Space station cell study seeks causes of major diseases

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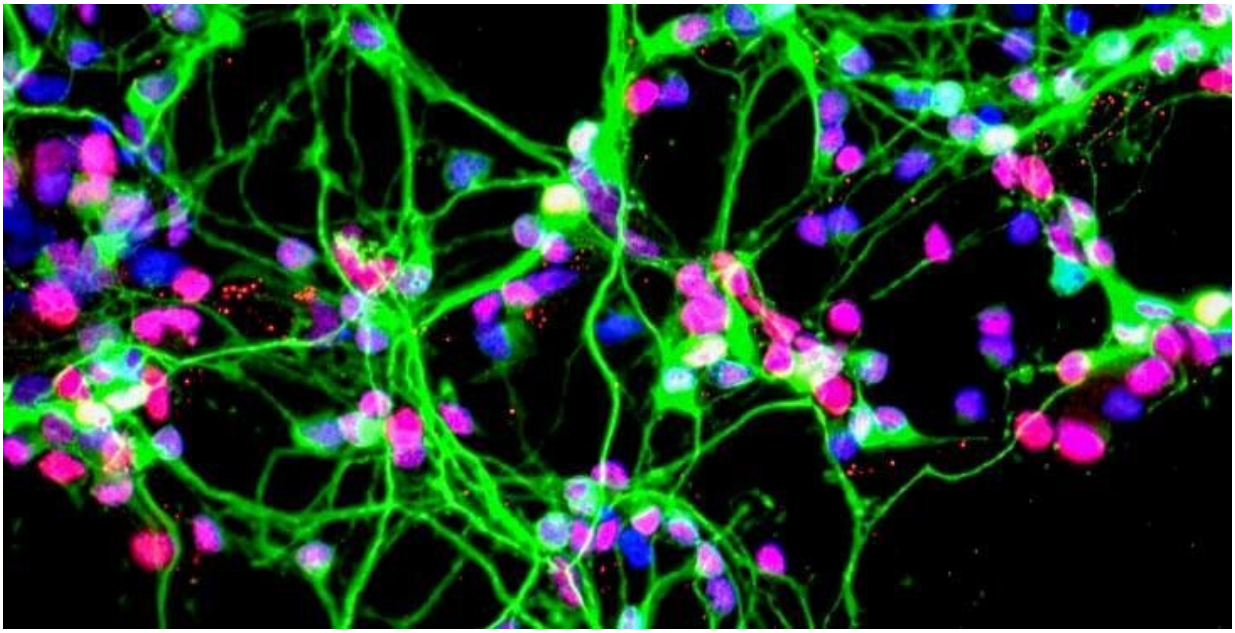


Dopaminergic neurons growing in a culture dish (20x magnification). A skin biopsy from a patient with Parkinson's disease was reprogrammed into induced pluripotent stem cells. The stem cells were then differentiated into dopaminergic neurons (green), the same cells that are lost in Parkinson's disease patients. Work is under way to use these cells as a replacement for lost neurons as a treatment for the disease. Credit: Aspen Neuroscience

High above the Earth, researchers are conducting a first-of-its-kind study to help patients with Parkinson's disease and multiple sclerosis on the

planet below. The International Space Station experiment is looking for what triggers these diseases by studying how nerve and immune brain cells interact.

The experiment, carried to the space station aboard the SpaceX CRS-18 cargo flight, will look at what is causing damage to the nervous system that is common in both illnesses and reveal how living in space affects similar cells in healthy astronauts.

The study is led by stem cell expert Andres Bratt-Leal of Aspen Neuroscience in La Jolla, California, and Valentina Fossati, a multiple sclerosis researcher with the New York Stem Foundation Research Institute in New York.

"This is the first time anyone is researching the effects of microgravity and spaceflight on such cells," said Bratt-Leal. "These cells are hard to study in a lab because of the way gravity influences them. The cool part is now we can do it in space!"

