, they typically require weeks of user training. It could take months for one staffer to learn how to use it—and then they were the only person who could operate it. If something went wrong, it often meant shutting down the machine until the vendor could send a programming expert to the site to troubleshoot.

Plus, standard robots are often closed systems, programmed by the vendor to complete one specific task, using only the vendor's reagents. They are not easily adjusted to take on other jobs—such as processing tens of thousands of coronavirus test samples.

RADICALLY SIMPLE ROBOTS

Opentrons' lab robots are different. They are radically simple, open-source, plug-and-play systems that require no coding knowledge to get started. Similar to buying a personal computer, once unboxed and set on a lab bench, these robots are ready to work.

With an Opentrons robot, designing and running experiments is easy. Protocols can be developed using code-free, drag & drop modules or downloaded from the free protocol library (which includes protocols developed by Opentrons as well as those shared by scientists around the world). Those who want to get creative can tweak existing programs or code their own using the open-source Python API. Opentrons technicians are also available online to help develop workflows.

Once a protocol is uploaded to the Opentrons app, the machine does the rest. That lab work that once took hours when done by hand—pipetting, serial dilution, NGS library prep, PCR sample prep, qPCR prep, and more—is now fully automated, allowing you and your fellow scientists to focus on your research, not pipetting.

> **"COVID-19 is the type of challenge Opentrons was built to meet."**
>
> **— Will Canine, Co-Founder and CPO at Opentrons**

TACKLING THE COVID-19 CRISIS

As laboratories around the world discovered in 2020, the user-friendly features of Opentrons robots also made it possible for many labs to quickly pivot to address the global public health crisis.

In early 2020, Opentrons published a **blog post** explaining how a set of eight Opentrons robots could be quickly deployed to automate several steps in

coronavirus testing—sample plating, RNA extraction, and qPCR setup—and run 2,400 tests every day. Within weeks, the newly developed **Opentrons COVID-19 Testing System**, which includes hardware and open-source protocols, had been ordered by and deployed at scores of clinical sites around the world.

- More than 300 hospitals and clinics in **Spain**, **Italy**, **Chile**, **Pakistan**, and other countries launched coronavirus testing systems using Opentrons robots.

- OpenCell, a London startup that provides early-stage biotech companies with affordable lab space, retrofitted a number of **shipping containers** with Opentrons COVID-19 Testing Systems. The shipping containers are fully functional labs that can be deployed anywhere in the world for coronavirus testing.

- In Manhattan, an area that was hit especially hard by COVID-19, Opentrons and scientists from NYU Langone Health established the **Pandemic Response Lab**, an entirely new coronavirus testing lab for New York City residents. Equipped with Opentrons liquid handling robots and thermocycler modules, as well as additional equipment, the lab is now processing 30,000 - 50,000 tests per day and turning around results in less than 24 hours in most cases—greatly exceeding the output of other local labs, and at a far lower cost.

- Opentrons **Pandemic Response Labs** are currently being established in several other cities.

> **"We knew there were many laboratories where staff was working 24/7 with overnight shifts overwhelmed by manual pipetting. I knew that liquid automation with the OT-2s would help decrease some of the labor burden."**
>
> **— Dr. Rocio Martinez-Nunez, King's College London's Department of Infectious Diseases**

"We're the only people in life sciences who try to make these systems and tests as inexpensive as possible," says Canine. "That shouldn't be the case, but it is."

The traditional life sciences model, Canine continues, is to take ten years to develop something and then patent it so no one else can use it. The Opentrons model, he says, is "How quickly can we innovate and bring these things to market as cheaply as possible? And let's do it in an open way that learns from our community and really amplifies innovation from our community."

"COVID-19 is the type of challenge Opentrons was built to meet," adds Canine.

MORE THAN JUST SPEED: ACCURATE AND REPRODUCIBLE RESULTS

Getting test results quickly is important, of course. But accuracy is also crucial. Opentrons robots, by automating many processes, greatly reduce the potential for human error and fatigue, leading to quality experimental results.

- Results are reproducible. With a clearly defined protocol that is carried out error-free by a robot, and then freely shared, your research is easily replicated and validated.

