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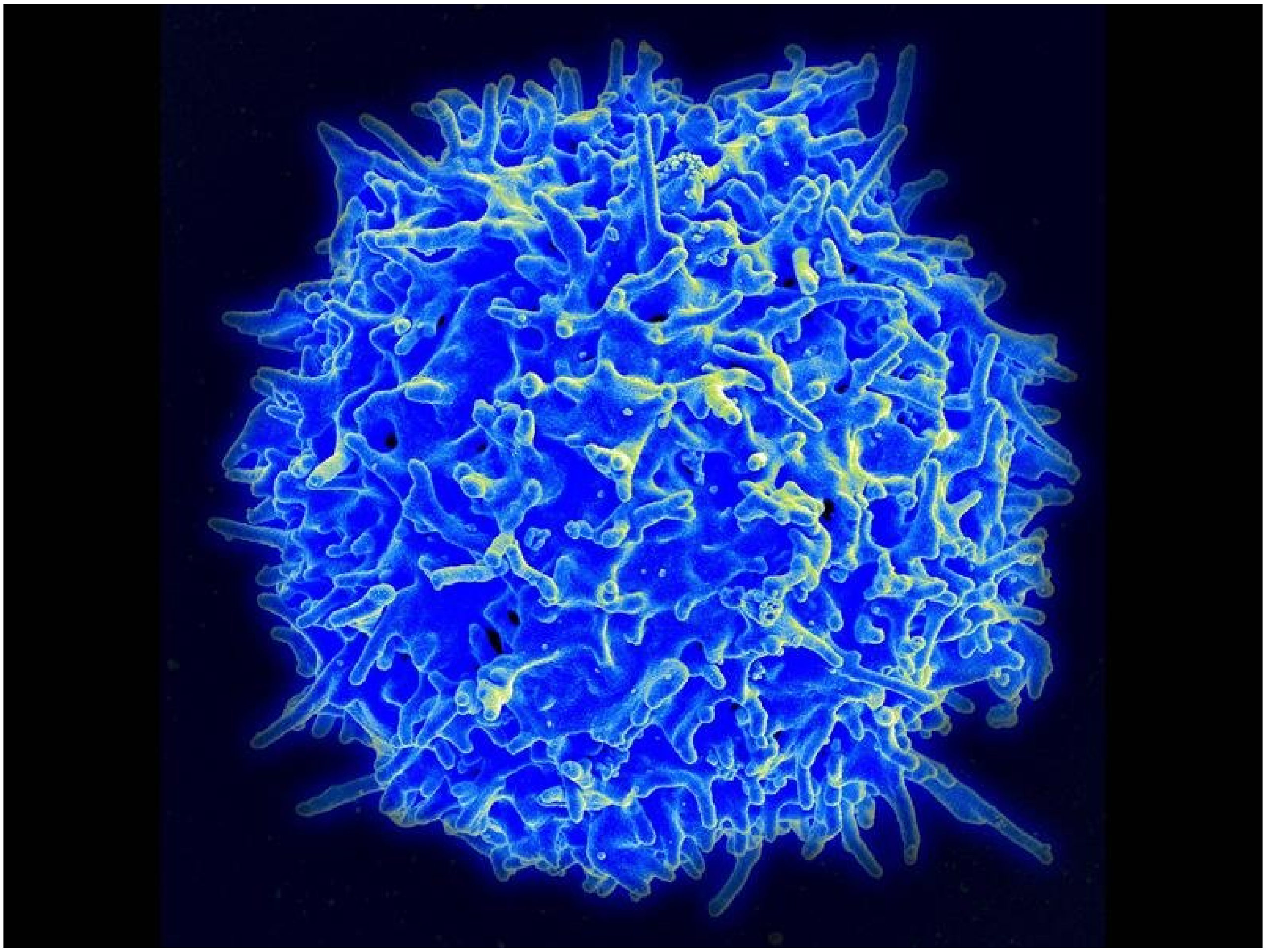

A human T-Cell (NIAID)

A Space Station Experiment for Astronauts—And Everyone Else

A current ISS study tackles the mystery of immune system suppression in microgravity.

By Heather Millar
airspacemag.com
October 7, 2014

Scientists have known for years that spending time in space seems to damage the immune system. Nearly half the Apollo astronauts suffered from bacterial or viral infections, either in flight or within one week of landing. What's been more difficult is figuring out just how spaceflight weakens our immune defenses, and what exactly goes wrong in our bodies.

A current study on board the International Space Station is addressing that question, and at the same time exploring how problems with astronauts' immune systems might be related to the normal decline in immunity that comes as we age.

Two years ago, an experiment on the station established that it is microgravity, and not all the other possible variables on a spaceflight—motion, radiation and so on—that affects T-cells. These cells act like traffic cops, or military generals, to coordinate our immune response. They give the "go" order to attack a threat to the body, or the "no go" order to ignore something harmless.

The principal investigator for the 2012 experiment, Millie Hughes-Fulford, a former Shuttle astronaut and director of the Laboratory of Cell Growth at the University of California, San Francisco, is also leading the follow-up study.

Researchers have found that people aging normally on the ground suffer the same kind of immunosuppression that affects astronauts after a few weeks or months in space. “And we have no treatment for that,” explains Hughes-Fulford. “If we can find out what turns T-cells on and off—upstream—that will be really important. I ask people to think of a waterfall: raindrops flow to a stream, and then to a river, and then over the waterfall. We’re looking at the raindrops and asking what raindrops are important.”

In April of this year, Hughes-Fulford’s team sent samples from eight different individuals up to the space station. That’s something no other team has done, perhaps because of all the complexities of preparing space experiments—going to Cape Canaveral for the launch, coordinating with eight different people to take blood samples at just the right time, and getting their samples placed on the spacecraft (in this case a Dragon cargo vehicle). It took several false starts, and required taking blood from 60 people, to get this batch of samples into space.

For this first phase of the experiment, the team is studying one particular molecular mechanism that activates T-cells. They plan to launch another set of samples in December to study other molecular pathways that activate T-cells.

“The work we’re doing is focused on finding out how the immune system works at the early stages of activation, and not just for astronauts going to Mars. It’s for anyone on Earth with some sort of immune problem,” Hughes-Fulford says. “We hope the result will be brand new pharmaceutical targets.”

Jenine Sanzari, a researcher at the University of Pennsylvania Medical School, takes a different, ground-based approach to studying immune suppression in microgravity. Her team suspends the hind legs and tails of mice to simulate the fluid shift that happens inside astronauts’ bodies in space. Yet she thinks the orbital experiments are valuable. “I don’t have the experience of flying samples in space,” she says. “[Hughes-Fulford] is doing a great job of relating T-cell activity to the aging process, using spaceflight as an inducer of this process.”

Oliver Ullrich, a researcher at the University of Zurich who has collaborated with Hughes-Fulford on several studies, agrees that the work on the space station is significant. “It is a major challenge to find out if our cellular machinery is able to live and to work without gravity force,” he says, “or if our cellular architecture will keep us dependent on the gravity field of Earth.”

About Heather Millar

Heather Millar writes about science, the environment and health from her home base in San Francisco, California.