THE AUTHOR FILE

Hana El-Samad

Traversing biology at multiple scales, a system automates flow cytometry. And a constitution changes lab culture.

Whoever joins the lab of Hana El-Samad, systems biologist in the biochemistry and biophysics departments at the University of California, San Francisco (UCSF) Center for Systems & Synthetic Biology, must abide by her 'lab constitution'. She drew up the document to empower her lab's mathematicians, computer scientists, engineers and biologists. "Talk to each other," it reads, because the lab is a "team of collaborators not a team of competitors."

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The most recent study from her constitutionally collaborative lab, with postdoctoral researcher Ignacio Zuleta as the first author, automates flow cytometry of yeast, a technology that opens a window into cellular regulation, says El-Samad. Scientists can perturb a pathway in different ways and make many measurements as the pathway reacts. "The applications are endless," she says. She and her team are using the approach to map the elements of a promoter, to do experiments that compare different strains in a 'competitive' way, and to map epistasis, which captures the influence of genes on one another.

After building the system, they realized all the "cool things" it would allow, and the team began having "a field day," she says. When queries arrived from near and far, they realized it was high time for a paper so that others could share the benefits of the technology.

El-Samad situates her approach to systems biology at the midpoint between whole-genome snapshots and mechanistic studies of one or two genes. She takes from each of those approaches, traversing organizational scales, such as by finding ways to quickly and dynamically make many measurements of one network.

"We zoom in on a network that genomic studies have pinpointed as interesting, and study that system with the mechanistic details that have been usually reserved for single-gene studies," she says. "We are trying to bridge the two scales of resolution." She enjoys cycling between these scales and moving mathematics into an experimental context such that the results help improve the theory.

It was her mother, says El-Samad, who sparked her interest in mathematics when she was a child growing up in Beirut, Lebanon. "I remember struggling with geometry, and she would sit with me and we would imagine planes intersecting and such together," she says of her mother, a math teacher. "It was tons of fun."

After attending American University of Beirut, she studied electrical engineering at Iowa State University and was then recruited to the University of California at Santa Barbara (UCSB), where she completed her PhD in mechanical engineering. She was then awarded a UCSF Sandler Fellowship, an independent research position. Fellows receive funding for research, including a lab of 2–4 members.

Her first encounters with biology happened at UCSB, where systems biology was in the air and a new generation of researchers was exploring gene and protein networks. "It felt like the Wild West, and that was immensely exciting," she says.

Less exciting to her is the dearth of women in systems biology. Discrimination used to be rampant and visible, making it a clearer enemy, she says. But now the challenge is much more subtle and complex. "The belief that a woman cannot have a family and vibrant personal life and a high-power professional career seems to be deeply ingrained in most people, most alarmingly in the young women I talk to," she says.

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There are many contributing factors, including the lack of childcare at universities, which are "doing a miserable job making affordable childcare accessible to their faculty," she says. Funding agencies do no better.

Other perceptions do not help—for example, that girls are supposedly bad at math. There is also a lack of role models and information about past gains women have made in the sciences. These factors, alongside dwindling research resources, tough competition and the occasional overt aggression, all make academia "not palatable to many women," she says. To remedy this situation, she believes that recruiting women to the sciences should begin when they are young and that mentoring should continue throughout their careers.

In a thought experiment, El-Samad says that if she were the director of a grant-funding agency, she would make childcare and contributions to a university career center for women permissible indirect expenses on every grant. "This," she says, "will incentivize these efforts in universities and make institutions that don't invest in these aspects less competitive."

Vivien Marx

Zuleta, I.A., Aranda-Díaz, A., Li, H. & El-Samad, H. Dynamic characterization of growth and gene expression using high-throughput automated flow cytometry. *Nat. Methods* **11**, 443–448 (2014).