This laboratory is run by robots.

These silicon scientists are executing thousands of experiments, searching for life-saving

drugs and building synthetic organisms -- all with virtually no human intervention.

It’s part of a industry-wide push to move away from time-intensive manual benchwork

and towards automation.

This has the potential to transform how we develop new therapies, and could fundamentally

reimagine scientific discovery.

The life sciences are really underserved by automation and technology in general.

If you go into a lab, you'll see humans doing a lot of labor intensive work.

There's a joke that sort of PhD students are free labor for professors.

When I was doing my PhD, that's actually when I first started using Strateos' robotic cloud

lab myself.

The concept was that you could log into a web application, design an experiment with

code, and then have it executed for you by robots remotely via the internet.

I got really excited and so I signed up, and then I actually started running experiments.

I remember being sat on the couch in my apartment and just sort of watching this experiment

execute while I was just relaxing, and I thought, "Well, this is the future of life science."

This is really about helping humans focus more on the creative aspects of hypothesis

generation and scientific interpretation, then the moving of small amounts of liquid

around or shining lasers at them.

Not only does offloading experimental work onto robots have the potential to save enormous

amounts of time, it could also mean more reliable results.

Often when you look at a protocol that a human is executing, there's very ambiguous steps

like incubate overnight, which is not a set period of time, or shake until the solution

is cloudy.

There's no real definition of cloudy or how much you should shake that sample.

Every experiment that Strateos has executed is actually defined by code. And so, when

I want my colleagues to replicate an experiment that I've performed, I can just give them

access to that code, and they can just click Go and it runs exactly the same way.

So the first step in getting robots to do your scientific bidding?

Log on to a website.

You actually see a whole menu of different scientific processes that you can choose from.

After you've put in all your parameters of the experiment, and you've also chosen your

samples as well, you click Launch and then our system actually automatically checks that

you're not trying to pipette a crazy amount of liquid, or you're trying to use something

dangerous.

If it's all good, our system automatically dispatches the work down to the robots.

We're inside one of our work cells here.

This is the robotic arm, you can see it's coming towards us.

This arm has been told to move around some inventory on this plate in particular, so

there's experiments all in this little plate.

And once that comes out, this plate is actually then going to go to an analytical device.

Meanwhile, the robot is then going to go off and do some other experiments for a different

user.

Once it's done, the user gets a notification via their email and they can just go in and

fetch their results.

At optimal conditions, a single workcell could execute 190,000 experiments in a day, and

Strateos currently has 23 workcells in operation.

We really believe that this is going to go more and more towards the types of scale that

cloud computing has reached.

You could picture a huge warehouse type of facility packed full of robotics and inventory

and storage equipment for samples.

And then thousands of scientists all using that equipment and infrastructure simultaneously

and remotely via the internet.

Faster, easier, and more reliable experimental results would be a game changer across industries,

but one that could benefit most is drug discovery.

The process of developing drugs has become extremely difficult.

We start by identifying a target that we're looking to develop a drug or some other therapy

for.

We design an assay that will tell you whether or not the activity of that particular target

has been inhibited or not, and then screen that over many, many possible compounds, many

possible drugs.

It can take years of experiments and cost billions of dollars to develop a single drug.

And often, after all of that, it could fail before getting to market.

Using a cloud lab could help drug developers streamline that process.

But we're really excited that we've been able to work with Eli Lilly and actually add synthetic

chemistry to the platform.

What that means is that entirely via the cloud users will be able to design molecules, have

them made and purified, and then ran through those biological assays so they can get that

whole process from their idea to data.

It's not just large pharma and biotech that have access to this.

This platform basically offers state-of-the-art equipment that's typically only been accessible

to the big guys and actually makes it easier for either startups or academics to have access to this.

COVID has been a really interesting time for Strateos.

The number of people that have reached out to us saying, "Hey, my lab is suddenly closed,

I need to keep this work going over this time."

I think people have seen the need to work remotely.

Science should be able to continue without physical access to a lab.

Automating the execution of experiments is a huge step towards more efficient and accessible

scientific discovery, but some want to go even further to develop robots that actually

design their own experiments.

A key concept in automated science is the idea of a closed loop for experimentation.

Closed loop experimentation starts with execution of some set of experiments.

The second step is to build a model from that data, and then the third step is to decide,

"What experiments should I do next in order to optimally improve that model?"

This loop relies on the union of robotics, machine learning and artificial intelligence.

And getting it right could completely upend how we find life-saving drugs.

So you can think of this like playing the game of Battleship.

You've got x and y coordinates, x being the drugs and y being the targets.

We're playing the game by doing A1, B1, C1, D1, and if anybody's ever played Battleship

you know that's not a winning strategy.

What we really need is to explore the board, and then build a model as you're doing that

and use that in order to make your next choice.

That's where automated science comes in is to tackle the creation of a full predictive

model for the experimental space of drugs and targets.

In the future, this same method could be expanded to build predictive models for the complex

interactions within our bodies, giving us a much clearer understanding of how they work

and what to do when they don’t.

But there’s still a ways to go.

Moving towards the future of automated science, one of the challenges of course is a technical

one.

How do we implement this for many different kinds of experimental spaces for different

cells, for tissues, for whole organisms.

And so that, of course, is going to take an enormous amount of work.

But there is a real bottleneck there in the adoption of this automated science approach

by scientists.

I thought that a good place to start would be by building a Master's program in automated

science.

The first class just finished their first year.

Those are going to be some of the most productive scientists around because they'll be able

to scale their experiments through code and automation, and also be able to scale the

actual data analysis piece as well.

A lot of people ask me, "What's the role for humans if you've eliminated humans from the

loop?"

I think that one answer to that kind of question is the same answer that's been given to automation

for hundreds of years which is that automation doesn't replace the need for people.

It changes the jobs that people do.

Now a PhD student themselves could be their own PI of all of these different robots doing

experiments for them.

So they can actually have much grander aspirations of the hypotheses that they want to evaluate,

and the scale of experimentation they want to accomplish.