- Results are accurate. No longer do you have to wonder if an unexpected result is due to a

NYC Mayor Bill de Blasio visiting PRL NYC. CREDIT: NYC.Gov

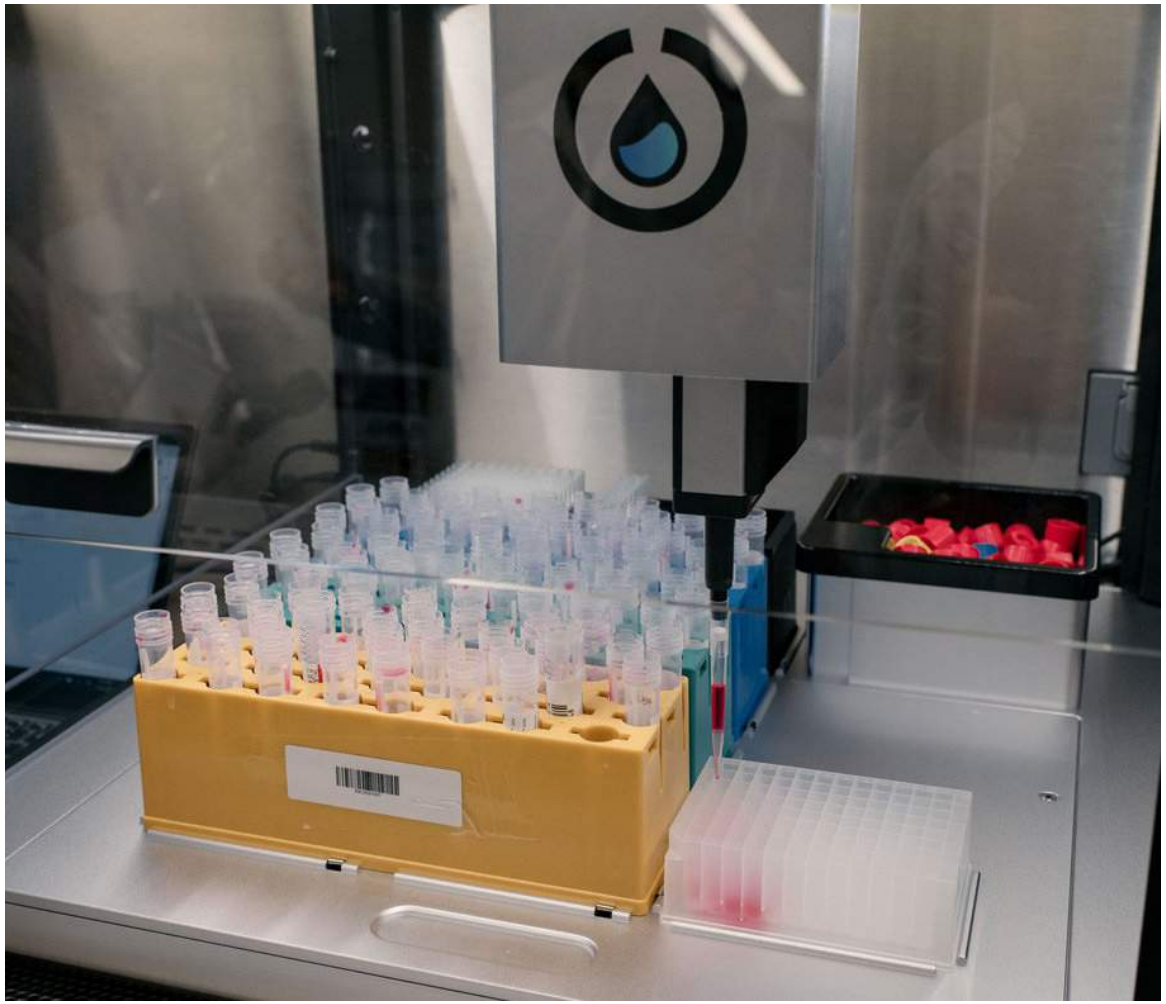
human-caused pipetting error, or if it might be a scientific breakthrough.

- Labs run more efficiently. With less human error, materials are conserved, which can be critical when resources are expensive or scarce, as in the case of endangered species DNA or global supply chain disruptions.

- Scientists are free to do "big things." They aren't wasting their time pipetting, routing out procedural errors, or learning how to operate an unwieldy robotic system. They can focus on what they were trained to do: develop tests and vaccines, explore intriguing scientific issues, design innovative research programs, analyze results, and share their knowledge with the world.

> **"The Pandemic Response Lab gives us a guarantee that tens of thousands of tests can be done everyday."**
>
> **— NYC Mayor Bill de Blasio**

In addition, your company is primed for innovation, regardless of its size. Today, big pharma is no longer the only potential employer for researchers. Many scientists are seeking out smaller companies: the biotech startup launched by a medical researcher with a promising molecule, a lab focused on personalized medicine, a nonprofit group focused on biodiversity or alternative energy. Ensuring that your scientists have the user-friendly and up-to-date tools they need to do the job is crucial to attracting top scientific talent.



