THE AUTHOR FILE

# Jennifer Elisseeff

Exploring the extracellular matrix in high throughput and leaping across scientific divides as if they weren't there.

Cells interact plenty with their neighbors. In tissues and organs, cells are above, below and next to one another and surrounded by an extracellular matrix (ECM) that is far more than a neutral scaffold, although the depth of its impact on cells is only slowly being appreciated, says Jennifer Elisseeff, a biomedical engineer at Johns Hopkins University.

Johns Hopkins University

Jennifer Elisseeff

The ECM is known to be complex—it contains hundreds of biomolecules that shape cell behavior with chemical and mechanical cues. Elisseeff seeks to find out which of these ECM components or combinations thereof influence cells, and she wants to explore general and tissue-specific characteristics of the ECM. She and her colleagues have now developed chips that allow scientists to study these issues closely and in high throughput. The chips reveal how cells growing flat on a dish or in a 3D spheroid react to ECMs of differing composition. Each chip has 40 spots, each one with a slightly different ECM. And chips can be made larger still, she says.

The method addresses a scientific divide. Some scientists prefer the control that synthetic ECM offers; others see tissue ECMs as more biologically relevant. Elisseeff and her team are looking at both approaches for scaffolds without taking sides as to which is better, she says. The arrays let researchers probe questions while bridging this divide. She hopes the chips can also move biomaterials and regenerative medicine into the realm of big data analysis and let labs investigate more of these materials' mechanisms.

The chips have offered some surprises that are likely to lead to more experiments. For example, ECM from bone stimulated bone growth in stem cells with both 2D and 3D chips, but lung tissue ECM also enhanced bone growth in cells. Bone ECM is known to stimulate cells to make bone, says Elisseeff. "However, the cool part was the unexpected—like lung," she says. Cancer in the lung can involve calcifications, and the lung ECM carries some of the needed signals, so that could partly explain the result, she says.

Linking the clinical realm and engineering matters to Elisseeff in that it gives technologies direct impact. This information can feed back into research, offering design parameters and presenting new scientific questions.

Being ready or getting ready for the unexpected is central to Elisseeff's approach to research. The idea for the chips came to her when she was evaluating some unexpected results in a biomaterials project involving patients. "What we noticed was that the cells around the implant were different depending on if it was adjacent to adipose, dermis or muscle," she says. This led to the chips project and to a sabbatical in Melody Swartz's lab at École Polytechnique Fédérale de Lausanne, where Elisseeff studied immunology and immunoengineering. These areas frame her lab's new direction as she connects the traditionally separate disciplines of cancer, stem cells and immunology. She hopes to develop biomaterials that modulate the immune system and promote healing.

Crossing the disciplinary divide takes respect, openness and understanding of different cultures and language, she says, just as in travel and international relations. "Different fields don't necessarily have divides; they just grow up in different places," she says.

Elisseeff completed her PhD in the Harvard-MIT Division of Health Sciences and Technology and did her first two years of medical school alongside her PhD studies. She was a postdoctoral fellow in developmental biology at the National Institute of General Medical Sciences, one of the US National Institutes of Health.

Her approach to expectations colors the way she mentors members of her lab. Often they have an expectation of what should happen in an experiment, and they get stuck when what they seek does not occur. "However, the coolest discoveries actually come from following the unexpected results and asking why," she says.

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Outside of the lab, Elisseeff values family time. Music is important, too; she has played the piano for years. She adores being in the countryside, on mountains and in the ocean swimming and snorkeling. Travel is integrated into her life; her husband lives part-time in Italy, and "going there and eating is always nice," she says.

"I have known Jennifer since she was a graduate student who was wise beyond her years as well as a wonderful human being," says MIT tissue engineer Robert Langer, her PhD advisor. "It's been such a pleasure to watch her grow," he says, from that young researcher in the early stages of her career to a highly successful professor and scientist as well as a "terrific leader and mentor."

**Vivien Marx**

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