

Faculty Spotlight — Dr. Corinne Lengsfeld

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1 DO YOU MIND TELLING US ABOUT YOURSELF, SUCH AS WHERE YOU WENT TO SCHOOL, HOW YOU BECAME INTERESTED IN YOUR MAJOR RESEARCH AREAS, AND HOW YOU FOUND YOUR WAY TO DU?

I'm a mechanical engineer by training. I got my degrees at the University of California, Irvine and of all things, I majored in rocket science. I worked on my postdoc at Boulder for two years, in the pharmaceutical industry in their Chemical and Biochemical Engineering Program, and re-trained myself from rocket engines into pharmaceuticals. There's actually a lot of commonalities between the two fields. At the time, I was one of three mechanical engineers that were working in the pharmaceutical industry, so I was sort of crazy weird. I joined DU in 1999, as a professor in mechanical engineering, and had a blast with the students. We did all sorts of incredible things, like working for the Air Force and working for pharmaceutical companies. We were well funded and we had a great time. I really love teaching and the whole teacher scholar model here at DU.

About eight years ago, the person that was leading research at the University stepped down and accepted

a dean position at another university, and she called me and suggested that I take over her position. I was hesitant at the time, because I had a big research group, and I was enjoying what I was doing. On the other hand, I also knew that DU was transforming from a school with a teaching intensive faculty to a faculty that balances their research with their teaching, and I was super interested in forging this university forward in the research sphere. It was important to me to do this in such a way that the love I had with the students would propagate forward and not be diminished by the research. So that's how I ended up heading research.

2 HOW HAS WORKING WITH INVESTIGATORS FROM DIFFERENT DISCIPLINES (YOU'RE A MECHANICAL ENGINEER BY TRADE, DR. SARAH WATAMURA A PROFESSOR OF PSYCHOLOGY, AND DR. PHIL DANIELSON A MOLECULAR BIOLOGIST) HELPED IN THE SUCCESS OF THE SPIT LAB?

Being interim provost at the start of the pandemic, I was pretty much all about COVID for four or five months. I decided to roll back to my research position, and it actually worked out really well because I had asked Sarah Watamura to help me with COVID while I was still Interim Provost and then when I rolled back to research, I helped her continue to run COVID. So, the two people that really had been running the university's response to COVID the whole time, ended up continuing together.

Sarah was a salivary scientist, she was collecting spit in kids for years and measuring their stress level. She suggested we should do COVID saliva testing and as an engineer, I understood pharmaceuticals, diagnostics, and supply chain. Then, we got Phil Danielson to join us. He's a forensic scientist, and if you're going to look for a little elusive molecule in saliva, who better than somebody that looks for all sorts of things in bodily fluids from crime scenes. The three of us just got together and dreamed up what is now the Spit Lab, which is incredible. A small team has been innovating all the way through and using every ounce of experience we

have but really just applying it in completely different spaces.

I knew we had to build all our own software, so I called over to computer science and spoke to Matt Rutherford. I said, "Do you know anybody that would help us?" He was like "Well, what do you mean?" I said, "I pretty much think we're gonna not sleep much. And we're gonna have to work really hard. And I don't even know if it's gonna work. But I think we'll save the day if we can do it." He's all, "I'm all in, it sounds perfect."

Then, Nancy (Lorenzon) was hanging out close to us one day. We were collecting saliva at the pod, and she came over and she said, "I want to help."

All of the aerosol calculations were done with Dr. Alex Hoffman in chemistry. That's how we figured out how to set up the rooms and which rooms needed extra filtration units.

Then, I spoke with Keith Miller, he's an environmental water sampler. I said, "So wastewater is kind of environmental, do you want to do this with me?" I think by September 9th we were starting to pull samples out of the sewers. It's been a lot of fun to work with so many different faculties.

3 AS PRINCIPAL INVESTIGATOR FOR DU'S SPIT LAB, WHAT ARE YOUR MAIN RESPONSIBILITIES?

There's the research side and the public health side, so let's start on the public health side. I'm ultimately responsible for the entire operation of the Spit Lab. This includes making sure Phil Danielson and his team have all the equipment they need and helping them to solve any problems or issues that they come up with. I help Nancy Lorenzon to oversee the interns and make sure they're trained and that we are living up to our CLIA lab certification. A major part of my role as PI is entering the results of tests into the system once they are sent to me from the lab, as well as clearing and posting the results in the medical records. In other words, I'm the final authority when it comes to all of the data collected by the lab. I might not do the finger work, but I will notify contact tracing of who's received a positive test and I'll have verified that the data is accurate. I also manage any questions that students or the parents may have about saliva as a new detection technique. Methods for saliva testing are wildly varying across the country, and our lab holds itself to the highest standard possible, so it's really easy to defend our results.

