

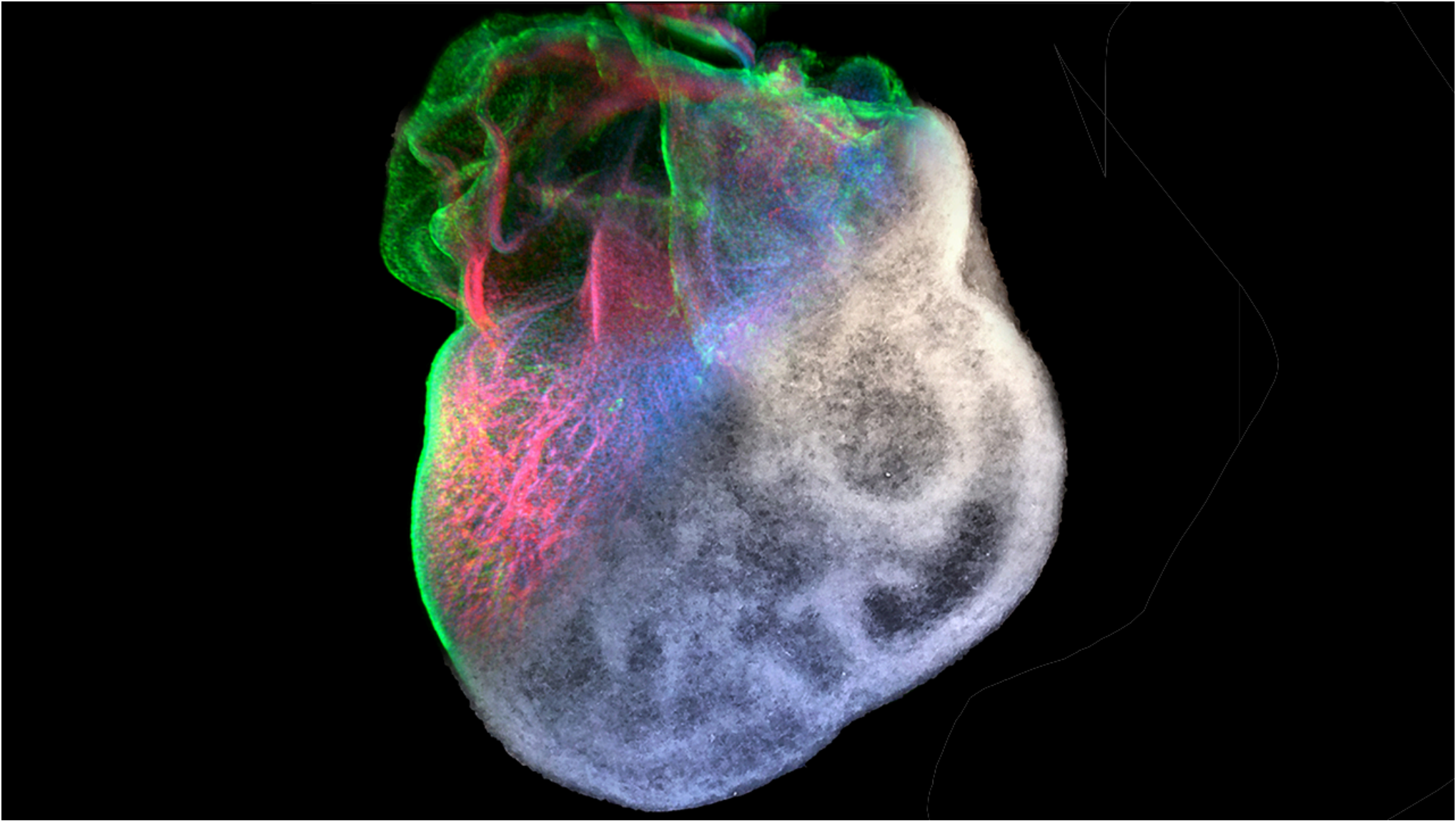
[HOME](#) > [NEWS](#) > [ALL NEWS](#) > 3D PRINTING SOFT BODY PARTS: A HARD PROBLEM THAT JUST GOT EASIER

NEWS TECHNOLOGY

3D printing soft body parts: A hard problem that just got easier

Inexpensive printer may one day repair cardiac tissue damaged by heart attacks

23 OCT 2015 • BY NALA ROGERS



A merge of the image of an embryonic chick heart and the 3D-bioprinted embryonic heart scaffold created from that image. THOMAS J. HINTON AND QUENTIN JALLERAT

SHARE:



Humans are squishy. That's a problem for researchers trying to construct artificial tissues and organs, and one that two separate teams of engineers may have just solved. Using a dish of goo the consistency of mayonnaise as a supporting "bath," a team led by biomedical engineer Adam Feinberg at Carnegie Mellon University in Pittsburgh, Pennsylvania, can now print 3D biological materials that don't collapse under their own weight as they form—a difficulty that has long stood in the way of printing soft body parts. Once printed, the structures are stiff enough to support themselves, and they can be retrieved by melting away the supportive goo. The other team, from the University of Florida (UF) in Gainesville, has a similar system for printing, but without the slick trick of the melting goo.

The Carnegie Mellon team's body parts—which include models of brains and hearts—are more intricate than anything created before, says Anthony Atala, a tissue engineer and director of the Wake Forest Institute for Regenerative Medicine in Winston-Salem, North Carolina, who was not involved in either project. "I think it's a very nice strategy that will open up even more avenues for future development and research," Atala says.

