[MUSIC PLAYING]

CECILE CHAZOT: Identity gives you a pair of glasses to see the world through. You experience the world a certain way because of the multiplicity of your identities and the certain identities you have. What it brings in science is if someone shows up, has a pair of glasses that see all blue, and then someone shows up and has a pair of glasses that see yellow, suddenly, we can see green.

SARAH HANSEN: Today on *Chalk Radio,* moving toward a more diverse and equitable field of science through hands-on online education.

I'm Sarah Hansen. For this episode, I talked with two founders of an online MIT program that's seeking to make Materials Science and Engineering education accessible to students beyond MIT. The program is called MICRO, or the Materials Initiative for Comprehensive Research Opportunity. My guests were two of the program's creators, Jessica Sandland and Cecile Chazot.

JESSICA SANDLAND: My name is Jessica Sandland, and I am a Lecturer in the Department of Materials Science and Engineering.

CECILE CHAZOT: I'm Cecile. I used to be a graduate student at MIT. I now graduated in May, so I am a MIT PhD. I'm shipping off to Chicago, where I'll be starting as a faculty in Materials Science and Engineering at Northwestern University.

SARAH HANSEN: Jessica and Cecile met while Cecile was the Graduate Student Representative for the Diversity, Equity, and Inclusion Collaborative in the Mechanical Engineering Lab at MIT. Diversity, equity, and inclusion, or DEI, is at the core of MICRO'S mission-- to make Materials Science more welcoming and accessible to minoritized undergraduate students. But before we delve into the program's mission, let's first get clear on a pretty important term.

CECILE CHAZOT: What is Materials Science? Materials science is the study of materials, basically understanding the materials from the atomic scale all the way to the macroscale. For instance, if I have metal... If I process metal a certain way, like I cast it, I can make certain types of objects, like a pot, for instance, if you want a beautiful Le Creuset cast-iron skillet kind of thing.

Now, if I shape it as a sheet, I can make cans for Coca-Cola or different aisles of sodas, that kind of stuff. So that's the whole point of Materials Science, is really understanding the link between how do you make a material from the atomic scales away to a centimeter, tons, kilogram scales for a large-volume application? And how is it affected at every step of the way?

JESSICA SANDLAND: It plays a role in so many different fields and in so many different applications. We have people in our department who are doing work in energy science. They're looking at sustainability questions. They're trying to figure out new ways of developing materials for novel medical devices.

And I think it just has such a reach for me. That's maybe one of the most exciting things about Materials Science, is just how many different fields it really touches.

SARAH HANSEN: Materials Science is a fairly new field that brings together different science specialties.

CECILE CHAZOT: It didn't use to be its own discipline until like about the '50s, '60s, where people started talking about Materials Science. We're a relatively young STEM field that initiated from physics, chemistry, engineering altogether.

SARAH HANSEN: Ok, so Materials Science is this relatively new field that incorporates all these different traditional STEM fields into the study of the materials we use every day. So what is the Materials Initiative for Comprehensive Research Opportunity?

CECILE CHAZOT: MICRO-- it's an online undergraduate research and learning program that is for students from minoritized background and that is focused on Materials Science and Engineering.

The initial motivation for this is, as I said, earlier Materials Science is a relatively young field. We have a lot of diversity problems that a lot of STEM fields have, but we have this added difficulty that it's actually not a topic in high school or, in fact, in the majority of undergraduate institutions. You can't major in Materials Science and Engineering. The goal of this program was really to promote our field of Materials Science and Engineering through a hands-on research experience, but it needed to be *accessible.*

I know it sounds a little paradoxical to talk about hands-on experience in an online program, but this is the whole concept we were pursuing is-- we've seen during the pandemic that people can do research remotely and can do very impactful research remotely.

SARAH HANSEN: I was curious to know more about how students do this hands-on research remotely. So Cecile gave me an example. She told me about a participant in the MICRO program named Toby. Toby is a Mechanical Engineering undergrad at the University of Maryland in Baltimore County. He paired up with an MIT grad student named Richard.

