K-State professor takes chemistry to another world

April 25 2005

Astronaut health is one of NASA's top priorities.
Once beyond Earth's atmosphere, astronauts are exposed to ionizing radiation and microgravity. Effects from these, along with the potential buildup of toxins in the enclosed environment of a spaceship, put astronaut health at risk.
Kansas State University professor Chris Culbertson has been working with NASA to investigate how such hazardous conditions affect humans at the cellular level and how to lessen such conditions, thus allowing astronauts to work in a healthier environment.

Culbertson, an assistant professor of chemistry, is an expert in microfluidics, a branch of analytical chemistry that is focused on miniaturizing chemical analysis instrumentation. To demonstrate the capability of microfluidics, Culbertson uses a variety of devices for performing complex chemical analyses.

"Essentially, a microfluidic device is just a small piece of glass with channels etched in it," Culbertson said. "Those channels are smaller in diameter than that of a human hair. We can move chemicals through these channels to either separate them or we can use them to perform chemical reactions. Specifically for NASA, we are developing microfluidic devices which will allow us to automatically monitor the health of human cells on orbit."

In the past, astronauts have had to freeze cells and bring them back to earth for analysis. With Culbertson's device, the astronauts can look at

DNA mutation rates in cells and how they change over time on orbit. Because of its compact size, the device is ideal for shuttle missions. Culbertson said it is also cost efficient because it does not require much power to operate.

To test the microfluidic devices, Culbertson and Greg Roman, graduate student in chemistry, have taken several flights on NASA's microgravity research aircraft.

"The 'vomit comet' is essentially an aircraft that does a series of parabolic maneuvers," Culbertson said. "The airplane basically goes into a parabola about 45 degrees nose-up, and then it begins to decelerate. When the deceleration matches the gravitational force -- which pulls us to earth -- you get a simulated freefall in the aircraft cabin."

In the future, Culbertson plans to take several more flights in hopes of qualifying the microfluidic devices for a future space mission.

Culbertson said that NASA is also looking for ways of providing more opportunities for science by developing unmanned free-flyer rockets.

"The problem with free-flyers is oftentimes biological experiments have to be returned to earth in order to get the data from them," said Culbertson. "But we hope to use our microfluidic devices to acquire the necessary data remotely by integrating our chemical analysis instrumentation directly with the biological experiments and then sending the data back to earth using radio communication. Thus, scientists can do the analysis in space and NASA won't have to design a reentry vehicle to bring the experiments back to earth . This will not only save a significant amount of money, but it will also make more room on the rocket to take experiments up in space."

Source: Kansas State University

Citation: K-State professor takes chemistry to another world (2005, April 25) retrieved 20 April 2024 from https://phys.org/news/2005-04-k-state-professor-chemistry-world.html

This document is subject to copyright. Apart from any fair dealing for the purpose of private study or research, no part may be reproduced without the written permission. The content is provided for information purposes only.