To date, that research has largely been geared to using rigid 3D-printed materials as prosthetics, some of which are even implanted in peoples' bodies. They take many forms, from titanium plates that replace missing chunks of skull to [dissolvable tracheal splints](#) that hold open collapsed airways. Several groups have been working to extend this success to create squishier

tissues, with the initial structure crafted in watery gels composed of loosely linked sugars or proteins. This matrix would then form the support for growing cells, with live cells either printed in the gel or added afterward.

SIGN UP FOR OUR CAREERS NEWSLETTER

Get great career content biweekly!

SIGN UP >

To form the matrix, scientists push the liquid molecules through a printer nozzle and then cross-link them into gels of various consistencies through exposure to chemicals or stimuli such as light. But the mixtures tend to flow away or collapse before they can stiffen into the elaborate shapes required for functioning organs.

To solve this problem, Feinberg and his colleagues decided to try printing their gels in a slurry made of blended collagen. Their new approach—[called freeform reversible embedding of suspended hydrogels](#) (FRESH)—worked. The collagen slurry, semisolid at room temperature, held printed objects in place until they hardened. And because the melting point of the slurry is much lower than that of the objects, it melted away once the temperature was raised to 37°C (99°F), they report today in *Science Advances*. In the same journal last month, Thomas Angelini's lab at UF [described a similar printing method](#) using a support gel made of synthetic materials, which they washed off with water.

To put the FRESH system through its paces, Feinberg and his colleagues printed replicas of real organs based on magnetic resonance imaging and microscopy images. Their creations included a miniature human brain and a scaled-up heart of a baby chicken, both printed to about the size of a quarter. They also made a branching pattern of arteries with walls less than one millimeter thick. The team printed structures in a variety of materials, including collagen and fibrin—both structural proteins found in the human body—and a seaweed-derived substance called alginate that is widely used as a thickening or structural agent in food, industry, and medicine. Whereas the more complex structures were made of a single material, the FRESH system can also print multiple materials simultaneously.

Jonathan Butcher, a biomedical engineer at Cornell University who is using another method to develop 3D-printed heart valves, found the artery tree particularly impressive. "I don't know if we can make that geometry with our approach," Butcher says. "The material complexity that they've been able to fabricate is really stunning."

What's more, Feinberg and his colleagues did it on the cheap, using open-source machinery and software. They started with an inexpensive commercial printer, and used it to make their own custom extruder heads. Now, other researchers will be able to make a basic FRESH setup for less than \$500, says Thomas Hinton, a graduate student in Feinberg's lab and first author of the study.

The next major hurdle for FRESH is incorporating live cells into their gel matrix. Feinberg and his colleagues have already demonstrated that cells can survive the FRESH process by printing a sheet of muscle cells in a simple sheet. But the model organs described in the paper contained no cells, and they only mimicked the outside surface of body parts. In order to function in the body, printed tissues need complex internal structures populated with living cells, or, in some cases, layers of cells on scaffolds.

The researchers are currently working to incorporate live cells into their matrices to create functional heart muscle, Feinberg says. Their next goal is to develop heart muscle "patches" that would repair heart defects. In the short term, such artificial tissues could help researchers study disease processes and test new drugs in the lab. Eventually, printed heart muscle might repair damage from a heart attack and help pump a living person's blood.

Meanwhile, Feinberg says he wants to make his method as widely available as possible. "I hope other people will take this up and run with it," he says. "Even in ways I can't imagine."

doi: 10.1126/science.aad4762

RELEVANT TAGS:

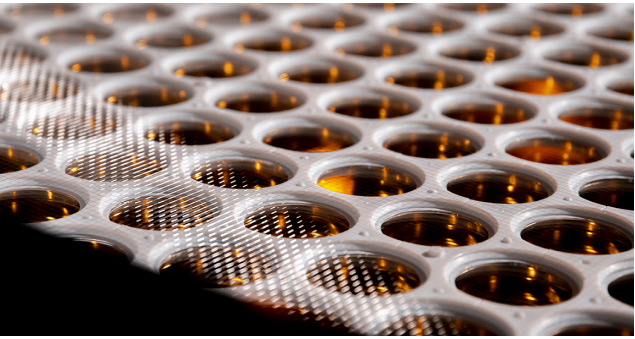
TECHNOLOGY

ABOUT THE AUTHOR



Nala Rogers 
Author

MORE FROM NEWS



26 AUG 2024
Hunt for dark matter particles bags nothing —again
BY ADRIAN CHO



24 AUG 2024
Confused about the mpox outbreaks? Here’s what’s spreading, where, and why.
BY KAI KUPFERSCHMIDT



23 AUG 2024
Mini-*Dune*! Soil viruses hitchhike on tiny worms to infect new victims
BY ELIZABETH PENNISI

[VIEW MORE >](#)

Got a tip for Science's news department?

[CONNECT >](#)

Sign up for ScienceAdviser

Subscribe to *ScienceAdviser* to get the latest news, commentary, and research, free to your inbox daily.

[SUBSCRIBE >](#)

SCIENCEINSIDER ⓘ



24 AUG 2024 | BY KAI KUPFERSCHMIDT
Confused about the mpox outbreaks? Here’s what’s spreading, where, and why.



22 AUG 2024 | BY ROBERT F. SERVICE
Synthetic biology, once hailed as a moneymaker, meets tough times



22 AUG 2024 | BY DENNIS NORMILE
Have China’s carbon emissions peaked? The answer is critical to limiting global warming



21 AUG 2024 | BY KATIE L. BURKE
Larger teams worsen academic career prospects