Discovery could create retinas from 'Jell-O'

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Researchers at the University of Toronto have developed a new method for creating 3D hydrogel scaffolds that will aid in the development of new tissue and organs grown in a lab.

The discovery is outlined in the latest issue of Nature Materials. Watch a video below.

Hydrogels, a “Jell-O”-like substance, are highly flexible and absorbent networks of polymer strings that are frequently used in tissue engineering to act as a scaffold to aid cellular growth and development.

The paper demonstrates for the first time that it is possible to immobilize different proteins simultaneously using a hydrogel. This is critical for controlling the determination of stem cells, which are used to engineer new tissue or organs.

“We know that proteins are very important to define cell function and cell fate. So working with stem cells derived from the brain or retina we have demonstrated we can spatially immobilize proteins that will influence their differentiation in a three-dimensional environment,” explained Professor Molly Shoichet of the Department of Chemical Engineering & Applied Chemistry, the Institute for Biomaterials & Biomedical Engineering and the Department of Chemistry.

Immobilizing proteins maintains their bioactivity, which had previously been difficult to ensure. It is also important to maintain spacial control as the tissue and organs are three-dimensional. Therefore, being able to control cell fate and understanding how cells interact across three dimensions is critical.

“If we think about the retina, the retina is divided into seven layers. And if you start with a retinal stem cell, it has the potential to become all of those different cell types. So what we are doing is immobilizing a protein which will cause their differentiation into photoreceptors or bipolar neurons or other cell types that would make up those seven different cell types,” said Shoichet.

The end result is a new hydrogel that can guide stem cell development in three-dimensions.

Shoichet identifies two long-term outcomes from this discovery.

“We could use... it as a platform technology to look at the interaction of different cells and build tissues and organ,” Shoichet stated, while also noting that it could help lead to a more fundamental understanding of cellular interaction. “By growing cells in a 3D environment, similar to how they grow in our body, we can develop a better understanding of cell processes and interactions.”

The research was led by Shoichet and was conducted by Ryan G. Wylie, Shoeb Ahsan, Yukie Aizawa, Karen L. Maxwell and Cindi M. Morshead.

Provided by University of Toronto