

Microbial 'omics for the masses

How an engaging young scientist's 'little course online' wound up captivating even beginners from around the globe



**BY ELISE
WACHSPRESS**

So what would an Alexander Hamilton-type dropped into the computer age look like?

Maybe something like A. Murat Eren, PhD, better known as Meren.

From a boyhood in the Barhal Valley of mountainous northeastern Turkey to the University of Chicago, this young scientist has become a leading proselytizer about the immense impact of microbes on our bodies and the environments we share. He is engaging people around the globe in ideas that stand to turn the world of microbiology upside down.

His journey — as unlikely as A-dot-Ham's and fueled by the same kind of restless intelligence, enthusiasm and energy — is inspiring a new generation of scientists.

Meren moved away from his family at 15 for high

school in Ankara. After seeing his first computer game, he decided a career as a computer engineer would allow him to play games his entire life. His undergraduate education at a poor university provided no access to cutting-edge tools, so he taught himself the open-source Linux operating system and serendipitously stumbled upon cryptography, learning English from the few textbooks he could find on the subject.

Cryptography landed him at the Turkish National Research Institute, developing a new Linux-based operating system. On a whim, he followed a friend to the U.S. with the plan of becoming a photographer, but his poor English made that impossible. To pay the bills, he started a PhD in computer science, but was fired from his PI's lab during his third year for

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his rebellious attitude. A chance meeting with a microbiologist who needed a programmer landed him a new placement.

It was there that Meren fell in love with the tiny creatures that preceded us on Earth by billions of years and populate every known environment on the planet — including our bodies. In the trillions of microbes with which we share the world, Meren had found an estimable target for his computational lens.

Through many more unlikely travels and adventures, that love has stuck. One crystalizing event was a somewhat chance meeting with the legendary microbial pioneer Mitch Sogin, PhD. Impressed by the confidence and chutzpah demonstrated by Meren's peripatetic youth, Sogin offered him a job at the Marine Biological Laboratory in Woods Hole, Massachusetts, and the past became just the prologue.

Today, Meren is an assistant professor in the Department of Medicine and Committee on Microbiology at the University of Chicago, a Marine Biological Laboratory Fellow and recipient of the 2021 American Society for Microbiology Award for Early Career Environmental Research.

And he is spreading his passion for microbes to the farthest corners of the earth.

"I thought it would be nice to offer a little course online about microbes and the computational ways to study them," Meren said. He envisioned free classes, delivered over the Internet, that explained microbial 'omics — genomics, metagenomics, phylogenomics, etc. — for beginners. The course would be an interactive and breezy introduction to the "key concepts and strategies that enable us to study the ecology, evolution and functioning of naturally occurring microbial populations."

But when someone with 46,000 Twitter followers offers "a little course online," it soon becomes a gigantic project. Within 24 hours, over 2,000 had registered for the six-week course, from every continent but Antarctica — people from Saudi Arabia, Ghana, Macedonia, even tiny Réunion Island, east of Madagascar in the Indian Ocean. There were registrants from time zones around the clock, for whom English was likely a third or even fourth language. The complications seemed to be snowballing out of control.

Luckily, Meren had an army of colleagues and students also captivated by the idea and ready to help. The first order of business was just to find someone who could send several thousand emails at



Iva Veseli

Third-year graduate student in the Graduate Program in Biophysical Sciences; her interdisciplinary research spans the labs of Meren and Bana Jabri, MD, PhD.

"Knowledge is power. We at the University of Chicago and other prestigious institutions are privileged to have many opportunities and structures for our research. It's easy to forget that science doesn't always go so smoothly elsewhere. By making this series open and accessible, we are helping to reduce that gap. The most inspiring part was seeing how many people from all over tuned in. In the midst of the global pandemic and other worldwide issues, scientists and nonscientists from all backgrounds and stages of their careers and education joined us every week to listen, learn, ask questions and help each other."



Emily Fogarty

Fourth-year graduate student in the Committee on Microbiology; her research focuses on mobile genetic elements in the human gut.

"People were excited to learn more about 'omics approaches and seemed grateful for the course. In graduate school, we learn so much by osmosis from the people around us. It was thrilling to see how quickly people with little or no background in microbial 'omics were able to grasp complicated techniques. I was particularly impressed by the questions I received from undergraduate students in the course, demonstrating how much they had learned over the six weeks."



Andrea Watson

Fifth-year graduate student in the Committee on Microbiology; her research focuses on bacterial colonization of the human gut.