Labware on the deck of the OT-2 being used to perform an assay. CREDIT: Opentrons

CHAPTER 3

Collaborative Science: The Time is Now

It's easy to collaborate with your colleagues across town or around the globe with Opentrons' open-source systems.

For decades, scientists have worked more or less in isolation. Their research methods and data all too often sit locked away in data silos—lab notebooks and other systems that are accessible only to a few colleagues. Some share their methods and results more widely at conferences or in journals, but that often takes years.

More recently, many scientists have chosen to reject those old ways and embrace "open science." That movement emphasizes sharing scientific protocols, data, and results openly with others, through online research platforms (such as **medRxiv** and **bioRxiv**), shared electronic lab notebooks, video conferencing, **Slack channels**...and Opentrons' **open-source protocol library.**

OPEN SCIENCE IS HERE TO STAY

In 2020, the open science movement exploded as the COVID-19 pandemic swept in an era of unprecedented global collaboration. Companies large and small worked together to rapidly develop diagnostic tests, launch clinical trials of therapeutics and vaccines, and share research results as early as possible.

"Overnight, science went from this super-fractured market to everyone working on the exact same experiments, focusing on antibodies, diagnostic testing, vaccines, and the like," says Canine. "It validated what we've been saying forever, which is that open science is super powerful and needed to accomplish a lot of things."

Opentrons' open-source systems, explains Canine, fully enable the open science movement and are already equipped to thrive in this new environment of global collaboration. "Our central protocol library will be even more important to the open science moving forward."

> **"The openness, and ability to integrate with multiple platforms, is a really important feature of Opentrons' product."**
>
> **— Henrik Jensen, co-founder of Fidabio**

The Opentrons open-source ecosystem empowers several advantages:

- With 24/7 access to the online open-source protocol library, researchers can immediately use standard plug & play protocols, use or build on what others have already developed, and share their own protocols.
- There's no need to wait for a distant equipment vendor to write a new protocol for your equipment, and no need to wait months for a journal article to be published to learn how colleagues on the other side of the world are moving science forward.
- Medical science can move forward more quickly, with many people globally using the same protocols. New therapeutics and vaccines can be tested faster, and results can be more easily validated and approved for global production.

- Other scientific fields can also collaborate to see faster progress; for example, scientists can work together to build DNA reference genomes to support endangered species research, develop ways to reduce pollution and electronic waste, and explore ways to combat climate change or build a sustainable food supply.

> **"I can be sitting in an airport in Portland while controlling one of our OT-2s in Atlanta; gimmicky for sure, but it's just an example of what we have been able to accomplish."**
>
> **— Adam Ericson, Emory University**

SOCIALLY DISTANT COLLABORATION IS HERE FOR A WHILE

Even with coronavirus vaccines now rolling out, we may need to practice social distancing for some time to come. Opentrons features make that easy.

Because Opentrons robots are so user-friendly, many people in each lab are able to use them. When labs are limiting staff access or implementing staggered schedules, the robot can still be put to full use. In addition, those who are working at home still have access to the online protocol library, and can develop their customized protocols from home. They can also watch their experiments progress via remote cameras installed in the machines.

The lab has a three month supply of reagents, chemicals used to process tests. CREDIT: Scortt Heins, Gothamist

One of the roughly 120 employees working at the NYC PRL lab CREDIT: Scortt Heins, Gothamist

CHAPTER 4

Affordable and Adaptable: A Practical Choice for Many Labs

Yes, you can afford a robot.

Large traditional robots are very expensive, and simply not in the budget for smaller facilities, pop-up testing labs, DIY researchers, and others. Plus, once you've invested in an expensive robot, you are tied to that system, dependent on that vendor's protocols, updates, reagents, and service contracts.

Opentrons lab robots are much more affordable, making them a realistic option for many more scientists. In large part, that is because Opentrons builds their robots using the same motors, electronics, and other systems now used to build 3D printers, and that supply chain is much less expensive than the robotics supply chain. In addition, from day one Opentrons has relied on open source technologies for its own core technologies, greatly lowering startup costs.

That all means that Opentrons' robots are accessible even to the vast majority of laboratories that have no automation now.

The Opentrons system is also highly adaptable. Opentrons does not lock customers into a single supply chain for reagents, labware, software, or any other components. Scientists are free to design their experiments using any tools they choose, or can lay their hands on—an important consideration given the global supply chain disruptions caused by the COVID-19 pandemic.