On the research side, I really am the only person that sees all the informed consents. For this reason, we haven't started any research studies. We've only collected public health data, but we have one of the best databases, in my opinion, that is able to tell us who has been positive, where they were living, and where they might have gone while carrying the virus. All of the

people in the database have consented to be a part of the study, and as the PI, I know who's consented and what I'm allowed to do with the data. I'm ultimately responsible for assuring that people's privacy is protected. This means that when we move into the research phase and other scientists get access to the database, they will see nothing but numbers and they will never see the names associated with the data. At this point, we have used all of our data for public health initiatives to help inform our response, but we haven't begun pursuing any research yet. Before any research can start, you need to be sure there are systems in place that protect the identity of everyone that participated in the study. It's not like you can just begin research right away, and as a responsible PI, you need to make sure that all of the data is presented correctly, and there will be no room for mistakes.

4 AT THE MOMENT, SALIVA TESTING IS NOT FDA APPROVED. HOW IS THE CURRENT RESEARCH YOU ARE DOING HELPING YOU AND YOUR TEAM WORK TOWARDS GETTING THAT FDA APPROVAL?

We submitted our Emergency Use Authorization application a few months ago, maybe in January, but we submitted at a time when the federal government announced they were not going to issue any EUAs to universities. We are one of 32 universities who have pending EUA applications. We have been in constant contact with the FDA, and we know that our application is under review because they keep asking Dr. Danielson questions.

We also know that of the 32 universities that have submitted applications, we're almost the only one that uses the extraction technique. You can either process saliva as is and send it into the PCR, or you can take an extra more expensive step to extract off the virus and concentrate it and send it into the PCR. We decided to use the extraction technique because it creates a higher standard of performance and accuracy. We are very confident that we will be one of the first university labs to be approved because essentially we are replicating the techniques used in nasal swab testing and applying them to saliva. It's just they don't want to approve any universities, yet, for whatever administrative reasons. So we'll wait, and then we'll get it.

5 TESTING FOR COVID-19 HAS BEEN MADE POSSIBLE THROUGH UNDERGRADUATE INTERNS AND VOLUNTEERS, CAN YOU GO INTO A BIT MORE DETAIL ON HOW UNDERGRADUATE STUDENTS HAVE BEEN IMPORTANT IN THE UNIVERSITY'S RESPONSE TO THE VIRUS?

I'm just going to kind of rattle off some of the jobs, we have two undergraduates run all the installation of the wastewater twice a week. Dr. Miller pulls the sample with a plunger then two students actually do all the installations on Sundays and Wednesdays. We also have some students that work inside the Spit Lab doing the antigen testing, which people often forget that the Spit Lab actually does do nasal swab testing, but we do it for antigen testing in symptomatic cases.

Then, we have all the spit interns that are wonderful, and they run the collection sites. We just promoted a few of them to be paid leads and actually take on more organizational responsibility. Then we have a number of the interns who are taking leadership roles out at the vaccination clinics, who are helping manage and organize the operations of different elements of the vaccine clinics. We have two interns that are pretty amazing, John and Maya, who have taken on pretty large responsibilities at the vaccination clinics.

We've had students also help in a number of other ways. We had a vaccine call clinic, and we were like the only place in the state you could call and talk to a human. We had a 13 phone phone-bank and the students could run it from their computer. Undergraduate and graduate students helped keep that phone bank alive for almost three months, taking appointments and registering people.

Then we have a bunch of students from Professional Psychology, who are part of our student ambassador program, that are using their psychology training to reach out and connect with students in quarantine and isolation. They just connect with them, make sure they're okay. Get them resources, if they're not.

We've had a bunch of students that would run around delivering from time to time, picking up things people needed. In the beginning of fall, our isolation dorms and our quarantine dorm rooms didn't have all the supplies, and there were students that would go out shopping and they would bring everything back to the university so we could go out and deploy it.

Students have been involved in ways that I don't think have been recognized, but they have been involved from the very beginning and are really supporting the COVID response team. We've been terribly grateful that they've been there, and they've never asked for anything in return. They've been so great and just really dependable.

6 FROM THE OUTSIDE LOOKING IN, IT LOOKS LIKE THE SPIT LAB HAS CONSTANTLY BEEN EVOLVING AND IMPROVING. WHAT HAS BEEN THE BIGGEST CHALLENGE YOU AND YOUR TEAM HAVE FACED, AND HOW DID YOU OVERCOME IT?

