BU Wins $20M for NSF Engineering Research Center

Goal is personalized heart tissue for clinical use / BY BARBARA MORAN

Boston University has won a $20 million, five-year award from the National Science Foundation to create a multi-institution Engineering Research Center, with the goal of synthesizing personalized heart tissue for clinical use.

THE GRANT, WHICH IS RENEWABLE FOR A total of 10 years and $40 million, is designed to accelerate an area of engineering research—in this case, bioengineering functional heart tissue—that is likely to spur societal change and economic growth within a decade.

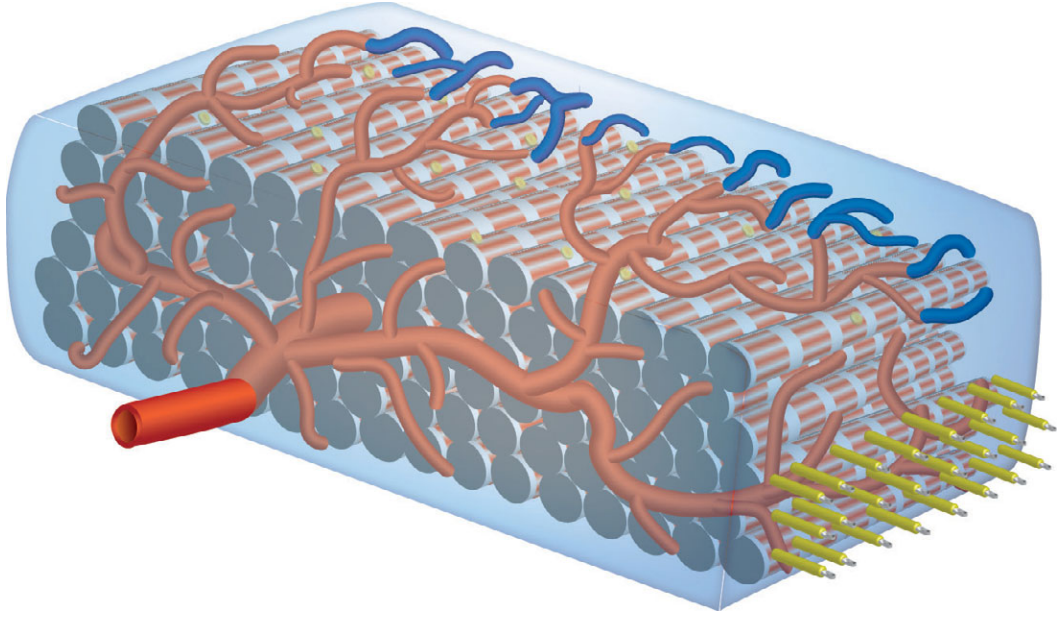
"The goal is moving from the basic research capability to a technology that could be disruptive," says Kenneth Lutchen, dean of the College of Engineering and a professor of biomedical engineering.

Engineering Research Center (ERC) grants are extremely competitive. Of more than 200 applicants, only 4—Boston University, Purdue University, the Georgia Institute of Technology, and Texas A&M University—received awards in 2017.

The ERC will be housed at BU, the lead institution on the grant. The award hits a "sweet spot" at the intersection of BU's strengths in biomedical engineering, photonics, and nanotechnology, says Lutchen. David Bishop, an ENG professor of electrical and computer engineering, a College of Arts & Sciences professor of physics, and head of ENG's Division of Materials Science & Engineering, will direct the center.

▲ "It's humbling to have the opportunity to work on something that could be a game changer," says David Bishop, who will direct the ERC.

Working with Bishop will be four leaders in specific areas of technical expertise: Thomas Bifano, an ENG professor of mechanical engineering and director of the Photonics Center, will direct imaging; Alice White, an ENG professor and chair of the mechanical engineering department, will direct nanomechanics; Christopher Chen, an ENG professor of biomedical engineering, will direct cellular engineering; and Stephen Forrest, a University of Michigan professor of materials science and engineering, will direct nanotechnology. Arvind Agarwal, a Florida International University (FIU) professor of mechanical and materials engineering, will work with White's team to advance nanomechanics methods, and will also lead FIU's involvement in the ERC, with a crucial role in education and outreach. The center will also develop areas of expertise in education, diversity, administration, and outreach.



▶ The center's ultimate goal is to advance nano-biomanufacturing methods that could lead to large-scale fabrication of functional heart tissue—like this cardiac patch—which could replace diseased or damaged muscle after a heart attack.

Two partner institutions—the University of Michigan and Florida International University—as well as six affiliate institutions—Harvard Medical School, Columbia University, the Wyss Institute at Harvard, Argonne National Laboratory, the École polytechnique fédérale de Lausanne in Switzerland, and the Centro Atómico Bariloche/Instituto Balseiro in Argentina—will offer additional expertise in bioengineering, nanotechnology, and other areas.

