Yale

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The Beauty of Engineering

L'Oréal and Yale students use rheology, surface tension, and other science to innovate personal care

The world is so filled with engineering problems and their solutions, it's easy to overlook some of them. Walk down the beauty products aisle next time you're out shopping. All those shampoos and conditioners, for instance, involve complex fluids and soft solids. Optimizing these materials to turn frizzy hair into shiny, springy curls requires a mastery of things like rheology, surface tension and microscopy.

Seyma Aslan has these skills, and even she hadn't considered how they might apply to the cosmetics industry until a few years ago, near the completion of her Ph.D. in Chemical Engineering here at Yale a few years ago.

"I never thought that I would work for a cosmetics company," said Dr. Aslan, now a manager of innovation at L'Oréal — the largest cosmetics company in the world. "I never knew this field even existed or that they were hiring people working in colloid systems."

When she started her job search, though, she found a lot of openings in the field. She applied to L'Oréal, got the job, and has been there since. Aslan recently returned to Yale to lead a nine-week program created through a partnership between L'Oréal, the School of Engineering & Applied Science (SEAS) and the Tsai Center for Innovative Thinking at Yale (CITY). The program, known as an "intensive," welcomed students from all disciplines to learn the process of identifying a problem, finding a solution, turning it into a product and creating a marketing plan. It proved a productive endeavor, and two of the projects are now in the process of patent approval.

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"It is a win-win-win approach, where students get a certificate of completion signed by L'Oréal," Aslan said. "Yale gets a great model for students to strengthen their innovation and soft skills, and L'Oréal wins by engaging with the students to identify talent and getting a lot of inspiration for innovation"

The program began to take shape when Aslan and her colleagues were brainstorming about personal care problems and their potential solutions. Perhaps, they decided, it would help to bring in some new ideas.

"We wanted to chat with university students and identify technical challenges and build strong collaborations," Aslan said. "And I remembered my good old days at Yale where we used to have a lot of hackathons in the Center for Engineering Innovation & Design (CEID)."

Aslan contacted Deputy Dean Vincent Wilczynski, director of the CEID, who had been her advisor while she was in the SEAS Advanced Graduate Leadership Program (AGLP), a program designed to give students work experience beyond the research lab. Wilczynski contacted Tsai CITY, and three parties hashed out some ideas, and the plan for the nine-week program was hatched. Thirty students were selected for the program (more than twice as many had applied).

Molly Grun, a graduate student in the lab of Mark Saltzman in biomedical engineering, heard about the program through her participation in AGLP. It sounded like a great opportunity.

"I hadn't had a lot of experience as a graduate student that involved anything like product design," she said. "And it was part of the reason I joined AGLP, because I had been wanting to work with Tsai CITY and learn about design process."

Below: *The L'Oréal Intensive was so popular that only half of the individuals who applied were selected.*

The students were broken up into seven four-person teams. Each team had a technical expert to advise them, some from L'Oréal, some from Yale. The student teams submitted their milestones every other week so the advisors could help keep them on track. That's an important part of the process; Aslan noted that industry timelines and methods can differ greatly from those in academia.

"Sometimes students are very ambitious, very innovative, very out of the box — but with only nine weeks it's impossible to create something like a moonshot," she said. "We didn't want to constrict their innovation in any way, but they needed to be aware of the obstacles."

Most of the work was done either at the Greenberg Engineering Teaching Concourse (GETC) or in the John Klingenstein Lab at the CEID. In both venues, the students learned to use various tools, like a Rayneri Turbotest benchtop mixer to make cosmetic formulations, and a rotary evaporator to remove solvents. Sara Hashmi, then a SEAS associate research scientist, was recruited to help with lab work.

"A lot of science goes into it," said Hashmi, now an associate professor of chemical engineering at Northeastern University. "The students were given pretty free reign — they were basically told 'We want you to go and make a product.' Some made actual hardware like hair rollers, and others made products from chemicals to add to your hair."