CECILE CHAZOT: Richard is a Materials Science student, is looking at making batteries with very, very high capacity based on nanomaterials. And he's doing that in the lab. He's making different batteries and trying to figure out how to make them manufacturable and high capacity.

And what Toby does is he models, uses finite-element softwares at a school*Console.* He does it on his laptop, remote in into a server we have in our lab, to simulate what would be the final properties of a battery depending on the shape we give, the size we give, the material we give for it, and how does that relate to how Richard can change his process, and make the battery even better by taking information from that model that Toby is developing and understanding, how different aspects, materials in the battery size, et cetera, can affect the final properties.

SARAH HANSEN: One of the core motivations for the MICRO program is to create opportunities for students who have historically been excluded from pursuing Materials Science and Engineering as a career.

CECILE CHAZOT: It was this idea of taking Materials Science research, involve undergraduate students who may not have a Materials Science program in their department and who are part of minoritized communities, so they can learn about Materials Science through the online courses we give them. We don't look for research *experience.* We look for research *potential,* even if an undergrad has never done research before.

And that's important because in numerous undergraduate institutions, you can't do research. If they have interest in research, and they explain to us why they're so interested in research even without prior research experience, they should apply. This is important. For us, the point is to reach people who may not have that opportunity otherwise.

SARAH HANSEN: Part of what makes MICRO so special is its emphasis on demonstrating the power of diversity, equity, and inclusion in STEM. Both Cecile and Jessica spoke about what it was like for them, as women, becoming professionals in the field of Materials Science. It left them with an understanding of the value and importance of identity, which informs their work at MICRO.

CECILE CHAZOT: The way I usually describe it is, identity-- regardless of if it is a visible identity or invisible identity-- what it gives you is it gives you a pair of glasses to see the world through. You experience the world a certain way because of the multiplicity of your identities and the certain identities you have. What it brings in science is if someone shows up, has a pair of glasses that see all blue and then someone shows up and has a pair of glasses that see yellow, suddenly, we can see green.

This is the power of diversity and innovation and really understanding this. And there is an example historically of that. To take the example of women in science, for instance, the increase of female representatives in the medical field in the United States in the '80s and '90s shed new light on understanding disease and pathologies that affect women, such as breast cancer or different heart diseases. And there was this brand-new wave of innovation that came because you had more diversity in your workforce.

JESSICA SANDLAND: I came to MIT as an undergraduate for the first time in 1995. At the time, as a woman in engineering, it looked very different here. But it was also very rapidly changing.

I understand-- yeah, from a personal level-- what it means as an engineer to see these role models, to see these people who are doing the best materials science and engineering work that is being done in the world. And they look a little bit more like me than they used to back in 1995. Having experienced that evolution, I think I really appreciate the power of it in a very real way.

CECILE CHAZOT: When we take this turn of understanding sustainability and understanding all those challenges our world is facing right now, diversity of identity brings diversity of perspective, and ergo, faster, more meaningful progress on the scientific level, but also on the human and societal level.

SARAH HANSEN: While getting underrepresented students through the door is an important step, supporting these students to then succeed in their work is another critical component of the MICRO program. One of the ways they achieve this is by providing hands-on mentorship. Cecile and program co-founder Max L'Etoile were grad students when the program was first enacted.

JESSICA SANDLAND: Cecile and Max as graduate students, I think, were also really, really essential to the success of this program in a way that I almost could not overstate. They're what we talk about sometimes as "near-peer mentors." They are these very experienced graduate students who have been successfully working in this field for a number of years, but they're not so far away from these undergraduates and their undergraduate experience.

They were able to provide advice. They were able to help with fellowship applications, and graduate school applications, and how do I write an abstract for this conference that I want to go to. I think that the barrier for approaching Cecile or approaching Max for help was much lower than it is coming to, maybe, a faculty member and saying, "I need help with this problem."

I think that having that near-peer mentorship opportunity was absolutely critical. And Max and Cecile were just so engaged and so fundamental to the success of that program. Beyond the actual MICRO staff, each one of these students had at least one-- and ideally, really, two research mentors.

