

Skin cells are turned into stem cells through a process called cellular reprogramming, and the stem cells can then be developed into brain cells.

In previous flights to the ISS, the NSCF team found that brain cells mature faster in space. In the upcoming experiments, NSCF scientists will test existing drugs and new ones in development to see if they interfere with disease progression. “The ability to see what happens to these cells in space as they mature is particularly valuable for diseases that are diagnosed later in life,” explained Grisanti.

Studies from stem cell-derived organoid models have significant advantages over traditional animal studies, Mesci said. For her doctorate in neuroscience from Pierre & Marie Curie University in Paris, Mesci used mouse models to study Lou Gehrig’s disease, or ALS, a fatal motor neuron disease.

“Mouse models are good to study certain aspects of diseases, but unfortunately, none of the treatments that we tried in those animals were translatable enough to develop a cure or to significantly treat symptoms in patients,” she explained. Organoids more closely represent how brain cells function in the human body, providing a more robust and accurate model.

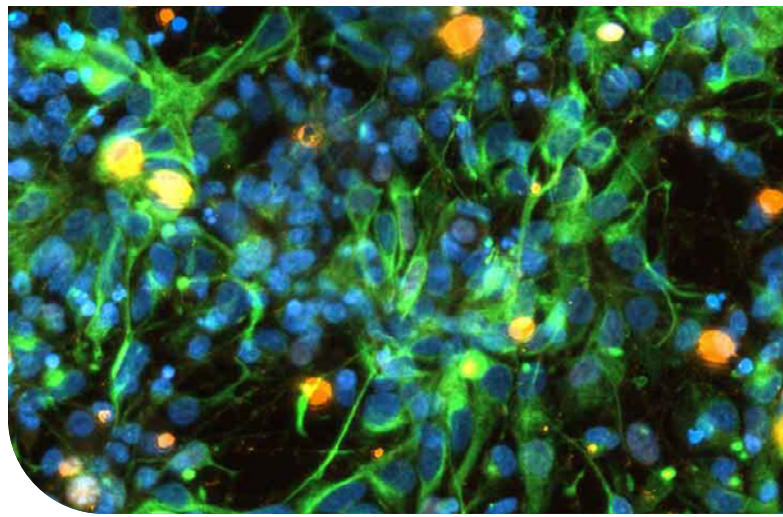
Tracing Inflammation Pathways

In the upcoming series of NSCF projects, the team will trace the inflammation pathways involved in neurodegenerative diseases. Findings could help researchers better understand disease onset and identify possible biomarkers.

“Unfortunately, studies have been done for many decades but have yet to lead to any treatment options, mainly because we lack a good biomarker,” Mesci said. “Biomarkers allow us to identify damage before the disease gets to the point that symptoms appear, at which stage it’s often already too late to intervene. For instance, in a disease like ALS, which is very aggressive, patients die within two to five years after symptoms begin.”

In the case of Parkinson’s disease, once tremors begin, significant nerve damage has already occurred. Estimates suggest that by the time symptoms are noticeable, a person may have lost almost 70% of the dopamine-producing cells in their brain, which regulate body functions like movement.

“Once you have a lot of things dying in the brain, chronic inflammation will amplify everything,” said Mesci. Using the analogy of a forest fire, she noted, “It’s much easier to put a fire out when it first starts than when hundreds of acres have already burned.”



Early-stage brain cells from NSCF study of Parkinson’s disease on SpaceX CRS-30.

Nicolette Pirjanian, NSCF partner lab New York Stem Cell Foundation

Building on Learnings from Past Missions

NSCF will leverage processes developed from earlier space station missions, including techniques for optimizing experiments to focus on the disease pathways. The team hopes to answer questions such as: What are the drivers of these diseases? What can human organoid models tell us about the diseases’ early stages when no symptoms exist? And how can we intervene?

Ultimately, NSCF plans to make its disease models available to pharmaceutical and life science companies for drug discovery and the development of new therapeutic options for neurodegenerative diseases.

“The ability to see and analyze cell interactions in a way not possible on Earth is creating an unprecedented opportunity to accelerate the discovery of new therapies for these and other neurodegenerative diseases that affect tens of millions worldwide,” Grisanti said. “This is a transformative moment in history for finding treatments and cures for some of the most costly and terrible diseases of our time.” ■

This content was abridged from an article that originally appeared on issnationallab.org/ISS360/.