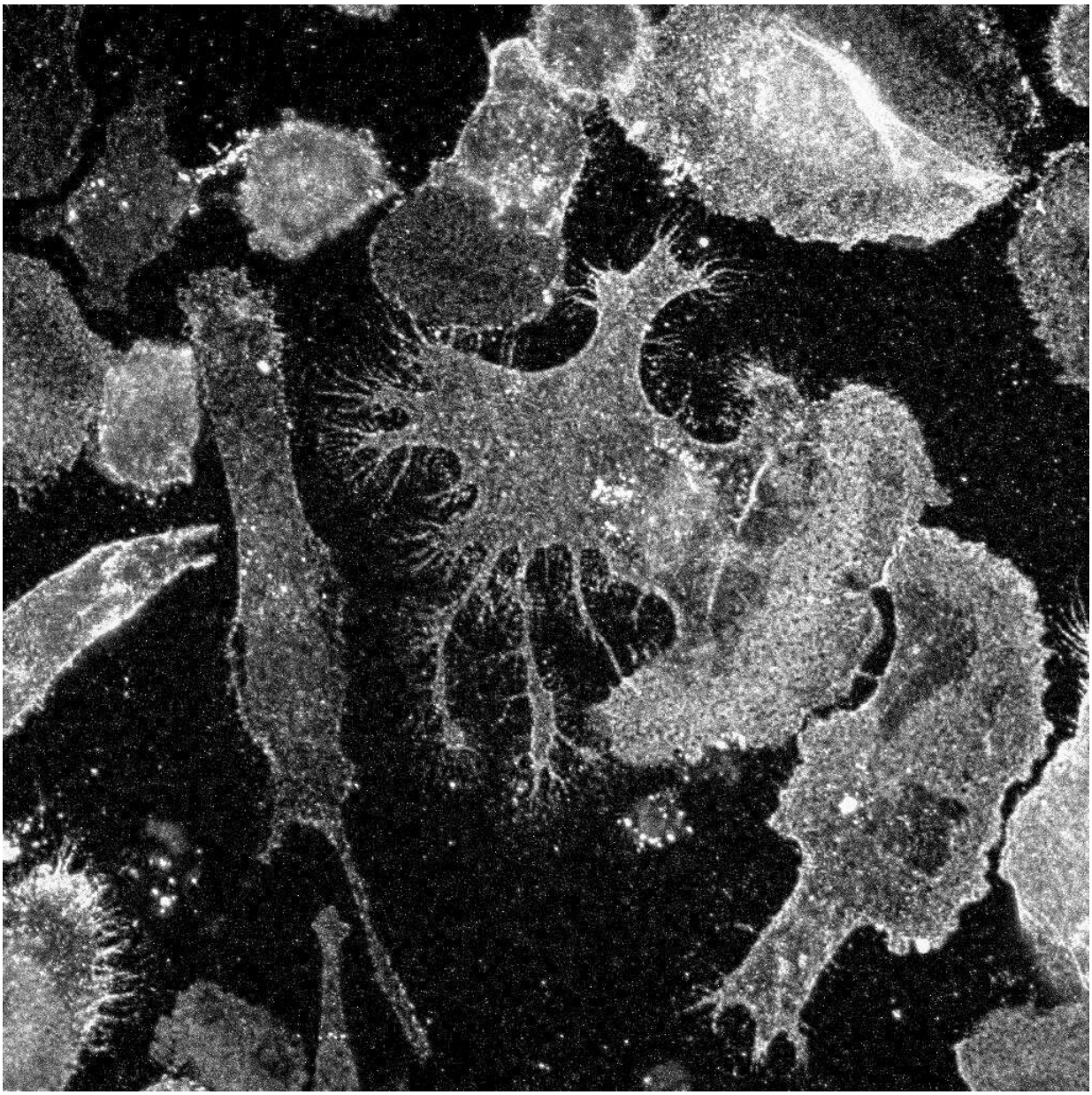
Neuron killers

Parkinson's disease and multiple sclerosis are neurodegenerative illnesses that damage the brain and central nervous system. The researchers suspect this damage may be the result of a glitch in the body's immune system. NASA is interested in how spaceflight changes the immune system since some astronauts experience strange effects following missions, including temporary activation of dormant viruses.

To learn more, Bratt-Leal and Fossati are focusing on the types of cells in the brain that seem to play key roles in the onset of both diseases. The first types are neurons and the cells that create them, which go on to form the body's nerve network and allow the brain to monitor and control it. The second are microglia: immune cells that patrol the brain

and try to defend the neurons from threatening invaders.

"The microglia are found in every part of the brain, and it's really starting to look like neurodegenerative illnesses develop because the cells begin behaving improperly or overreacting," said Fossati. "Misbehaving microglia may contribute to killing the neurons."



Microglia cells growing in a culture dish (63x magnification). Microglia are the immune cells of the brain and play a role that is not fully understood in neurodegenerative diseases like multiple sclerosis. The cells shown here were differentiated from induced pluripotent stem cells that were made from a patient's skin biopsy. Credit: New York Stem Cell Foundation (NYSCF) Research Institute

A new way to make old cells

To find out whether that is the case, the researchers need to study the growth of neurons and microglia from people with the diseases and compare them to healthy people of the same age. Since these cells are located within the brain, they cannot be extracted safely.

Bratt-Leal and Fossati found another way, harnessing a new stem cell technology called "induced pluripotent stem cells" to make neurons and microglia from the skin cells of patients and healthy people in laboratories.

Space for cells

Bratt-Leal and Fossati launched newly created diseased and healthy cells into space to observe them away from the heavy influence of Earth's gravity.

"We know that forces can influence the behavior of cells by changing aspects such as their shape. So, what happens when you remove gravity?" said Bratt-Leal. "How the cells respond will tell us new things about how they function."

The cells are now aboard the space station, living inside a CubeLab

developed by Space Tango, a company that develops equipment for microgravity research. The CubeLab is approximately the size of a small shoebox.

Inside the CubeLab is a camera to watch the experiment as well as a pair of 96-chamber containers holding the cells. One "well plate" holds the cells of a Parkinson's patient and a healthy person of similar age. The second plate contains the cells of a multiple sclerosis patient and an age-matched healthy donor. A tubing and pump system automatically provides liquid food to the cells inside their chambers.

Over the course of 30 days, Bratt-Leal and Fossati can watch remotely to see how the neuron cells organize into balls, called "organoids," and how the microglia cells respond to and infiltrate them. After a month, the cells will be returned to Earth, where researchers plan to examine their shape and arrangement and test their DNA to see if microgravity and space radiation exposure altered their gene expression.

The results of the research ultimately could help scientists identify new ways to treat Parkinson's disease and multiple sclerosis. Also, discovering the way nerve cells are affected by microgravity and radiation may lead to improved methods for protecting astronauts in space, particularly on long-duration missions.

Provided by NASA