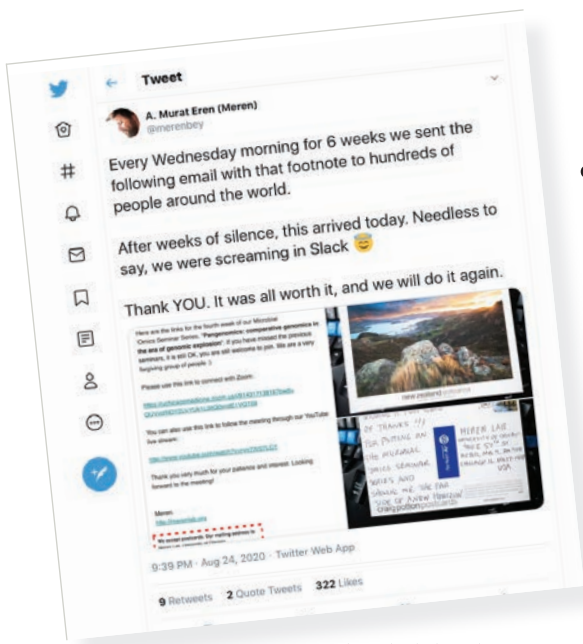
"Working in the Meren Lab has been an amazing opportunity to combine computational and statistical methods with my background in more traditional microbiology. It has been particularly exciting to use these approaches to try to unwind what it takes for microbes to colonize the human gut and to see how subtle genetic variations can have such a large effect on colonization outcomes. It has been so rewarding to pass on some of what I've learned to others."



Jessica Pan

Rising first-year student at the Massachusetts Institute of Technology, whom Andrea describes as "the most impressive high school student I've ever met."

"This was incredible outreach, the sort of project that exemplifies what UChicago can do for science education. The methods in this course have the potential to revolutionize our understanding of environmental ecology, the human microbiome and phylogeny — nothing like what I was taught in high school biology. Honestly, I might recommend them to the professor of my biology classes."



once without landing them in everyone’s spam — that alone took several days and three companies.

Then there was the problem with Zoom. Though the pandemic now had everyone familiar with the technology, Meren’s account was limited to 500 participants. The team was determined to make the sessions interactive; in fact, they

decided the classes would be structured with an hour presentation followed by 45 minutes of Q&A. And the first hour must allow for both live chat and the ability to unmute for questions in real time, to make sure no one was left behind during the presentations. How would they manage this with more than

500 people? Hosting the class in parallel on YouTube meant they could accommodate more people and make the lectures public for posterity.

The dual enterprise took a village. Graduate student Iva Veseli (see Page 5) stepped up to moderate the chat on Zoom. She would watch carefully for questions that called for clarifi-

cation in order to understand the next concepts and then break in at opportune moments for Meren or others to answer. Emily Fogarty, another graduate student, would do the same on YouTube. Andrea Watson became the interface between the two: She volleyed questions back and forth using Slack and compiled them into the YouTube comments, which, to the easily distracted, seems like a job from hell. “There were a lot of windows open,” Watson admitted, “but we wanted to integrate and document the questions so people could review things they did not understand at first.”

Even more tedious was the job Jessica Pan, a rising freshman at MIT who worked in the Meren Lab this

past summer, adopted. She volunteered to transcribe every word of the classes into subtitles, to help participants for whom English was a struggle — and there were many.

Others facilitated in multiple ways. Some provided short presentations on specific subjects: Jessica Mark Welch, PhD, from the Marine Biological Laboratory, on microbial interactions; Roland Hatzenpichler, PhD, at Montana State University, on the limitations of genetic sequencing alone; and Mike Lee, PhD, of NASA’s Ames Research Center, on phylogenomics. Others assisted by weighing in on questions posed on the chat (often by participants who were well past the “beginner” stage) and citing the papers that could help the questioner.

When it became clear that undergraduates might be intimidated by the expertise reflected in the chats, Watson, Fogarty and Veseli volunteered to run an hour-long session before each class to help the college students get their “sea legs” on the subject, so to speak.

This writer listened to every word of all six classes and found them amazingly understandable — charming, actually — for a lay audience. In fact, I would put a 12-year-old in front of class No. 1. If you didn’t find microbes fascinating after that first hour, you might want to check your imagination-o-meter.

But the microbial ’omics team believes in data, not anecdotal responses. They wasted no time in surveying participants and analyzing feedback. Over 99 percent found the class useful. Many cited the clever, hand-drawn diagrams and illustrations, which really clarified the content. Others noted the “lucidity of the creative analogies.” Nearly all articulated appreciation for the opportunity to get questions answered in real time and the incredible responsiveness of the chat moderators. Participants noted “the consideration put into making the seminars accessible to different backgrounds, levels, language backgrounds, etc.” that “helped a beginner understand what is going on behind all the fancy words in ’omics papers.”

For Meren, the “polymath, pain-in-the-ass” iconoclast, the entire enterprise was immensely gratifying. No Hamiltonian duels, not even verbal duels. Just a revolutionary exercise in how a team that works together can bring people from around the world together and into the most complex science.

PHOTO BY JESSIKA FUESSEL



The professor confers with Kiki FÜbel, official “mood regulator” for the Meren Lab.

Revisit the entire course on YouTube: merenlab.org/momics-2020