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Combining Biology and Engineering to Revolutionize Tissue Engineering

Organovo's 3D bioprinting technology coupled with Corning's Transwell® permeable supports takes 3D cell culture research to a new level.

A scientist at Organovo preps one of the company's proprietary bioprinters. Image courtesy of Organovo.

"We can print a full plate of tissue, such as liver, in a 24-well Transwell insert within 60 minutes, so the printing process is a relatively fast and efficient procedure."

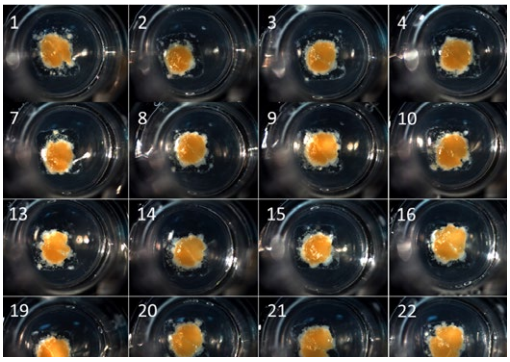
— SHARON PRESNELL, CHIEF SCIENTIFIC OFFICER AT ORGANOVO

Imagine the scientific possibilities when combining the principles of 3D printing with cell culture. Thanks to the innovative conceptual research of Professor Gabor Gorgacs from the University of Missouri and Dr. Thomas Boland from Clemson University, this revolutionary technique is now a reality. Now operating as the medical research company, Organovo, and being run by Sharon Presnell, Chief Scientific Officer, 3D bioprinting allows researchers to reproduce the unique features found in the geometry of natural tissues, while creating the cell-cell relationships that drive cellular function.

This latest technology, supported by Corning's Transwell permeable supports, is advancing the field of tissue engineering. It reflects a technological evolution in both the biological and engineering side of cell culture, and it is enabling scientists to develop a more balanced approach to new tissue design.

How It Works

Using primary human cells, Organovo researchers formulate them into "bio-inks"—some of which are 100% cellular, whereas other bio-inks may have components added to provide stiffness or other favorable attributes. In order to facilitate cell-cell relationships rather than cell-material relationships, researchers will work with



3D bioprinted human liver tissue. Image courtesy of Organovo.

Sharon Presnell, Chief Scientific Officer at Organovo and President of subsidiary company Samsara

"Corning has also been great to work with in terms of flexibility and helping address our special needs. We are currently collaborating with our partners at Corning to develop a Transwell tray to improve ease-of-use and streamline our tissue manufacturing process. It has been a pleasure to work so productively and collaboratively with the team at Corning. It's always good to have partners like that."

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fugitive biomaterial that disappears quickly after printing. The media used are at least 30% cellular, all the way up to 100% cellular, even at the time of their printing, which is an important part of Organovo's platform.

Researchers then print the tissue into Transwell® permeable supports, which enables the tissues to anchor. For each tissue printed, Organovo uses at least two or three different materials laid down independently, which provides much-needed flexibility in the number of components and architectures that can be made. The result—different cell types are able to pattern in all three directions—x, y, and z—and this is the unique advantage of bioprinting over other typical 3D cell culture strategies that utilize scaffolds or hydrogels. "We can print a full plate of tissue, such as liver, in a 24-well Transwell insert within 60 minutes, so the printing process is a relatively fast and efficient procedure," Presnell said.

A Partnership for Success

According to Presnell, Organovo chose to partner with Corning because of the good repertoire of products, along with the diverse types of surfaces, pore sizes, and coatings available. "[This gave] us a range of options to pick from, which is ideal, because not all tissues are created equally," Presnell said.

Organovo researchers ultimately chose Transwell permeable supports because the tissue can be fed from all directions through the membrane's pores. By *in vitro* standards, the bioprinted tissue is fairly large, so it's important for the tissue to have nutrient access from the bottom as well as the top. This work, "would simply not be possible without the Transwell permeable supports," said Presnell.

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Applications and a Look to the Future

Currently, bioprinting has enabled the creation of physiologically relevant cell models for *in vitro* drug testing. "We're focusing on developing really robust applications around the tissues we make, so, with the example of liver, we have a pretty good handle on what that tissue can provide in the way of toxicology testing. We have shown that we can take these tissues and perturb them in certain types of ways, causing them to develop biomarkers and histological features that are aligned with certain disease states, such as fibrosis," Presnell said.

Bioprinting has also generated a buzz around its potential for the generation of complex organs, which could be used for *in vivo* implantation in the near future. Adds Presnell, "Where I would love to see us progress to, as a field, is developing more ways to get information out of the 3D systems that are efficient. By broadening our understanding, we can find out how to make the tissue more like a natural model tissue."

For More Information:

Learn more about the science and technology behind bioprinted human tissue models from Organovo by visiting **www.organovo.com**

Visit **www.corning.com/3D** to discover why more scientists reach for Corning permeable supports than any other research tools of their kind.

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Corning Incorporated
Life Sciences
836 North St.
Building 300, Suite 3401
Tewksbury, MA 01876
t 800.492.1110
t 978.442.2200
f 978.442.2476
www.corning.com/lifesciences

For additional product or technical information, visit **www.corning.com/lifesciences** or call 800.492.1110. Outside the United States, call +1.978.442.2200 or contact your local Corning sales office.