Above: *Students were able to hear from L'Oréal representatives on such topics as innovation, operations, and business management. They also had a chance to learn how to use various tools, like a rotary evaporator, or rotovap, used to remove solvents.*

In addition to working on their projects, the students also attended inspirational talks from L'Oréal representatives, each with a different take on how industry works — innovation, operations and business management.

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Top to Bottom: *The four-person teams — seven in all — were designed for background diversity, so engineers worked with students from completely different disciplines. The first- and second-place teams' products so impressed L'Oréal that the company has filed patents for each.*

"The students enjoyed hearing about the real-world problems — some failures, sometimes success stories," Aslan said. "They got to hear about what it actually means to work in industry and the kinds of things you encounter."

Rodrigo Ojeda, a graduate student in the lab of Jan Schroers in Mechanical Engineering, said it was that real-world experience that appealed to him about the program. His team ended up developing a product to help consumers' hair dry faster, using super-absorbent polymers.

"For me, it was about getting more industry experience," he said. "You're doing research, but you still have to come up with results in some way. You might have these great ideas, but can you actually deliver them in this time frame? We had to take into account the time and the budget needed to produce the project. So you get the industry experience — but you're not exposed, like 'Oh I'm going to get fired!'"

The teams were pre-assigned and designed for background diversity. So engineers might work with someone from the School of Management or a history major. Both Grun and Ojeda noted that working with non-engineers on a project like this was a new experience. "It's challenging to work in interdisciplinary teams, but everyone does have something to contribute — you just have to work at it," Grun said.

Another lesson Grun learned early on in the process: "Coming up with new ideas is really hard. The consumer product field is a very crowded space — if you think of an idea, it's probably been done before." Nonetheless, her team came up with an original idea and marketing plan. Combining chemistry and smartphone technology, the product tested for hair health. It took third place at the pitch-off that was held at the end of the nine weeks.

The pitch-off was judged by L'Oréal USA's Mohamed Kanji, Senior Vice President and head of research & innovation, the company's human resources director, Omer Imtiaz, and head of Hair Care Development labs, Anthony Potin. From Yale the judges were Katherine Schilling, associate research scientist and Paul Anastas, the Teresa and

H. John Heinz III Professor in the Practice of Chemistry for the Environment.

"When the seven groups presented, everyone in the room was amazed by the quality of the work," Aslan said. "The approaches and solutions were all very pragmatic, and all the teams brought a prototype, which is astonishing for a nine-week, non-credit certification program."

The first- and second-place teams' products so impressed L'Oréal that the company has filed for patents for each. The first-place team presented a product that allowed users to change their hair colors within seconds.

"The students did a demonstration, and the audience was shocked that they could come up with a solution with such a dramatic effect on the hair in such a short amount of time," she said. Besides the product's technological innovation, she said, it also meets consumer demand for ever-faster products. "Consumers desire different things, depending on the time they live in. This is the time of 'I want it now, at this moment!'"

The second-place team devised a product to broaden hair-curling possibilities — again filling a consumer need, Aslan said. "This area has been neglected for so long and curly hair is very hard to manage. It's a complex routine and there are certain challenges to be addressed."

Aslan said much of her job is aimed at reaching out to neglected consumers. On example is a paper that she and her colleagues recently published in the International Journal of Cosmetic Science on the physical characteristics of the hair of Mexican women.

Above: *A team poses with Aslan (far-right) after successfully presenting their product, which uses super-absorbent polymers to make hair dry faster.*

After four years in the cosmetics industry, Aslan said she's still glad she took the job. Unlike the pharmaceutical or refinery industries — the two fields she had expected to enter while a student — you see results fast.

"Seeing a product you worked on when you're passing through the supermarket, it's such an amazing feeling," she said. "Having an impact on consumers and actually being able to explain your innovation and your work to your grandmother – it feels great!"