With Opentrons robotic systems, labs can put their funds to better use:

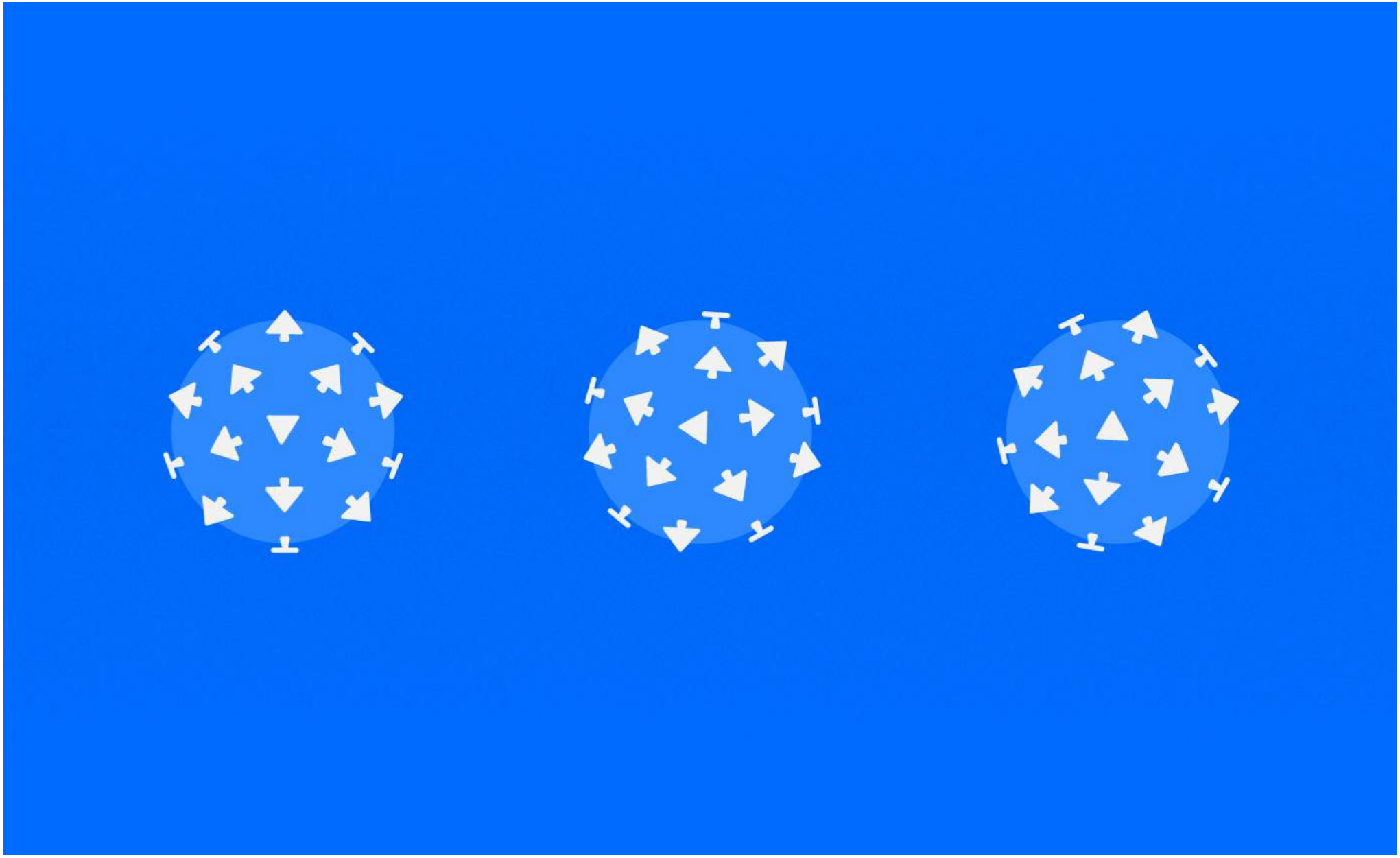
- Funds can be invested in research questions that don't promise a huge ROI, such as treatments for orphan diseases (uncommon conditions, such as progeria and acromegaly, that don't attract a lot of research dollars) .
- Labs can make better use of limited start-up funds, helping them to meet research milestones faster, and so secure their next round of funding.
- Labs can afford to develop flexible spaces, sites that can be quickly reconfigured in terms of both equipment and staff, to take on new research questions as well as ensure social distancing.

And, as we saw in 2020, with lower-cost equipment available, many more labs around the globe can quickly pivot and retrofit to find solutions for a worldwide health crisis.

THE LIFE SCIENCES WORLD HAS CHANGED

In order to meet the changes caused by COVID-19, life scientists must embrace automation.

Contact Opentrons (**info@opentrons.com**) to learn how to automate your lab.



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