So, I gotta say, there's two most difficult moments. Once we got the lab up and running, it was about December 1st. We'd run for two weeks, and had figured out what we wanted to do and wanted to start testing. And then we ran out of supplies, like we literally ran out of supplies. We had to ask National Jewish and the CDPHE to borrow some things to keep us in business, but on December 4th I had to close the lab. I didn't fire anybody or anything like that, but I said, you're not allowed to run a single sample because I needed us to open on January 4th, when the first people moved into the dorm. I only had supplies to go from January 4th to January 10th, and so on December 4th, we closed. It was a very difficult day for Phil, Sarah, and I to admit that we hadn't kept track of the supply chain enough, that we hadn't understood what it was going to be. And then what was worse is that we had to jump into a supply chain market that, you know, we're a medium sized school, like, I couldn't buy enough to become the powerhouse so we ended up getting these two people in purchasing to help us. These two staff members who just volunteered extra time and when everybody else left on December 21st, we worked every day trying to find plastics all over the world. Our goal was to get us to January 15th. And then from January 15th, could we get to January 30th. It wasn't until about January 30th that we had enough supplies to get us through winter quarter. I mean, we sweated it every day. That was really a major situation, but now that we're at about 1200 samples a day, I don't think anybody on this campus has had to manage a supply chain like that, with so many complex scientific items at that type of volume. That has been a serious challenge for us, just yesterday I was down in the warehouse myself counting pipette tips and bringing them to the lab because we thought we might be low and, nope, we had them. But you know, you've got to always keep on top of that.

The other really horrible one was when all of us went to go get vaccinated, everyone that was in the lab or those of us that were pulling wastewater samples because we were in contact with the virus all the time. We went to get vaccinated on a Wednesday, and then the lab called me Friday morning and said we got a positive test in the lab. That meant that everybody would be quarantined, and we'd have to shut down the lab. So there we were, out there in the middle of night measuring the distance between lab spaces and finding a six foot distance or not. Can you imagine, it's 12:30 at

night and you're out there with a tape measurer trying to figure out if everybody was safely distanced. Many of the interns will remember the very next Monday at a group meeting I said everybody has to be six feet apart, I don't care if you're friends, I don't care if you're roommates, but the lab they quarantined. It was a really bizarre sort of surreal 10 days in which three people had to do the work of what used to be five people. It was a strange, surreal sort of problem to live through. It was great because the virus didn't spread, and there were no connected cases, we were literally six feet apart wearing masks and it all worked. But we were really worried that it was going to be the whole lab at some point and that we didn't get vaccinated early enough. So that was another real challenge to overcome, balancing the needs of the campus with what each of those individuals needed for their own personal well being. It was just an incredibly difficult time, those early days in January. For us, you never knew if we were going to be successful or if it was going to sort of fall apart. Every night was sort of a watershed night.

7 WHAT ARE THE NEXT STEPS FOR YOU AND YOUR RESEARCH TEAM?

I think that from a public health point of view, what we really are interested in is how many people who are vaccinated have breakthrough infections? How many who have already had COVID, get COVID Again? Is it the variant? Is there a preference of the variants? We're really interested in that because that tells us what we need to do for the fall. In the wastewater, picking up the variant has been tough. So, Dr. Miller and Dr. Danielson have teamed together and really came up with some interesting ways to improve our wastewater monitoring. We used to do that all third-party, but now we do it all in house at the university to save money, but also to up our game a little bit.

I think the variants are so interesting, right? Like, I watched the variant come to campus. I remember the night we got the first variant case. And I remember Phil calling in a panic. Actually, we were on the intern call, so we finished up our meeting, and I headed down to the lab and we have two variants that might appear in there. We load the first one into the robot that processes the samples and all the equipment breaks, and it breaks in dramatic fashion all in the same night. It throws all the PCR plates against the wall, so it ruins all the samples, and then leaks all over the floor. That was a hard night, because none of us knew what the variant meant. It was in the dorms and everybody said it was so infectious and spreading. It was a difficult night. We bought dinner for all the techs because it was a 2:00 AM kind of night.

That night actually determined how we were going to quantify the variant, how we were going to definitively

say, that's the variant and that's not. That science wasn't out there, Phil and I were building that science. We then were writing a small research paper and submitting it to Sarah as the peer reviewer, in sort of a mini peer review cycle. So, it was really intense, but we just leaned on our old research methods to do it once again. And then over time, we saw this sort of sweep of variant shift that is incredible to observe. Because we are able to have our own lab, we have so much more data and that has been so empowering.