"We have assembled a very competitive team from world-class institutions with a compelling vision," says Bishop, noting that the grant is designed to move research from the lab into industry, while also creating education, job training, and employment opportunities. "This grant gives us the opportunity to define a societal problem, and then create the industry to solve it. Heart disease is one of the biggest problems we face. This may allow us to solve it, not make incremental progress."

Heart disease—including coronary heart disease, hypertension, and stroke—is the leading cause of death in the United States, according to the American Heart Association. About 790,000 people in the United States have heart attacks each year, about one every 40 seconds. Of those, about 114,000 will die. Statistics like these, and the fact that cardiovascular disease is relatively advanced in terms of regenerative medicine, led the team to target heart disease in their ERC proposal.

Scientists and engineers have been struggling to build or grow artificial organs for decades. But aside from simple, nonmoving parts, like artificial windpipes, the field has not lived up to its early promise. This is partly because organs, with their multiple cell types, have proved difficult to synthesize, and also because researchers have learned that the body's dynamic stresses—beating hearts, stretching lungs—play a larger role in how tissues grow and perform than originally thought.

The ERC plans to accomplish four goals with the cellular metamaterials it intends to build: fabricate responsive heart tissue containing muscle cells and blood vessels; understand and control the tissue using optical technologies; scale the process up to easily create multiple copies of the tissue; and personalize the product, so it can be tailored to individual patients. The first goal will be to create "functionalized heart tissue on a chip," says Lutchen, tissue that could be built with a specific patient's cells and used to test new drugs and therapies. The ultimate goal is to fabricate heart tissue that could replace diseased or damaged muscle after a heart attack.

"It's humbling to have the opportunity to work on something that could really be a game changer," says Bishop. "If we succeed, we'll save a lot of lives and add meaningful years for many people."

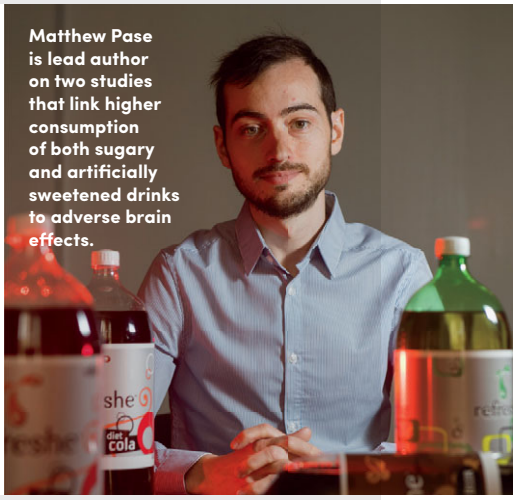
FACING PAGE: CYDNEY SCOTT (TOP), COURTESY OF JEROEN EYCKMANS; THIS PAGE: CYDNEY SCOTT (TOP), VITRANC/ISTOCK

IN PROGRESS

Soda's Effect on the Brain, Checking in on Airbnb, How to Grow Blood Vessels, Too Much Sleep and the Risk of Alzheimer's Disease

IS TOO MUCH SODA BAD FOR YOUR BRAIN?

Americans consumed nearly 11 million metric tons of sugar in 2016. New research suggests that people who frequently drink sugary beverages like soda are more likely to have poorer memory, smaller overall brain volume, and a significantly smaller hippocampus—an area of the brain important for learning and memory. A follow-up study found that people who drank artificially sweetened diet soda daily were almost three times as likely to develop stroke and dementia when compared to those who did not.



Matthew Pase is lead author on two studies that link higher consumption of both sugary and artificially sweetened drinks to adverse brain effects.

AIRBNB NOT HURTING BOSTON HOTEL SECTOR

The growth of Airbnb has had little effect on the Boston hotel market, a School of Hospitality Administration study found. Data from January 2015 to September 2016 show that Boston's hotel sector maintained or increased its room rates and revenues per room, even as the supply of hotel rooms has increased. A second SHA paper found that Airbnb customers will pay more for features that hotels can't always provide, such as handicapped accessibility, family-friendly accommodations, or a free breakfast.

GUIDE FOR GROWING BLOOD VESSELS

Narrowed, hardened, or blocked blood vessels starve tissue, often resulting in heart attack, stroke, or gangrene. Surgery can correct the problem in large vessels, but treatment is more complex in vessels that are smaller or damaged by prior treatment. ENG's Christopher Chen, using 3-D–printed patches infused with cells, is developing a promising method to growing healthy blood vessels. The patch fosters the growth of new blood vessels, while avoiding some of the problems of other approaches.

People over 65 who sleep longer than nine hours each night may be showing early signs of Alzheimer's disease.

TOO MUCH SLEEP COULD SIGNAL DEMENTIA

BU researchers have found that people over age 65 who consistently sleep more than nine hours every night had twice the risk of developing dementia and Alzheimer's disease within the next 10 years when compared to those who slept less than nine hours a night. Longer periods of sleep can also be a sign of depression. The results suggest that longer sleep sessions may be a symptom rather than a cause of the brain changes that occur with dementia. Earlier detection can help patients and their families plan and obtain services and support.

ONLINE: *Read more about BU research at bu.edu/research.*