CECILE CHAZOT: Also, our program had additional components apart from the research and the Materials Science curriculum. There was a soft-skill component where we organized workshops for the students to learn how to write an abstract, for instance, how to define research questions. Also skills that are beyond technical skill but are super important if you're thinking about a research career, or even an academic-- like additional degrees in academics. The other component was the mentoring component, which is really teaching those research mentors on how to provide meaningful and inclusive mentoring for these students.

SARAH HANSEN: The inclusive mentoring training included a series of worksheets for mentors that instructed them in things like effective and inclusive communication in a remote environment, planning, and managing, and more. We'll provide links to these worksheets in the Show Notes for this episode.

While MICRO certainly does benefit its student participants, one of my favorite parts of the conversation was the importance that Jessica and Cecile put on how much the mentors and labs actually benefited from the work these highly talented students produced.

JESSICA SANDLAND: One of the things that I would really like to point out is that these students are engaging in real, impactful research. They are doing science. They are doing engineering.

We talked a lot earlier about the mentors and what the mentors have to offer the mentees. But I really think it's also important to point out that these laboratories are getting the work of these talented, *really* enthusiastic students. And they're bringing new ideas into their lab groups, and they're taking initiative to try new things. I think it's something that we hope is valuable to our MICRO students, but it's also a really valuable thing for the lab groups as well.

CECILE CHAZOT: My favorite example is, Nick is a math major. I don't think he had done research before. Nick is from Grand Valley State University and he applied as a Math major in MICRO.

And he started doing research on data analysis of some chemical characterization of protein. Nick was, like, "the way you're doing this, there's a better way of doing it with math." [Cecile laughs] "I don't understand why you guys are doing this way because there's a much better way of doing it.

There's this math method that's just going to work just fine." And he just came up with this algorithm that just goes through enormous volume of data to classify efficiency of markers on protein, something that I personally do not fully understand. What is so funny is then we talked to his grad student mentor and the professor of the lab group he was part of.

And they were, like, "oh, yeah, Nick is great. Nick just came up with this thing that we don't fully understand the math, but it's fantastic. It works out great." Ergo, yet another example of this-- you come up with another pair of glasses, and you look at this problem, and you're like, "I have a solution for this that is so much simpler than what you've been doing for years."

SARAH HANSEN: One of the things we at OCW love about MICRO is how it harnesses the power of online learning to make science education more accessible and equitable. Both Jessica and Cecile share this passion.

JESSICA SANDLAND: The reason I'm so interested in, and passionate about, online learning is that it has so much potential to increase access. And it has so much potential to share what we do here at MIT more broadly. I have been working in online learning at MIT now for nine years, almost a decade.

We do a lot of experiments. And we have to do a lot of experiments because some things that sound like a good idea really aren't. [Cecile laughs] And some things that you don't think are going to work out can work out really, really, really well. And if you don't try them, you don't learn.

This was just one of those projects that I thought, this could work really well, and it does two things that I'm really, really, really excited about. This is a tangible opportunity to increase diversity in our field. And this is a tangible way of exposing more people to Materials Science and Engineering. To me, if I can use my online learning experience to do those things, I want to do that because that's why I work in this field.

SARAH HANSEN: Each student that participated in MICRO has written a brief description of their work within their MIT labs. If you're interested in seeing what research the participants did, and learning more about what's possible in a remote setting, you can check them out at micro.mit.edu. You can also learn about how to become a participant in the program there, as well. You'll also find all of the MICRO Creative Commons licensed teaching materials on our website at ocw.mit.edu.

You can help others find these resources and this podcast by leaving us a rating and review. Until next time, signing off from Cambridge, Massachusetts. I'm your host, Sarah Hansen from MIT OpenCourseWare.

MIT *Chalk Radio's* producers include myself, Brett Paci, and Dave Lishansky. Show notes for this episode were written by Peter Chipman. The MICRO Supplemental Resource was built on OpenCourseWare by Shiba Nemat-Nasser. We're funded by MIT Open Learning and supporters like you.

OpenCourseWare will *always* be free and open for you to learn anytime, anywhere. Millions of people learn with OCW resources each month, and none of it would be possible without the generosity of OCW users who give back when they can. We hope you'll consider making a donation to help power free and open resources from MIT for learners like *you.*